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The Development and Evaluation of A Patient Workstation

Volume I

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هذا من فضل ربي

This is by the grace of my Lord

This thesis is dedicated to my mother, my father, my brother Mohammed, Sharifa, Rahima, Thurayya, my daughter Najat and all my nephews and nieces, who all in their own way have contributed to this work and I am most grateful to them all.

Declaration

This thesis is submitted in fulfilment of the requirements for the degree of Doctor of Philosophy at the University of Glasgow, Faculty of Medicine, Department of Public Health. Unless stated otherwise, the work is that of the author.

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Key to the thesis

A. Title indication

1.	**Titles**
1.1	**Sub-titles**
1.1.1	*Sub-sub-titles*

B. Abbreviations and phrases

n	Sample size
No.	Numbers
P	P value (Probability)
(%)	Percentage
SD	Standard Deviation
vs	Versus
&	And
	Identifies collapse of variables in cross-tabulations.
GLADYS	Glasgow Diagnostic System for Dyspepsia
HADS	The Hospital Anxiety and Depression Scale
ZAAC	The Zuckerman Affect Adjective Checklist
ANOVA	One way analysis of variance

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Abstract

Computers have been used successfully for computer interrogation of the patient and for patient interrogation of the computer, however, these activities have normally been separate. This style of information gathering or information provision is unlike normal face-to-face communication in which there is more interaction and one speaker can 'interrupt' the other. Therefore, in order to provide better patient care and thereby patient compliance, it is necessary to investigate the process of patient-computer interaction, where the computer can ask the patient questions and receive answers, and similarly, the patient would be able to interrupt the computer interrogation and ask questions and receive answers. Moreover, some of the existing computer interviews may be too long, and patients may have questions they want to ask during the computer interrogation, or may lose interest.

The objectives of this study were primarily to investigate the design and the use of a patient workstation in a gastro-enterology clinic. In particular, to investigate a more interactive form of patient-computer interviewing by combining computer interrogation of the patient with patient interrogation of the computer. The main question that this study addressed was whether or not patients should be offered more 'freedom' in their interaction with the computer such that they could stop or 'interrupt' the computer interview to find out more information. A subordinate question to the main question was whether or not, within the combined system, a 'tailored' or an adaptive type of information provision is 'better' than a more general type.

A patient workstation was developed and evaluated to combine computer interrogation of the patient and patient interrogation of the computer. A new version of the existing GLAsgow diagnostic system for DYSpepsia-GLADYS was developed. This version allowed the combination of the 'pure' interviewing system GLADYS and an interactive health information system focused on the health needs of dyspeptic patients. Evaluation studies compared three situations for the system, where patients were automatically randomised to use one of the three styles. (1) *Style A* : Computer interview or interrogation of the patient followed by patient interrogation of the computer, where the patient can seek general health information in gastro-enterology after the computer interview. (2) *Style B* : Same as style A but allows the patients to interrupt the computer interview to seek health information in gastro-enterology. (3) *Style C* : half of the patients from style B were presented with a selected range of information in gastro-enterology adapted to some degree to their own characteristics and to their interview responses.

Two-hundred patients were recruited and randomised to either style, 100 patients for *style A*, 50 patients for *style B* and 50 patients for *style C*. Data collection included actions taken by the patients and their emotional feelings and satisfaction. The study findings provided useful baseline information in identifying the potential user and in factors affecting successful patient-computer interaction. There was no difference between computer interrogation of the patient and patient interrogation of the computer kept completely separate, and when combined by allowing a facility to interrupt the computer interrogation to seek information. However, there was evidence that some patients, mostly younger and with previous computer experience, would use the facility to seek information during the computer interrogation, and would be more interested in the resultant interaction. Older patients preferred to continue with the computer interrogation before seeking information, and appreciated a simpler interface and a more restricted personalised information. An *adaptive style C* system would provide control and flexibility for younger patients and computer users, and as for older patients and non computer users, the system would provide the simplicity of the interface design and can adapt itself to a *style A approach* interface when needed. A *style B approach* interface would be much more important to a new system than an existing system, where there might be still some doubt as to whether or not patients understood all the terms within the computer interview.

On a practical level, the research attempted to explore the feasibility of introducing patient workstations into the Omani health care service. The study investigated the process of translation of English to Arabic of a patient workstation, and the feasibility and acceptability of introducing a patient workstation into a gastro-enterology clinic in Oman. The results of this research will be valuable in assisting the introduction and the use of advanced patient workstations into the Omani health service.

Chapter I

Introduction & Study Background

"Tell me and I forget ....
Show me and I remember ....
Involve me and I understand ....."

A basic educational theme, originating in the sixth century BC

Contents

1 Patient-Computer interaction

We are in the 'information age' and entering into the emerging field of 'patient informatics'[1]. It has been suggested that many of the major changes which will take place in medicine over the next few years will be in response to this information revolution and the accompanying advances in information technology (McManus, 1991). This information revolution will have a major impact on health care, where advanced clinical information systems are beginning to empower patients to take a more active role in their own health care, and to provide them with the necessary information to enhance their decision making. Similarly, systems which interrogate patients for clinical history-taking, diagnostic analysis and therapeutic purposes, empower health providers with the necessary information about patients, and thereby facilitate and enhance patient care.

Computer interrogation of the patient[2] or clinical interviewing systems have been used successfully to interview patients for more than 30 years (Jones and Knill-Jones, 1994). Patients' interactions with the systems being merely answers to questions. These systems have been used for routine clinical interrogation since the late 1960's; for history-taking (DeLeo et al., 1993; Glen et al., 1989; Quaak et al.,

[1] The term 'patient informatics' was used by Kahn (1993) and could be viewed as part of consumer health informatics, where the public are the consumers and the field itself is devoted to the development and the implementation of health information systems and providing the public with the necessary health information.

[2] Computer interrogation of the patient is the questioning of the patient by his interaction with the computer in order to elicit medical history data. Lucas et al. (1976) distinguished 'computer interrogation' from 'history taking', as in 'history taking', besides verbal responses from the patient, the doctor receives non verbal information and adapts his questioning accordingly, while the computer is normally denied all non verbal information.

1987; Slack, 1966); and for diagnostic and therapeutic purposes (Turnin et al., 1992; Knill-Jones et al., 1990). Computer interrogating systems also include "expert" interviewing systems, such as GLADYS - the GLAsgow diagnostic system for DYSpepsia (Lucas et al., 1976; Spiegehalter and Knill-Jones, 1984). GLADYS interacts directly with the patient by means of a question-answer dialogue, and then provides an output of a list of estimated diagnostic probabilities and further action for the patient to take. On the other hand, patient interrogation of the computer or patient-education systems have also been used successfully for several years (Gillispie and Ellis, 1993; Kahn, 1993; Skinner et al., 1993; Anderson-Harper, 1994; Chambers and Frisby, 1995). These systems provide information for the patient with no manipulation of data, although they may also be interactive, resulting in the patient interrogating the system.

2 Purpose of the study

Although computers have been used successfully for computer interrogation of the patient, and for patient interrogation of the computer, these activities have normally been separate. This style of information gathering or information provision is unlike normal face-to-face communication in which there is more interaction and one speaker can 'interrupt' the other. In a normal physician-patient interaction physicians ask patients questions and receive answers both verbally and non-verbally. Similarly, patients ask physicians questions and receive answers. During physician-patient consultation, the patient has numerous opportunities to 'interrupt' the doctor so that terminology or misunderstood questions could be clarified. Also, the patient could ask the physician questions on other issues such as the diagnosis or therapy. It might seem logical therefore, to allow the 'facility' of being able to interrupt a computer interrogation, as patients might also have questions to ask the computer. Also, some of the existing interviews are quite long and may take between 45 to 60 minutes (Sanders et al., 1994) or even 90 minutes (Dove et al., 1977). During such long computer interviews, patients may have questions they want to ask or they may lose interest. However, patients who have never used a computer before may already be under stress because of their condition or anticipated treatment, and so may prefer to 'do one thing at a time'. Systems which offer more 'facilities' are not always 'better'[3] and may facilitate misunderstanding and confusion. On the other hand, regular computer users have become accustomed to 'multitasking', for example switching from word-processing to the use of a spreadsheet and back.

Tailoring or personalising information, or the ability to adapt, is another strength of face-to-face communication. The potential of patient education can be greatly enhanced by providing the ability to tailor an educational message to an individual patient, thereby increasing the overall effectiveness of the physicians' time and the quality of health care. However, the difference between a computer and a physician is that, whereas the computer is totally denied of the patient's non-verbal expressions, the physician is continually interpreting the patient's verbal and non-verbal expressions and adapting the consultation accordingly.

[3] For instance, it may be more difficult and confusing learning how to operate video recorders which offer more facilities.

Research indicates that patients who have access to health information and participate more actively in decision-making often believe that they have greater control over their health, which in turn enables them to be more active participants in the treatment process (Tomita et al., 1995; Lee et al., 1994; Kaplan, 1989; Brody et al., 1989; Greenfield et al., 1988). When the patient is no longer a passive recipient of health care, but one who is well informed and involved in decision making, he is much more likely to be compliant with the physician's recommendations (Greenfield et al., 1985). Studies have shown that patients want more information (Jimison and Sher, 1996; Baldry et al., 1986; Parrott et al., 1988; Gill and Scott, 1986; Polkinhorn, 1993; Bird and Walji, 1986; Essex et al., 1990), want to understand medical records (Jones et al. 1992c; 1996b, Cawsey et al., 1995; Jones and Sanham, 1994), and that the process of sharing information enhances the physician-patient consultation and the patients' compliance (Eraker et al, 1984).

However, despite the well established value of providing patients with health information, physicians may have insufficient time to devote to health promotion, disease prevention and patient education, especially when a patient's need for further explanation is not obvious (Skinner et al, 1993; Wilson, 1992; Goldman, 1990; McPhee et al., 1986; Woo et al., 1985; Romm et al., 1981). Similarly, various reports have shown that patients are reluctant to ask questions (Ley, 1972; Mayou et al., 1976). A concern that often makes patients reluctant to seek information from their physicians is the fact that they may be taking too much time (Luker and Box, 1986). Studies have also shown that patients' understanding (Kincey et al., 1975; Byrne and Edeani, 1983; Spiro and Heidrich, 1983; Davis et al., 1990; 1994; Jolly et al., 1993) and recall of what they have been told is poor (Ley et al., 1973; 1979; Anderson et al., 1979; Tuckett et al., 1985). Inadequate patient understanding of common medical terms used in medical consultations may be a significant factor in noncompliant behaviour of patients (Eraker et al, 1984; Byrne and Edeani, 1983; Spiro and Heidrich, 1983).

It is with the background of the limitations and drawbacks of the existing computer interviewing systems, and the inadequacy of the patient-doctor consultation that this study was undertaken. Computer technology may facilitate in the information integration process between patients and physicians by providing 'intelligent'[4] workstations[5] where patients may interact directly with the machine and interrupt the computer interrogation to seek health information when needed. While the doctor-patient relationship cannot be replaced, computer systems can supplement the information provided by physicians, and may facilitate the information integration process between patients and physicians.

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[4]The term 'intelligent' as Booth (1992, page 211) noted "does not necessarily mean that of a system which attempts to emulate human cognitive abilities, but is rather often used loosely within the computing field to mean a sophisticated system". Such a system should be adaptive to the user's needs by anticipating those needs and being able to respond to them appropriately.

[5] A workstation is the physical environment - including the computer and any inputting and / or outputting devices such as the keyboard, mouse, touch screen.

3 A patient workstation

Within the last decade, much research had been done in the area of developing an integrated clinical workstation for the physician in primary care. When using a clinical workstation, physicians would be provided with integrated access to clinical information from diverse sources within the health care environment (Stetson, 1991; Grams, 1992). The aims of a clinical workstation are to integrate clinical applications to help physicians improve their work load and efficiency; and to improve clinical information presentation. The same aims could be applied to a patient workstation where patients would be provided with integrated access to clinical information such as medical records and applications from diverse sources within the health care environment (Jones et al., 1996a).

A patient workstation is a computer with a simple interface and devices designed for the patient's use. Unlike the clinical workstation which is designed with a sophisticated keyboard and mouse, a patient workstation should be designed to be simple, interesting and intuitive to use, yet powerful and sophisticated enough to allow complex interactions such as medical diagnostic interviews. The workstation should include : a high resolution graphics display, an input device, which could be a 'simplified' keyboard, a pointing device such as a mouse or a pen, or a touch screen, a colour display and (if needed) audio output. The workstation might also be connected to other similar workstations in a network, (which would include a shared database or databases), with shared peripherals, such as remote file servers and high quality printers. A patient workstation would be an integration of one or several computer interviewing systems, patient education systems, and patients' medical records. Such a system should be adaptive to the patients needs by anticipating those needs and being able to respond to them appropriately. A patient workstation may (i) improve the patient's knowledge and well-being, (ii) enhance patient-physician communication, and (iii) shorten consultation time. Compared with written materials (e.g., brochures or pamphlets), using interactive computer programs and involving the patient in actively doing things, may be more likely to enhance the patient's learning, understanding and retention of information.

One major feature of the patient workstation might be the combination of computer interrogation of the patient and the 'facility' where the patient can interrupt the interrogation, and then browse or seek information from the computer. A two-way communication between the patient and the computer may offer the potential to increase levels of understanding and interest during a computer interview. Hence, the potential advantages of both computer interviews and computer-based patient education systems may be enhanced in a system which combines the two styles of interaction. The process of sharing information during a physician-patient consultation may be enhanced and thereby increase the patients' compliance.

Another feature of the patient workstation would be tailoring the information to the individual patient. The ability to tailor an educational message for an individual patient may greatly enhance the potential of a patient workstation by facilitating patient involvement, so that the patient could actively explore information according to his preferences and information needs. One way to individualise information is to identify patients' characteristics, responses to questions or choices on the system during the patient-computer interaction. Another way would be by using the medical record (Jones et al., 1992c), however, the medical record may not necessarily identify the type of information the patient wants to see. Jones et al. (1996b) suggested a better method would be the combination of using the medical record and a 'user model'[6]. The advantages of on-line access to personalised information is that it would provide patients with more flexibility in determining their choices; and offer them the opportunity to expand explanations of the information provided; and link them to relevant educational applications.

However, although experience and evaluation studies have suggested that the development of a patient workstation is a worthwhile aim (Jones et al., 1996a), very little research has been done so far in the area of an integrated patient workstation. There are numerous research questions to be answered on the design and implementation of a patient workstation. This study has looked at one aspect of a patient workstation - the patient-computer interface. The main question which the research examines is whether or not it is worth trying to combine computer interrogation of the patient and patient interrogation of the computer in a patient workstation.

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[6] This would usually be done by asking patients questions at the beginning of the computer interaction and then identifying users' responses to questions or choices on the system.

Most of the work in patient interaction with computers has been concerned with developing interviews for different speciality areas, for example psychiatry, headaches, urology and dyspepsia. There has been 'no'[7] work done comparing different styles of computer-patient interactions in the same interview content area. The problem may be that there are many components to the question of style. Some of these components include: vocabulary; response options; software and hardware tools; humour; multimedia[8]; response time; design and evaluation issues. In short, we need a theory for stylistic presentation to help guide future research. In order to do this we need to know something about the respondents or the users. That is, in what ways do patients differ that make some receptive to one style, and others receptive to a different style? Furthermore, we need to know how can we encourage patients to be more involved in the computer patient interaction. Also, how can we design computer interviews to be flexible and respondent to the needs and preferences of different patients. This study examines, how patients used and reacted to two different styles of computer interactions. The research attempts to combine the two types of systems, the "pure" interviewing system and the "pure" information system, and investigates the benefits (or drawbacks) of patient-computer interaction which allows the patient to be more interactive.

On a practical level, the research also attempts to explore the feasibility of introducing patient workstations into the Omani health care service. The results of

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[7] The researcher did not find any work in the literature review.

[8] Multimedia incorporates audio-visual presentations, sophisticated images, illustrations, animation, and video presentations.

this research will be valuable in assisting the use of advanced patient information systems together with interviewing and diagnostic systems into the Omani health service. Studies in other countries have shown that such systems have helped patients to assume a greater role in maintaining their own health, in promoting recovery from illness, and in minimising the use of unnecessary and expensive services. However, no such studies have yet been carried out in Oman.

Nevertheless, before reviewing the literature on the issues concerning the development and evaluation of a patient workstation, it is important to have some background information on patient computer interaction, and in particular, on relevant work done in Glasgow.

4 Background history

Patient-computer interaction systems for routine clinical interrogation for history-taking, diagnostic analysis and therapeutic purposes have been used successfully since the late 1960's (Slack et al. 1966). Computer interviewing has been successful in several specialities where data collection relies mainly on patients reporting their symptoms and where history taking is more important than examination. However, there are no examples of computer interviews in specialities where the main source of data relies on the examination of the patient (Jones and Knill-Jones, 1994). Most of the computer interviews were designed to be used to take history with a print out of the patient's details before the patient-doctor consultation. Only a few, for example GLADYS (Card and Lucas, 1981;

Knill-Jones et al., 1990), calculated diagnostic probabilities and indicated further actions for the physician to take. However, although there is a history of over 30 years of computer interviewing, there has been a slow growth in the number of publications, with the majority of the publications being in the area of psychiatry (Jones and Knill-Jones, 1994). Further investigations by Jones and Knill-Jones showed that many of the computer interviews were research studies and were not carried forward to clinical practice.

The first report on computer interviewing of the patient, was on the LINC[9] computer by Slack et al. on a computer-based medical history system in the New England Journal in 1966, Wisconsin, U.S.A (Slack et al. 1966). The LINC computer interacted directly with the patient and collected information on clinical histories with symptoms of allergy. The history questions on allergy appeared on the computer screen, where the patient had four possible options: "Yes", "No", "Don't Know", "Don't Understand", displayed on the computer screen (VDU) and numbered 1 to 4. The patient then pressed a number corresponding to the four options. Almost all patients reported that the computer interview was interesting and enjoyable. The computer print-out of patients' allergy histories was superior to that of the physician recorded past histories, but less detailed.

Work in the United Kingdom was initiated on GLADYS as early as 1968 by W.I.Card in Glasgow and Chris Evans in London. Initial experiments used a time-

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[9] Acronym for Laboratory INstrument Computer.

sharing mainframe, but by 1977 the first microcomputer systems became available. Even with early experiments, where patients used a teletype[10], the GLADYS interview was accepted and liked by patients (Anonymous, 1973; Card, 1974). To avoid complexities which might occur in data input, the researchers (Lucas et al. 1976) then used a simplified keyboard to reduce typing errors and improve data entry speed. The keyboard had only three keys, namely 'yes', 'no', 'don't understand'. Later versions included a touch screen and four other keys namely, 'probably yes', 'possibly yes', 'probably no' and 'possibly no', while the 'don't understand' option was eliminated.

The MICKIE (Evans et al., 1977; Somerville et al., 1979) was an early patient interviewing system designed to interview a patient with low back pain. The system was originally developed by Chris Evans at the National Physical Laboratory (Teddington, Middlesex), in collaboration with a number of general practitioners and hospitals. The original MICKIE used a video screen, and a keyboard with three buttons labelled 'Yes', 'No' and '?', which the patient used to answer questions. When the patient had answered all the questions, a summary of his/her answers was printed and given to the doctor to help in the medical consultation with the patient. Modern versions of MICKIE are able to access all the information held in the patient's electronic medical record to determine which questions to ask next and to validate the response.

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[10] The teletype was bulky, noisy and by today's standards may be considered as 'user unfriendly'.

5 The use of computers by patients and the public in Glasgow

Scotland, and particularly Glasgow, is strong in patient-computer interaction. Computer patient interviewing has a long history in Glasgow. As early as 1968 work on GLADYS was initiated by Card and Chris Evans, and later by Robin Knill-Jones, Spiegelhalter and Roger Lucas. Doug Small and Eric Glen at the Glasgow Southern General Hospital developed touch screen interface computer interviews in urology, day case screening and psychiatry. Bill McClymont developed PASS, a patient interviewing system for anaesthesia prior to surgery, in Glasgow. While in Dundee and Carstairs, Peter Gregor, Norman Alm and colleagues have been developing computer interviews in mental health.

On the other hand, patient and public interrogation of the computer has also been particularly strong in Glasgow. Ray Jones and Lynne Naven have been working on a public access touch screen health information system, Healthpoint since 1988. The system has been the basis for several studies and is the first public-access health information touch screen system in the UK, and probably the world. It is the most widely used with over 40 sites. Ray Jones has also been involved with Alison Cawsey in developing a Cancer system, which provides patients access to explained versions of their medical records, by using artificial intelligence and text generation. This system has been involved in a randomised trial, comparing personalised patient education with generalised patient education, for patients receiving radiotherapy for cancer at the Beatson Oncology Centre in Glasgow.

The idea of a patient workstation[11], the potential of an on-line access to medical records and health information was initiated by Ray Jones, mainly from work on a Diabetes System in Nottingham between 1979 and 1984, and later work on Healthpoint. Several studies by Jones et al. (1980; 1988a; 1988b) examined the acceptability and the use of the medical record and the censoring of the 'problem lists' which appear on the patients' records. No attempt was made to explain or simplify the terminology in the medical records. The researchers found that 14% of the patients did not understand something on the record (Jones et al., 1988a). The idea of a patient workstation seemed obvious then (Jones et al., 1996a).

The following is a brief introduction of some of the work and systems developed in Glasgow.

[11] This is a patient interacting with a computer, which is linked to his medical records with explanations, interviewing system/s, patient education system/s and any other relevant clinical information.

5.1 GLADYS (The GLAsgow Diagnostic system for DYSpepsia[12])

GLADYS is a microcomputer system used for the interrogation of patients and diagnostic decision support in dyspepsia. The system is used directly by the patients and the patient can respond by touching the screen[13]. GLADYS then compares the results of the interview with a database, calculates probabilities of different diagnoses and suggests therapy. The system has been translated into several different languages, including Swedish (Lindberg et al., 1987; 1992), Chinese (Yuyuan et al., 1990) and now Arabic.

GLADYS is referred to as a statistical expert system, where a statistically oriented 'knowledge base' is built by utilising scores, reflecting the diagnostic value of different symptoms, from a previously collected data base of 1200 patients suffering from dyspepsia. The program uses a method consisting of a combination of elements from Bayes' theorem and logistic regression, known as the Spiegelhalter-Knill-Jones method (Spiegelhalter and Knill-Jones, 1984) to calculate probabilities of ten diagnostic classes. These diagnostic classes include gastric cancer, oesophageal class, ulcer class, bowel class, alcohol-related dyspepsia, gallstone disease, and functional dyspepsia. The Spiegelhalter-Knill-Jones approach does not assume that all risk factors are acting independently within each outcome class, and predictions are presented by weighing up 'points for and against' which

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[12] Crean et al. (1985) defined dyspepsia as "any form of episodic or persistent discomfort or other symptom referable to the alimentary tract, excluding jaundice or rectal bleeding".

[13] Early versions of GLADYS had a simple keyboard with 3 push-buttons labelled 'Yes', 'No', and 'Don't understand' (Lucas, 1976).

is much more clinically oriented. The system has been welcomed by several statisticians and is thought by most patients to be a friendly and 'knowledgeable clinician' (Spiegelhalter and Knill-Jones, 1984).

GLADYS is considered an asset from a physician's point of view, for providing both a summary of the interview results, and a clear convincing explanation of the reasoning of its diagnostic decisions. The system consists of four main stages.

1) The patient is interviewed directly by the system, in order to determine the presence or absence of symptoms.
2) A probabilistic diagnosis of the possible causes of dyspepsia in the patient is achieved by comparing the results of the interview with a data base, and calculating the probabilities of different diagnoses.
3) A 'balance of evidence' account is printed, indicating 'points for' and 'points against' of ten diagnostic classes for the patient, together with advice on further investigation and management of the patient (therapy).
4) A computer-generated report for the physician and the patient's referring doctor, indicating the results, is printed in the form of a referral letter.

The user interface

The patient is interrogated directly by GLADYS, about his symptoms, where a total of approximately 200 questions are available for use in the interview, in the Excel[14] version of GLADYS. The questions are displayed one at a time, and the

[14] The original BASIC version had a maximum of 375 questions aimed at eliciting information.

patient can respond by touching the screen. Although the majority of the questions can be answered as 'yes' or 'no', uncertainty is provided for by graded options: probably yes/no, possibly yes/no. This grading was introduced to give the patient the feeling of flexibility so that they did not feel too restricted in their responses (Lucas, 1977). Other questions present a set of mutually exclusive options, where the patient may choose one. The system's choice of the next question is governed by the patient's symptoms and responses. Therefore, by skipping over irrelevant questions, only 30 to 50 of the questions are presented during an interview. All questions are written in as simple a vocabulary as possible, avoiding technical terms and long words, to facilitate understanding by all patients. Depending on the patients' symptoms and response time, the BASIC GLADYS interview session generally lasts about 30 minutes, while the Excel GLADYS interview lasts about 20 minutes.

5.2 The Urological History-taking and Management system

The Urological history-taking and Management system was developed in the late 1980's to interact directly with the patient. The computer history-taking system for general urology was introduced, to take a full urological history of new patients and thereby reduce waiting times for new patients. The system ensured a detailed clinical information was recorded and enabled the clinician to concentrate on the immediate problem of suggested symptoms and investigations (Glen et al., 1989; 1990; 1991). Over 650 patients have used the system and has been in routine practice in the Southern General Hospital in the out-patient urology clinic since

1990 (Glen et al., 1990; 1991), where it has been well received by both patients and doctors.

A printout summarises the patient's medical history and suggests appropriate investigations to be carried out by the medical staff. The program has a maximum of 300 questions, of which the patient only has to answer a limited number. All the questions are of multiple choice format, which the patient answers by using a light pen. The flow of the questions is modified according to sex, age and the response of the patient to a previous question. A patient would ideally answer the questions, read the printout produced by the system, and then indicate his approval or disapproval of the summary history by ticking a box at the foot of the printout. Finally, the patient would meet the urologist and discuss corrections or additional information.

5.3 PASS - The Pre-Anaesthetic Screening system

PASS is a patient interviewing system, which was developed to work as an assessment to anaesthesia, prior to surgery (McClymont et al., 1990). The program was developed to reduce the problems and inconvenience which patients face before surgery, and to reduce costly operation postponements due to patients' problems which are discovered only after they have been admitted to hospital.

The system interviews patients with simple 'yes' or 'no' response questions, and a list of short multiple answer questions. The keyboard was designed with only three keys, namely 'yes', 'no', 'don't understand'; and instructions on how to answer the questions are given prior to the interview. On completion of the interview, the system provides a summary report and suggestions to specialists. Although, trials at the surgical outpatient clinic have shown that patients have accepted the system, PASS is not in routine clinical practice, and due to lack of funding, further development has ceased.

5.4 Healthpoint

Healthpoint was the first public-access health information, touch screen system in the UK and probably in the world. It is the most widely used with over 40 sites in the UK (Jones et al., 1990; 1992d; 1993b). Its aims were and still are (i) to meet the consumer demand for health information; (ii) to raise awareness of health issues; (iii) to measure interest in health topics in the community (Naven et al., 1996). Healthpoint provides health information at the community level and can be tailored to take account of local issues of interest. Besides providing general health information, there are several versions of Healthpoint, such as the Radiological Healthpoint for particular therapy (Campbell and Jones, 1992), the Stoma Care Healthpoint for specific conditions, and a prototype Healthpoint on healthy eating. There are also links with Spain and Argentina to a new Spanish Healthpoint (InfoSalud).

The system was first developed and evaluated in 1988-1989 (Jones et al., 1990), and used a modified keyboard. A redeveloped system, using a touch screen, was evaluated in 1991 on 25 sites in and around Glasgow (Jones et al., 1993a; Jones et al., 1993b). Healthpoint has been well accepted by the general public (Jones et al., 1992d; 1993b; Naven et al., 1996). It is necessary, however, to choose a setting for Healthpoint which gives the user a certain degree of anonymity (Jones et al., 1993a; 1993b). Healthpoint was more successful when distributed in busy supermarkets than in staff canteens. Its attraction is that it allowed the public to become more involved while interacting with it, as the user would be in control of the system. When users are in charge of their own pathway through information, they can move at their own pace, review and repeat sections as needed, move quickly over an area with which they may already be familiar, and explore more thoroughly those topics of particular interest. By actively involving the user, this method of computer interaction enhances the user's learning, understanding and the retention of information.

The user interface

Healthpoint uses a simple vocabulary and is simple to use. The system is robust enough to withstand public use, even abuse, and provides general health information on different aspects of health. Topics include: Smoking, Alcohol, Sex, AIDS, Sports, Back Pain, Teenage Pregnancy, and even 'embarrassing' topics, such as Bed Wetting. The topics available are indicated by alphabetical buttons and a scrolling menu. In order to receive information the user has to select one of the alphabetical buttons and then, the topic in the scrolling menu. Each topic has six to eight screens of information. An internal monitor provides a measure of feedback on the system's usage and the popularity of topics and thus allows for adopting, expanding and deleting information according to the interest of the public.

5.5 Patient medical records and the Cancer system

The Data Protection Act requires that patients should have access to explained versions of their computer-held medical record. Studies by Jones et al. (1992c; 1996b), Cawsey et al. (1995) and Jones and Sanham (1994) have examined the provision for giving patients personalised information on their medical records. These studies found that most patients would use the computer to look for explanations of their medical record, if it was routinely available, and that patient education and the provision of information to patients would be most effective, if it could be tailored to the individual patient by linkage to the medical record.

Similarly, Jones et al. (1996b) investigated the potential benefit of providing patients with personalised information based on the medical record. In a pilot study of 15 patients attending a radiotherapy treatment for breast, prostrate, cervical, or laryngeal cancer, none of the patients appeared distressed when they saw their medical record on the screen, even though, some may have been under 'external pressures' (such as someone waiting for them). The main work following this pilot study started in June 1996. The study is being carried out at the Beatson Oncology

Centre in Glasgow and aims to recruit 900 patients over a period of 16 months. Its main objective is to examine the provision for giving patients personalised information on their medical records, compared with general computer-held information and leaflets.

The software used for the study is the touch-sensitive Cancer system. The system provides both general information on breast cancer and individualised explanations for the medical record. The Cancer system was developed in Lisp, and uses artificial intelligence and hypertext style interface, where medical terms or phrases are activated to link to further information. More 'technical' terms are used as the starting point for explanations; that is terms which would normally be used by the clinician. An example of this is:

> "According to your record, ... your breast cancer was
> recorded as being <u>an invasive ductal carcinoma grade 2[17]</u>
> of the left breast."

Thus by using 'technical' terms unlike most interviewing systems such as GLADYS, where all questions are written in simple vocabulary, avoiding technical terms and long words[18], the Cancer system could easily lead to misunderstanding, thereby creating a necessity for the patient to seek more information.

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[17] The underlined words are activated and appeared in a different colour on the screen.

[18] The developers of GLADYS, when designing the questions, aimed at a 95% level of comprehension, with the program text at a sixth-grade or seventh-grade reading level, so as to facilitate understanding by all patients (Lucas et al., 1981).

Chapter II

Literature Review

"The search for the truth is in one way hard and in another easy; for it is evident that no one of us can master it fully, nor miss it wholly. Each one of us adds a little to our knowledge of nature, and from all the facts assembled arises a certain grandeur."

Aristotle, 350 BC

Contents

1 Introduction

This study investigates patient-computer interaction which allows the patient to be more interactive by combining computer interrogation of the patient with patient interrogation of the computer. In particular, the design of a patient workstation which would combine computer interrogation of the patient with a 'facility' for the patient to browse or seek information from the computer during the computer interrogation.

A comprehensive review of the literature was carried out by searching through the MEDLINE from 1966, and BIDS[1] (EMBASE and ISI) from 1981, and also manually, so as to place the study in perspective. Numerous search strategies were used. These included search strategy by author name, by single words such as 'medical record*[2]', or by combining words such as 'computer' and 'interview*', and 'computer' and 'education'. The review is divided into six sections. These are:-

1 Patient Care

This section focuses on the patient-doctor interaction process. The benefits of increasing patient involvement in the consultation process are discussed. Similarly, problems encountered in the patient-doctor consultation, such as inadequate

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[1] Bath Information and Data Services.

[2] The '*' stands for any letter/s or a space.

patient understanding of common medical terms used in medical consultations and the physicians' lack of time for patient education, are examined. The need for a patient workstation to facilitate in the process of integration of the information between patients and physicians is justified.

2 Computer Interrogation of the Patient

Problems associated with traditional history-taking are explored and examples of computer interviewing systems from the literature review are presented. The benefits and disadvantages of computer interviewing are discussed. This is important in designing a patient workstation so that the benefits of computer interviewing are enhanced and the drawbacks and limitations minimised.

3 Patient Education and Health Promotion

The benefits obtained from patient education and health promotion, and computer-based patient education including its role in the emerging field of 'patient informatics', are emphasised. Issues about consumers' demand for information, home-based patient education, the Internet and incorporating multimedia features into a patient workstation are also discussed.

4 Patient Medical Records

Issues on the practical and ethical problems which may be encountered when implementing a patient workstation are reviewed. The practical benefits of computerising patients' medical records, and the arguments for and against letting patients have access to their own medical records are discussed.

5 System Design Issues and Tools

Several issues related to design and tools to be used when designing a patient workstation are discussed. These include: (a) suitable input/output devices; (b) the effectiveness and practicality of a smart card[3]; (c) appropriate software; (d) system design methodology; and (e) methods of ensuring system usability and user acceptability.

6 The Evaluation of Clinical Information Systems

Since this study evaluates a patient workstation, the types of evaluation methods, evaluation criteria and examples of evaluations of clinical systems are explored and discussed.

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[3] A smart card is a patient-held integrated-circuit, credit-card-sized plastic card, which is machine-readable and holds electronically-erasable data of patient medical information.

2 Patient care

2.1 Patient-doctor consultation

Patient care is an information-intensive activity, largely involving interactions between health-care providers and patients. During such interactions, providers ask patients questions, and receive answers both verbally and non-verbally. Similarly, patients ask providers questions and receive answers. Patients who ask questions, exchange concerns and opinions, generally receive more information and emotional support from providers (Roberts et al., 1994; Tibbles et al., 1992; Waitzkin, 1985). Similarly, patients who participate more actively in decision-making often believe they have greater control over their health, which in turn contributes to better health and quality of life outcomes (Kaplan et al., 1989; Brody et al., 1989; Greenfield et al., 1985; 1988). Greenfield et al. (1985), for example, demonstrated that patients with ulcer disease displayed improved treatment outcomes, when they were trained to understand better the logic of the medical care process and to be more effective in seeking information from their physicians. Schain (1990) reported that when patients were provided with choices for treatment and when physicians showed interest in the patients' perspective, patients reported fewer physical and psychological problems after surgery. Also, lack of adequate information in treatment alternatives, was one of the reasons for a patient's reluctance to become involved in choosing treatment (Schain, 1990; Cawley, 1990). Thus, involving patients actively in consultations can maximise their fullest potential in self-care, and this should encourage the patient to take an active role in the consultation process (Street et al., 1995; Skinner et al, 1993; Armstrong, 1989; Greenfield, 1985).

Patients' involvement in the consultation will be affected by how the physician communicates with the patient. Patients will be more likely to be active in the medical consultation if they perceive an interest from their physicians in their feelings and beliefs, and encouragement to express their opinions and concerns (Street, 1991; Street, 1992). On the other hand, if the patient perceives that the physician wishes to be in charge of the medical consultation, do most of the talking, and make the decisions, then many patients will be more likely to assume their traditionally passive role (Waitzkin, 1985).

2.2 Personalising patient information

Tailored information, based on individual needs and circumstances, enhances face-to-face patient counselling, and physicians would proceed more intelligently in the medical consultation when they have some background information about the patients' beliefs, practices and other factors, and not simply assume that all patients are similar (Brug et al., 1996; Skinner et al., 1993; 1994; DeVellis et al., 1988).

Patients are likely to differ on factors that influence their health beliefs and behaviours, and counselling to motivate one patient may be irrelevant, or actually discourage, appropriate behaviour in another patient. Skinner et al. (1994)

revealed that tailored messages were a more effective medium for physicians' mammography recommendations than standardised letters of mammography recommendations, and that tailoring information may be especially important for women of low socio-economic status. Brug et al. (1996) reported that tailored nutrition information on changes in fat, vegetable and fruit consumption in an experimental group, showed a significant decrease in fat consumption, and changes in attitudes toward reduced fat intake for the respondents compared to a control group. Furthermore, respondents in the experimental group were more satisfied with the nutritional information they received, and reported more often a change in their diet as a result of the information. Similarly, over a 12 month period in Scotland Osman et al. (1994) compared the outcomes between asthmatic patients taking part in an enhanced personalised education program and patients receiving conventional oral education at outpatient or surgery visits. The patients who received the personalised asthma education program based on computerised booklets, were more likely to experience a reduction in hospital admissions morbidity.

2.3 Problems with patient consultation and education

Lack of time, lack of compensation for counselling patients about preventive health practices and other practice constraints, have often hindered health providers in dispensing the necessary information to patients during clinical consultations (Skinner et al, 1993; Wilson et al., 1992; Goldman, 1990; McPhee et al., 1986; Woo et al., 1985; Romm et al., 1981; Williams et al., 1995). For example, Wilson et al. (1992) reported that shortage of time is a major factor in physicians' failure to realise their potential in patient education in the United Kingdom. Since a physician's time is already in short supply, there is little time for patient consultation.

Furthermore, in order to co-operate fully in the medical consultation patients must understand what is being asked and what is being stated to them. Effective communication between health providers and patients is not only essential in the accurate and adequate gathering and dissemination of information, but also in achieving patient compliance. Inadequate patient understanding of common medical terms used in medical consultations may be a significant factor in noncompliant behaviour of patients (Eraker et al, 1984; Byrne and Edeani, 1983; Spiro and Heidrich, 1983). Byrne and Edeani (1983) demonstrated that, despite an improvement in patients' knowledge of medical vocabulary over the past twenty years[4], there were still misconceptions of medical terms among patients. Spiro and Heidrich (1983) reported that significant misconceptions of medical terminology were common among patients of all ages and educational backgrounds. The researchers also demonstrated a positive association between education and knowledge.

Smeltzer (1980) found that race, education and age predicted a significant level of understanding of medical terminology, and that while patients might recognise

[4] Byrne and Edeani (1983) compared patients' understanding of ten medical terms with an earlier study conducted by Samora et al. (1961).

some of the terms used by the health providers, they may not be able to define them correctly. Jones et al. (1980; 1988a; 1988b) examined the acceptability and the use of the medical record and the censoring of the 'problem lists' which appear on the patients' records. No attempt was made to explain or simplify the terminology in the record. The researchers found that 14% of the patients did not understand something on the record (Jones et al., 1988a).

Providing patients with written material after medical consultations is one approach to overcoming the physician's lack of counselling time, and

> "to eliminate problems with the assimilation of purely
> verbal information and clinician's words would backed
> by appropriate written material" (Fawdry, 1994).

However, there are several shortcomings with written material. Not only it is difficult to tailor written materials to the needs of each individual patient, but also patients may not fully understand what is written and may not have access to help. Studies have shown that patients may not fully comprehend written material and that the text may often be at a level higher than the reading age for many patients (Davis et al., 1990; 1994; Jolly et al., 1993). Davis et al. (1990) reported a gap of more than 5 years between patient reading levels and the comprehension levels required by written patient materials in the public clinics. Most of the patient education materials at the public clinics required a reading level of 11th to 14th grade, while the average reading comprehension of the patients was of 6th grade. Similarly, Davis et al. (1994) reported that, a significant amount of the health education material available for parents of pediatric outpatients required a higher reading level than most parents had. The researchers also demonstrated that parents' self-reported education level will not accurately indicate their reading ability. Davis et al. (1994) suggested that in such settings, all health education material should probably be written at a level lower than high school, if most parents were expected to read them. Similarly, Jolly et al. (1993) when measuring the reading ability of emergency department patients, found that a significant proportion of the patients were unable to understand common written medical instructions, and that medical instruction sheets were written at a level higher than the reading age range of many of the patients.

2.4 Computer technology and patient care

As mentioned, due to lack of time, and other practice constraints, the exchange of information between health providers and patients may be hindered; the counselling of patients on topics including preventive health practices; the patient's understanding of diagnostic procedures, and decision-making in choosing therapy may all be inadequate. Also, by increasing the patients' understanding of their condition and prescribed treatment, patients compliance can be enhanced (Eraker et al., 1984). Therefore, in order to enhance patient compliance:

- health providers should encourage the patient to take an active role in the medical consultation process and thereby maximise the patient's full potential in self-care

- accurate, simple to comprehend, and tailored information should be provided to the patient during medical consultations

Computer technology may facilitate the information integration process between patients and physicians by providing 'intelligent' workstations where patients could interact directly with the machine. While the doctor-patient relationship cannot be replaced, computer systems can supplement the information provided by physicians. Compared with written materials (for example, brochures and pamphlets), using interactive computer programs and actively involving the patient in doing things, may enhance the patient's learning, understanding and retention of information more effectively. In addition, an interactive program can tailor information to the individual patient; for example, provide the user with individualised health topics to view. The program would facilitate patient involvement, where the patient can actively explore information according to his preferences and information needs.

3 Computer Interrogation of the Patient

Patient interviewing systems were initially developed to overcome problems associated with traditional history-taking and to assist the doctor in his diagnosis (Dove et al., 1977). The computer interview was never seen as a substitute for doctor-patient interaction, but just as an aid to traditional history-taking, which itself has many well-known problems. In out-patient clinics and general practices, the limited time available to obtain a history from a new patient may lead the physician to take shortcuts and fail to record data in a way that can be readily used later (Dove et al., 1977). As a result, patients often feel hurried, reluctant to seek information from their physicians and may fail to explain their real problems (Luker and Box, 1986). This may be compounded if the patient speaks poor English (Davis et al., 1990), is deaf, fails to understand the question (Spiro and Heidrich, 1983) or is too embarrassed to answer frankly (Lucas et al., 1977).

A literature review on computer interviewing systems showed that the field was rich in psychiatry and to a lesser extent in other medical specialties. Examples of systems designed to interview patients in the area of *psychiatry*, include: (a) Child Behaviour Checklist to the parents of children referred to a child psychiatry service (Sawyer et al., 1991); (b) The computerized version of the National Institute of Mental Health Diagnostic Interview Schedule (DIS) for psychiatric patients (Mathisen et al., 1987; Levitan et al., 1991); (c) The assessment package for a group of neuro-otological outpatients (O'Connor et al., 1989).

Numerous investigators have developed interviews for assessing behavioural risk factors for HIV infection drug abuse, reception of blood transfusion, sexual behaviour, alcohol consumption and abuse linked to adverse pregnancy outcomes. Because of the sensitive nature of this material, the privacy and therefore the decreased likelihood of embarrassment offered by the computer make it an appealing option. Examples of such systems include: (a) Schneider's (1991) use of computer interview to assess individual risk for HIV infection by analysing personal case histories pertinent to drug abuse, receptive blood transfusion, and sexual behaviour. (b) Erdman et al.'s (1985, 1987) suicide risk prediction computer interview. (c) Sanders et al.'s (1994) computer-based utility assessment tool to assess patients' understanding towards HIV-related health states and identify risk behaviours (both sexual and drug related). (d) Gerbert et al.'s (1996) multimedia sexual risk assessment system for HIV infection. The system uses a 'video doctor' to question patients about risk-associated sexual behaviour. (e) Bernadt et al. (1989) produced a computer interview to collect the drinking histories of patients. (f) DeLeo et al.'s (1993) used a computer interview to collect the sexual histories in adolescents. (g) Lapham et al. (1993) produced a computer interview for screening pregnant patients for substance abuse and other behavioural risk factors linked to adverse pregnancy outcomes. (h) Millstein and Irwin (1983) developed computer-acquired sexual histories in adolescent girls. (i) Greist et al. (1983a; 1983b) used direct patient-computer interviews in mental health.

The use of a computerised data base in a *headache* clinic is another area of computer interviews. Investigators in this field include: (a) Bana et al. (1981) who developed an interactive computer-based headache interview for patients; and (b) Leviton et al. (1984) who produced computerised behavioural assessment for children with headaches.

Numerous other specialties include: (a) *Gynaecology*: where Hasley (1995) produced a computer interview relating to patients' general and gynaecological health; (b) *Hypertension*: Taenzer et al. (1996) produced the health interview which is a health assessment and educational computer interview for hypertension patients; (c) *Gastroenterology*: Lucas, Card, Knill-Jones and others produced GLADYS (Card and Lucas, 1981; Knill-Jones et al., 1990a). This system is described in Chapter I of this thesis. Also, Holt et al. (1992) produced a computer interview to interview gastro-enterology patients. (d) *Back pain*, Pynsent and Fairbank (1989) developed a computer-based interview system for patients with back pain. This system has been well accepted by patients and is in routine clinical use in several hospitals. Similarly, Bolton and Christensen (1994) produced a back pain computer-interview system. (e) *Neuro-otology*: O'Connor et al. (1989) produced the neuro-otology computer interview for patients. (f) *Urology*: The Urological history-taking and management system (Glen et al., 1989; 1991). (g) *Dietary behaviour and weight reducing diet*: Witschi et al. (1976) produced a computer-based dietary counselling system to interview people about their dietary behaviour and planned a weight-reducing diet for them. Smucker et al. (1989)

developed a dietary and risk factor questionnaire and analysis system. (h) *Cancer*: Lippman et al. (1992) developed a quantitative cancer-risk appraisal tool designed to promote cancer prevention and screening, and to assist physicians in risk identification and patient counselling. (i) *Antenatal care*: Brownbridge et al. (1988) produced an antenatal computer interview. Lapham et al. (1993) produced a computer interview for screening pregnant patients for substance abuse and other behavioural risk factors linked to adverse pregnancy outcomes. Similarly, Fawdry (1989) produced *PAM*, Programmed Aid for use in Midwifery, to elicit information from by the expectant mother. (j) *Pre-anaesthesia*: McClymont et al.'s (1990) produced *PASS* - a pre-anaesthetic screening system (described in Chapter I of this thesis). Similarly, Tompkins et al. (1980) produced a computer-assisted pre-anaesthesia historical interview and a computer-generated summary, which have been developed as an aid to preanaesthesia ward rounds.

However, although clinical interviewing systems have been successfully used to interview patients for more than 30 years, in almost all of these systems, the patients' interaction is limited merely to answering questions, with most of the questions being presented in a yes/no or multiple-choice format. For example, the *LINC* computer (Slack et al., 1966), *GLADYS* (Lucas et al., 1976; Card and Lucas, 1981; Knill-Jones et al., 1990a) and *PASS* (McClymont et al., 1990)[5]. Only a few clinical interviewing systems, besides answering questions, provide some feedback for the patient at the end of the interview. For example, the *Health*

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[5] All these three systems are described in Chapter I of this thesis.

Interview (Taenzer et al., 1996) where patients were first interviewed by the system and then given a personalised risk-factor summary and a life style advice. Patients used a keyboard to choose the correct answer from a list of options in a highlighted bar. To move a highlighted bar up and down the user would use the arrow keys and the 'Enter' key to move to the next question. Another example of such systems, is Lapham et al.'s (1993) computer interview for screening pregnant patients for substance abuse and other behavioural risk factors linked to adverse pregnancy outcomes. The program collected information about the patient's eating habits, life-style practices, and life situations, and at the end of the interview it provided a summary of the assessment and individualised educational information both on a video screen and on computer-generated printouts.

3.1 Potential advantages of computer interviewing

Computers can collect histories which are complete, consistent and comprehensive. Although the human interviewer would be more 'human' and observant than a computer system, interactive computer programs may surpass human beings in several attributes. By exploiting these attributes and as a result of the patient's interaction with the computer, the subsequent interview with the doctor is often more valuable. These attributes include: having near-infinite patience (Slack, 1966); taking detailed patient information and past medical histories (examples of systems by DeLeo et al., 1993; Bernadt et al., 1989; and *AIDA* by Quaak et al., 1987a); storing of large amounts of information and rapid processing capability (Brennan and Dodd, 1996). In addition, during a computer interview, the patient is given the time needed to think about his or her problem, and patients' responses can be stored directly into the medical record, thereby, reducing the risk of coding or transcription errors.

Early concerns about the impersonal nature of computers and 'computer-phobia' have been set aside by the growing literature indicating acceptance and support of computers by patients. Much of the evidence in the literature indicates that patients like interacting with computers (Jones et al., 1988a; 1993b; 1996b; Mathisen et al., 1987). Numerous studies have revealed that computer interviewing is generally acceptable and even likable by patients (Card and Lucas, 1981; Quaak et al., 1987a; Pynsent and Fairbank, 1989; Fawdry, 1989; Hasley, 1995; Taenzer et al., 1996; Dove et al., 1977) and that the computer is a reliable, unbiased and accurate tool in collecting and assessing information (Sawyer et al., 1992; Lewis, 1994).

3.1.1 Structure and flexibility of the computer interview

Computer interviews obtain their benefits from their structure and specificity, and although structure can be provided by human interviewers or written questionnaires, it is much easier to impose structure on a computer than on a human being.

Ferriter (1993) compared three interview conditions with patients' parents: unstructured human interviewing, multiple-choice structured interview delivered by a human being and the same structured interview delivered by a computer. Structured interviewing, by both the computer and the human interviewer, collected significantly more information than unstructured interviewing, and also showed that the study subjects were more candid in the computer interview condition. Lilford et al. (1992) revealed that an interactive computerised structured questionnaire provided more and better information than an unstructured paper questionnaire. Similarly, Hawken et al. (1994) demonstrated that more information was obtained by a routine antenatal HIV testing computer interview than by a standard paper questionnaire.

The computer can provide a level of flexibility that paper questionnaires cannot. It can be programmed to ask follow-up questions for problems which respondents report, and to skip follow-up questions for areas which they indicate are not a problem. For example, the computer can be tailored to avoid asking male patients questions on pregnancy, or to skip subsequent questions for a patient who does not suffer from a particular symptom. For example, Brownbridge et al.'s antenatal computer interview contained 342 questions, however, in practice only about 80 to 90 were asked during an average interview (Brownbridge et al., 1988). Therefore, the computer's decision on which questions to ask can be dependent on responses to prior and/or current questions and/or multiple conditions. This branching capability can be somewhat 'messy' when using a paper questionnaire.

3.1.2 Reliability and accuracy of computer interviews

In contrast to the human-administrated interviews, computer interviews are very reliable. Unlike physicians, computers never forget to ask a question, and given the same pattern of responses by a client, the computer will always ask the same questions in the same way. Moreover, compared with written questionnaires, computer interviews can avoid incomplete responses by repeating questions until a response is given and thereby increase data integrity. The computer can assure a conscious choice of skipping a question if the respondent so wishes rather than carelessly forgetting. Quaak et al. (1987b) found an average rate of 36% of missing information in a written medical record compared to a 2% rate in a computer-based medical record of 99 out-patients.

However, a literature review on comparative studies to assess the accuracy of computer interviews showed that, although there was good agreement between the computer and the physician in eliciting information from the patient in the majority of the studies, there were some differences in a number of the studies. The differences between the two methods may not indicate that the computer is better than the human being in eliciting information from the patient or vice versa. Lucas et al. (1976) reported that the computer interviews were roughly comparable with the physicians in accuracy. In a study of 70 patients with dyspepsia, it was found that the computer recorded 18% 'false positive' or 'false negative' replies compared with 9% for each of two gastroenterologists interviewing the same patients, who were both involved in writing the questions for the computer interview. Similarly, in a comparative study of a questionnaire for obtaining clinical history by doctors from patients with dyspepsia and a computer interview (*GLADYS*), Knill-Jones et al. (1990a; 1990b) found that there was good agreement between the two methods for most of the questions. However, there was a tendancy for the computer to obtain more 'Yes' responses than the doctor. The response rate for positive responses was 40.1% for the binary questions recorded by the computer compared to 30.8% with the doctors. Similarly, two comparative studies by Lewis et al. (1988) and Lewis (1994) of a self administered computerised assessment of neurotic psychiatric disorder (psychiatric morbidity) with an identical assessment administered by a human interviewer, demonstrated that a computerised interview in assessing the overall severity of a psychiatric disorder, was as accurate as that of the physician.

However, although computer interviews cannot replace the skills of a sensitive physician, there is some suggestion that computer interviewing may be an acceptable and valid means of collecting sensitive information from patients. Due to the impersonal nature of the computer, computer interviews have the potential of being less embarrassing for the patient than face-to-face interviews, and patients may be more frank with the computer when providing sensitive information such as thoughts of suicide, sexual difficulties, psychological problems, diverse life-styles or alcohol consumption. Lucas et al. (1977), for example, found that patients at an alcohol treatment centre reported 30% higher levels of alcohol consumption to the computer than to a psychiatrist. There was significantly greater alcohol use reported to the computer than to an experienced psychiatrist. Since patients were interviewed in a treatment centre for alcohol addiction, the higher alcohol consumption report was more likely to be true.

Several studies supported Lucas et al.'s (1977) findings. Lapham et al. (1991; 1993) on computer interviewing of patients' history of adverse life-style also revealed that drug use and physical abuse were reported significantly more often during the computer interview compared with information obtained from the patients' medical records. Similarly, Locke et al. (1992, 1994) when using computer interviewing to detect factors related to the risk of the human immunodeficiency virus (HIV) among potential blood donors, also revealed that patients were more honest to a computer interview than to a human interviewer. Among 272 prospective donors who were interviewed by a computer and a human interviewer, the computer identified 12 patients who reported behaviour associated with a risk of acquiring HIV or symptoms compatible with AIDS. None of the 12 patients was identified by the face-to-face interviews or the written questionnaires. Patients also enjoyed the computer interview and judged it more private than the standard method for donor assessment. Romer et al. (1997) supported the hypothesis that interviews delivered by computers would elicit more reports of sexual experience and positive feelings toward sex than face-to-face interviews. The researchers tested the hypothesis by comparing the results of both face-to-face interviews and interviews administered by 'talking' computers with children between the ages of 9 to 15 years. The results revealed that a subset of the children (n=31) who had completed both interviews reported more favorable feelings toward sex in the computer interview.

However, Bernadt et al (1989) contradicted Lucas et al. (1977) and others. In a study where the drinking histories of 102 patients were elicited by both a computer and a clinician, Bernadt et al (1989) found that the computer did not elicit higher consumption of alcohol than the human interviewer. The study demonstrated that the computer can interview patients as accurately as a nurse or a psychiatrist and that there was better agreement for questions which were dichotomous (yes/no) than for interval data such as volume of alcohol consumed. The researchers suggested that the higher consumption of alcohol reported to the computer in Lucas et al.'s (1977) study may have been an indication of some disagreement, rather than that the computer was better than human beings in eliciting quantity and frequency of drinking. The findings of Bernadt et al. (1989) were in agreement with those of Skinner and Allen (1983), where there were no significant differences between computerised and face-to-face interviews in reporting participants' levels of alcohol consumption. An earlier study by Skinner et al.'s (1985a) compared histories of alcohol, tobacco and drug abuse by a computer, interview or self completed questionnaire, also showed no significant differences among methods of assessment in reporting levels of consumption of alcohol, cigarettes, and drugs or related problems. Similarly, Bungey et al. (1989) compared the use of a computer to screen for alcohol and drug use with face-to-face interview and paper and pencil questionnaire. The researchers found that levels of reported consumption were similar across assessment methods, and that the computer was more acceptable to patients reporting non-medical drug use, which was a potentially threatening and sensitive issue.

Computer interviewing may also have the advantage of eliminating observer bias or the influence of the doctor on the patient, which is a serious problem in clinical research. A physician may react emotionally to some of the patient's feelings and statements, and even if the physician is not judgmental, a patient may feel embarrassed. A study by Canoune and Leyhe (1985) indicated that response differences between human and computer interviews do occur and that the differences result primarily from interviewer differences and the nature of the questionnaire items. The study which provided summary scores for six values-support, conformity, recognition, independence, benevolence and leadership-observed that response differences occurred mainly for values susceptible to social pressures (conformity, benevolence and recognition). Subjects were more likely to try to impress the human interviewer than the computer, and to respond according to social standards (conform).

Similarly, Holt et al (1992) demonstrated that patients confided more to the computer about adverse life-style than to the clinician during a clinical interview, and that the computer provided an acceptable, efficient, and potentially cost-effective way to assess life-style. Thirty-four patients attending a gastro-enterology clinic were questioned by a computer on their history of alcohol, caffeine, cigarettes, illicit drug use, sexual activity and nutrition. Comparisons of the information obtained by the computer with clinical records showed that clinicians documented only 3% of the patients as problem drinkers, 3% as caffeine abusers, and 17% as smokers, whereas the computer identified 10% of the patients as problem drinkers, 27% as caffeine abusers, and 43% as smokers.

However, although there may be a tendency to feel that the computer interview is more accurate than the human interviewer in assessing adverse life style, this may not always be so. Another tendency is to assume that computer responses of subjects may be equivalent to the human interviewer in values not susceptible to social pressures. This may not always be the case, and findings from several comparative studies differ. Hasley (1995), for example, in a comparative study of computer-based and personal interviews for a gynaecological history update, demonstrated that patients would answer a computer interview in the same way as they would answer a personal interview. The findings revealed that the computer interview generated responses which were equivalent (96%) to that of a human interviewer. A pilot study on sensitive information to identify HIV risk behaviour by Sanders et al. (1994) also demonstrated that the agreement in patients' responses between face-to-face and computer-based interviews was excellent. There were 3 discrepancies in 180 compared responses.

The impersonal nature of the computer not only encourages patients to be more frank with the computer than with a human interviewer on sensitive subjects, but also in some cases, the computer may be more successful in eliciting risk factors. Levine et al. (1989) compared 102 patients admitted to a general hospital following an episode of deliberate self-harm, who were interviewed by a computer, and then by a psychiatrist who was blind to the results of the computer interview. The computer interview was acceptable to the majority of the patients and the data suggested that the patients confided more information to the computer than to the clinician. Moreover, the computer appeared to be a better predictor of the risk of suicide than the clinician. Similarly, Erdman et al. (1987b) when comparing predictions by clinicians for suicidal attempts for 52 patients and predictions made by the computer for the same patients, found that the computer was significantly ($p=0.001$) better at predicting attempters, but clinicians were significantly ($p=0.01$) better at predicting nonattempters. Overall results showed that the computer was better, but the difference was not significant.

3.1.3 Clinical effectiveness of computer interviews

The computer interview not only has the potential of playing an important role in the collection of clinically relevant information, and thereby saving the time of medical staff who assist clinicians (Sawyer et al., 1990; 1992), but also encourages patients to concentrate more on their state of health (Roizen et al., 1992). Roizen et al. (1992) found that by using the computerised instrument, the *HealthQuiz*, the numerical health status derived from the patients' answers to the computerised instrument was similar to the numerical health status derived by a physician after a patient-physician interview.

Alm and Morton (1990) demonstrated that the quality of the information produced by the computer interviews of parents in a child psychiatric clinic experiment was equivalent to that produced by clinician-conducted interviews. The computer interviews offered more information, thereby saving the clinicians' time. The study also revealed that the interaction with the computer appeared to improve communication between the patient and the clinician. Mathisen et al. (1987) demonstrated that not only did the patients interact well with the computer, but the psychiatrists treating them found the computer reports generally accurate and helpful.

Sawyer et al. (1992) suggested that computer interviews could assist the clinicians by collecting a broad range of clinical information about the patients. The authors investigated the effect of providing clinicians with a report from a computer assisted interview, conducted prior to the clinical assessment of children referred to a psychiatric unit. There was some suggestion that the computer interview reports influenced the type of problems identified by the clinicians and the services that they recommended to manage the children's problems. Similarly, Lewis et al. (1996a) examined the clinical effectiveness of providing physicians with the results of computerised assessments, and found that they were more helpful when compared with other two control groups.

3.1.4 Acceptability of the computer interview

Evidence in the literature indicates that most patients not only like to be interviewed by the computer but find it less embarrassing, and that they are more honest about revealing sensitive information to the computer than to the human interviewer (Greist et al., 1987; Lapham et al. 1993; Sanders et al., 1994; Gerbert et al., 1996; Anonymous, 1973; Carr and Ghosh, 1983; Millstein and Irwin, 1983; Greist et al. 1987; Levine et al. 1989; Lapham et al. 1991; Locke et al. 1992, 1994; Holt et al. 1992; Erdman et al. 1992). Patients may feel it difficult to communicate with physicians because of shyness about answering embarrassing questions, class differences, mood or clash of personalities. Deaf patients would certainly prefer written questionnaires or computer interviews. Sanders et al. (1994), for example, found that patients preferred to use the computer to disclose sensitive information regarding risk behaviours towards HIV-related health states, than to be interviewed person-to-person by a human interviewer. Lapham et al. (1991; 1993) found that almost all women rated a computer interview of taking patients' history on adverse life-style favourably, and reported significantly more often on drug use and physical abuse to the computer interview compared with information obtained from the patients' medical records.

Carr and Ghosh (1983) found that when phobic patients were allowed to respond directly to a computer assessment, all of them were able to complete a computer interview. Moreover, half of them claimed that they found the computer interview more acceptable and easier to communicate than with a clinician. Greist et al. (1987) assessed the acceptability of computer interviewing compared with personal interviewing. One-hundred and fifty psychiatric patients were asked to be interviewed twice, once by a trained human interviewer using the Diagnostic Interview Schedule (DIS), and once by a computerised interview format of the DIS in which the patient interacted directly with the computer. Although patients had positive feelings for both methods, a significant majority preferred the computer interview and found it less embarrassing. Similarly, Erdman et al. (1992) revealed that patients had positive attitudes toward the computer interview, and although they could better describe their feelings and ideas to a human being, felt that the computer contact was less embarrassing.

Similarly, patients may prefer to communicate with the computer than with the physician on sensitive matters. For example, Gerbert et al. (1996) examined the effects of an interactive multimedia[6] sexual risk assessment[7] program on 393 patients. The multimedia program used a 'video doctor' to question patients about risk-associated sexual behaviour. Most respondents (99%) reported that

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[6] Multimedia incorporates audiovisual presentations, sophisticated images, illustrations, animation, and video presentations.

[7] Sexual risk assessment for early detection of HIV infection and other sexually transmitted diseases (STDs).

they had answered the questions truthfully, 74% reported that they had felt comfortable answering the questions, and 79% stated that they would return to the physician portrayed in the video. Skinner and Allen (1983) reported that patients rated the computerised interview as less friendly than a face-to-face interview or a self-report questionnaire, but shorter, more relaxing, lighter, more interesting, and faster than the face-to-face or self-report formats. Similarly, due to the computer's interactive nature, patients may also prefer the computer interview to the standard questionnaire. O'Connor et al. (1989), for example, in eliciting basic neuro-otological information prior to clinical interview, reported that 81% of the patients preferred the computer assessment to a standard questionnaire. Moreover, the computer system was found to be more efficient than the standard paper questionnaire.

3.1.5 Therapeutic effect of the computer interview

Computer interviewing can also be an effective therapeutic tool. Card and Lucas (1981) suggested that interviewing systems have therapeutic effects in two ways. First the interview could be therapeutic in itself by leading the patient to some degree of self-knowledge. For example, an alcoholic may learn the facts and risks of alcoholism and recognise the symptoms in himself. Secondly, the interview could also be therapeutic in that it leads to the treatment of the problem itself.

Dove et al. (1977) found that patients at a general-practice health centre, who had their medical and social history taken by a computer prior to a doctor's consultation, profited from therapeutic and educational benefits. Most of the patients enjoyed using the computer and felt that the system encouraged them to focus on their medical problems. The computer interview allowed them to express themselves more clearly and participate actively in the doctor's consultation. The study also revealed that monitoring within the computer could lead to interesting clues. The response time to questions was measured and this gave an indication of how certain the patient was about his answer, a point which was later discussed with him by the doctor. The researchers found that patients who had frequently pressed the 'don't understand' key, and were later questioned about the issue by the physician, often revealed deep seated problems. Lucas et al. (1976) also measured the time the patient took to respond to a question presented by the computer. It was shown that the longer a patient takes to answer a question, the more uncertain he is about his answer.

3.1.6 Educational benefits of the computer interview

Computer interviewing can also elevate patients' knowledge on health issues and can assist patients in understanding important aspects about decisions, thereby enabling them to participate in decision making. The computer interview has an educational role in helping patients to formulate what they want to say more precisely. Lapham et al. (1991) demonstrated not only the potential value of computer-interactive software programs for assessing high-risk behaviours among pregnant native American women, but also in educating them about healthy behaviours during pregnancy. The computer interview screened pregnant patients for substance abuse and other behavioural risk factors. A much higher percentage of the women participants reported alcohol and drug use during the computer interview than was obtained from the patients' medical records. Study participants also scored significantly higher on a test measuring knowledge of the effects of stress, diet and substances of abuse on pregnancy than did a control group.

3.2 Potential disadvantages of computer interviewing

Given the acceptability of patients, the quality of data, and that much progress has been made in developing new and powerful systems, the fact remains, as Jones and Knill-Jones (1994) found, that most of the clinical interviewing systems, especially in the United Kingdom, such as those of McClymont et al. (1990), Fawdry (1989) and Brownbridge (1988) have only been research studies, and have not been carried forward into routine use. Jones and Knill-Jones (1994) suggested that the reasons for computer interviewing systems not being so widespread are: (a) the time taken to construct such systems; (b) the technology has only recently become easy to use; (c) computer interviewing is limited to situations where a defined set of questions can be answered; (d) funding for such systems has been difficult.

Major limitations of computer interviews have been the length of time needed to complete the interview and the space required to locate the patients and the equipment. Another limitation is that computer interviews take longer than face-to-face human interviews (Lucas et al., 1976; Dove et al., 1977; Duffy and

Waterton, 1984), and many computer interviews take more than half an hour to complete. For example *GLADYS*'s BASIC version lasted about 30 minutes (Lucas et al, 1976) and Sanders et al's (1994) computer-based interview to identify HIV risk behaviours took 45 to 60 minutes. Some computer interviews have taken even longer, as long as one and a half hours. For example Dove et al.'s computer interview to take patients' medical and social history took an average of 90 minutes (Dove et al., 1977). Patients may have questions to ask during such lengthy computer interactions or lose interest. Also, space problems may arise if more than a tiny number of patients are to participate in a lengthy computer interview.

Limitations also occur in patients' response options; practical and yet simple keyboards for patients may present only three keys, namely 'yes', 'no', 'don't understand'. For example, patients using the *LINC* computer (Slack et al., 1966) were limited to only 'Yes', 'No', 'Don't know' and 'Don't understand'. Quaak et al. (1986) found that 21% of the patients who used his system felt that the allowable options for responses were too restrictive to be accurate. Lucas et al (1976) found that patients felt too restricted with only the three options ('yes', 'no', 'don't understand') and found it useful to qualify the responses by including 'certainly', 'probably' and 'possibly'. Moreover, typing errors might occur when using a keyboard. To reduce typing errors and improve data entry speed, investigators (Lucas et al., 1976 ; Olson and Jasinski , 1986 ; Roberts and Rahbari, 1986; McClymont et al., 1990) suggested simplified keyboards.

However, with today's advancement in technology and the availability of tools for designing computer interfaces such as multimedia, computer interviewing programs have become more sophisticated. For example, Gerbert et al.'s interactive multimedia sexual risk assessment program which used a 'video doctor' to question patients about risk-associated sexual behaviour (Gerbert et al., 1996). Free speech input, where the patient enters his basic symptoms by engaging in a dialogue with the program, has also been successfully[8] explored (Johnson et al., 1992). However, problems with voice recognition still occur as the computer has to extract the essential information from a wide range of possible answers. Another weakness of computer interviewing is that computers have difficulty with anything other than structured, verbal information. Also, unlike the person-to-person interview, some patients[9] may require assistance with their first usage of the computer interrogation (King and Pantin, 1996).

A major problem with computer interviews, is the creation of the questions themselves, which is both a complex and time consuming task. The human interviewer usually detects not only the substance of an answer but also the manner in which it was delivered, and the rest of the interview can be tailored accordingly. An ambiguous reply could also be cleared up by rephrasing the question, while signs of disease may appear in the complexion, eyes, talk or walk. These can be written down and eventually help in diagnosis and therapy. Since the

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[8] Johnson et al. (1992) had an overall semantic accuracy of 87%.

[9] 21% of the patients required assistance with their first experience of using a scoring system developed for drug related morbidity.

computer is denied all non-verbal expressions, body language or voice tone, which the patient may use in a face-to-face interview to show that he may not fully understand a question, a computer interview needs clear, unambiguous wording. The patient must understand the question at once. Therefore, as Knill-Jones et al. (1988) suggested, questions should be constructed carefully, using simple vocabulary, and avoiding technical terms and long words. The computer interview should enable accurate and reliable information to be collected in the absence of any health care provider. Questions formulated in a friendly manner with positive and sympathetic feedback, allow the patient to feel as if the computer is taking a personal interest in him (Dove et al., 1977; Knill-Jones et al., 1988). Also, to ensure that slow readers do not feel rushed or pressured and fast readers do not become bored, the speed at which the questions appear can be adjusted to the individual patient (Lucas et al, 1976).

4 Patient Education and Health Promotion

The benefits obtained from patient education and health promotion have been emphasised by several researchers (Street et al., 1995; Gillispie and Ellis, 1993; King, 1983; Eraker et al., 1984; Turner, 1985; Ley, 1988; Ellis et al., 1979; Dove et al., 1977; Jones et al., 1990; 1992d; 1993b). These benefits include:

a) Providing patients with the basic human right to be informed of their own health and other general health matters.

b) Promoting healthier life styles and disease prevention (Hill, 1997; Krishna et al., 1997, Tronni and Welebob, 1996; Kahn, 1993; Fisher et al., 1977; Martin and Connor, 1996; Lewis, 1996b; Consoli et al., 1995; Luker and Caress, 1989; Wetstone et al., 1985). Wetstone et al. (1985) developed and evaluated a computer-based education lesson for rheumatoid arthritis. Evaluation results showed that patients enjoyed the computer program and reported a significant improvement in the outlook on life ($p<0.01$); hopefulness of a good prognosis ($p<0.01$); decreased belief in the role of luck or fate in determining their health ($p<0.05$) and an increase in self-help such as joint protection ($p<0.02$) and rest ($p<0.05$). In a review of twenty-two studies on patients exposed to computerised patient education interventions, Krishna et al.(1997) found that all the studies, except one on the treatment of alcoholism, reported positive results for interactive educational intervention, and that all the diabetes education studies (n=7) reported decreased blood glucose levels among the patients exposed to this intervention.

c) Improving communication between the patient, the doctor and other health care professionals, where the patient could be an informed active participant rather than an uninformed passive recipient. This phenomenon encourages the patient to discuss their health problems and worries with the health care professionals. This not only leaves the patient feeling satisfied with the health care offered, but also makes him more inclined to follow the medical advice as a result of a better understanding of his illness. A study by Ellis et al. (1979) in Edinburgh, showed that the provision of brief, supplementary, written information improved the patient's understanding and recall. Similarly, Street et al. (1995) showed that pre-consultation education appeared to be an effective clinical strategy in helping patients gain an accurate understanding of their treatment options before meeting the physicians. The researchers produced a pre-consultation computer-based education program for breast cancer patients. Those who used the program tended to learn more about breast cancer treatment after using the multimedia program than after reading the brochure. However the method of education did not affect patient involvement in the consultation.

d) Lessening patients' anxiety: as a result of increased patient satisfaction, the patient's anxiety is decreased, although this does not always guarantee patient compliance (Ley, 1988; Eraker et al., 1984; Dove et al., 1977).

e) Decreasing costs by promoting advice and treatment for ailments and minor infections, where patients can treat themselves without resorting to the doctor. Montgomery et al. (1994) developed *PROPATH*, an advisory system for Parkinson's disease, which provided a useful adjunct to medical therapy of Parkinson's disease. Evaluation results showed that the intervention group had significantly increased exercise, decreased summary Parkinson's scores by approximately 10%, and 12 of 13 variables showed differences favouring the intervention group. Visits to the doctor, hospital days, and sick days were also reduced in the intervention group.

4.1 Consumers' demand for information

Patients have the basic right to know about and understand their health problems, physicians' diagnoses, proposed investigations or surgery, and consultations, and the practice of good medicine. Moreover, as stated by Cooling et al. (1997):

> "The need for patient education in general practice
> is increasing due to patient expectations and the
> changing nature of general practice."

Patients want to have more information about their own health and illnesses (Jimison and Sher, 1996; Baldry et al., 1986; Parrott et al., 1988; Gill and Scott, 1986; Bird and Walji, 1986; Essex et al., 1990; Polkinhorn, 1993). Therefore it is necessary to involve the patient in diagnosis and therapy, in order to obtain compliance with the treatment.

However, few patients have received such a service. There is sufficient evidence of patients' frequent dissatisfaction with physicians' advice both in general practice and in hospital clinics (Dunkelman, 1979; Polkinhorn, 1993). The gap of communication between the doctor and the patient produces misunderstanding and even mistrust of the diagnosis and therapy to be followed, leading to a decreased compliance with treatment. Two survey studies by Polkinhorn (1993) to determine the need for health information in general practice in East Anglia, showed that the majority of the practices wished to provide more health information for patients, but wanted more information on how to do so. Results of the survey of patients in a local surgery, also showed that more than 70% of the patients wanted more information about the surgery and its services, on medical conditions and hospital waiting lists; and 78% of the patients wanted health information in the form of leaflets.

The term, consumer health information describes "the provision of information about medical conditions, healthy living, health services and other health issues directed to consumers" (Polkinhorn, 1993). Consumers are increasingly interested in information that will help them manage their own health and that of their families. Today, the scope of consumer health information has become huge and diverse, with over 600 software products for health care, patient education, health promotion and decision-making (Jimison and Sher, 1996; Deering and Harris, 1996). Consumers have developed both broad interests and very specific needs. Examples of software health references for home use include: Mayo Clinic Family Health-book, Medical HouseCall, HealthSource, Health Reference Center and MDX Health Digest, Dr. Schueler's Home Medical Advisor (Jimison and Sher, 1996).

4.2 Computer-based patient education

The benefits of computer-based patient education and its role in the emerging field of 'patient informatics' have been emphasised by several researchers (Hill, 1997; Tronni and Welebob, 1996; Kahn, 1993; Skinner et al., 1993; Anderson-Harper, 1994; Chambers and Frisby, 1995; Jones et al., 1990; 1992d; 1993b; Fisher et al., 1977; Ellis, 1985; Albright, 1990; Martin and Connor, 1996; Lewis, 1996b; Consoli et al., 1995; Luker and Caress, 1989; Wetstone et al., 1985). However, Lewis (1996b) pointed out that, although educators are interested in computer-based patient education as an educational strategy, the primary barriers to using computers in clinical practice are the lack of computer availability for patients and limited financial resources.

Computer-based patient education offers tremendous potential in various specialties with numerous educational needs. Some of these specialties include: *low back pain* (Spunt et al., 1996); *cardiovascular risk* (Consoli, 1996); *psychiatry* (Madoff et al., 1996); *heart failure* (Liedholm et al., 1996); *breast* *cancer* (Owens and Robbins, 1996; Street et al., 1995; Paterson and Adamson, 1992; Morio et al. 1989); *self-care for colds and flu* (Reis et al., 1994); *AIDS and HIV-Positive people* (Pingree et al., 1993); *pregnancy and infant health* (Mercer and Sweeney, 1995; Kinzie et al., 1993; Wong and Richards, 1990), *oral health care* (Ireland, 1996; Miyawaki et al., 1995); *arthritis* (Rippey et al., 1987; Wetstone et al., 1985); *renal* (Luker and Caress, 1992); *diabetes* (Lo et al., 1996; Farris et al., 1994; Turnin et al., 1992; Biermann and Mehnert, 1990; Levy et al., 1989; Farrant et al., 1984); *bronchial asthma* (Tomita et al., 1995); *haemophilia* (Carl and Gribble, 1995); *joint replacement surgery* (Tibbles et al., 1992); *general drug knowledge* (Beck et al., 1982); and in *primary care practice* (Williams et al., 1995).

There is much evidence in the literature that patients like interacting with computers regardless of their age, education or socioeconomic background, and that computer-based patient education has been accepted even by users who might be considered 'computer-phobic', such as the elderly (Jones et al, 1993b; Biermann and Mehnert, 1990; Deardorff, 1986; Fisher et al, 1977; Rippey et al, 1987). This is mainly due to the fact that users can interact with the computer at their own pace, repeat and explore topics of interest, and are in control of the speed and depth of the learning process. For example, Jones et al (1993b) reported a high acceptance of Healthpoint to all ages, even though the survey showed that those who were 50 years and over were slightly ($p<0.1$) less likely to have used Healthpoint compared to those who were under 50 years. Similarly, Williams et al. (1995) found that HealthTouch users were younger on average than the overall patient population, and the majority (89%) were either very satisfied or satisfied with the system. However, Rippey et al. (1987) demonstrated that older persons (age range 52-88) with osteoarthritis can also use a computer-based patient education for osteoarthritis with a significant increase in knowledge gain and self-reported beneficial behavioural changes. Similarly, evaluation results of patient acceptability of *DIABLOG*, a computer-based patient education system for diabetic patients with insulin therapy (Biermann and Mehnert, 1990) indicated a good acceptance of the program even by patients with no previous computer experience.

Madoff et al. (1996) found that hospitalised patients with acute psychotic conditions can participate in, and learn from a computerised medication instruction. Patients were randomly assigned to receive computer-based (n = 21) or personal instruction (n = 21). All the subjects reacted positively to the computer program, although knowledge retention (indicated by changes in test scores) and compliance with medication regimens after discharge (indicated by telephone follow-up at one week, one month, and three months) were similar in the computer and control groups.

Another example of patient acceptance of computers as a method of learning is the development and evaluation of seven computer-assisted instruction (CAI) programs, for patients participating in a continuous ambulatory peritoneal dialysis

Caress (1991; 1992). The programs offered information about kidney function, causes and effects of kidney failure, and treatment options. Patient interaction times with the computer ranged from 15 to 25 minutes. The program was evaluated with 30 patients, whose mean age was 50.9 years with diverse socioeconomic backgrounds. Patients did not have difficulty using the computer and 80% described the experience as 'very useful'.

However, some of the earlier systems, although they proved to be helpful, flexible and easily customised to the needs of particular groups of patients, were not at all simple to use by the casual patient (Pelican, 1987). Until the late 1980s, there have not been many patient information systems developed due to two factors: First, the time required to develop such a system is significant and "sometimes it seems outrageous" (Pelican, 1987); secondly, the developer has to possess a wide range of skills. These include skills in computer programming, educational theory, knowledge of the topic to be presented, and a talent in the creative design of presentations which will be easily comprehended and manipulated by the patient.

Early user-interface design moved from the traditional character-based user interface to the popular graphical user interface (GUI), and has now moved to a third interface: the multimedia user interface[10]. By the mid-eighties patient

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[10] Multimedia interfaces communicate with users by using multiple media, for example video, voice, music, animation, and graphics, and sometimes, multiple modes such as written text with spoken language.

information systems improved in user interface design and were more popular to patients and the public, and were easier to develop by researchers using the new authoring tools. For example, Jones, et al. (1992c) found that most patients who were provided with on-line access to their medical records reported that the computer was easy to use. Moreover, patients also reported that if the computer was routinely available, most of them would use it again. Similarly, some of the patients using the *urological history-taking and advisory system* (Glen et al. 1991) welcomed the system in routine practice use.

4.3 The use of home-based computers for patients

Today patients or the general public can interact with computer-based education systems on ordinary television sets and run the programs themselves at home. Similarly, new technologies, such as computer networks[11] can link health care providers with patients, or between patients in similar circumstances, to provide support and ways of meeting the needs of home-based patients in an effective manner (Brennan, 1996). The *ComputerLink* produced by Brennan et al. (1991) was successfully introduced to provide home-care support to persons living with acquired immune deficiency syndrome (AIDS) and AIDS-related complex (ARC), to a community in Ohio, U.S.A. Patients using the *ComputerLink* appeared to participate more actively in their own care, and physicians remarked that these patients asked more questions and appeared more knowledgeable about their care.

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[11] Computer networks are electronic links between computers in patients' homes and a centralised computer. Computer networks permit users to read, send and receive messages in complete privacy and at a time convenient to them.

Similarly, Liedholm et al. (1996) produced an interactive education program for heart failure which was presented on a Kodak Photo CD Portfolio disc. The system was designed to improve heart failure patients' knowledge of the disease and the drug treatment of the disease. Patients were able to view and run the program themselves on an ordinary television sets.

Another example of a home based computer-based patient education is *CHESS* (Comprehensive Health Enhancement Support System). Developed by Pingree et al. (1993), *CHESS* is a computer-based support system for HIV-positive people. Computers were placed in the homes of HIV-positive people, and, by using the computers' internal monitoring, *CHESS* was found to be popular and heavily used by the participants. The authors argued that the heavy *CHESS* use by a wide variety of HIV-positive people suggested that the computer can overcome "information poor" barriers in health information campaigns. *CHESS* was also used to assist people dealing with other health crises such as breast cancer via a personal computer and modem that are placed in patients' homes (Owens and Robbins, 1996). Women of all ages and varied socioeconomic backgrounds have successfully used this program to help them to participate actively in their care following a diagnosis of breast cancer. Besides home based computers, today there is an increased interest in the Internet which, besides other information, also provides health-related information to patients and the public.

4.4 The Internet

The Internet is a computer network accessible to over 50 million computer users worldwide, with a growing number of new users between 1 and 2 million per month (Brettle, 1997; Jimison and Sher, 1996; Benjamin et al., 1996; Pallen, 1996). By default, the Internet has become the 'information superhighway', and has been greatly accelerated by the development of the World Wide Web (WWW).

The WWW is one of the client-server protocols for publishing information on the Internet. It provides a vast array of sites which are relevant to health education for health care professionals and the public. Many opportunities to learn, to educate, and to communicate new ideas are provided by the WWW, and many of its sites provide information of interest to the public and health care professionals. The cancer information server called OncoLink for gynaecological oncologists and the public on the Internet (Benjamin, 1996) is an example. OncoLink is rich in multimedia content containing text, pictures, illustrations, sound, and video. Another example is the computer-based resources in health promotion and disease prevention based on HIV prevention (Fulop and Varzandeh, 1996). The computer-based resource provides hypertext links to specific health information helpful to health promotion planners and consumers.

In a study reviewing communications from non-medical individuals requesting medical information in cardiovascular diseases over a 12-month period from the physician at an established site on the WWW, Widman and Tong (1997) demonstrated an increasing use of the Internet by the general public seeking specific medical information for themselves and for their families. The study also suggested that there is a widespread, unmet need for objective medical advice by the general public.

4.5 The benefits of Computer-based patient education

1) Computer-based patient education can provide an efficient way to enhance the doctor-patient interaction and provide specific education to patients. Fisher et al. (1977) when comparing different methods of instructing patients, found that subjects who received computer instructions in giving an uncontaminated urine specimens (for diagnosis of urinary tract infections) tended to have fewer contaminating bacteria and had significantly fewer problems than did subjects who received written instructions or verbal instructions from a medical student. The authors suggested that "individualized quality of the dialogue, self-pacing, self-testing, and privacy of the computer instruction might have been attributes to the effectiveness of the computer instructions". Patients were also not embarrassed to ask for clarification or afraid that they may be taking up too much time. Deardorff (1986) compared computer-based, face-to-face, and written methods of communicating information on sexually transmitted diseases, and the participants' reactions to the three methods. Recall was better with the computer-based and written methods than with the face-to-face method. The participants preferred the computer-based and face-to-face

method. Similarly, Wetstone et al. (1985) demonstrated that there was significant gain in knowledge, self-care behaviour and an improved outlook on life for patients who used a computer-based education lesson for rheumatoid arthritis compared to a control group who did not. The computer-based education lesson was also accepted and enjoyed by the patients. Consoli et al. (1995) found that, when comparing to a control group, patients' overall mean cardiovascular knowledge score before education improved significantly after using a hypertension and cardiovascular risk education interactive multimedia program. Tronni and Welebob, (1996) also compared end-user satisfaction with manual versus computer generated materials, and found that computer generated materials were given a higher rating than were the manual materials. Similarly, older patients with osteoarthritis, showed a significant increase in knowledge and beneficial behaviour changes after using Rippey et al.'s, (1987) computer-based patient education for osteoarthritis.

2) Computer-based patient education can be an effective therapeutic tool, and motivate self management. For example, Turnin et al. (1992) produced *Diabeto*, a diet self-monitoring system, which appeared to be an effective therapeutic tool in the control of metabolic diseases when it was used by diabetic patients. The system helped diabetic patients self-monitor their diets and balance their meals with personalised counselling. *Diabeto* led to significant improvement of dietetic and dietary habits to diabetic patients. Farris et al. (1994) also produced a computerised diabetes education module

for diabetic patients. Major content areas documented were blood glucose monitoring, nutrition, hypoglycemia, and foot care. Patients indicated that the diabetes education module greatly improved their ability to review goals previously addressed and to identify unmet goals. Similarly, Levy et al. (1989) developed an interactive educational expert system, *SESAM-DIABETE*, for diabetes, which provided personalised advice and therapeutic recommendations for insulin-requiring diabetic patients. *SESAM-DIABETE* also offered sophisticated explanation facilities, and all information about patients was stored in their medical records, which allowed follow-up of patients.

3) Computer-based patient education can encourage patient interaction with health providers and practice with decision making about themselves. Tibbles et al. (1992) developed a computer assisted instruction program for patients undergoing total joint replacement surgery. The system included two preoperative lessons, and a third lesson presented postoperatively at the bedside, and encouraged patient interaction and practice with decision making. It included an assessment of knowledge about arthroscopic surgery, preparation for surgery, and decision making about topics such as recognising infection and what to do. The system was well accepted by the patients, whose age ranged from 50 to 80. Spunt et al. (1996) produced a computerised, interactive video program to help patients make informed decisions about undergoing low back surgery. Presented information was tailored to each patient's age and diagnosis; and included a narrative, excerpts from patient

interviews, animated graphics illustrating spinal anatomy, and tabular summaries of the benefits and risks of both surgical and non-surgical treatment. Most patients who viewed the video program rated the information provided by the program very useful and fewer patients (17%) remained undecided about therapy after watching the program than before (29%).

4) Computer-based patient education offers the potential to increase levels of health education efforts with no increase in staff. While using computer-based patient education, patients can proceed at their own pace, with several options to repeat and review information without being concerned that they are taking too much of a health care provider's time (Kahn, 1993). This frees the health care provider to spend more time exploring or reinforcing aspects of the learning that are most particular to the patient. Tomita et al. (1995) produced a computer assisted instruction multimedia program which provided medical information for patients with diabetes or bronchial asthma. The system provided motivation for the patients in self management, and as a result of this a reduction in the nurses' workload was achieved along with patients gaining profound and standardised knowledge. Carl and Gribble (1995) produced *HealthDesk* for Haemophilia, an interactive computer and communications system for chronic illness self-management. The system was designed to provide self-management information, self-care skills, on-going communication with health care providers, and user-friendly record keeping. Patients and their

families who used *HealthDesk* for six months in the homes reported a gain in confidence in their illness self-management skills.

5) Computer-based patient education can provide new information to patients with particular learning difficulties; for example the blind or partially sighted, subjects with cognitive impairments and people who are illiterate or have a low reading ability. Computer-based patient education can also demonstrate potential for effecting change in behavioural intention. Programs using multimedia can provide numerous opportunities for user interaction, and may be designed to require only a little reading ability. For example, Kinzie et al. (1993) produced a computer-based multimedia prenatal alcohol education program, designed to educate low-income expectant mothers with limited reading abilities concerning the need to limit alcohol consumption. The program was found to be well accepted by participants, and demonstrated the potential for effecting change in behaviour. Morss et al. (1993) produced a multimedia patient education system using 'digitized voice' for Schizophrenic patients. Instructions were presented both by 'digitized voice' and in print, and, if necessary, were clarified by a moderator. The system was well accepted by the Schizophrenic patients, who understood almost all the computer instructions (92% mean comprehension).

6) Computer-based patient education can increase patients' involvement in health care. Lee et al. (1994) examined the impact of a multimedia system on

patients' behaviour in using eye care services. The researchers found out that using multimedia campaign combined with interactive patient involvement can directly increase the use of eye care services. Wetstone et al. (1985) and Rippey et al. (1987) produced computer-based patient education systems for rheumatoid arthritis and osteoarthritis, respectively. Both systems were accepted and enjoyed by the patients who used them, and there were significant increases in patients' knowledge gain, improved outlook on life and self-reported, beneficial behaviour changes.

7) Computer-based education can provide individualised or personalised information, which would offer patients the opportunity to expand explanations of the information provided, and to link them to relevant educational material. Personalised information can help motivate patients to change their behaviour; to track their needs; and to facilitate thorough communication between patient and physician. Methods of personalising information include: building a 'user model' by identifying the characteristics and preferences of the user. This would usually be by asking patients questions at the beginning the computer interaction and then identifying users' responses to questions and reactions when using the system. An example of an information system built from a 'user model' respective is the migraine system developed by Buchanan et al. (1992, 1995) and Carenini et al. (1994). The system tailors its interaction to: (i) the class of migraine patients, (ii) the individual patient, and (iii) the previous dialogue. It consists of two main components: (a) an interactive history-taking

module which collects information from patients prior to each visit, builds a 'user model', and summarises the patients' status for their physicians; and (b) an intelligent explanation module which produces an interactive information sheet containing explanations of both general medical terminology and specific knowledge about migraine which are tailored to individual patients. De-Carolis et al. (1996) have also produced a knowledge-based system which adapts its information content, order and style to the user. The system was designed after several studies on patients' information needs and physicians' explanatory attitudes and generates different printed explanations of drugs for patients, physicians and nurses.

Tailoring could also be enhanced by using the medical record (Jones et al., 1992c). An example of a system which uses the medical record to personalised information is the *Cancer system* described in Chapter I (Jones et al., 1996b; Cawsey et al., 1995). However, as Jones et al. (1996b) suggested, the medical record may not necessary identify what type of information the patient wants to see, and a 'better' method would be to combine both the patient's user model and the medical record. Other examples of computer-based patient education personalised systems are: (a) Spunt et al.'s (1996) interactive videodisc multimedia system for low back pain patients, which tailors information according to each patient's age and diagnosis. (b) The *health interview* (Taenzer et al., 1996), a health assessment and educational system for hypertension patients, which produces personalised patients' risk-factor summary and life style advice.

(c) *The Cancer Information Service System*[12] (Paterson and Adamson, 1992) which displays information into sections, tailored according to patient' needs and requests. (d) *SESAM-DIABETE*, an interactive educational expert system which provides personalised advise and therapeutic recommendations for insulin-requiring diabetic patients (Levy et al., 1989).

4.6 Interactive multimedia systems for patient education

Modern technology provides a means of improving health education and promotion by actively involving the patient in using modern computing applications and facilities, including interactive multimedia. Multimedia has been used successfully in the health care environment in providing health care information for patients (Adsit, 1996; Stocking and Mo, 1995; Kahn, 1993). As the software and hardware costs decrease in the marketplace, the use of multimedia technology in the health care field is likely to increase.

Multimedia computing is the result of the combination of four industries: telecommunications, television and video, publishing, and computers (Willmot and Clough, 1993, Lippincott, 1990; Yager, 1992a; Tazelaar, 1990; Robinson, 1990). Sprague (1992) described the integration of multimedia data types into desktop computers as a revolution in the personal computer industry: *the multimedia Revolution*. Multimedia interfaces communicate with users using multiple media

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[12] This system is obsolete now (personal conversations).

(for example video, voice, music, animation, and graphics), and sometimes multiple modes such as written text with spoken language.

Interactive multimedia provides a more powerful and attractive means in holding the user's attention and involving him in information retrieval than paper-based information presentations (Rash Jr., 1992; Maybury, 1992). It has been anticipated that eventually multimedia capabilities will integrate into almost all layers of software, offering new interfaces, redefined programming tools, and possibly new operating systems (Lynch and Mera, 1992; Kim, 1992; Lippincott, 1990). Multimedia applications have already been used in the health care especially in the field of training and education offering significant benefits and cost savings over traditional methods (Adsit, 1996; Paterson et al., 1993). Evidence indicate that patients like interacting with systems using multimedia and that multimedia is an effective teaching tool (Spunt et al., 1996; Consoli, 1996; Liedholm et al., 1996; Adsit, 1996; Street et al., 1995).

Therefore, multimedia features such as animation, moving pictures, still images, music and voice (within a sound-proof kiosk or environment), could be incorporated into a patient workstation in order to provide better presentation to the patient. By utilising multimedia, the full potential benefits of interactive systems may be achieved. However, the use of voice and music, without sound-proof kiosks, may be impractical with clinical systems for reasons of annoyance and bother to the other patients in the hospital clinic or health centre and lack of privacy of information to the individual user. Other characteristics such as moving pictures and animation could be quite useful in several ways including emphasising parts of information that are likely to be of greatest use.

4.6.1 Advantages of using multimedia

Multimedia as an instructional strategy has some advantages and disadvantages, even though, the advantages seem to outweigh the disadvantages. Several authors (Adsit, 1996; Stocking and Mo, 1995; Street et al., 1995; Skinner et al, 1993; Paterson et al., 1993; Rash Jr., 1992; Maybury, 1992) have proposed various advantages. These advantages include:

1) Interactive multimedia places the user in control of the learning process, by involving the user in actively doing things. The user has the control of the routes through the information, and may follow a specific line of inquiry where he is free to consult and integrate the system as often as necessary. For example, Miyawaki et al. (1995) produced an interactive consultation multimedia software for orthodontic patients. The software was designed to be operated by orthodontic patients themselves or by their parents, and to help patients choose the information in which they are interested. The system consisted of various multimedia such as images, sounds, characters, and biosignals, and emphasised audio-visual understanding of orthodontic practice, including terminology, and provided patients with a detailed explanation of any term they choose.

2) The ability to produce presentations that incorporate text, graphics, sound, animation, and video, interactive multimedia provides a powerful means of successful communication of information to the users. Street et al. (1995) produced a multimedia program on early breast cancer, which proved to be an effective clinical strategy for helping patients gain an accurate understanding of their treatment options before meeting with physicians. Similarly, Spunt et al. (1996) produced an interactive videodisc program for low back pain patients with animated graphics illustrating spinal anatomy, and tabular summaries of the benefits and risks of both surgical and non-surgical treatment. The system also proved effective in helping patients gain an accurate understanding of their illnesses and treatment options.

3) Multimedia techniques provide clear and simple navigation mechanisms with adequate instructions for use and self directed learning which are needed for naive users. Kinzie et al. (1993) produced a multimedia prenatal alcohol education package for expectant mothers of low-income with limited reading abilities concerning the need to limit alcohol consumption. The multimedia design provided numerous opportunities for user interaction and required little reading ability and offered the potential to increase levels of health education efforts with no increase in staff. The program was found to be well accepted by the women. Similarly, Liedholm et al. (1996) produced an interactive education program for heart failure patients on a CD-ROM. The system used

clear, simple written information, as well as movie and video film. The program can be viewed on an ordinary television set and run by the patients themselves.

4) Patients enjoy computer-based health education systems using multimedia. Morss et al. (1993) developed a multimedia patient education system using 'digitised voice' for Schizophrenic patients. The system was well understood and accepted by the Schizophrenic patients. Mercer and Sweeney (1995) produced the *Healthy Touch Series*, a collection of four interactive *multimedia* programs which were also well accepted by participants. The programs were produced to provide health promotion information to underserved groups on topics related to maternal-infant health. They had bilingual audio tracks in English and Spanish and ran on a CD-ROM platform with touch-screen control.

4.6.2 Disadvantages of using multimedia

According to various researchers (Barber et al., 1995; Maupin, 1992; Adsit, 1996; Billings, 1986) the disadvantages of using multimedia in clinical systems include:

1) Misuse of the multimedia technology by using multimedia just for technology's sake. A designer may go overboard with flashy displays and sounds that actually distract the user's attention from the point the program is trying to make.

2) Multimedia technology may compromise the privacy of patients (for example the use of sound in a busy clinic), and may subvert the accountability and professional secrecy of health care professionals.
3) The expense of both hardware and software to purchase or to develop multimedia systems.

5 Patient Medical Records

A patient workstation would be the integration of one or several computer interviewing systems, patient education systems, other packages within the health environment, and patients' medical records. The system should be able to obtain knowledge of the patient by intelligently analysing his/her medical record of past histories and recent information, and then adapting the interaction accordingly. However, there may be practical and ethical problems which may be encountered when implementing such a system. Concerns may arise in identifying the practical benefits of computerising patients' medical records. An ethical question which often arises is: should patients be allowed to have access to their medical records, and if so, should the records be censored?

Studies by Jones et al. (1992c; 1996b), Cawsey et al. (1995) and Jones and Sanham (1994) have examined the provision for giving patients personalised information on their medical records. These studies found that most patients would use the computer to look for explanations of their medical record, if it was routinely available. In a study of 65 patients in general practice, Jones et al. (1992c) found that the majority of the patients enjoyed the opportunity to use the computer to see their own medical record and many commented that, as the clinician did not have enough time for explanations, the computer was useful. Most of the patients (n=59, 84%) commented that they would use the system again. However, more than one in four of the problems in the medical records were not understood by the patients until, a further explanation screen had been seen. One in four of the patients also queried items or thought that something was incorrect in their medical records. The authors concluded that patient education and the provision of information to patients would be most effective, if it could be tailored to the individual patient by linkage to the medical record.

5.1 Problems of paper patient records

The diagnosis and therapy offered to the patient will depend on the reliability, accuracy and completeness of the medical history taken, examination of the patient and the recording of the symptoms, and the therapy offered to the patient in the medical record. Without an adequate medical record the history will be incomplete and so the diagnosis and therapy of the patient inappropriate. Therefore, in general, a medical record should be valid, accurate, complete, reliable, accessible, readable and timely.

However, an important drawback of paper-based systems is poor accessibility of information. As a result, important information may be overlooked or ignored because it is not found easily in the record. Health care professionals show significant discontent with the traditional medical records and find it too bulky, disorganised, inefficient, unstructured, redundant (Bauersachs and Piwernetz, 1991). Furthermore, the Audit Commissions report of 1995 (Brennan and Dodd, 1996) highlighted the unsatisfactory condition of paper-based patient medical records, and concluded that many records are "poorly legible, ill-structured, bulky and untidy", and that relevant patient information is difficult to find due to the volume of disordered paper.

Numerous studies and reports have shown that paper patient medical records are lacking in several desirable properties that medical records should possess (Rowe, Galletly and Henderson, 1992; Fisher et al., 1992; Saunders, 1992; Graham and Livesley, 1988; Kamien and Sampson, 1984; Pill et al., 1989; Jachuck et al., 1984; Elkind et al., 1988; Swansea Physicians Audit Group, 1983). Rowe et al. (1992) examined the accuracy of text entries within a manually compiled anaesthetic record by comparing the record of the anaesthetist with that of an observer, present throughout the procedure, but whose sole purpose was the documentation of events. Eighty six items of information were analysed for accuracy from 197 records. The mean proportion of omissions was 35% and the mean proportion of incorrect entries was 3.4%. Where no entry should have been made, the mean proportion of unwarranted entries was 1%. However, accuracy varied according to the information contained, omissions were common for preoperative status, fluids, tourniquet use, aspects of monitoring, local anaesthesia and intraoperative problems. The most consistently accurate information was the description of the patient and that relating to drug use. Inaccuracy was common for the majority of sites on the record, irrespective of their reflecting on the anesthetist's performance. The authors suggested that the reason for this inaccuracy of data may reflect the anaesthetists' attitudes to the record's value and response to inadequacies in its design.

Similarly, a study by Pill et al. (1989) showed that medical records are incomplete, and under estimate the amount of lifestyle counselling which is conducted in general practice. The extent of recording and counselling of lifestyle problems by general practitioners and their staff was examined on 130 working class mothers, over a period of five years. Fifty-nine per cent of the women had one or more aspects of lifestyle recorded in their medical records, the most common being smoking habits. Despite the evidence for good coverage of smokers in the population, alcohol and exercise problems were under recorded. The medical records only included details of advice given and follow-up plans for lifestyle problems in 40% of patients' records. Yet the women themselves remembered advice being given on 48% of cases.

A study by Jachuck et al. (1984) which evaluated the quality of recorded consultation of general practice records and the quality of communication storage, also showed that medical records are incomplete. One-hundred and seventy-one consecutive medical records of patients with hypertension and 298 consecutive medical records for evidence of tuberculin skin tests or BCG vaccination were examined. There was no mention of urine analysis and blood test results for 43% and no record of specific examination for 61% of the records of patients with hypertension. The information about tuberculin skin test or BCG immunization, or both, was not available in 78% of the records. Reassessment of the individuals, however, showed that 89% of the studied population had had the test or vaccination, or both.

Elkind et al. (1988) also demonstrated inaccuracy and incompleteness in the medical records. The researchers looked at the reasons why women did not attend a clinic following an invitation for a cervical smear test offered through a computer managed scheme. They found that some women were inaccessible because they no longer lived at the address recorded. Other women who were ineligible or unsuitable within the criteria of the scheme but had been sent invitations inappropriately because their screening records were incomplete or out dated. Similarly, the Swansea Physicians Audit Group (1983) reported inaccuracy and incompleteness of medical records of patients with myocardial infarction, bronchitis or stroke in Swansea. Patients' medical records showed incorrect filing of admission and progress notes (10%), discharge summaries (40%), laboratory results and medications forms (20%). A radiology report was present in only 24% of the occasions that diagnostic radiology had been performed, the names of the drugs used in treatment were missing in 10% of the medical records, and the dose and frequency on 20%.

Furthermore, Graham and Livesley (1988) demonstrated that long delays were caused by the processing of medical records at the central register, and the transfer of records between family practitioner committees and general practitioners. Thirty five (5%) of a total of 671 patients aged 75 and over were entered as new patients onto the age-sex register of an urban group practice during one year. Twenty nine had moved into the area and six had changed their general practitioner for personal and other reasons. An average of 141 (range 71-296) days elapsed before dispatch of their medical records to the new practice. During this period an average of 3.5 (range 0-15) consultations with a general practitioner were recorded, indicating the need of such patients for medical care.

5.2 Computerised patient medical records

The interest in computerising patients' medical records started in the late 1960's, when computer-stored medical records were used to handle patient information stored on magnetic tape (Collen, 1967; Davis, 1968). As we are now in the new information and communication age, this interest is widely spread. Nevertheless, Ornstein et al. (1994) claimed that despite the interest in computer-based patient records (CPRs), less than 1% of patients' medical records in the United States are stored electronically. The deterrents to introducing computerised medical records have not been only cost and bad publicity from inadequate systems, but also genuine doubts about the real advantages and cost effectiveness of computerised patient records (Rodnick, 1990; Sigurdson, 1984).

The Department of Health in the United Kingdom launched a program in the Spring 1993, on the Electronic Patient Record (EPR). The aim of the program was to improve the quality of patient medical records, and, therefore, provide more effective and efficient patient care (Brennan and Dodd, 1996). Another aim was to research the electronic patient medical record, so that the National Health Service would benefit from the recent changes in technology, where "ultimately all systems are transparently integrated allowing real time sub-second interaction between systems through the clinical workstation along a robust and efficient network" (Brennan and Dodd, 1996).

The use of electronic patient medical records has obvious benefits for data management and patient care. Electronic patient medical records provide us with the opportunity to safeguard important information, and to facilitate the linkage of relevant information. They provide physicians with easy access to information, facilitate clinical encounters, and improve physician-patient relationships and the quality of care delivered. Shortliffe and Perreault (1990) listed several advantages of computerised patient medical records. These advantages included: the enhancement of patient care, that is, the time taken by physicians to access patient data is reduced considerably. Computer-based systems permit both remote access and simultaneous access by different members of medical staff at the same time.

Computerised records are more accurate, legible, better organised and complete than the manually written records. Systems can verify and analyse the data entered.

Quaak et al. (1987b) compared three different ways of recording patient histories for 99 out-patients: by a computerised patient interview (patient record), by the usual written interview (medical record), and by the transcribed record, which was a computerised version of the medical record. The researchers found that a 36% rate of the data in the medical record was not present compared with a 2% rate in the computerised version of the medical record. Liaw et al. (1996) demonstrated that providing patients with computer-generated patient-held medical record summaries enhances patient care. The researchers suggested that a computer-generated patient-held health summary and an explanatory booklet together is more effective than either separately, in changing patients' knowledge attitudes and behaviour in health promotion setting.

Disadvantages of computerised records can include extra costs in hardware, software, data entry, and staff training. Problems of system acceptability and record confidentiality may arise. However, studies revealed that patients and health care professionals accept and support the use of computer-based patient record systems (Ornstein et al., 1994, Wald et al., 1995). For example, the *Health History Interview* is a computer-administered patient interview used in primary care (Wald et al., 1995). The system interacts directly with patients and enters patients' clinical information directly into the electronic patient medical record and was well accepted by patients and health providers. Safran et al. (1991) produced a computer-based outpatient medical record system to facilitate direct physician interaction with the clinical computing. The researchers found that clinicians readily entered data directly into the computing system when they were given the appropriate tools, and wrote more words per problem when they were working at the computer compared when they were writing in the paper medical record. During a two years period of installing the medical record system, the clinicians considered that the computer-based problem list was a valuable improvement over its paper counterpart, and that the use of a computer-based medical record system had benefits for data management and patient care.

5.3 Should patients be given access to their own records?

Confidentiality and privacy of health care information present significant challenges in this information age. Confidentiality and security of patient medical records are not only fundamental ethical principles, but also essential prerequisites for effective medical care. Therefore, it is vital that medical records (patient paper records) should be kept secure, that is, in locked or restricted area. Software and medical database security could be ensured by enabling access only to authorised users with special user names and passwords before access to sensitive data is allowed by the computer operating system.

However questions remain about who should have access to the medical records, and whether or not patients should have access to their own medical record. Since medical care depends on teamwork, therefore not only the patients' own doctor should have full access to the patient medical record, but also doctors in other specialties, nurses, pharmacists, radiographers, and other medical staff who will be in contact with the patient. However, there is much controversy over whether or not the patient himself should have access to his own medical records and several researchers have debated on this issue.

There are several reasons, legal, utilitarian and ethical for giving patients access to their own medical records. The Access to Medical Records Report Act came into force in January 1986 (Brahams, 1989b). This Act allowed patients to have access to medical reports written about them by a doctor who has been responsible for their treatment. A second Act, the Data Protection Act (The Data Protection Registrar, 1984), came into operation in November 1987 (Jones et al. 1988b). This too gave patients access to their personalised medical information. It provided patients access to any computerised personal information and to a copy of the medical record within a specified time limit. The public attitude, as expressed both in the press (Frankel, 1984), the journals (Coleman, 1984; Shenkin and Warner, 1973; Wecht, 1978; Chouinard, 1975) and other publications (Faulder, 1985), has also been in support of patients to be given unlimited access to their own medical records.

However, although there was much debate whether or not patients should be given access to their own medical records, the benefits do seem to outweigh the drawbacks. The benefits put forward by several researchers (Kaufman, 1988; Baldry et al., 1986; Parrott et al., 1988; Gill and Scott, 1986; Bird and Walji, 1986; Brahams, 1989a; Jones et al., 1988b; Draper et al., 1986; Thomson, 1985; Gilhooly and McGhee, 1991; Essex, Doig and Renshaw, 1990; Gillon, 1991; Adcock et al., 1991; Brahams, 1989b; Bronson et al., 1986) include:

(a) Improved patient education, where trust and confidence between patients and the medical authorities is enhanced. The patient feels more informed with the information about his illness and treatment. This gives him an extra degree of control in the consultation process, and a greater choice in agreeing or disagreeing with his treatment. As a result the paternalistic relationship between the doctor and the patient is reduced with the doctor placing more responsibility on the patient. (Baldry et al., 1986; Bird and Walji, 1986; Thomson, 1985; Gilhooly and McGhee, 1991; Essex et al., 1990; Gillon, 1991; Bronson et al., 1986).

(b) The patient could 'audit' his own record by correcting the inaccuracies in it, thus helping to eliminate administrative and record keeping errors. (Baldry et al., 1986; Bird and Walji, 1986; Thomson, 1985; Gilhooly and McGhee, 1991; Essex, Doig and Renshaw, 1990; Gillon, 1991).

A study by Jones and Hedley (1986) investigated the accuracy and completeness of data before and after the implementation of a computer-based clinical information system, in an outpatient clinic for diabetes. To encourage accuracy and completion of data, each patient was issued with an edited version of a copy of his medical record to check its contents. By comparing results of a previous study into data accuracy and completeness, a considerable improvement in the completeness of clinical information was achieved.

(c) Improved patient-doctor communication and understanding (Baldry et al. 1986; Bronson et al., 1986; Parrott et al., 1988; Gill and Scott, 1986; Bird and Walji, 1986; Thomson, 1985; Gilhooly and McGhee, 1991) may follow access to a patients' personal medical record, although Thomson (1985) found that increased time may be required to discuss the contents of the medical record with patients. However, this was outweighed by the benefits that:

(1) the patient becomes aware of the doctor's knowledge and perception of his problems.

(2) outstanding problems could be managed and negotiated.

(d) Patient access to medical records will help in eliminating unjustified offensive remarks made by doctors about their patients (Baldry et al.

1986; Thomson, 1985; Gilhooly and McGhee, 1991; Essex et al., 1990), thus encouraging honesty and clarity.

Arguments brought forward *against patients access* to their own medical records, include:

(a) Patients will not be able to fully understand the medical information in their records. This would result in the patient requiring more time with the doctor to discuss the contents of his medical record. (Thomson, 1985; Short, 1986). However, Jones suggested that this problem could be tackled if patients were given routinely available on-line access to their medical records contained with the necessary explanations (Jones, 1988a; Jones et al., 1996b).

(b) Patient open access to his own record may increase the patient's anxiety by reminding him about his problems or by seeing alarming and worrying comments in the record. Thomson (1985) and Baldry et al. (1986) reported that between 2% to 11% of patients who were allowed to read their censored medical records have claimed that this caused them anxiety and confusion. Similarly, patients may prefer to be ignorant of certain health problems (Thomson, 1985; Short, 1986; Sheldon, 1982). This case was seen to be of particular concern to psychiatric and cardiologic patients. However, a study by Jha et al. (1996) demonstrated that both psychiatric and diabetic patients did respond favourably to reading their own medical records, although the psychiatric patients responded less favourably than the diabetic patients.

(c) The reports and notes in the records may cease to be frank, since doctors would become careful in not using sensitive insulting comments. Doctors may be tempted to keep a second set of notes or may 'censor' information resulting in incomplete medical data (Short, 1986).

All the above arguments against patient access to medical records were attacked by several researchers (Parrott et al., 1988; Dove et al., 1977; Gilhooly and McGhee, 1991; Essex et al., 1990; Jones et al., 1988a). These researchers supported patients' access to their own medical records and patients' awareness and involvement as active participants in their own health. Gilhooly and McGhee (1991) argued that it is a "good thing" that doctors would be careful not to use insulting remarks about their patients. Essex et al. (1990) and Parrott et al. (1988) demonstrated that psychiatric patients were willing to have access to their own medical records and found the experience useful and acceptable. The studies indicated patients' willingness in participating actively in their own health. Both Essex et al. and Parrott et al. argued that patients' access to medical records promotes progress in their treatment, and in better understanding and communication between the patients and the medical staff where patients could discuss their problems.

Similarly, numerous other studies (Jones, 1988a; Baldry et al. 1986; Parrott et al., 1988; Gill and Scott, 1986; Bird and Walji, 1986; Draper et al., 1986; Essex et al., 1990) indicated that patients were pleased to become actively involved in their own health. The information "broke down barriers between doctors and patients, enhanced their confidence in doctors, and was reassuring, interesting, helpful and informative" (Baldry et al., 1986). Similarly, several researchers (Jones et al., 1992c, 1996b; Jones and Sandham, 1994; Cawsey et al., 1995) have shown that patients were pleased to use a computer to explain any misunderstood terms or queries in their medical records.

There is much evidence from the literature that patients want access to their own medical records (Jones, 1992c; Jones and Sandham, 1994; Cawsey et al., 1995) and that the benefits of this approach outweighs the drawbacks (Gilhooly and McGhee, 1991). As Gilhooly and McGhee stated:

> " on the whole the arguments 'for' outweighs the arguments 'against' patient-held records", and "there are no substantial practical drawbacks and considerable ethical benefits to be derived from giving patients custody to their own medical records".

6 System Design Issues and Tools

Besides considering issues on incorporating multimedia features when designing a patient workstation, and the practical and ethical problems which may be encountered when implementing a patient workstation, several other issues and tools have to be considered when designing the patient workstation. These include: (a) suitable input/output devices for implementation; (b) security and data transfer; (c) the appropriate software to use; (d) system design methodology; and (e) system usability and user acceptability.

6.1 Input/Output devices

Since a Patient Workstation is designed to be used by a wide range of naive users, complexities which may occur in data input and in interacting with the system should be avoided. Several researchers (Lucas et al. 1976; Olson and Jasinski, 1986; Roberts and Rahbari, 1986; Lapham et al., 1993; Taenzer et al., 1996) have suggested or used simplified keyboards in order to reduce typing errors and improve data entry speed. Earlier versions of *GLADYS* used teletypes (Anonymous, 1973; Lucas et al., 1976) and now the system uses touch screen, although the Swedish *GLADYS* uses a mouse with no problems (Lindberg, 1992). Practical and yet simple keyboards for patients may present only few keys. For example, the *MICKIE* interview (Somerville et al. 1979) used a special keyboard for the patient to use with only three basic buttons, 'Yes', 'No', 'Don't know'; and a fourth button labeled '?' or 'Don't understand' is sometimes added. McClymont et al.'s (1990) *PASS* - the pre-anaesthetic screening system, also used only three keys, namely 'yes', 'no', and 'don't understand'. However, Lucas et al. (1976) found that patients felt restricted with the initial *GLADYS* three options 'Yes', 'No', and 'Don't know'. Three further keys were added to allow patients to qualify their answers, which were 'certainly', 'probably' and 'possibly'. While Lapham et al.'s (1993) computer interview[13] minimises the need for the keyboard by using a fiberglass overlay to cover the keyboard, exposing only the number keys and the return keys. Patients can answer all the questions by entering one of 10 numbers and pressing the return key. A similar example of using an overlay to cover the keyboard and exposing only the relevant keys is the scoring system for drug related morbidity in asthma[14].

Numerous investigators (Fieler and Borch, 1996; Jones et al. 1993b, 1992a; Eglowstein, 1992; Sears and Shneiderman, 1991; Pickering, 1986; Shneiderman, 1992; Stone, 1987; Ostroff and Shneiderman, 1988; Karat et al., 1986) have indicated that the use of touch screens is the most appropriate way to select data for input. This is because pointing to an item or touching it on the screen is the most natural way of selecting it compared to using a mouse or keyboard. Users' comments about using the mouse showed restrictions in its use (Paterson and

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[13] Computer interview for screening pregnant patients for substance abuse and other behavioural risk factors linked to adverse pregnancy outcomes.

[14] Rebecca King's presentation at a one day workshop for direct patient input to the medical record, Birmingham Motorcycle museum, 28th November 1996.

Adamson, 1992), and Ellis et al. (1991) found that older adults preferred the keyboard to the mouse. While touch-sensitive systems like *Healthpoint* (Jones et al., 1993b) and *HealthTouch* (Williams et al., 1995) were well accepted by patients and the public, Jones et al. (1993b) found that people of all ages could interact with *Healthpoint* using the touch screen. Fieler and Borch (1996) found that a touch-screen computer system was an effective method for distributing cancer information in a clinical environment. Durability and simplicity in use have made touch screens favoured by many applications (Jones et al., 1993b; Jones et al. 1992a; Campbell and Jones, 1991, Jones et al. 1992b; Williams et al., 1995) for public access interviewing and information systems.

The light pen used in patient interviewing systems is similar to the touch screen in that it points to objects on the screen. The *Urological History-taking and Management* system (Glen et al. 1991; Glen, Small and Morrison, 1990), and Pynsent et al.'s (1989) computer-based interview system for patients with back pain, showed that patients using the light pen had no problems in interacting with the computer interface. Moreover, experiments with users (Pickering, 1986; Shneiderman, 1992; Karat et al., 1986; Pynsent et al., 1989) have shown that the use of both light pens and touch screens is easy to learn, fast and natural to respond, require no typing skills or additional work space, and is very durable. However, although simple to use, the light pen is not as durable as the touch screen in public accessed systems, since it could be broken, misplaced or stolen. Also, as Jones and Knill-Jones (1994) suggested, while light pen interfaces offer the advantages of portability, this factor alone is not important in patient computer interviewing, as most patient interviewing will take place in outpatient clinics or health centres with defined seating for patient workstations.

On the other hand, touch screens would be most appropriate in public accessed systems, for example *Healthpoint*, where durability for public abuse and simplicity for novice users is needed. However, touch screens may have a reputation for high error rates due to the lack of precision of the human finger and arm fatigue (Pickering, 1986; Shneiderman, 1992). Shneiderman (1992) recommended touch screens when durability and public access is needed, the mouse and track ball when accurate pixel-level pointing is needed and cursor jump keys when there is a small number of targets. Sears and Shneiderman (1991) compared the touch screen and the mouse for targets ranging from 32 to 4 pixels per size and found that there was no difference in accuracy between the two input devices. Other studies (Ostroff and Shneiderman, 1988; Karat et al., 1986) also showed that the touch screen was the fastest and that users preferred it compared to the keyboard or the mouse.

Petheram (1988) compared five input devices, the mouse, joystick, tracker ball, concept keyboard and touch screen, enabling stroke victims to interact with a microcomputer. Success rates, times, and subjective preference were all recorded. The tracker ball was found to be the best in terms of success rate and subjective preference. Murchie and Kenny (1988) when comparing the keyboard, light pen and voice recognition, found that the keyboard was considered the quickest, the most accurate, the easiest and the most preferred input device by the medical staff in an intensive care unit. Ellis et al. (1991) compared the use of the keyboard and the mouse interacting with a computer-based health risk appraisal by patients. They found that older patients interacted as much as the younger patients with the system, and rated the health appraisal more helpful than the younger group. However, the keyboard was more effective and preferred to the mouse by the older users.

An example of continuous speech as input, is that of Johnson et al.'s (1992) automated speaker-independent continuous speech history-taking system, *Q-MED*. The system was designed to allow a patient to enter his basic symptoms by engaging in a dialog with *Q-MED*. An evaluation of the natural language parser showed an overall semantic accuracy of 87 percent. No other example of continuous speech as input has been identified in the literature. However, there are various examples of multimedia patient education systems using 'digitised voice' as output. For example, Morss et al.'s (1993) multimedia patient education system for Schizophrenic patients used 'digitised voice' and a print out to give instructions for patients. Similarly, Gerbert et al. (1996) produced an interactive multimedia sexual risk assessment program which used a talking 'video doctor' to question patients about risk-associated sexual behaviour.

6.2 Patient data cards

Today's technology has given rise to the new patient-held integrated-circuit card or the smart card and the optical memory card (OMC) (Engelbrecht et al., 1995; Jocelyn, 1995; Robertson, 1993; Penn et al., 1993; Smith, 1991; Anonymous, 1988). Both cards hold electronically-erasable data of patient medical information embedded in a credit-card-sized plastic card. These machine-readable patient data cards promise a portable, up-to-date, confidential medical record carried by the patient. However, to maintain confidentiality patients and medical personnel would only have access on the cards by using unique pin numbers. The use of these cards may enhance patients' involvement in the health care process, and may accelerate the transfer of information between primary care, secondary care and pharmacy. There is much support in the literature for this new technology of using smart cards in health care (Engelbrecht et al., 1995; Jocelyn, 1995; Robertson, 1993), and successful results of using patient data cards in health care experiments have been reported (Shiina et al., 1991; Ognibene, 1991; Bouckaert et al., 1992; Leroux, 1991; Jocelyn, 1995; Murata et al., 1989).

Bouckaert et al. (1992), for example, tested the use of the microchip cards as portable medical records in a small Belgian town. The investigators found that the use of the cards was acceptable to patients and that the cards could be used as a useful innovation for emergency situations. Similarly, Shiina et al. (1991) reported excellent results of the application of optical cards in medical care in Japan. This was mainly due to improvements in the technology for encoding optical cards and devices used to increase read-write speed. Leroux (1991) reported that the French Santal Project showed that the use of the smart card helped patients to communicate more accurately and faster with their health care providers, and as a consequence left more time during the consultation to discuss the problem that generated the visit.

Ognibene (1991) also successfully demonstrated the use a portable record for the patient's medical for prescription history as 'Smart Pharmacy Cards'. He developed a prototype system using the 'smart cards' in order to analyse every new prescription. This enabled a pharmacist to determine if the new prescription conflicted with disease states, allergies, prescription and non-prescription drugs documented in the card. Murata (1989) produced a prototype system using patient data cards called the Computer-assisted Radiological Reporting System (CRRS) for use with a PC. The system used radiography patient cards, embedded with recordings of the patient's identification and medical histories. Results showed that using CRRS to obtain diagnostic histories together with the patient data cards has improved efficiency of the reporting procedure.

Jones et al. (1988a) also suggested that systems such as *Healthpoint* would be most effective in patient education and providing health information if they could be tailored to the individual users needs. The system could be linked to a medical records database, or with the use of smart cards the system could adapt itself to the patient's needs by providing information and advice relevant to the patient's latest health problems. Information on the patient's medical record could be easily accessed, and the system could be interrogated on any inquiry or misconception in the medical record by the patient. The system will, therefore, be able to provide personalised medical information to the patient, on topics most relevant to the individual's needs.

The University of Aberdeen (Robertson, 1993) have been carrying an independent evaluation on the effectiveness and efficiency of the use of patient data cards, and its appropriateness by collating the opinions of 8,000 patients. Jim Beattie and others[15] at Inverurie in Scotland, have also been carrying out randomised trials to evaluate the use of the optical data card in the transfer of information between different health centres. A similar project, the Quebec Patient Smart Card Project (Jocelyn, 1995), is being carried out, which aims to look at how the use of patient smart cards can assist the health service in Quebec.

However, Regan (1991) is sceptical about the use of patient data cards. He questions whether general practitioners will accept the implementation of the cards, and whether the use of patient data cards in general practice would be cost-effective. However, he admitted that patient data cards may accelerate computer storage and transfer of information in general medical practice. Nevertheless, a major concern on the effectiveness of the smart cards is that eventually when all the National Health Service is networked, will the smart cards then be needed to

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[15] Through personal conversations with Jim Beatie.

help in the communication process of information between primary care, secondary care, and pharmacy? Obviously, not. But then when will the National Health Service be fully networked?

6.3 Software

A variety of languages and 'authoring' packages have been used to develop interviewing and patient-education computer based systems, distributed over CD-ROMs, floppy disks, and laser videodiscs. Software development has become easier than before with the introduction and maturing of several programming languages and the introduction of multimedia authoring products. There are several examples of packages in the medical field using software languages such as BASIC, Lisp, C+ and database packages such as FoxPro, authoring packages such as Authorware and Toolbook.

However, there do not appear more than a very few examples of a 'special' software for developing computer interviewing systems. For example, the *Interview* produced by the Dundee group (Gregor et al., 1996) who intend to market it, was designed for the clinician to create his own computer interviews. Clinicians can type their interview questions to patients using a normal word processor. The computer can be instructed on the order in which to present the questions by adding a few symbols without relying on computer programming knowledge (Alm and Morton, 1990; Gregor et al., 1996). Similarly, Quaak et al. (1987a) in the Netherlands produced a package called AIDA to develop an interview for patient history, and Locke et al. (1992; 1994) used Converse to develop computer interviews to detect factors related to the risk of the human immunodeficiency virus (HIV) among potential blood donors.

6.3.1 Languages

Computer languages such as BASIC, C+, Lisp and Prolog, database packages such as FoxPro and authoring packages, have been used to develop computer interviews and clinical educational packages. Examples include:

- *Healthpoint* (Jones et al., 1996a; 1990a; 1992e) was initially developed in the authoring package Storyboard Live. However, being a DOS package, Storyboard had limitations such as multimedia capabilities and passing parameters. The latest version of *Healthpoint* uses a multimedia database, FoxPro, which has proved more successful in combining pictorial style of information and database facilities than earlier experimental versions in authoring packages and multimedia databases (Jones et al., 1996a; 1996c).

- *GLADYS* (Lucas et al., 1976; Knill-Jones et al., 1990a) was initially developed in BASIC for Apple and a later version was developed in Microsoft Excel for Apple and Windows.

- The urological history-taking and Management system was initially developed in the late eighties in BASIC using an Apple II microcomputer (Glen et al., 1989), and later, reprogrammed in DATAFLEX to run on IBM compatible machines (Glen et al., 1990).

- The Pre-Anesthetic Screening patient interviewing System - *PASS* by McClymont et al. (1990) was initially developed in Turbo BASIC and a later version was developed in Smalltalk-V for DOS.

- Beck et al. (1982) developed *drug I.Q. quiz*, in BASIC for Apple. The computer-assisted lesson on general drug knowledge on the micro-computer was designed for patients in the waiting room of an ambulatory-care clinic.

- Morio et al. (1989) produced *The Early Detection Breast Cancer expert system*, an advisory system for patients, in Prolog to work on the PC.

- Several computer-based health education packages have been developed using the C language. These include: MACHeart, Medical HouseCall, Dr. Schueler's Home Medical Advisor, Body Works and Body Works Voyager (Stocking and Mo, 1995). Pynsent et al. (1989) also developed the computer-based interview system for patients with back pain in C+.

- The *Cancer* system produced by Jones et al. (1996b) to access explained versions of patients medical records was written in Lisp. The system used artificial intelligence and text generation.

6.3.2 Types of Authoring Tools.

There are two main types of authoring tools, these are:

i) *Card- or page- based tools.* Examples of these include HyperCard and SuperCard (Macintosh) and Toolbook (Windows).

ii) *Icon-based, event-driven tools.* Examples of these include Authorware (Macintosh and Windows), IconAuthor (Windows) and HSC Interactive (Windows).

HyperCard 2.0 (Apple Macintosh)

HyperCard[16], with its incorporated programming language Hypertalk, is a card-based authoring tool for the Macintosh. HyperCard offers a Hypermedia environment, of user-friendly, multimedia and hypertext. Even though Hypertalk is very easy to use, it offers most of the features found in advanced software development systems, and has been used to produce several medical education products (Stocking and Mo, 1995).

SuperCard (Macintosh)

SuperCard is an authoring application also for the Macintosh, used to produce sophisticated multimedia presentations, front-ends to databases, and computer-based education packages in medicine. SuperCard uses a scripting language called SuperTalk and one can build integrated, stand-alone Macintosh applications

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[16] Originally developed in 1987 as a software construction kit for the Macintosh.

which would include multiple windows of any type, full colour graphic objects with attached scripts, and a wide variety of other standard Macintosh interface elements. A SuperCard program contains windows, and windows contain backgrounds and cards that in turn contain drawn and bitmapped graphics, buttons, and text fields. SuperCard can convert HyperCard stacks to SuperCard format.

Toolbook (Windows)

Toolbook provides similar features to HyperCard 2.0 and it is tempting to see the package simply as a PC version of Applause's HyperCard. A separate package called Convert-It[17] converts HyperCard to Toolbook but not otherwise. Using similar features as HyperCard, Toolbook exchanges stacks for books and cards for pages, and uses OpenScript as its programming language. Text, buttons, icons, record fields, and graphics can be placed on pages, linked in a nonlinear fashion, and controlled by internal scripts. Hot words in text fields could be connected to related information that appear in different places throughout a book, or other books that can be opened. Thus, by clicking a hot word a word responds like a button.

Toolbook has played an important part in the production of several computer-based patient education systems. Examples of such systems include:

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[17] Convertit! translates all of HyperCard's objects into ToolBook objects, and it converts most of HyperCard stack's HyperTalk scripts into functional ToolBook OpenScript.

a) *The Cancer Information Service System* by Paterson and Adamson (1992) was designed for public access using multimedia techniques, in Asymetrix Toolbook 1.5 running under Windows 3, although a later version was developed in Aldus Supercard 1.5 running under Apple Macintosh II.

b) *CodeRed!* (Tanner and Gitlow, 1991) written in Toolbook presented typical cardiac emergencies with a full-colour interactive educational experience.

c) *Images in Rheumatology* (Nashel and Martin, 1992) used multimedia Toolbook to provide clinical information, x-ray images, and sound for instruction in rheumatology.

Authorware (Macintosh and Windows)

Another popular authoring tool in medical education software is Multimedia Authorware, which is an icon-based authoring tool, which runs on both Macintosh and windows applications. Authorware is an event-driven tool providing a visual programming approach to organising and presenting multimedia. Unlike HyperCard and Toolbook, a user can build sophisticated applications without scripting. Programs can be developed by selecting from a group of eleven pre-defined icons and arranging them along a flow line through clicking and dragging with a mouse. By placing icons on the flow line, one can, therefore, sequence events and activities, including decisions and user interactions. However, the advantage of designing or tailoring one's own scripting (of events) may produce more flexibility and control over the events. *ATLAS-plus* (Miller et al., 1992) is an example of a medical teaching tool using Authorware.

The program produces digitised images, sound, animation, and text to teach histology, embryology, and anatomy.

6.4 System design criteria and methodologies

Fox and Frost (1985) proposed a set of criteria for clinical systems, in primary care, which included that systems should be acceptable to the user, robust, versatile, and easy to maintain and cost effective. McGraw (1992) stressed that user interfaces should be designed to incorporate effective messages, help facilities and user documentation. Rissland (1984) in a paper entitled "Ingredients of intelligent user interfaces", also suggested that intelligent user interfaces should provide on-line assistance and documentation for carrying out automatically menial and routine tasks. He proposed that systems should be understandable, helpful, forgiving, and encouraging, with information presented in a clear, unambiguous manner.

System design methodologies are formalised rules which, when followed in sequence are intended to facilitate the design process and produce a good effective approach to the design of interactive information systems. The importance of a good design methodology was well expressed by Wasserman et al. (1986, page 326):

> "....use of a methodology can improve many aspects of the entire software development process, including a better fit to user requirements, fewer

> errors in the resulting system, better documentation throughout the entire process, and significantly reduced costs for system evolution."

Numerous researchers (McGraw, 1992; Wright and Monk, 1991; Walters and Nielsen, 1988; Shneiderman, 1992; Capindale and Crawford, 1990; Jacob, 1983; Buchanan et al. 1983; Moran, 1981; Foley and Wallace, 1974; Rubinstein and Hersh, 1984; Wasserman, et al. 1986; Sutcliffe and McDermott, 1991; McMath et al., 1989; Heylighen, 1991) have proposed several methods of user-interface design methodologies.

These methods include the *Rapid Prototyping methodology* proposed by McGraw (1992) which is a simple, but rather limited method used for developing small and less complex systems. It consists of four stages (1) Requirements; (2) Acquire knowledge; (3) Coding; (4) Testing. The methodology is most effective if the problem to be solved is trivial and could be managed by one person, and, if the system to be developed is experimental and developing tools for the prototype system are available. Another method of user interface design method is the *Iterative Engineering methodology* for user interface (IEI), which provided developers with a method to design, develop and evaluate user interfaces, and then effectively integrate the developing user interface into the prototype system (McGraw, 1992). At any point of the development process developers can evaluate the system's performance, and if problems should be encountered iterate back to the problem source. McGraw (1992) also suggested pre-design activities which primarily are comprised of three things, the system, the user and the environment. To provide an effective system, designers must :

a) identify system functionality and interface requirements.
b) involve the targeted user, either through formal or informal interviews, questionnaires and observations, in order to survey user characteristics, expectations and requirements of the system.
c) know and involve the environment in which the system will be used.

Similarly, Rubinstein and Hersh (1984) presented the design process as mainly occurring in five stages:- (a) The gathering of information; (b) System design and specification; (c) Implementation design and construction; (d) Testing and evaluation, both informal and formal; (e) Delivery of the system and evaluation of user reactions on the field.

6.5 Ensuring system usability and user acceptability

A system development cycle is mainly three general stages: system analysis, system design and system implementation. Some users, and perhaps most users in some local communities, may have 'computer-phobia' towards public access systems, believing that computers are hard to use and learn. Therefore, designers must involve their potential users early in the system development in order to know them, and thereby tailor the design accordingly ensuring user acceptability. The design of the system throughout the prototype development should be 'user driven' and targeted to the requirements and expectations of potential users. The developed system should be easy to learn, useful and pleasant to use.

To ensure successful system implementation and high user acceptability several researchers have suggested different aspects to consider while designing the system. Brody (1993) suggested that "computer developers should target the silent majority. They should be paying close attention to what annoys people about today's computers and taking appropriate action". Both Microsoft and Apple have established 'usability labs' where software developers give test users new programs and assign them a task. The developers then observe the users through a one-way mirror (Brody, 1993). Gould and Lewis (1985) stated three principles for good user interface design to provide the highest level of system usability and acceptability. The approach they advocated required the building of prototypes and the useful observation or 'measurement' of the way users behave with them.

a) *Early focus on users and tasks*: designers must understand their users by early focusing on their cognitive, behavioural and attitudinal characteristics.
b) *Empirical measurement*: intended users should be involved throughout the prototype's development and testing. Their performance and reactions should be observed, recorded and analysed.
c) *Iterative design*: system design must be of iterative cycle, test user acceptability of the system, measure encountered problems and redesign the

system again. This cycle should be repeated as often as necessary in order to ensure the highest level of system functionality, usability and user acceptability.

Heathfield et al. (1990) argued that there are two main reasons contributing to the problem of lack of user acceptance in currently operational clinical systems. First, when interacting with their users, current systems are not user driven, allowing no free expression of ideas within the consultation process, where systems tend to ask users a series of questions which cannot be queried. Secondly, systems require large amounts of data from users in order to reach a conclusion. The authors suggested that to improve system acceptability, systems must be designed to function in a co-operative manner, where the user is actively involved in the consultation process.

Lun et al. (1986) have suggested that more advanced systems and programs for clinical information processing should be built upon already existing Health Information Systems (HIS) and population registers. Therefore, there will be less need for users to answer questions about information that has already been collected, the problem of systems requiring extensive information from users can be solved. A patient workstation, where clinical information can be integrated from different sources (such as medical records), can obviously solve the problem of the system requiring extensive information from the patient.

7 The Evaluation of Clinical Systems

The potential of any patient workstation will only be established by evaluating it 'step by step' in primary care or hospital clinic. Evaluation, whether informal or formal, is a vital step in the development of a patient workstation, as it provides a feedback process for improving the workstation. An evaluation is primarily concerned with the software's accuracy, its usefulness, and in determining whether the workstation complies with its original requirements and goals. As expressed by Gaschnig et al. (1983, page 244),

> " Evaluations by domain experts help to determine the accuracy of the embedded knowledge and the accuracy of any advice of conclusions that the system provides. Evaluations by users help to determine the utility of the system - namely, whether it produces useful results, the extent of its capabilities, its ease of interaction, the intelligibility and credibility of its results, its efficiency and speed, and its reliability."

Evaluation of interactive clinical systems has only recently received serious attention (Botti et al., 1987; Fieschi and Joubert, 1986). Traditionally systems have been validated by comparison of the computer outputs with the consensus view of the experts, examples include *MYCIN* (Yu et al. 1979) and computer-aided diagnosis of acute abdominal pain (Adams et al. 1986). Validation is slightly different from evaluation. Both, evaluation and validation, are concerned with the program accuracy and whether the initial problem was solved. However, unlike validation, evaluation focuses also on the software's usefulness.

7.1 Types of evaluation methods

Researchers (Kaufman D, Lee S, 1993; Hewett, 1986; McGraw, 1992) have identified two forms of evaluations; *formative* and *summative*. Formative evaluation is an iterative process occurring during the development of the system and user interface, and in its testing stages. This type of evaluation helps the designer to refine the system after each prototype testing, where qualitative information, as suggested by Hewett (1986), is more likely needed to identify problems and so refine the design. For example designers may need to know why errors occurred rather than how many errors occurred. Summative evaluation occurs at the final stage when the system is developed. The purpose of this type of evaluation is to assess the usability and the impact of the system. Quantitative information rather than qualitative data is required in this process which will help developers determine the usefulness of the changes to the design.

7.2 Evaluation criteria

In order to conduct the evaluation of interactive clinical information systems, a set of evaluation criteria is needed. Researchers (Gaschnig et al. 1983; Anderson et al., 1976; Boehm et al. 1978; Fieschi, 1990; McGraw, 1992, Spiegelhalter, 1983, Fieschi and Joubert, 1986 ; Shortliffe and Clancy, 1984) have proposed different criteria to be used for evaluation. Gaschnig et al. (1983) identified a set of evaluation criteria for interactive information systems, where the quality, usefulness and cost effectiveness of the software are important elements. Anderson et al. (1976) suggested four main general criteria to be taken into account in the evaluation of a clinical system. These are:

- *Effectiveness* - the ability of a system to perform the function it was designed to perform.
- *Feasibility* - the capability to implement the procedure.
- *Economics* - the financial considerations of application of the system.
- *Credibility* - the belief by users that the system is competent.

The measurement of each criteria depends on the perspective of the user. A system may be very credible from the patient's point of view, but may not be effective from the expert's point of view. Hence, in evaluating a clinical interactive system there are different 'spheres of use' within the same system's evaluation depending upon perspective being used.

A number of clinical interviewing systems have been evaluated from the patient's perspective. Card and Lucas (1981) suggested that the criteria of evaluation for computer patient interrogation systems was: (a) *accuracy* of the system; (b) *acceptability* of the system by patients; and (c) *cost* to develop and implement the system. Lucas (1977) suggested that the attitudes of patients, the users, are of the utmost importance in the evaluation of a computer interview. *GLADYS* was evaluated in a study of 75 patients, where each patient was interviewed by the system and then asked to take home a questionnaire and return it by post (Lucas, 1977). The researchers used this method so as to avoid the bias of completing the questionnaire in the clinic which tended to want to please the doctor or researcher and respond accordingly. However, Kushniruk et al. (1996) attacked this method as it is limited by imprecision, reliance on the user's memory, and the tendency to be influenced by recent events.

Naven et al. (1996) suggested that evaluation methods should reflect the aims of the system being evaluated. For example, *Healthpoint* was involved in various evaluation studies (Jones et al., 1993b; 1992d; Naven et al., 1996), where methods included evaluating users' acceptability, the value of the information and the effectiveness of the system.. Similarly, O'Connor et al. (1989), in evaluating a computer interview system for use with neuro-otology patients, examined the effectiveness, feasibility and credibility of the interview system from the patients' perspective. The system had to be *effective* by gaining basic medical information and general medical history from the patients. The system also had to be *acceptable* to the patients and *credible* when compared with the current system in gathering information.

Examples of evaluation studies include, *DIABLOG*, the computer-based education system for diabetic patients, where evaluation results indicated a good acceptance of the program even by patients with no previous computer experience (Biermann and Mehnert, 1990). Another example is Kinzie et al.'s (1993) evaluation study of a multimedia program for prenatal alcohol education. The system was evaluated by determining the appropriateness of the program content and the acceptability of the computer format to the users, and to evaluate the interactive functions of the program. A number of other evaluation studies from the patients' perspective compared cases with controls, and the results showed that the majority of the patients interacted well with the computer (Mercer and Sweeney, 1995; Levitan et al., 1991; Mathisen et al., 1987 and Wetstone et al., 1985).

However, there is yet no standard means of evaluation of clinical computer systems, controlled by the National Health Service or other international medical services, unlike the way medicines are controlled before they reach the market place, so as to prove the system can do what its developers claim. This is perhaps due to the many problems and limitations faced when building interactive clinical systems, and because it takes several years to build such systems and then to prove them reliable. System designers should develop their own set of evaluation criteria prior to the design and development of the system's prototypes, so as to suit the task analysis and requirements of the system being developed. As the requirements evolve during the prototype testings, new goals would be introduced, and so the set of evaluation criteria may change.

Yet, although much progress has been made in developing new and powerful systems, the fact remains, as Jeremy Wyatt (1990) stated, that "while world-wide thousands of clinical expert systems had been built, only about 100 had been evaluated and only 10 are in use!". Similarly, as Jones and Knill-Jones (1994) found out, a number of clinical interviewing systems in the United Kingdom, such as those of McClymont et al. (1990), Fawdry (1989) and Brownbridge (1988), have only been research studies and have not been carried forward to routine use.

8 Concluding Comments

This chapter has discussed the relevant literature on the development and evaluation of a patient workstation, which would combine computer patient interrogation and patient seeking information from the computer. The need for a patient workstation to facilitate the information integration process between patients and physicians has been justified.

The benefits and the disadvantages of computer interviewing have been explored. This is important so that when designing a patient workstation, the benefits should be enhanced, and the drawbacks and limitations should be minimised. It is with the background of the inadequacy of the patient-doctor consultation, and the drawbacks and limitations of the existing computer interviewing systems that this study was undertaken. The aim of the patient workstation is to enhance the process of sharing information during a physician-patient consultation, and thereby increase patients' compliance. Within a patient workstation limitations and drawbacks of computer interviews, such as the length of time needed to complete an interview and the creation of the questions themselves, could be explored and may be minimised.

The literature review has also looked at numerous examples of computer interviewing systems and computer-based patient education systems, so as to place the study in perspective. The benefits obtained from computer-based patient education, and its role in the emerging field of 'patient informatics' have been discussed. Since a patient workstation would combine both the benefits of computer interviewing systems and patient education systems, the effectiveness of the benefits of the two styles of interactions may be enhanced. The practical and ethical problems which may be encountered when implementing a patient workstation, by allowing patients to have access to their medical records, have been emphasised. The arguments for and against letting patients having access to their medical records have also been discussed.

Several issues and tools to be used when designing a patient workstation have been explored. Types of evaluation methods, evaluation criteria and examples of some of the evaluations of clinical systems have been discussed. The volume of literature in the field of the evaluation of clinical systems is large. This review has only highlighted some of the key issues and examples in the evaluation of clinical systems.

Chapter III

Aims and Objectives

"We know what we are, but know not what we may be."

William Shakespeare

1. Aims

1) To investigate the design and use of a patient workstation in a gastro-enterology clinic. In particular, to investigate patient-computer interaction which allows the patient to be more interactive, by combining computer interrogation of the patient with patient interrogation of the computer.

2) To explore the feasibility of introducing such a patient workstation into a gastro-enterology clinic in Oman.

2. Objectives

1) To examine the benefits (or drawbacks) of computer interrogation of the patient and patient interrogation of the computer being kept completely separate.

2) To examine the benefits (or drawbacks) of combining computer interrogation of the patient and patient interrogation of the computer, by allowing the patient to interrupt the computer interrogation to seek health information.

3) To compare the benefits (or drawbacks) of providing patients with 'selected' topics related to their symptoms and the interviewing process, and providing them with 'general' health topics in the computer information system.

4) To compare the characteristics of patients who interrupt the computer interrogation to seek health information and those who do not.

5) To determine patients' perceived feelings of control and confusion when interacting with a computer.

6) To compare patients' perceived feelings of embarrassment when being interviewed by a doctor, and when being interviewed by a computer.

7) To determine patients' perceived feelings of knowledge gained after using the system.

8) To determine patients' perceived feelings of being able to remember some of the information gained after using the information system, when they have left the clinic.

9) To determine patients' preferences of the method of accessing health information.

10) To compare younger and older patients' reactions when interacting with a computer.

11) To examine the effect of patients' previous computer experience when interacting a computer.

12) To compare male and female patients' reactions when interacting with a computer.

13) To examine the effects of patients' emotional feelings when interacting with a computer.

14) To compare the reactions of patients who used a long computer interview and those who used a short computer interview.

15) To compare the reactions of patients who used a paper questionnaire and those who used an on-line questionnaire.

16) To investigate the process of translation of a patient workstation from English to Arabic.

17) To investigate the feasibility of introducing a patient workstation into a gastro-enterology clinic in Oman.

3. Null Hypothesis

1) There is no difference between computer interrogation of the patient and patient interrogation of the computer being kept completely separate, and when combined by allowing the patient to interrupt the computer interrogation to seek health information.

2) There is no difference between providing patients with 'selected' topics related to their symptoms and the interviewing process, and providing them with 'general' health topics in the computer information system.

3) There is no difference between the characteristics of patients who interrupt the computer interrogation to seek health information in the computer information system, and those who do not.

4) Patients' interaction with a computer would not affect their perceived feelings of control and confusion.

5) There is no difference between patients' perceived feelings of embarrassment when being interviewed by a doctor and when being interviewed by a computer.

6) Patients would not perceive to have gained knowledge after using the computer health information system.

7) Patients would perceive to be unable to remember some of the information gained after using the computer health information system, when they had left the clinic.

8) Patients would prefer to access health information from a book or pamphlet instead of the computer.

9) There is no difference between younger and older patients' reactions when interacting with a computer.

10) There is no difference between the reactions of patients who used computers before the study trial and those who had never used computers, when interacting with a computer.

11) There is no difference between the reactions of male and female patients when interacting with a computer.

12) There is no difference between the reactions of patients who had negative feelings and those who had positive feelings, when interacting with a computer.

13) There is no difference between the reactions of patients who used a long computer interview and those who used a short computer interview.

14) There is no difference between the reactions of patients who used a paper questionnaire and those who used an on-line questionnaire.

Chapter IV

Materials and Methods

" .... and what is the use of a book," thought Alice,
" without pictures or conversations ? "

Alice in Wonderland by Lewis Carroll

Contents

1. Introduction

The GLAsgow diagnostic DYSpepsia system (GLADYS) was redeveloped to comprise computer interrogation of the patient and patient interrogation of the computer. Comparisons were made of three different 'styles' of patient computer interaction:

- **Style A** : Computer interview or interrogation of the patient followed by patient interrogation of the computer, where the patient can seek general health information about gastro-enterology after the computer interview.

- **Style B** : Same as style A but this allowed the patient to interrupt the computer interview to seek health information about gastro-enterology.

- **Style C** : Half of the patients from style B were presented with a selected range of information about gastro-enterology adapted in some degree to their own characteristics and interview responses.

2. Program Specifications

In order to meet the requirements of the objectives of the research the main program specifications were as follows:

The system to be designed was to consist of the three different styles of patient computer interaction mentioned above.

1) The system was designed to be used in a gastro-enterology clinic by patients who were non-computer users, interacting directly with the computer by using a touch screen as an input device.

2) The system was designed to enable patients to interact easily with the computer. The information presented to patients by the system would be clear, consistent, effective and easy to understand. Points considered when designing the system were: (a) that the reading ability of the patients may be low, (b) their eyesight may not be good and (c) patients might never have used a computer before.

3) In general, patients would be able to feel some degree of control and not be confused when interacting with the system. After using the system, patients would be able to have a positive attitude towards the system and perceive the usefulness of the health information system.

3. The computer system[1]

A new version of the existing dyspeptic patient interviewing diagnostic system GLADYS (The **Gla**sgow **Dy**spepsia System) was developed using a new more flexible software (Toolbook). This version allowed the combination of the 'pure' interviewing system GLADYS and an interactive health information system

[1] A comprehensive description of the system is in chapter 5.

focused on the health needs of dyspeptic patients. Evaluation studies compared three situations for the system where patients were automatically randomised to use one of the three styles mentioned.

4. Tools and materials

4.1 The hardware and software

The Patient Workstation was designed using Asymetrix Toolbook version 1.5 for Windows. The computer system can also run using Multimedia Toolbook version 3, as Toolbook automatically adapts any systems using previous versions to later versions.

The software and hardware required to run the system:

- A 66-MHz IBM PC-Compatible computer system with an Intel 80486 processor (minimum requirement).
- Hard disk capacity available for the system 20 MB
- A SVGA touch screen monitor with 256 colours and 800 x 600 pixels resolution.[2]
- Asymetrix Toolbook for Windows version 1.5
- Microsoft Windows version 3.11

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[2] The program can also run using screen resolutions of 1024 x 768 and 640 x 480, however, with the latter the full screen would not be displayed, and the user would have to use the scroll bar to see the full screen.

- Canon scanner software was used for scanning images. Adobe photoshop 2.5.1 was then used to convert the images to BMP files (file extension .bmp) and then imported to Toolbook.
- CoralDraw version 5 was also used to obtain images where some of the images obtained from CoralDraw were redrawn, in order to add to, or emphasis important features.
- Pictures and information provided by medical and health related books and software packages using Microsoft Windows.

4.2 Books and pamphlets used to develop the system

a) Patients' booklets and pamphlets on dyspepsia-related illnesses at the Southern General hospital.

b) Boots pharmacy booklets and pamphlets on dyspepsia-related illnesses and health issues.

c) The British Medical Association. Family Doctor. Home Advisor by Tony Smith (ed.).

d) The British Medical Association Complete Family Health Encyclopaedia by Tony Smith(ed.).

e) The Family Guide to Alternative Health Care by Professor Patrick Pietroni.

f) Pictures of dyspepsia-related illnesses were also scanned from a clinical calendar for dyspepsia provided by Zantac.

g) Microsoft Windows package Family Medical Dictionary.

h) Microsoft Windows package Drugs.

Children's books (chosen for their colourful illustrations and simplicity)

a) You and Your Body by Angela Royston.

b) Illustrated Dictionary of the Human Body by Mel Sainsbury.

4.3 Asymetrix Toolbook for Windows

Asymetrix Toolbook for Windows was chosen for the development of the computer system. As a Windows authoring system, Toolbook is built to exploit most of the attractive and interesting facilities which Windows offers. Toolbook uses OpenScript for its programming language and enables the combination of text, graphics, sound and animation.

Toolbook has two working levels: Reader and Author. A book's scripts[3] can be run at the Reader level, while, at the Author's level, commands to create new books, create and modify objects on pages, and write scripts, are available. OpenScript can also be extended by writing additional functions and Dynamic Link Libraries (DLLs)[4]

[3] A 'little' program or a procedure is called a 'script'. Examples of scripts can be seen in Appendix XIX.

[4] DLLs are separate programs that Windows applications can dynamically link to and call to perform tasks. They are used to add capabilities not available directly from Toolbook. The Gladys Toolbook system was designed to be connected to an earlier Excel Gladys version, where patients' responses from the Toolbook Gladys were transferred into the Excel Gladys and then probabilities calculated. It was vital therefore to have the DLL facility to allow this connection.

4.3.1 Advantages of using Asymetrix Toolbook over other authoring systems

Asymetrix Toolbook was found to be a suitable tool for developing the computer system, as it has advantages over HyperCard and Authorware, even though the latter runs on both the Macintosh and Windows applications.

- Asymetrix Toolbook is similar to Apple's HyperCard, in that they are both card-based authoring tools. Like HyperCard which uses Hypertalk as its programming language, Toolbook uses OpenScript. However, although Hypertalk is as powerful as OpenScript, OpenScript has an advantage over Hypertalk. In OpenScript a relational database could be constructed whereas with Hypertalk, such a database can not be constructed. This is also an advantage which Toolbook has over Authorware, as Authorware does not provide any database functions or any capacity to import large documents or data sets. When developing a patient workstation it is necessary to use software which has such a facility so that patients would be provided with integrated access to clinical information, such as being linked to medical records and applications from diverse sources within the health care environment.

- Another advantage of OpenScript over Hypertalk is that 'hot words'[5] in text fields can have a 'script' attached, where they can be connected to related

[5] Words which are activated

information which appears in different places throughout the program. Thus, by clicking a hot word, the word responds like a button.

- Authorware is an icon-based authoring tool, which is an event-driven tool providing a visual programming approach. Unlike HyperCard and Toolbook, in Authorware a user can build sophisticated applications without scripting. By placing icons on the flow line, one can sequence events and activities, including decisions and user interaction. However, the advantage of Toolbook over Authorware is that by designing or tailoring one's own scripts, more flexibility and control over the scripts is provided.

- Toolbook is used extensively and is much cheaper than Authorware.

5. The Pilot study

Within a period of four months, a pilot study was carried out at the Southern General Hospital with 42 willing patients, interacting directly with the patient workstation. The pilot study provided information on the acceptability of the design and allowed piloting of questionnaires and other evaluation tools.

5.1 The setting

The gastro-enterology clinic, at the Southern General Hospital, was opened for gastric related patients only twice a week, on Wednesdays and Thursday, from 1 p.m. to 4 p.m. However, on Thursdays most of the patients suffered from liver related illnesses and only one doctor looked at dyspeptic patients. Therefore, Wednesdays were the best days for the researcher to see patients. It was decided by the medical staff at the clinic, that only the doctors would ask the patients if they were willing to participate in the pilot study trials, and then only after the patients had seen the doctor. However, the doctors were often too busy to remember or were disinterested to ask the patients. In addition, in most cases, even if the doctors remembered to ask the patients after their consultation, the patients often refused due to lack of time. As this was a 'rush'[6] clinic most patients would often have other plans, such as going back to work or picking up the children from school. Therefore, many patients had no time available for the pilot trials.

As a result, within four months, from the 25th May 1995 to the 27th of September, only 42 patients were recruited into the pilot study, with approximately 2 to 3 patients per week. Due to the low number of patients, it was not feasible to continue with the research at the Southern General gastro-enterology clinic, and therefore, it was necessary to move to another clinic.

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[6] Clinicians referred to this clinic as a 'rush' clinic, meaning a clinic where patients would have an appointment with a doctor for about ten minutes. Often the patient would have to wait for some time before seeing the doctor.

5.2 Materials

To achieve the study objectives, three study specific questionnaires and an internal monitoring within the system were developed. The three study specific questionnaires were the 'Introductory' questionnaire (Appendix VI), the 'Study Trial' paper questionnaire (Appendix VII for style A and Appendix VIII for styles B and C), and the 'Patients' Evaluation' questionnaire (Appendix IX). The majority of the questions within the questionnaires were 'closed', in that the patient could only choose between predetermined responses. This format was chosen because of the ease in categorising and scoring responses, and also it was easier for the respondent to complete the questionnaire with a high level of accuracy. The majority of the questions were also based on a four point Likert scale which ranged from a strongly favourable attitude to a strongly unfavourable attitude. During the pilot study trials, the 'Study Trial' paper questionnaire went through several changes at different stages until the final version (Appendices VII and VIII) was felt to be satisfactory.

5.3 The systems' internal monitoring

The system's internal monitoring in the patient workstation helped to determine the number of times the patients used the explanatory buttons, such as the 'library' and the 'help' buttons. The internal monitoring was also useful in measuring the patients' demand for the facility to interrupt the computer interview, and 'move' to the information system during the GLADYS interview to seek health information. The internal monitor also helped to determine the topics viewed in the GLADYS information system and how often the patients interrupted an interview to seek information. Items the internal monitor recorded included:

* Type of study
* Date
* Time
* Style of interview
* Patient's characteristics, for example patient's name, gender and age
* Patient's main symptom
* Patient's symptoms
* Flow of responses
* Topics chosen
* The buttons which the patient used while interacting with the system
* Total number of times the Previous, Help and Library buttons were used.

5.4 The Pilot Study Process

To design and develop the system, a method of *rapid prototyping* and *formative evaluation*[7] was adopted. This method involved several cycles of development and evaluation. During each cycle '*process measures*' were examined. These measures included:

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[7] Rapid prototyping and formative evaluation is an iterative process occurring during the system and user interface prototype developing and testing stages. This type of evaluation helps the designer to refine and form the system after each prototype testing, where at each stage problems are identified and the design is refined. At any point within the iterative development process the system's performance is evaluated and if problems are encountered the designer iterates back to the problem source.

(a) The usability and acceptability of software and hardware tools: this measure examined the 'bugs' or the programming defaults within the system and if patients perceived ease in using the system for example was the touch screen easy to use and therefore was it a suitable input device tool.

(b) Information presentation: examined measures included:

- ***Data display effectiveness***: in general, did the patients feel the effectiveness of the information displayed; for example, did the colours used, the clarity of the computer instructions and the arrangement of the information presented on the screen, enable them to view the topics and related information in the GLADYS information system with ease and interest.

- ***Language use***: in general, did patients understand the terminology used in the GLADYS interview and the information system.

- ***Consistency and object selection of the screens***: was the screen layout consistent and did patients feel it easy to use and recognise buttons, such as the 'previous' or the 'help' buttons throughout the system.

- ***Help and explanatory messages***: in general, did patients feel the help and the explanatory messages provided by the system useful and effective when needed.

(c) User customisation: did the patients appreciate the usefulness of the health information presented in the GLADYS information system and the relevance of the topics to themselves.

(d) General user interface principles: examined measures which included patients' acceptability and compliance. These measures were:

- ***Effectiveness and feelings of control***: in general, did the patients feel in control while interacting with the system, and were they able to use the system, within a certain amount of time, without too much confusion or too many errors.

- ***User attitude***: in general, did the patients have a positive attitude towards the system, and did they feel that they would able to remember some of the information after they had left the clinic.

- ***Flexibility***: in general, did the patients feel that the system was easy and intuitive to use, and was the information presented by the system clear and easy to understand.

- ***Feelings of knowledge gained***: in general, did the patients appreciate the usefulness of the information provided, and feel that they had learned something new.

The researcher carefully observed and wrote the patients' reactions and comments on the system on the patient's questionnaires during the pilot study trial. This was very useful in assisting the system's design and development. Initial problems in the interface design, user interaction with the system, questionnaire design and the general environment of the task performance were identified during the pilot study trials. In addition to these, the pilot study also identified the level of knowledge, the nature and the scope of the information required by patients at a gastro-enterology clinic. This enabled the researcher to develop relevant topics and explanatory information to suit the general needs of the patients at the clinic. Communication between the patients and the clinicians at the clinic was also observed by the researcher and the patients' requirements were noted in order to investigate what potential users needed to know. These observations assisted in the design and the development of the GLADYS information system by giving more relevance to the topics provided in the information system, in order to avoid future problems in patients' acceptance and compliance.

6 The randomised study trial

Evaluation studies of the patient workstation were conducted at the gastro-enterology clinic in the Victoria Infirmary, Glasgow. Two-hundred patients were recruited and randomised to one style; 100 patients to style A, 50 patients to style B and 50 patients to style C. Data collection included actions taken by the patients and their emotional feelings and satisfaction. Most patients at the clinic were slightly uncomfortable, anxious and with limited time. In order to avoid any time constraint and to help create a more relaxed atmosphere, after two months of the randomised study trial, the remaining 80 patients were offered a shorter version of the GLADYS interview. In addition, to avoid

avoid any missing responses among some patients, an on-line questionnaire, instead of the paper, 'Study Trial' questionnaire, was also given. These two changes were introduced at the same time and were both found to be more satisfactory among the patients and medical staff involved at the clinic.

6.1 The setting

The gastro-enterology unit, at the Victoria Infirmary, Glasgow, was found to be a more suitable clinic, than the Southern General gastro-enterology clinic. Patients at the Victoria were recruited by the nurses and not by the doctors. Unlike the gastro-enterology clinic at the Southern General, the gastro-enterology unit at the Victoria Infirmary also had the advantage of being opened daily, with an average of 3000 patients per year, with about 250 patients per month. This resulted in recruiting more patients within a short period of time. However, within the gastro-enterology unit, all patients were fasting and were due to have either an endoscopy, a colonoscopy, or a breath test. Patients were therefore slightly uncomfortable, anxious and with limited time. Patients were selected to participate in the randomised study trial before their medical examination.

The unit functions all week days, starting at 8.30 am and, and may last up to 3.30 p.m. depending on the schedule , except on Fridays when the unit operates until 12.30 p.m. The trials were conducted in both morning and afternoon sessions. Morning sessions were usually between 8.30 a.m. and 10.00 a.m. but might last up to 11.30 am, while afternoon sessions could be anywhere between 1.00 p.m. and 3.30 p.m. The researcher was given a corner of the tea room situated at the unit for the study trials, with sufficient space to accommodate two computers. There was a 'division like' board between the two computers.

Initially, it was agreed with the head of the gastro-enterology unit that the nurses would recruit 200 willing patients for the study trials. Although 200 patients seemed quite a large number after the Southern General experience, within a period of four months this number was reached. However, even though the researcher wished to stay longer at the unit so that more patients could be recruited for the study trials, this was not practical or possible. After four months of the study trials, the staff at the unit were not keen for the trials to continue. This was not surprising as the researcher occupied half of the staff's tea room with two computers, chairs, also besides the space inconvenience, the staff felt that their privacy was being invaded. The study trials often coincided with the staff's tea breaks, with the researcher and the patients hearing the staff's private conversations. Despite this invasion of the staff's privacy and space, and taking their time to select and ask the patients to participate in the study trial, the staff at the Victoria Infirmary were very co-operative and friendly.

6.2 The Patients

Two-hundred patients were recruited and randomised to one style of computer interaction; 100 patients to style A, 50 patients to style B and 50 patients to style C. Patients participated in the randomised study trial within a period of four months, from the 29th of September 1995 to the 26th of January 1996. All patients who participated were willing to do so, and none of the patients had ever used the Toolbook GLADYS version before. Almost all patients suffered from symptoms, and most were due to undertake the medical examination for the first time. Thus, most patients at the clinic were slightly uncomfortable, anxious and with limited time.

Patients were usually given appointments for medical examinations from 8.30 a.m. at half hour intervals. Patients normally arrived at the clinic a few minutes earlier than 8.30 a.m., although, doctors usually saw the first patients at about 9.00 a.m. This was because all the patients had to go through several procedures before being examined by the doctors. As a result, there was a waiting period before a patient underwent his/her particular medical examination.

6.3 Patients' activities at the clinic

Patients went through several procedures before being examined by the doctor. These procedures included:

a) Waiting at the reception area

b) Changing into an operating gown for the examination

c) Lying on one of the beds in the waiting room

d) Being sedated before the examination and losing consciousness

e) Being examined in the examination theatre

f) Still asleep, being taken back to the waiting room

g) Regaining consciousness and going home usually with a relative or friend.

Patients were selected for the randomised study trial while waiting in the reception area or after they had changed into an operating gown and were lying on the bed. There were several nurses (four or five) who asked the patients whether or not they would like to participate in the study trials. The nurses varied slightly in their method of asking the patient. However, the usual way would be: *"Hello Mr/Mrs/Miss (name), there is a researcher from Glasgow University who is doing research on patient-computer interviewing who would like to ask you some questions ...."*. The nurse then walked with the patient to the tea room near the waiting room to meet the researcher. The researcher then welcomed the patient, identified herself and gave a short, simple and informal description of the research. Participating patients were then asked to :

- answer two standard measures[8]
- answer one study specific questionnaire[9]
- use the GLADYS computer interview and information system
- answer the paper or on-line questionnaire[10]
- answer a patient acceptability questionnaire[11].

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[8] The Hospital Anxiety and Depression Scale (HADS) (Appendix IV) and the Zuckerman Affect adjective Checklist (ZAAC) (Appendix V), both described in section 6.5 of this chapter.

[9] The 'Introductory' questionnaire (Appendix VI) (all questionnaires are described in section 6.5 of this chapter).

[10] The 'Study Trial' questionnaire (Appendices VII and VIII).

6.4 The medical examinations

The selected patients came from three main groups, endoscopy patients, colonoscopy patients and breath test patients.

a) The breath test

Helicobacter pylori is a bacterium which is found on the lining of the stomach in 50% of the population of Britain, and in some developing countries it may reach 70-80% (Kamath, 1995). Studies have shown that it plays an important role in causing duodenal ulcers and that eradicating the infection cures the ulcer disease (Patchett et al., 1991). There are also suggestions that the infection may play a role in patients who have dyspeptic symptoms but show no evidence of the actual ulceration.

The breath test which determines H Pylori Status, is an examination designed to detect *Helicobacter pylori* bacterium. In order to do the test, the patient is asked not to eat or drink from the previous night, such that he/she takes the test with an empty stomach. At the clinic, the patient is asked to blow into a glass tube which collects a sample of the patient's breath. This breath may have some radio activity in it and a measure of the *Helicobacter Pylori* bacterium infection can be detected. The patient is asked to swallow a radio active isotope solution (tastes and looks like water) and then drink a milk shake. After thirty minutes the patient is again asked to blow into the glass tube and a second reading is taken. Thus, two such readings are taken at thirty minute

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[11] The 'Patients' Evaluation questionnaire (Appendix IX).

intervals in order to detect the presence of *Helicobacter pylori* (HP) bacteria[12]. The results from the Pathology department are usually obtained within three or four days.

Breath test patients usually attended the clinic in the afternoons, and would be asked to participate in the study during the half hour interval between the two breath tests. The test usually took only a few seconds, hence, a patient would continue with the study trial if he/she did not complete it between the two breath tests.

b) The endoscopy examination

An 'endoscopy', also called a 'gastroscopy', is a test which allows the doctor to look directly at the lining of the oesophagus (the gullet), the stomach and around the first bend of the small intestine (the duodenum). To do the test, the patient is asked not to eat or drink from the previous night, such that the examination is done on an empty stomach. At the clinic, and under sedation, an endoscope is passed through the mouth of the patient into the stomach. The endoscope is a long flexible tube (thinner than the little finger) with a bright light at the end. Looking down the tube, the doctor gets a clear view of the lining of the stomach and can check whether or not any disease is present. Using tiny forceps, the doctor can then remove a minute amount of tissue (painlessly) through the endoscope. This sample of tissue, called a biopsy, is then taken to the laboratory for analysis.

[12] The original isolation of *Helicobacter pylori* was by BJ Marshal in 1983 from Australia (Marshal and Warren, 1984; Marshall et al., 1985), where this spiral gram negative bacterium was found to be responsible for various gastroduodenal disorders.

c) The colonoscopy examination

This is an examination of the large bowel through an instrument, the colonoscope, inserted into the rectum. This examination enables the doctor to view the lining of the colon and hence establish the cause of the patient's symptoms. The doctor can also obtain biopsy specimens which help in giving accurate diagnosis.

In order to do the test, the patient is asked not to eat or drink anything from the previous night, so that the examination is done on an empty stomach. The patient is also asked to take a laxative, usually a thick white liquid, a day or two before the examination. It is important for the examination that the bowels and colon are empty. Before the examination, the patient is asked to lie on the left side and is then given a sedative injection. The doctor then examines the anus (back passage) with his finger before inserting the colonoscope which has been lubricated. The colonoscope is then gradually negotiated round all the bends in the colon until the ceacum, near the appendix, is reached. The whole examination may take from a few minutes to one hour.

6.5 Materials

After the pilot study, the three study specific questionnaires which were the 'Introductory' questionnaire, the 'Study Trial' questionnaire, and the 'Patients' Evaluation' questionnaire, were found to be satisfactory. For the randomised study trial, patients were asked to answer these three study specific questionnaires, and two standard measures. The system's internal monitoring also recorded patients' responses and actions.

(a) The 'Introductory' questionnaire

All patients were asked to complete the 'Introductory' paper questionnaire which asked the patent's name, age, whether he/she had used a computer before and if so, how they rated themselves (Appendix VI). Age was recorded as a continuous variable. The two questions on previous computer use were 'closed' and categorical, and the patient could choose between predetermined responses, based on a four point Likert scale.

(b) Two standard measures

After three weeks of the randomised study trial, it was clear that most patients at the clinic were slightly uncomfortable and anxious, as they were asked to use the computer while waiting to take an endoscopy or a colonoscopy medical examination. It was felt that within such an environment, it was necessary to measure the patients' levels of anxiety and emotional feelings, since anxiety and depression can influence a patient's ability to retain information and their motivation to learn (Phillips, 1986). Therefore, it was assumed that patients' emotional feelings might have an adverse affect on their performance and attitude towards the computer. One-hundred and fifty-four patients were given two standard measures which were chosen to examine patients' levels of anxiety and depression before using the computer. Although there are many well used instruments to measure patients' emotional state (Beck et al., 1961; Goldberg and Hillier, 1979; Zigmond and Snaith, 1983; Zuckerman and Lubin, 1965), the Hospital Anxiety and Depression Scale (HADS) (Zigmond and Snaith, 1983) and the Zuckerman Affect Adjective Checklist (ZAAC) (Zuckerman and Lubin, 1965) were selected. Zigmond and Snaith's (1983) Hospital Anxiety and Depression Scale (HADS) (Appendix IV) was chosen because it is quick to administer, simple to interpret and covers both anxiety and depression. The ZAAC checklist (Appendix V) was selected so as to identify the patient's inner-most feelings at the time of the randomised study trial.

(i) The Zuckerman Affect Adjective Checklist (ZAAC) (Appendix V) : One hundred and fifty-four patients were offered the ZAAC checklist. This check-list listed 21 feelings which were classified as either negative or positive, for example, 'nervous', 'tense', where the patient was asked to choose only one of the items listed which identified his innermost feelings. The word 'thoughtful' was classified as a positive feeling, even though, a patient may be 'thoughtful' with negative, worrying thoughts. In this study, it was necessary to find out which emotional feeling prevailed as most patients were slightly uncomfortable and anxious. However, there was some degree of difference between a patient who was 'nervous' or 'worrying' and a patient who was 'terrified' or 'panicky', as the patients' emotional feelings might have had an affect on their interaction with the computer.

(ii) The Hospital Anxiety and Depression Scale (HADS) (Appendix IV) : One hundred and fifty-four patients were asked to fill in the HADS self-assessment instrument, before using the computer. The HADS has been found to be a reliable self-assessment instrument for detecting depression and anxiety in hospitals and medical outpatient clinics in Western countries (Zigmond and Snaith, 1983). It is composed of 14 items, 7 for anxiety and 7 for depression. Scores for each question ranged from 0 to 3 and the total HADS scores ranged from 0 to 21, with higher scores indicating more anxiety and more depression. A borderline range was taken for both the anxiety and the depression sub-scales; where scores of 7 or lower were classified as non-cases, 8 to 10 as borderline cases, and 11 or more as definite cases[13].

(c) The 'Study Trial' questionnaire

This questionnaire was mainly designed to measure the major outcome variable of 'patient satisfaction' (Appendices VII and VIII). Therefore, most questions asked about feelings of usability, interest, utility and the relevance to the patient of the information provided in the GLADYS information system. The majority of the questions within the questionnaire were also 'closed'. This format was chosen because of the ease in categorising and scoring responses, and for its ease for the respondent. Most questions were based on a four point Likert scale, with the options provided ranging from a strongly favourable attitude with a score of 4, to a strongly unfavourable attitude with a score of 1. However, in order to avoid missing responses among some of the patients,

[13] As recommended by the authors, Zigmond and Snaith.

an on-line questionnaire of the 'Study Trial' questionnaire was later offered to the patients instead of the paper questionnaire.

Categorisation of variables of the 'Study Trial' questionnaire

The major outcome variable of the research was patient satisfaction, which consisted of four variables: usability, interest, utility and the relevance of the topics provided.

Variables were categorised as follows:

a) Usability variables included the ease of computer use, ease in using the input device, ease in selecting a topic, clarity of the computer instructions, feelings of confusion and of the lack of control ('no control'), feelings of computer 'comfort', and feelings of embarrassment when being interviewed by the computer.

- Variables 'ease of computer use', 'ease in input device use', and 'ease in selecting a topic', were categorised as follows:

  very easy, moderately easy, not very easy, not at all

- Clarity of computer instructions was categorised as follows :

  all the time, most of the time, some of the time, only occasionally

- Variables 'feelings of confusion' and 'feelings of no control' were categorised as follows :

  yes, no

- Feelings of computer comfort were categorised as follows :

  very comfortable, moderately comfortable, not very comfortable, not at all

- Feelings of embarrassment when being interviewed by the computer were categorised as follows :

  very embarrassing, moderately embarrassing, not very embarrassing, not at all

b) Loss of interest while working with the computer, was categorised as follows :

all the time, many times, not often, not at all

c) Perceived utility consisted of the variables; 'images usefulness', 'information usefulness', 'feelings of being able to remember information', and 'feelings of having learned something new'.

- Variables 'images usefulness' and 'information usefulness', were categorised as follows :

  very useful, moderately useful, not very useful, not at all

- Variables 'feelings of being able to remember information' and 'feelings of having learned something new', were categorised as follows:

  very much indeed, quite a lot, not very much, not at all

d) Feelings of the relevance of the topics provided, were categorised as follows:

very relevant, moderately relevant, not very relevant, not at all

<u>Variables which are not included in the major outcome variable 'patient satisfaction'</u>

a) Previous computer use was categorised as follows:

daily, often, occasionally, never

b) Variables in the ease of navigation ; 'move to information system ease' and 'move back from the information system ease', were categorised as follows:

very easy, easy, not very easy and not at all

c) Variables 'confusion time' and 'no control time' were categorised as follows:

all the time, most of the time, some of the time, only occasionally

d) Feelings of embarrassment when being interviewed by the doctor were categorised as follows :

very embarrassing, moderately embarrassing, not very embarrassing, not at all

e) Preference of the method of accessing health information was categorised as follows:

computer, anything, book or pamphlet, don't know

(d) The 'Patients' Evaluation' questionnaire

This was a 6-item paper questionnaire, which examined patients' acceptability towards the 'Study Trial' questionnaire (Appendix IX). It included items on : the ease of understanding the questions, the relevance of the questions, the difficulty felt by patients in completing the questionnaire, the length of the questionnaire, the levels of confusion felt by patients while answering the questionnaire, and their preferences about the style of questionnaire. Patients' preferences indicated whether they would prefer a 'paper questionnaire', an 'on-line computer questionnaire', to be 'interviewed verbally', or 'no preference'. All questions were 'closed' and the majority of the questions were also based on a four point Likert scale. The options ranged from a strongly favourable attitude with a score of 4, to a strongly unfavourable attitude with a score of 1.

Fifty patients who filled in the paper 'Study Trial' questionnaire and another 50 patients who filled in the on-line 'Study Trial' were selected to fill in the 'Patients' Evaluation' questionnaire. These selected patients were usually those who had time left before the medical examinations.

6.6 Sequence of each patient's activities

The sequence of patients' activities during each contact was as follows. The researcher made a conscious effort to try to establish an atmosphere of trust, ease and friendliness between herself and the patient. After an introductory welcome which consisted of a personal introduction and the general overview of the study, the researcher then asked the patient to fill in the introductory questionnaire and the two standard measures, HADS and ZAAC. Afterwards the researcher wrote down the patient's symptoms and relevant information, such as whether or not the patient had taken the examination before. During the study trial, patients' verbal comments or characteristics were recorded by means of written notes on the introductory questionnaire. The researcher then asked the patient to use the computer, where the patient was randomised by the computer to one of the interaction styles. After using GLADYS, the patient was then asked to fill in the paper study trial questionnaire, or continue using the computer and to respond to the on-line study trial questionnaire. Finally, after completing the 'Study Trial' questionnaire, and if extra time was available, the patient was asked to answer the patients' evaluation questionnaire. At the end of each trial, any queries raised by the patient were clarified, and the patient was thanked for his/her co-operation.

7. Data analysis

The main question of the research was whether a patient workstation which combines the giving of information with a structured interview provides more patient satisfaction than a system which has these elements separate. A subordinate question to this main question was that, if it is so, then within the combined system, was a 'selected' or an adaptive type of information provision provides more patient satisfaction than a more general type. From these two questions the major outcome variable of the research was 'patient satisfaction'.

Patient satisfaction was a summary measure (mean) of the combined aggregate scores[14] of patients' usability, loss of interest, perceived utility, and relevance of the topics provided by the information system. Usability was determined by the patient's use of the system within a certain limit of time without too many difficulties or confusion. The system's internal monitoring was also able to assist in determining the usability to the patient. The usability variable was also determined by a summary measure (mean) of the combined aggregate scores of several questions put to the patient on investigated characteristics such as ease of use, clarity of the computer instructions, feelings of well-being, feelings of confusion and no control. The perceived utility variable or the usefulness of the system was determined by a summary measure (mean) of the combined aggregate scores of several questions on the patient's own 'perceived' utility.

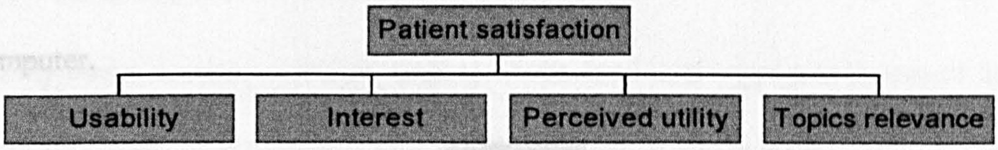
[14] For a missing response or responses, the number of missing item or items are deducted from the devisor.

Patients were asked to use the system and then to complete a questionnaire on their reactions to the system. The questionnaire examined 'patient satisfaction' including four different aspects: usability, perceived utility, loss of interest while working with the computer, and the relevance of the topics in the GLADYS information system. The classification of 'patient satisfaction' and each of the four different aspects were as follows:

7.1 Patients' satisfaction

This was a summary measure (mean) of the combined aggregate scores of patients' feelings of ease when using the computer, ease when using the input device, and ease when selecting a topic, feelings of confusion and no control, perceived clarity of the computer instructions, perceived feelings of comfort and embarrassment when being interviewed by the computer, loss of interest, feelings of the usefulness of the images used in the computer system, feelings of the usefulness of the information provided by the GLADYS information system, feelings of being able to remember some of the information, feelings of having learned something new after using the computer system, and feelings of the relevance of the topics provided by the GLADYS information system.

All the items ranged from 1 to 4, except for confusion and no control, which ranged from 1 to 2, and all the items carried equal weight. The combined mean score of 'patient satisfaction' could range from 1 to 4, the highest score being 4 and the lowest 1. The higher mean scores indicated more satisfaction for patients.

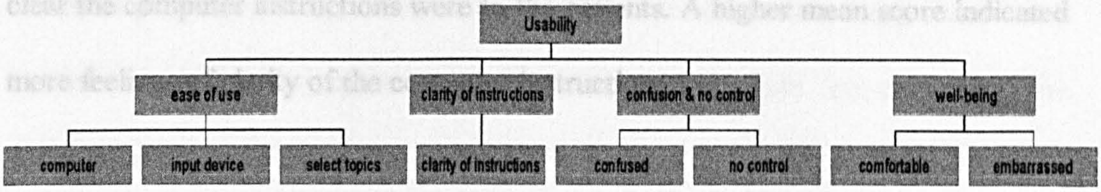


Patient satisfaction score = (ease of computer use + ease of input device use + ease in selecting a topic + clarity of computer instructions + feelings of confusion + feelings of no control + feelings of computer comfort + feelings of embarrassment when being interviewed by the computer + loss of interest + images usefulness + information usefulness + feelings of being able to remember information + feelings of having learned something new + perceived feelings of the relevance of topics)/14.

7.2 Usability

Usability was a summary measure (mean) of the combined aggregate scores of patients' ease when using the computer, ease when using the input device, and ease when selecting a topic, clarity of the computer instructions, feelings of confusion and no control and feelings of comfort and embarrassment when being interviewed by the computer.

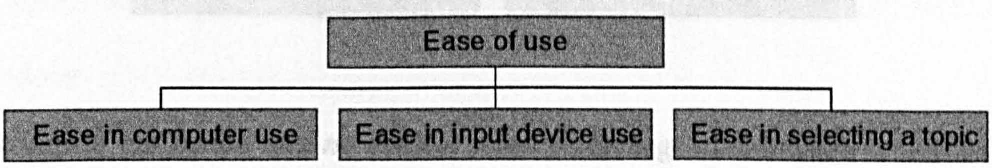
All the items ranged from 1 to 4, except for confusion and no control, which ranged from 1 to 2. The combined mean total usability score of all the four items could range from 1 to 4, the highest score being 4 and the lowest 1. The higher mean scores indicated more perceived ease, less feelings of confusion, more control, more comfort and less embarrassment when being interviewed by the computer.



Usability score = (ease of computer use + ease of input device use + ease in selecting a topic + clarity of computer instructions + feelings of confusion + feelings of no control + feelings of computer comfort + feelings of embarrassment when being interviewed by the computer) / 8

7.3 Ease of use

Ease of use was a summary measure (mean) of the combined aggregate scores of patients' ease when using the computer, ease when using the input device, and ease when selecting a topic. A higher mean score indicated more feelings of ease when using the computer.



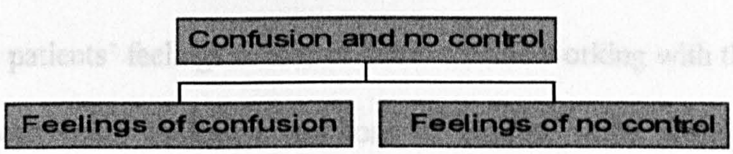
Ease of use score = (ease in computer use + ease in input device use + ease in selecting a topic) / 3

7.4 Clarity

Clarity was a summary measure (mean) of the combined aggregate scores of how clear the computer instructions were to the patients. A higher mean score indicated more feelings of clarity of the computer instructions.

7.5 Feelings of confusion and no control

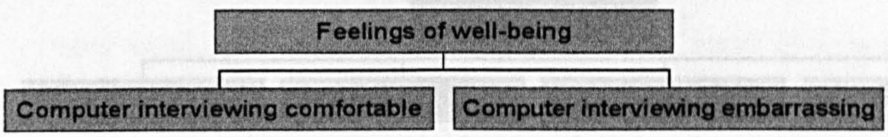
Feelings of confusion and no control was a summary measure (mean) of the combined aggregate scores of patients' perceived feelings of confusion and no control when using the computer. The score of each item ranged from 1 to 2, with 2 indicating not confused and in control. The combined total mean score of the two items could range from 1 to 2, the highest score being 2 and the lowest 1. The higher mean scores indicated less confusion and more in control when using the computer.



Feelings of confusion and no control score = (feelings of confusion + feelings of no control) / 2

7.6 Feelings of well-being

Feelings of well-being was a summary measure (mean) of the combined aggregate scores of patients' feelings of comfort and embarrassment when being interviewed by the computer. A higher mean score indicated more comfort and less embarrassment.



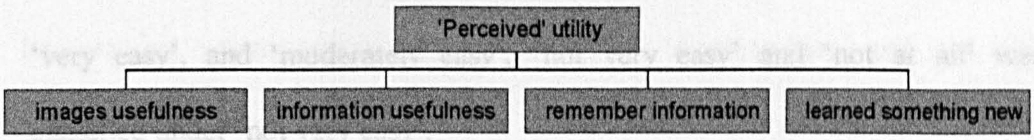
Feelings of well-being score = (feelings of computer comfort + feelings of embarrassment when being interviewed by the computer) / 2

7.7 Interest

Interest was measured by the frequency of 'loss of interest' a patient experienced while working with the computer. This was a summary measure (mean) of the scores of the patients' feelings of loss of interest while working with the computer. A higher mean score indicated less loss of interest while working with the computer.

7.8 Perceived utility

Perceived utility was a summary measure (mean) of the combined aggregate scores of patients' usefulness of the images of the computer system, usefulness of the information provided in the GLADYS information system, feelings of being able to remember some of the information, and feelings of having learned something new after using the computer system. The score of each item ranged from 1 to 4. The combined mean score of all four items could range from 1 to 4, the highest utility score being 4 and the lowest 1. The higher mean scores indicated more perceived utility.



Perceived utility score = (images usefulness + information usefulness + feelings of being able to remember information + feelings of having learned something new) /4

7.9 Feelings of the relevance of topics

This was a summary measure (mean) of the scores of patients' feelings of the relevance of the topics provided by the GLADYS information system. A higher mean score indicated more feelings of the relevance of topics.

7.10 Coding and re-categorisation of variables

For some of the response categories of the 'Study Trial' questionnaire (Appendices VII and VIII), it was realised that the numbers and frequencies were too small to enable tests of significance to be carried out. Thus, some of the categories had to be re-coded. The following is the re-coding procedure:

a) Computer frequency : 'daily', 'often' and 'occasionally' were classified under 'used computer', and 'never' remained the same as its original coding.

b) Categories in variables ; computer ease, touch screen ease, mouse ease, previous button ease, move to information system ease, move back from the information system ease, select a topic ease : 'very easy' was classified under 'very easy', and 'moderately easy', 'not very easy' and 'not at all' were classified under 'not very easy'.

c) Computer instructions clear : 'only occasionally', 'some of the time' and 'most of the time' were classified under 'not very clear', and 'all the time' was classified under 'very clear'.

d) Lost interest : 'many times', 'sometimes' and 'not often' were classified under 'sometimes, and 'not at all' was classified under 'not at all'.

e) Categories in variables ; images usefulness, help usefulness, and information usefulness : 'very useful' was classified under 'very useful', and 'useful', 'not very useful' and 'not at all' were classified under 'not very useful'.

f) Categories in variables ; confusion time and no control time : 'all the time', 'most of the time' and 'some of the time' were classified under 'some of the time' and 'only occasionally' was classified under 'only occasionally'.

g) Computer interviewing comfortable : 'very comfortable' was classified under 'very comfortable', and 'comfortable', 'not very comfortable' and 'not at all' were classified under 'not very comfortable'.

h) Categories in variables ; doctor interviewing embarrassing and computer interviewing embarrassing: 'very embarrassing', 'embarrassing' and 'not very embarrassing' were classified under 'embarrassing', and 'not at all' was classified under 'not at all'.

i) Topics relevant : 'very relevant' was classified under 'very relevant', and 'relevant', 'not very relevant' and 'not at all' were classified under 'not very relevant'.

j) Categories in variables ; remember information and learned something new : 'not at all' and 'not very much' were classified under 'not much', and 'quite a lot' and 'very much indeed' were classified under 'quite a lot'.

k) Preference of the method of accessing health information : 'computer' and 'anything' were classified under 'computer or anything', and 'book or pamphlet' and 'don't know' were classified under 'book or don't know'.

8 Statistical analysis

The Statistical Package for Social Sciences (SPSS) for Windows was used to analyse data. Epi6 software for Windows was also used to carry out the Fisher's exact test in 2x2 tables where expected values were very small.

8.1 Numeric data and parametric tests

For numeric or continuous data, means and standard deviations (SD) were used as summary statistics followed by parametric tests for comparisons. Parametric tests such as *t*-tests and ANOVA (one way analysis of variance) were used, as the distribution of the continuous variables in this study was approximately a normal distribution. If the observed significance level was less than 0.05, then the null hypothesis was rejected. The methods of analysis used in the study assume a normal distribution for continuous variables. Some of the statistical analysis were repeated using appropriate non parametric methods (Kruskal-Wallis tests and Mann Witney tests). These gave similar results indicating that the assumption of normality was not crucial in the interpretation of the results.

8.2 *t*-tests

t-tests were used to compare outcome scores between styles A and BC, and other comparisons between the scores of two independent samples. Comparisons were carried out to assess whether there were significant differences between the scores of the two independent samples.

8.3 ANOVA (one way analysis of variance)

The ANOVA (one way analysis of variance) was used to compare outcome scores between the three styles A, B and C, to assess whether there were significant differences between the scores.

8.4 Categorical data and Chi-squared tests

Chi-square tests of difference or association (χ^2 -test) were used to measure the difference or association between two or more categorical variables. For each response category of each variable, numbers and percentages were presented. The χ^2 -test does not use the actual values of the observations, but replaces them with expected values. However, when some of the expected numbers were too small, the responses were collapsed to a two point scale and the variables compared using a 2 X 2 table to be able to carry out the test of significance. Otherwise, for even smaller numbers Fisher's exact test was performed.

8.5 Logistic regression analysis

A stepwise multiple logistic regression analysis was performed to assess the relationship between patient characteristics and the study outcomes, to find out which patient characteristics were significant predictors of the study outcomes.

Patient characteristics were defined as independent variables, and these were age, gender, previous computer use, type of medical examination, patients' emotional feelings whether negative or positive, HADS anxiety and depression scores, and type of interview (short or long). The study outcome measures were 'computer use ease', 'selecting a topic ease', 'clarity of computer instructions', 'feelings of confusion', 'feelings of comfort', 'loss of interest', 'usefulness of the information', 'ability to remember some of the information', 'feelings of having learnt something new' and 'relevance of the topics'. Each outcome measure was defined as a dependent variable, and these were categorical data of two or four options. Categorical data of four options were collapsed under the same classification mentioned in section 7.10, titled 'Coding and re-categorisation of variables'. For example: 'very easy', 'moderately easy', 'not very easy', and 'not at all', were collapsed into two options of 'very easy' and 'not very easy', so as to fit the dichotomous requirement of a dependent variable of logistic regression.

8.6 Sample Size Calculations

Sample sizes were calculated on the basis of a comparison between style A and styles B and C combined for any one of the characteristics being investigated (for example ease of use, confusion, feeling of control). Most of these questions were asked using a four point scale for responses. To take a pessimistic view the responses may have to be 'collapsed' to a two point scale, and then style A and style B/C compared using a 2 X 2 table and chi squared test. The sample size needed therefore is based on the difference in two proportions. Sample sizes of 100 for style A and 100 for B and C combined will give 80% power to detect a difference of 20% between the two proportions (for example 30% vs 50% or 20% vs 40%) at the 5% level of significance (Machin and Campbell, 1987).

Differences between styles B and C will be investigated but with these sample sizes only larger differences of, for example between 30% and 57% will be detected as significant. However, the study may indicate that differences may exist and would then be worthy of further study.

9 Limitations and difficulties

9.1 Patients' emotional state

At the Gastro-enterology unit, at the Victoria Infirmary, patients were waiting for medical examinations, and therefore were slightly uncomfortable, anxious and with limited time. The ideal clinic for such a study would probably be a clinic where patients were waiting to see the doctor for a check-up or consultation. Although the gastro-enterology clinic at the Southern General Hospital in Glasgow was such a clinic, it was possible to get only 42 patients within a period of four months. As this was a 'rush' clinic, patients often had no time to spare, and also, it was decided by the medical staff that only the doctors should ask the patients if they were willing to participate in the trials. This was only after the patients had seen the doctor. However, the doctors were often too busy to remember or took little interest in asking the patients. In most cases, even if the doctors remembered to ask the patients after their consultation, the patients often refused due to lack of time. Although patients were waiting for medical examinations at the Glasgow Victoria Infirmary, it was possible to get a suitable number of patients.

9.2 Space inconvenience and time availability

The researcher was given a corner at the tea room situated at the unit for the study, with sufficient space to accommodate two computers. There was a 'division like' board between the two computers, and the trials occupied half of the staff's tea room with the two computers and chairs. The randomised study trials often coincided with the staff's tea breaks. This resulted in the researcher and patients often hearing the staff's private conversations, which may have distracted some of the patients' concentration from the trials. The staff may also have felt that their privacy was being invaded.

As patients were waiting for medical examinations at the unit, time available was limited. To avoid any time constraint and to help create a more relaxed atmosphere, a shorter version of the GLADYS interview[15] was later introduced instead of the longer (original) version.

9.3 Missing responses

There were some missing responses in some of the paper questionnaires. To avoid any missing responses, an on-line questionnaire was later introduced to the patients. The reasons for missing responses were due to several factors :

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[15] A full description of the long and short versions of the Gladys interviews is presented in Chapter 5, Section 3.

a) Age might have been a factor. Some of the patients were very old and therefore may not have been used to paper work, and may have left some of the questions.
b) Feelings of anxiety. Some of the patients were anxious and may have missed some of questions.
c) Lack of time. Some of the patients may have felt rushed to finish the questionnaire due to their awaited medical examination.
d) Lack of interest or desire among some of the patients to answer all the questions.

9.4 Difficulties

The randomised study trial was conducted during both morning and afternoon sessions. Morning sessions were usually between 8.30 a.m. and 10.00 a.m. but might last until 11.30 a.m., while afternoon sessions were anywhere between 1.00 p.m. and 3.30 p.m. Therefore, there was usually a long waiting period after the morning session when the researcher would wait at the infirmary for the afternoon session. This was often inconvenient for the researcher as the waiting period varied and could last up to four hours or more. Another difficulty for the researcher was the very long journeys involved from her residence to the infirmary, which were costly, time consuming and tiring.

Chapter V

Results I : System Design

" Everything should be made as simple as possible, but not simpler."

Albert Einstein

Contents

1. Introduction

The main program specifications were listed in chapter IV. These were: (a) the system was to consist of three different styles of patient computer interactions; (b) the system was to be used by patients in a gastro-enterology clinic who were non-computer users; (c) the system was to enable patients to interact easily with the computer and directly with the computer by using a touch screen as an input device; (d) patients were to be able to feel some degree of control and not to feel too much confusion when interacting with the system.

As mentioned in Chapter IV, a pilot study of 42 patients was undertaken at the Southern General hospital, Glasgow, during the design and the development process. A method of *rapid prototyping* and *formative evaluation*[1] was adopted, which involved several cycles of development and evaluation. Within each cycle 'process measures' were examined[2]. Also mentioned in Chapter IV are the Hardware and Software Requirements[3] to run the system.

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[1] Rapid prototyping and formative evaluation are described in chapter 4, section 5.4, page 167 (footnote).

[2] Process measures are mentioned in chapter 4, section 5.4, page 167.

[3] Mentioned in chapter 4, section 4.1, page 160.

2. System design

A new version of the existing dyspeptic patient interviewing diagnostic system the GLAsgow diagnostic DYSpepsia system (GLADYS) was developed using a new more flexible software Asymetrix Toolbook with OpenScript programming language.

2.1 General features

Previous versions of GLADYS were in BASIC and Excel. The new Toolbook system's questions are the same as that of the Excel version[4] and the system is designed to run together with the Excel version. The Toolbook version is designed to 'dump' patients' responses into the Excel version which thereby calculates the probabilities for diagnoses and suggests therapy. The new GLADYS version is more than 20 Mega Bytes (requiring 17 disks) and contains around 700 screens.

The touch screen sensitive system is designed to randomise patients to one of the three styles of interaction, A, B or C. Being a touch screen sensitive system, all the buttons for navigation within the GLADYS system are designed to be big enough for the finger tip. Dark blue, red and yellow are the main colours of the GLADYS system. The background of the system shows the medical logo. Scanned images, graphics and drawings are used throughout the GLADYS system, to facilitate clearer understanding and interest among users.

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[4] About 200 questions, while the BASIC version has around 375 questions.

As mentioned in chapter 4, section 5.3, the new system included internal monitoring which recorded patients' characteristics, symptoms, flow of responses, navigation (activities), topics chosen, buttons used, and other items. The internal monitoring helped to measure patients' demand for the 'interrupt' facility. The facility of being able to interrupt the computer interrogation, and move to the information system to seek health information. Screens 37 and 38 illustrate the system's internal monitoring report. Screens 37 demonstrates the patient's responses to the GLADYS interview, and screen 38 shows the patient's responses for the on-line questionnaire.

2.2 Program structure

The new GLADYS version allowed the combination of the 'pure' interviewing system GLADYS and an interactive health information system focused on the health needs of dyspeptic patients. This system comprised computer interrogation of the patient and patient interrogation of the computer and allowed the comparison of three different styles of interaction. The system adapts itself automatically to one of the styles. These styles are:

- **Style A**: comprised computer interrogation of patient followed by patient interrogation of computer, where the patient can seek general health information in gastro-enterology after the computer interrogation. Computer interrogation of patient and patient interrogation of computer kept completely separate. Structure diagram Figure 1 in Appendix I illustrates Style A. Screen

11 shows a typical screen during the first part of this process (computer interview) and screens 12 to 14 show typical screens during the second part (information system).

- **Style B**: Same as style A but allows patients to interrupt the computer interrogation to seek health information in gastro-enterology. Structure diagram Figure 2 in Appendix I illustrates Styles B and C. Screens 15 to 19 show typical screens during the first part of this process (computer-interview) for style B. Style A was the same apart except for the removal of the 'Library' button. Screen 20 shows an example of the 'Topics Menu' screen for style B. Patients in style A had access to the 'Topics Menu' screen at the end of the interview; the screen was the same apart from the removal of the 'Interview' button (Screen 12). Screens 19 to 22 and screen 24 are examples of the information screen within the 'library' or information system, where the 'Interview' button is included so that the user can return to the interview. On the equivalent screens for style A there was no 'Interview' button.

Style C: Within Style B the range of topics was reduced with a selected range of information in gastro-enterology adapted to some degree to user's own characteristics and symptoms as entered on a on-line questionnaire and to their interview response. Screen 23 shows an example of the 'Topics Menu' screen for style C.

The user specifies his/her preference of selection, either randomly or manually, as shown in screen 2. If the user chooses 'styles randomised', the system is programmed to randomly adapt itself automatically to any of the three styles. Each style whether its style A, B or C is divided into three main parts; (a) the GLADYS interview; (b) the information system; (c) the on-line questionnaire. The following is a brief description of each of these divisions.

3 The GLADYS interview

The GLADYS interview (the first part of the program) consists of 210 screens. Of these 14 screens are not part of the GLADYS interview but are 'welcoming screens' and of a 'tutorial' session. The GLADYS interview consists of 9 sections (Structure diagrams Figures 1 and 2 in Appendix I). The system starts with the section 'Presenting symptoms', and then goes through all the other sections where the sequence of its branching is according to the patient's main symptom.

3.1 Welcoming screens

The GLADYS system can be run or 'opened' by using a required password. The user can be randomised to one of the three styles A, B or C, or can choose a style. Flowchart in Appendix III illustrates the 'welcoming' process and the screens 1 to 6 are examples.

3.2 Tutorial session

After the 'welcoming' screens there is a tutorial session. Screens 7 to 10 illustrate this tutorial session for styles B and C, while the same tutorial session is used for style A except the button 'Library' is hidden.

3.3 Long and short interviews

As mentioned in chapter 4, 120 patients were given a long interview or the original GLADYS interview and the remaining 80 patients were given a shorter interview, the same questions as the original but the questions were reduced from each section. Appendix III shows the flowcharts of all the 9 sections of the long version of the GLADYS interview[5]. The short version of the GLADYS interview contains the same questions as the original GLADYS interview. However, the total number of the questions within each section are reduced to approximately half the number of the questions in the original GLADYS interview.

3.4 Options for responses

Most of the options for responses within the GLADYS interview consisted of 6 items. These are 'yes', 'probably yes', 'possibly yes', 'no', 'probably no', 'possibly no'. These options were introduced by Lucas et al. (1981) so that patients would not feel too restricted, even though, all the options for the three 'yes' options are considered as a 'yes' by the system and the same is true for the three options of

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[5] Original GLADYS version same questions as the Excel version.

'no'. Screen 11 and screen 17 of the GLADYS interview illustrate these options. Screens 15 to 16 and screen 18 illustrate examples of some of the other options.

3.5 Buttons for navigation

The buttons for navigation for style A are the Previous button[6] and the Help button[7] and the Exit button[8]. Screen 11 illustrates these buttons for style A interview. While, besides the 'Previous' and the 'Help' button, styles B and C have an extra button, the 'Library' button used, to move to the information during the GLADYS interview. Screens 15 to 18 illustrate these buttons for styles B and C.

3.6 Colours and fonts

Each section of the GLADYS interview has a different colour scheme, and all the screens within a particular section contain the same colours. Screens 15 to 17 are examples of the section 'Presenting Symptoms'. Times New Roman fonts, style bold and italic, size 28, were used for the titles. Ms San Serif fonts, style bold and size 14, were used for text notes in the GLADYS interview. Times New Roman fonts, style bold, size 18, were used for the buttons. While Times New Roman fonts, style bold and italic, size 24 and 28, were used for the 'welcoming' screens.

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[6] To go back to a previous page.

[7] To get help during the interview.

[8] To quit the GLADYS system.

4 The information system

The GLADYS information system (the second part of the program) consists of 438 screens. For style A, patients can only have access to the information system after the computer interview, and when in the information system they cannot go back to the GLADYS interview. While, for styles B and C patients can have access to the information system during the interview by touching or clicking the button 'Library', and when in the information system they can go back to the GLADYS interview by touching the button 'Library'. Structure Diagram Figures 4 to 30 illustrate the design of some of the topics in the information system. Screens 19 to 22 and screen 24 are examples of screens in the information system for styles B and C[9]. There are 3 'welcoming' screens for the GLADYS information system.

4.1 The topics menus

The 'Topics Menu' screen for style A and B is the same, which contains general topics in gastro-enterology (Screens 12 and 20, respectively[10]). There are 228 topics with related information offered in the GLADYS information system (Appendix II). Within the 'Topics Menu' screen, the user selects the first letter of the topic required, this changes the list of topics in the menu scroll bar and then the user selects the topic required. Whereas, for style C, the range of topics was reduced, and topics were selected to be adapted to some degree to the patients'

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[9] Equivalent screens for style A do not have the 'Interview' button.

[10] Noting that the button 'Interview' is hidden in Screen 12 for style A compared to Screen 20 for style B.

own characteristics and symptoms as entered in an on-line questionnaire and to their interview responses (Screen 23). However, although topics are selected according to the user's characteristics, symptoms and interview responses, the following topics 'endoscopy examination', 'colonoscopy', 'irritable bowel syndrome', 'dyspepsia', 'exercise' and 'fibre diet', are listed for all the users. This is because the study was conducted in a gastro-enterology unit where patients had to undergo medical examinations, and many of them suffered from illnesses such as diarrhoea and dyspepsia, it was assumed that these topics would be of interest to the patients within the unit. Within the 'Topic Menu' screen (Screen 23), the user can select the topic required and the screen would change to the topic's related information (Screen 24).

4.2 The topics information

There were 433 screens of information within the information system, consisting of 228 topics (Appendix II) and their related information for styles A and B[11]. Structure Diagrams Figures 3 to 45 in Appendix I illustrate the design of some of these topics. Most of the topics had three themes or questions attached to them. These were (a) What is IT[12]; (b) What causes IT; (c) How can I help myself, that is, treatment and guidelines. Screens 23 of topics' information offered for the topic 'Exercise'. More topics would be provided when the user touches/clicks the button 'More'.

[11] For style C topics are selected according to patients' symptoms and responses to the interview.

[12] IT = The topic.

4.3 Buttons for navigation

The buttons for navigation within the information system for style A are the 'Topics' button[13] and the 'Help' button[14] and the 'Exit' button[15] (Screens 13 to 14). While besides these buttons, styles B and C have an extra button the 'Interview' button, used to go back to the GLADYS interview (Screens 19 to 22). For topics where there are several menus of a particular topic, where each menu contains different questions or themes, or when there are several screens for a particular topic or question, two extra buttons are included 'More' and 'Back'. The button 'More' is for either getting additional selection of questions or themes within a particular topic (Screen 24), or for turning to a new screen of related information for the same topic (Screen 14). The button 'Back' will send the user back to the menu screen of the topic where the question or theme was selected (Screen 19).

4.4 Colours and fonts

Dark blue, red and yellow are the main colours of the GLADYS information system. All the topics information screens consist of the same three colours (Screens 19 to 22), except for the 'welcoming' screens and the 'Topics Menu' screens. Times New Roman fonts, style bold and italic, size 32, were used for the

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[13] To go back to the 'Topics Menu' screen for styles A and B, which contains a list of general topics in gastro-enterology (Screen 20). Also, for the 'Topics Menu' screen of style C, which contains a list of selected or 'tailored' topics according to user's symptoms and responses (Screen 23).

[14] To get help during the interview.

[15] To quit the GLADYS system.

titles. Ms San Serif fonts style bold and size 18, were used for notes in the GLADYS information system. Times New Roman fonts, style bold, size 18, were used for all the buttons. While Times New Roman fonts, style bold and italic, size 24, were used for the topics in the topics bar. Times New Roman fonts of size 30 and Arial fonts of size 60, both fonts of style bold and italic, were used for the 'welcoming' screens.

5 On-line questionnaire

As mentioned before in chapter 4, 120 patients were given a paper questionnaire and the remaining 80 patients were given an on-line questionnaire. Screens 29 to 34 are examples of the on-line questionnaire. The buttons, 'Previous' where a patient can re-answer a previous question; 'Help' to get help; and 'Exit' to quit the system, were used for navigation.

Appendix X shows the flowchart of the on-line questionnaire, where the questions were identical as the paper questionnaire. However, unlike the paper questionnaire the on-line questionnaire had the advantage of branching, thus inconsistency was reduced in questions such as Q8 'Did you feel confused while working with the computer', the computer would branch to Q10 if 'no' otherwise would continue to the next question Q9. This reduced inconsistency for those patients using a paper questionnaire, who may report as not confused for question Q8 but then respond to 'only occasionally' for question Q9. Also, unlike the paper questionnaire, the on-line questionnaire had the advantage of eliminating missing responses, as the system would only move to the next question after the patient had responded to the previous question.

6 Hotwords

OpenScript 'hotwords' in text fields have a 'script' attached, where they are connected to related information that appears in different places throughout the program. Therefore, by clicking a 'hotword', the word responds like a button.

Hotwords[16] are used throughout the GLADYS interview for styles B and C to allow the 'interrupt' facility, and are 'hidden' for style A. Thus, the user can touch or click a 'hotword' in the GLADYS interview and related information appears in the GLADYS information system. All hotwords are coloured green and are underlined. For example, screen 18 illustrates a GLADYS interview question with the hotword 'alcohol'. If the patient touches the word 'alcohol', the screen changes to screen 19 of the information system. The patient can go back to the GLADYS interview by touching the button 'Interview' or can get information on diarrhoea by touching the hotword 'diarrhoea'.

Hotwords are also used throughout the GLADYS information system, although here they are coloured yellow but are also underlined. The user can touch or click a 'hotword' in the GLADYS information system and related information appears.

[16] Activated words.

For example, if the user touches the hotword 'heartburn' within the topic dyspepsia in screen 13, the screen changes to screen 21 of the topic 'heartburn'. The patient can go back to 'dyspepsia' by touching the hotword 'dyspepsia'.

7 Humour

Humour was used within the GLADYS system as an attempt to: (1) put the patient at ease, reduce 'computer-phobia' among non-computer users and create a more 'friendly' environment; (2) provide an overall approach of enjoyment or fun so that patients would be motivated to continue to interact with the computer; and (3) present a style that seemed not very technology-oriented. Screens 5 to 7 and 18 are examples of screens within the GLADYS interview where humour was used. Humour was also used within the GLADYS information system by the use of images, for example Screen 19 and screen 24. Screens 32 to 36 are examples of screens where humour was used in the on-line questionnaire.

8 On-line help

The GLADYS interview provides on-line help when the button 'Help' is touched or clicked. The GLADYS information system also provides on-line help when the button 'Help' is touched or clicked. Structure diagram Figure 3 in Appendix I illustrate the design of the on-line help module and screens 29 and 30 are example screens of the on-line help module.

9 Clinician vs patient

The GLADYS system can be 'run' for both the patient and the clinician. All the screen examples above are for the patient mode. However, extra facilities are provided for the clinician, so that the system could be updated. One of the screens of the 'welcoming' process to the system asks the user to identify himself. If the user is a clinician, the system will provide the user with a menu scroll bar and the 'Topics Menu' screen for styles A and B will change from screen 20 to screen 25, where the 'GLADYS Library ListMaker' facility is offered.

9.1 Security

Toolbook has two working levels: Reader and Author. A book's scripts can be run at the Reader level, while, at the Author's level, scripts or procedures could be written to create the program. To ensure security of the program a password is used to enter into the Author's level so that screens or scripts cannot be changed except by authorised personnel.

9.2 Updating : using the ListMaker

Within the clinician mode, the system offers the facility to update the topics menu scroll bar of the 'Topics Menu' screen of styles A and B[17] (Screen 25). If the button 'ListMaker' is touched or clicked, screen 25 changes to screen 26, where five buttons appear. These buttons are:

(a) *Change Topic*: where the name of any topic and its relevant information could be changed. For example, if the button Change Topic of screen 26 is touched or clicked, a window will appear (Screen 27) to ensure if the user wants to change a topic. If the user clicks/touches yes the screen will turn to screen 28, giving the user options in editing.

(b) *Add New Topic*: where a new topic and its relevant information could be added into the GLADYS information system.

(c) *Delete Topic*: where a topic and its relevant information could be deleted.

(d) *Delete All Topics*: where all the topics and their relevant information could be deleted within the GLADYS information system.

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[17] Updating the menu scroll bar (list of topics) would be unnecessary for style C, as the topics provided in the menu bar are individualised for each user and, therefore, would be different for each user. Although, however, the selection of topics for users could be changed within the code through out the program.

10 System Code

The GLADYS system was designed using Asymetrix Toolbook version 1.5 for Windows. In chapter 4, Section 4.3, some of the features of the software Toolbook were mentioned and the advantages and the limitations of ToolBook were also discussed. Similarly, the reasons for choosing Asymetrix ToolBook for Windows for the development of the system were discussed.

As mentioned, Toolbook uses OpenScript for its programming language and enables the combination of text, graphics, sound and animation in a network format, where by touching or clicking pointers such as 'buttons' a little program called a 'script' would be activated. Appendix XXI illustrates some of the GLADYS system's code written in the Author's level. It would not be possible to show all the code that was written to develop the GLADYS system, as this would be too many pages. Scripts or programming code were written in several places, for example within all options for patient's responses, within all buttons, and almost all pages (screens), backgrounds, and for the system as a whole (book scripts).

11 Status Report and Recommendations

11.1 The system status

At present, the GLADYS system has reached a satisfactory level, according to the specifications given in Chapter 4. The structure has been fully tested and there do not appear to be problems during the running of the system.

11.2 Deficiencies

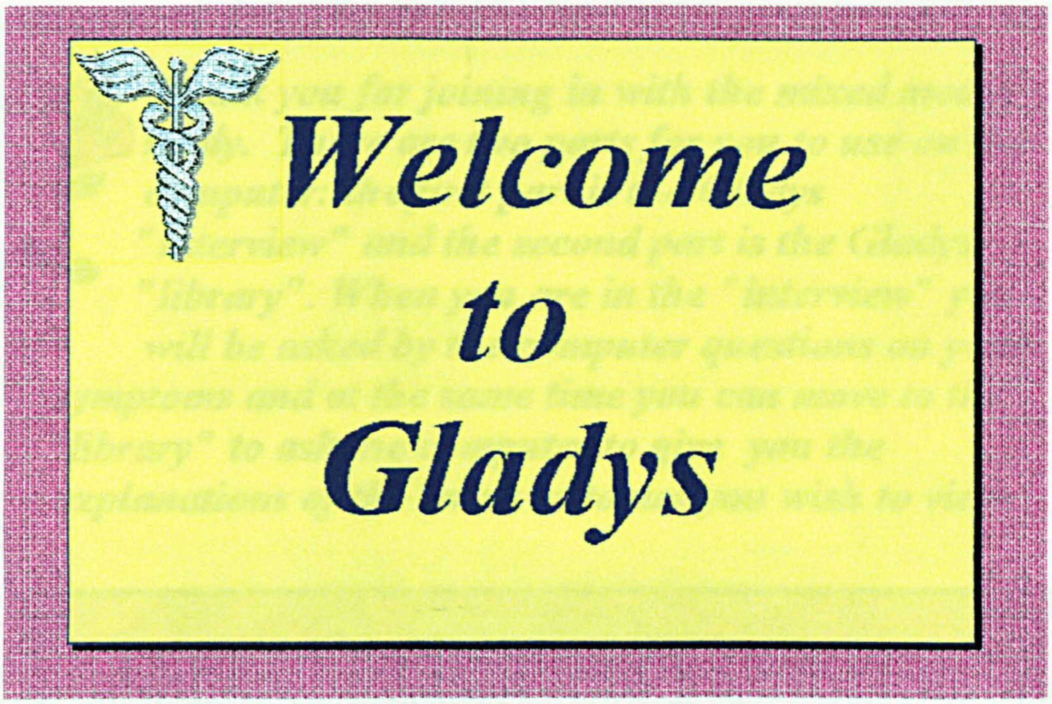
There is no particular deficiency still to be corrected concerning the specifications given. However, although the code on the 'ListMaker' for the clinician mode to update the system is not complete, the ListMaker is not part of the specifications for this study.

11.3 Recommendations for further development

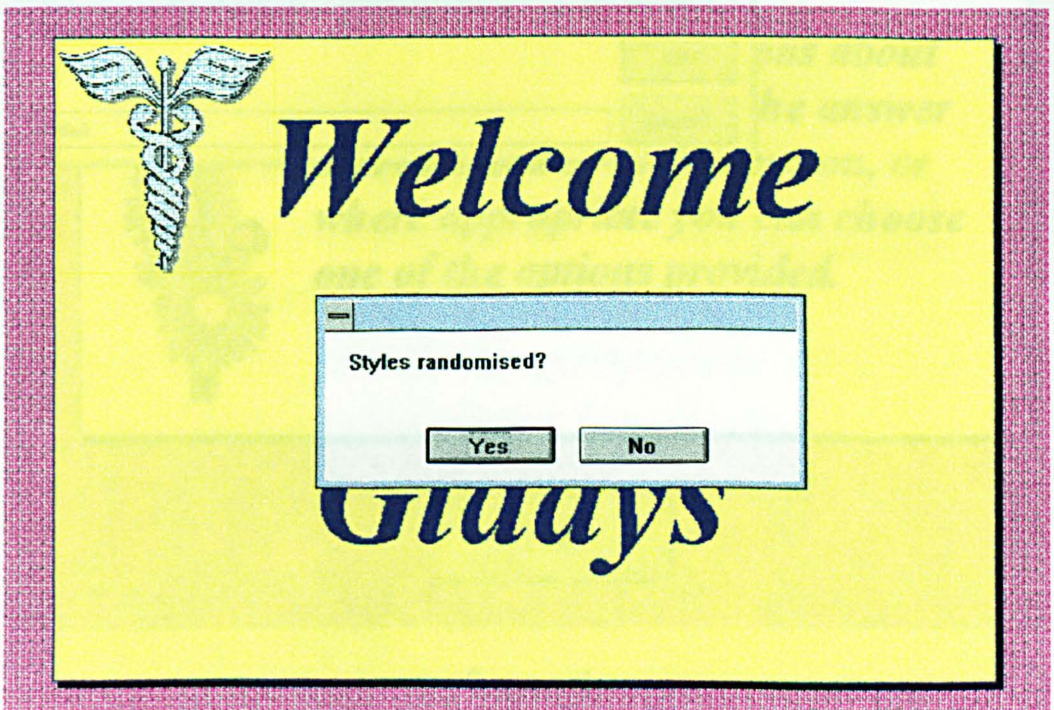
1) The current Toolbook GLADYS version provides facilities to update the program, by expanding and deleting topics from the topics list according to the needs and interests of users. Within the clinician mode, the system offers the facility to update the topics menu scroll bar of the 'Topics Menu' screen of *styles A* and *B* (Screens 25 to 28). For example, if the button 'ListMaker' of screen 25 is touched or clicked, screen 25 changes to screen 26, where five buttons appear. Facilities to change a topic, add a new topic, delete a topic, delete all topics are provided. However, the code for the 'ListMaker' within the

clinician mode to update the system is not complete. Further work is needed to complete the code to appreciate the full potential of the 'ListMaker' facilities.

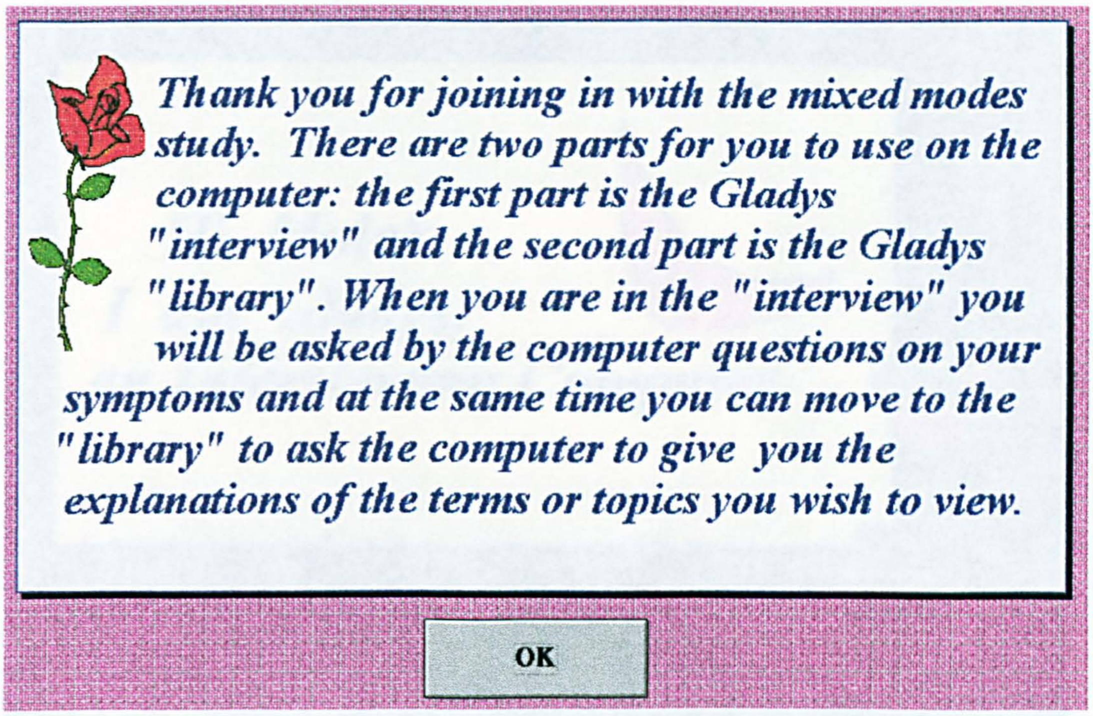
2) The new Toolbook GLADYS system's questions are the same as that of the previous GLADYS Excel version, and the Toolbook system is designed to run together with the Excel system. The GLADYS Toolbook version is designed to 'dump' patients' responses into the GLADYS Excel version which, thereafter calculates probabilities for diagnoses and suggests therapy. Further work is also needed to calculate probabilities for diagnoses and to suggest therapy within the GLADYS Toolbook version, so that the program would act independently from the GLADYS Excel version. This could be achieved by calculating the probabilities within the 'book script' and then 'dumping' the results on to a 'page' of the GLADYS Toolbook version. The program's accuracy could be examined by running it parallel with the GLADYS Excel version.



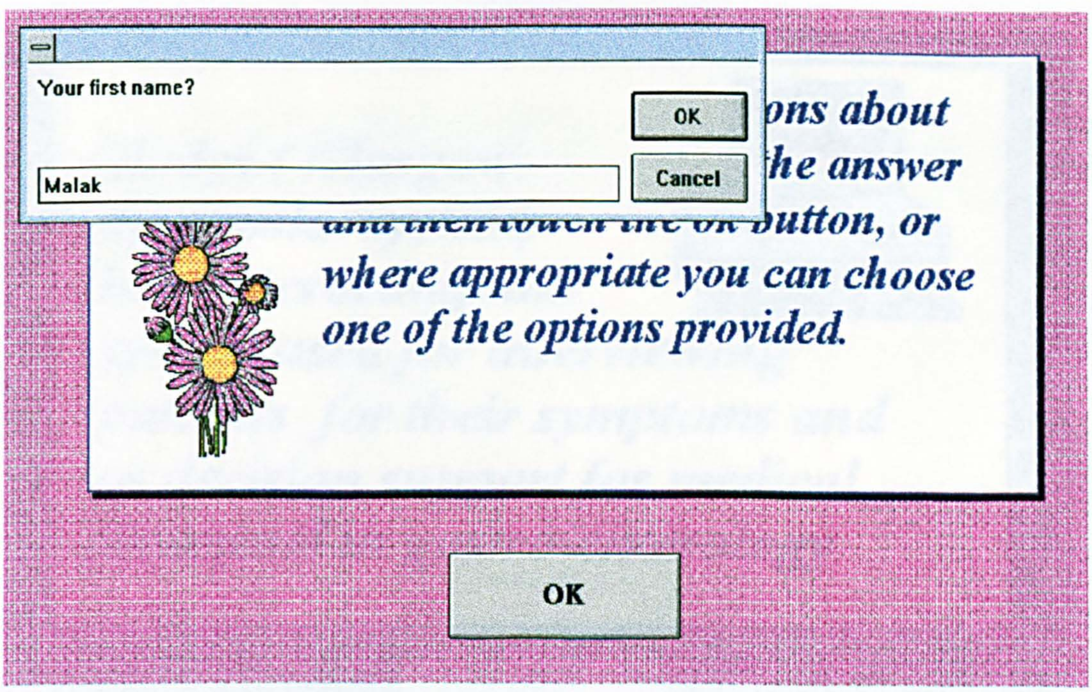
Screen 1



Screen 2

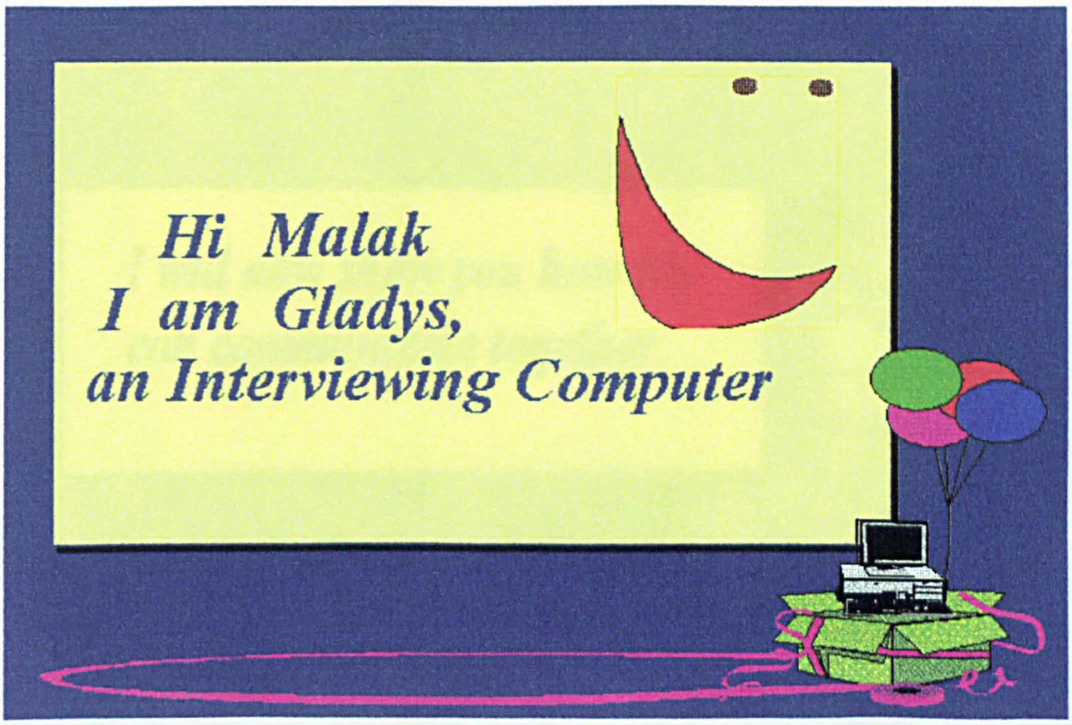


Screen 3[a]

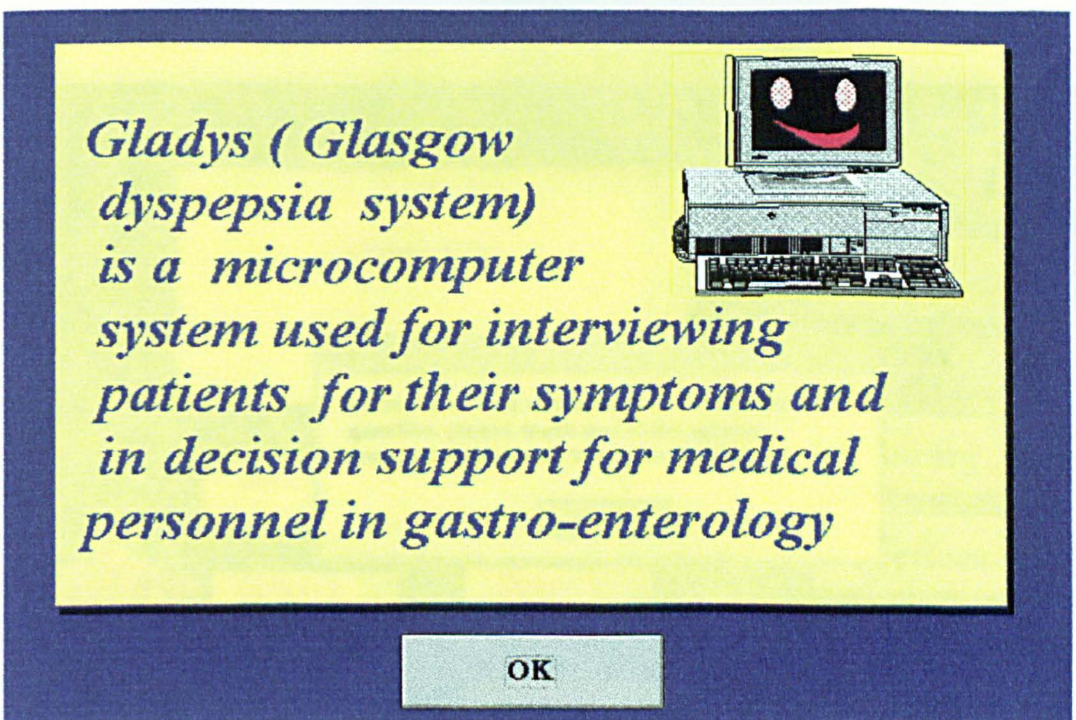


Screen 4

[a] Images of flowers are used in the welcoming screens as 'flowers bring people together'. But will a human and a machine be brought together by images of flowers?



Screen 5[b]



Screen 6

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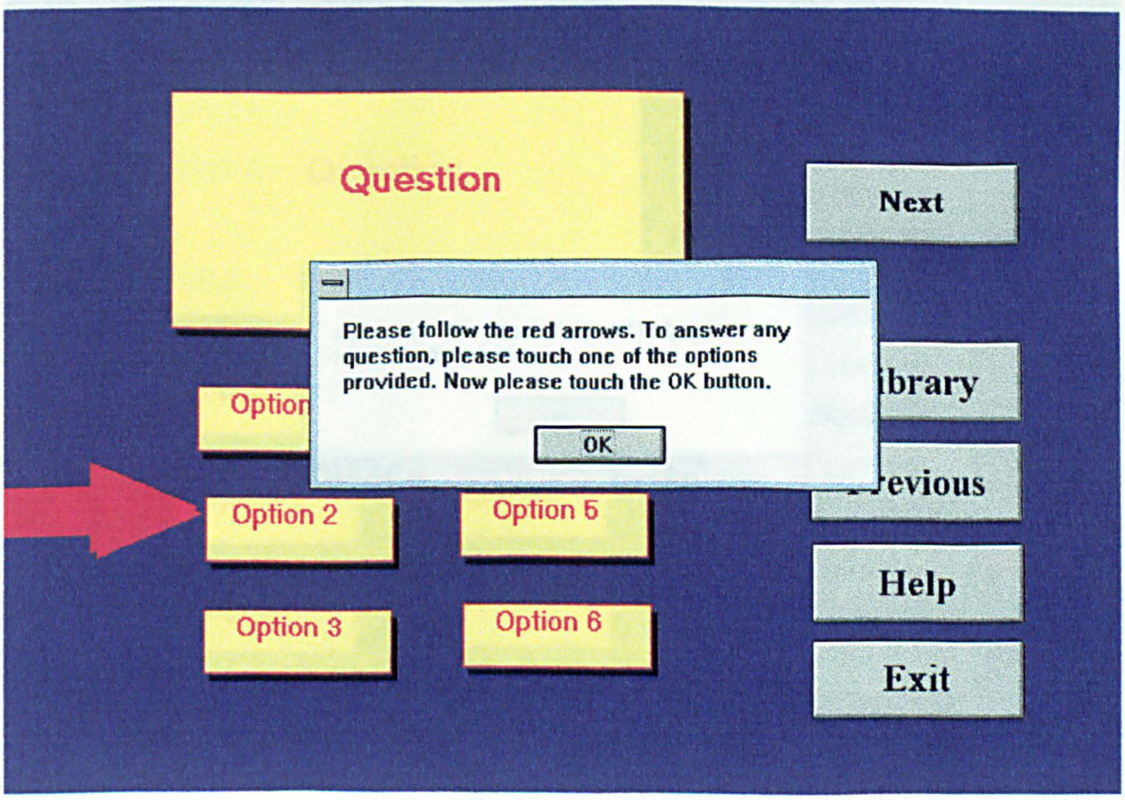
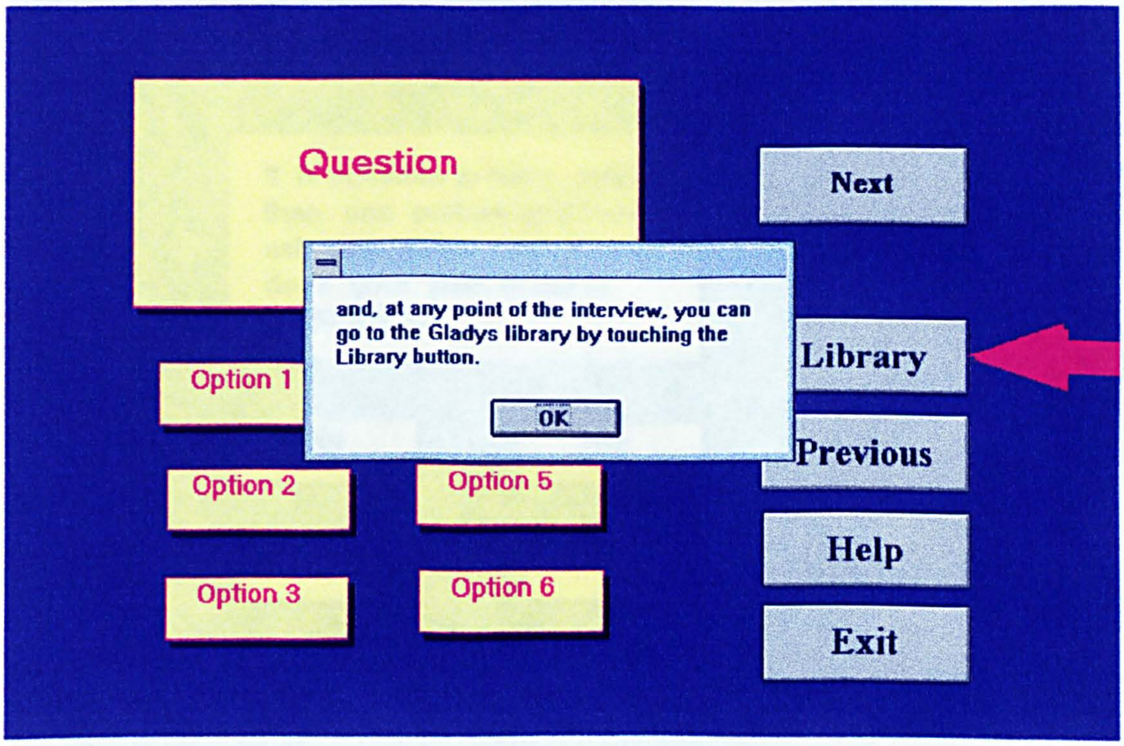
[b] The evaluation of the system was around the Christmas season, so Gladys could also come as one of the gifts. Of course, this was an attempt to bring about humour and thereby lessen 'computer-phobia' and create a more friendly environment.

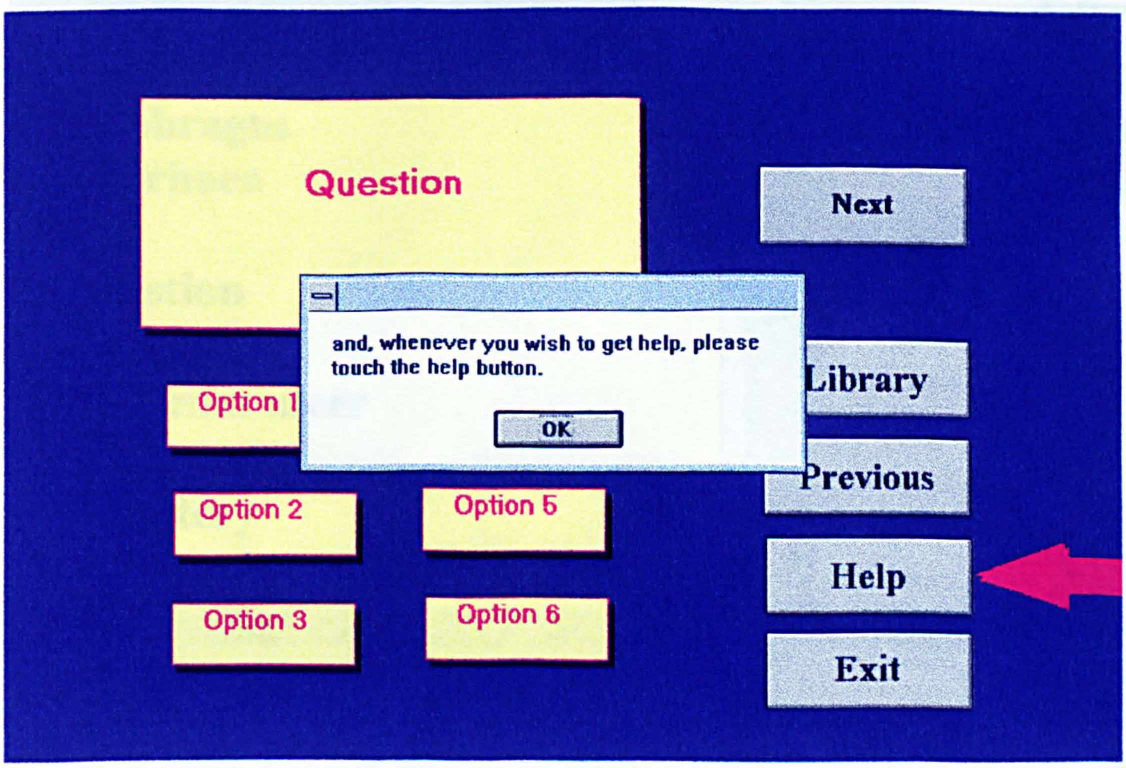
Screen 7



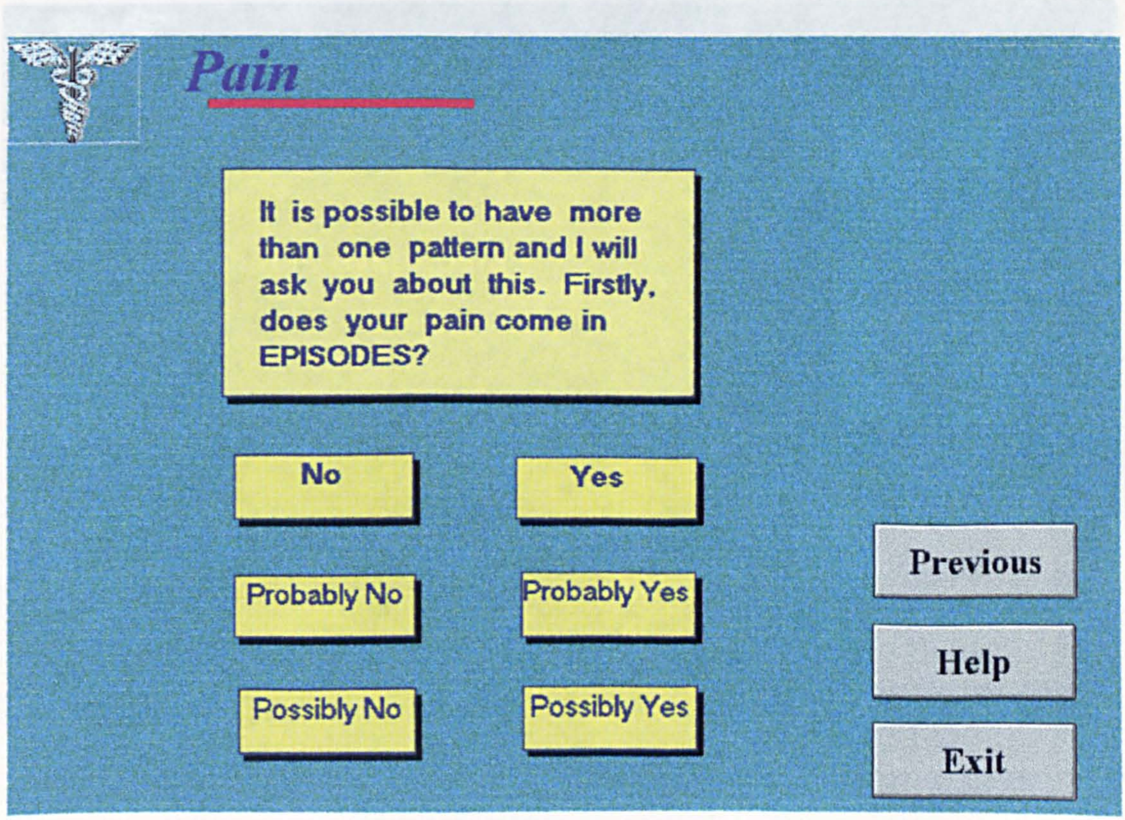
Screen 8



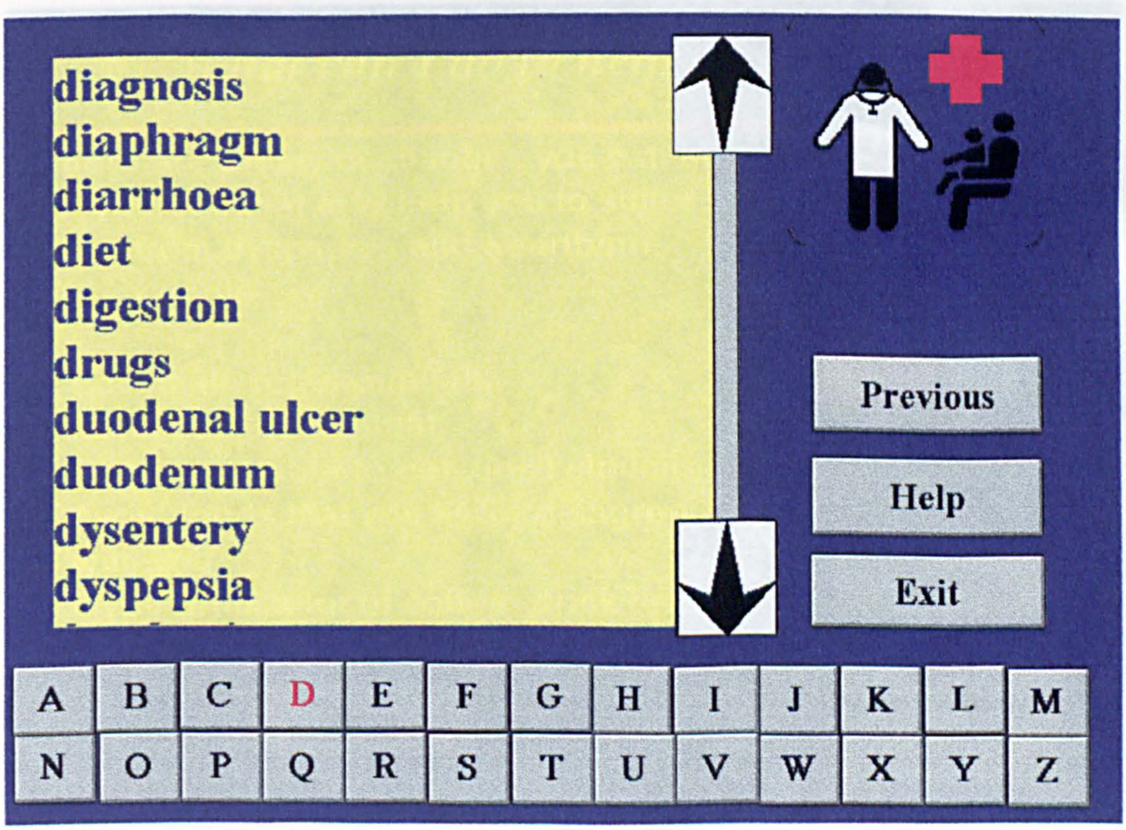
Screen 9



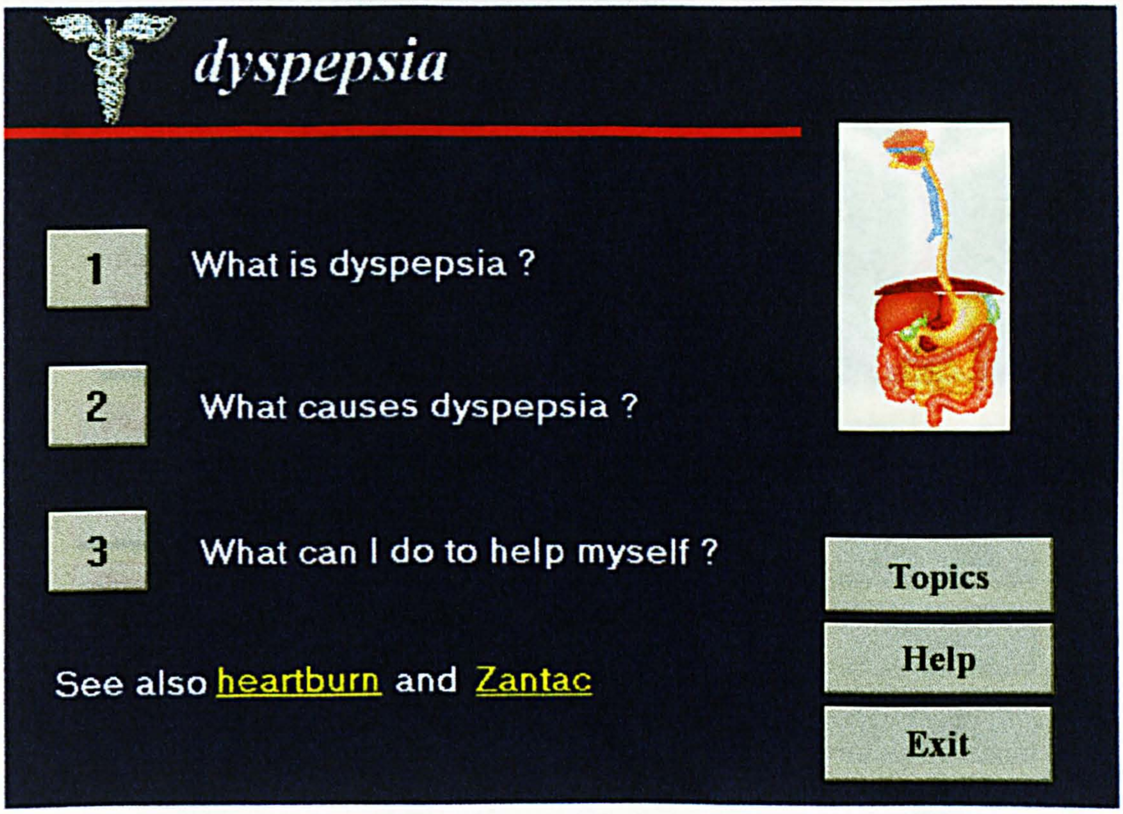
Screen 10



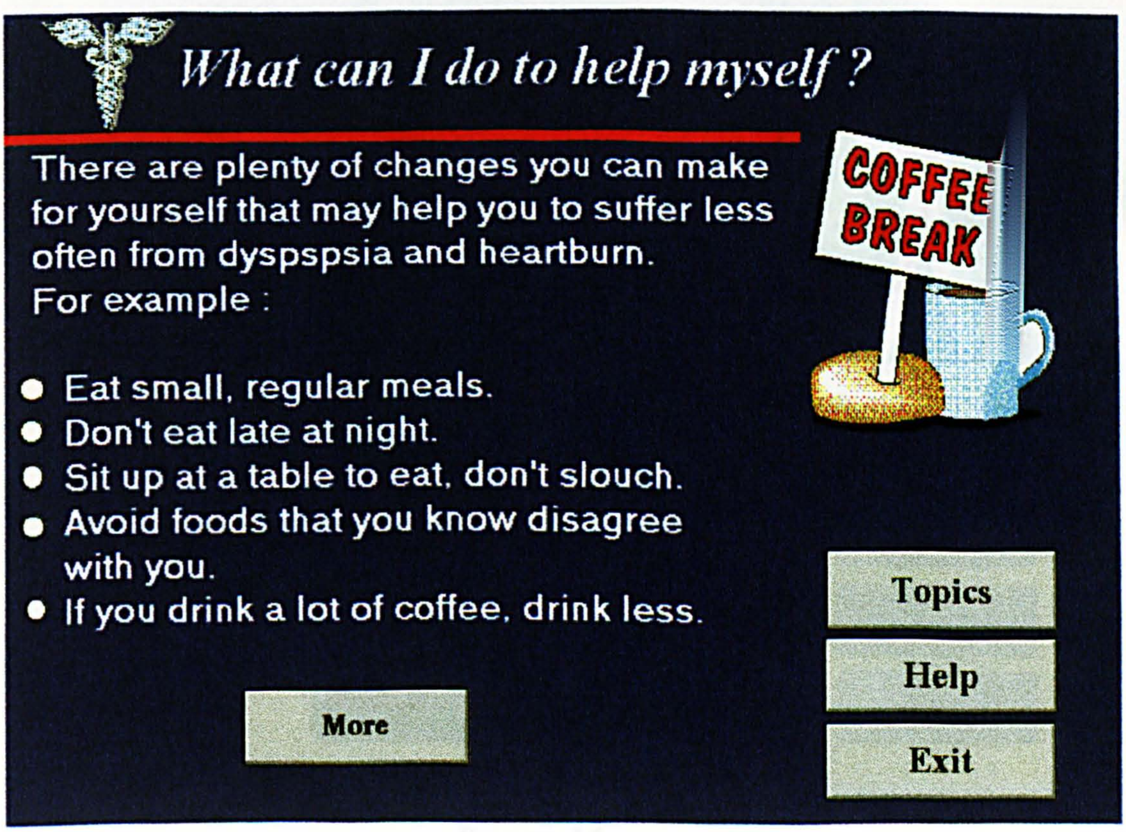
Screen 11



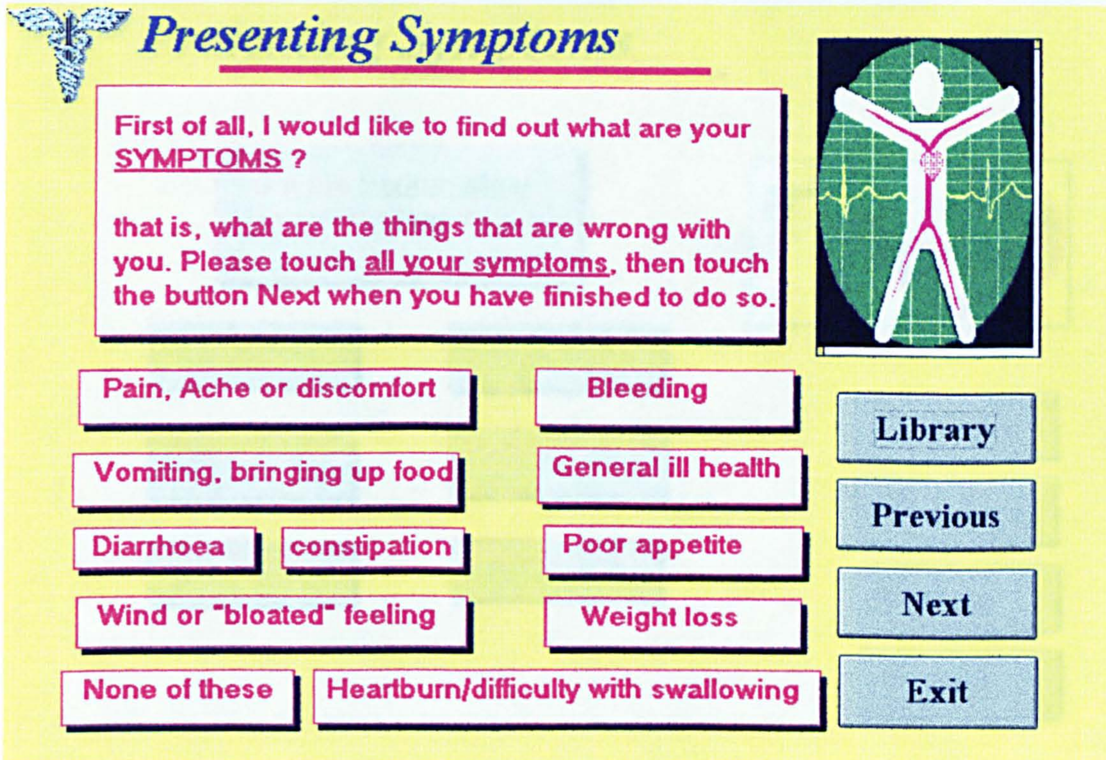
Screen 12



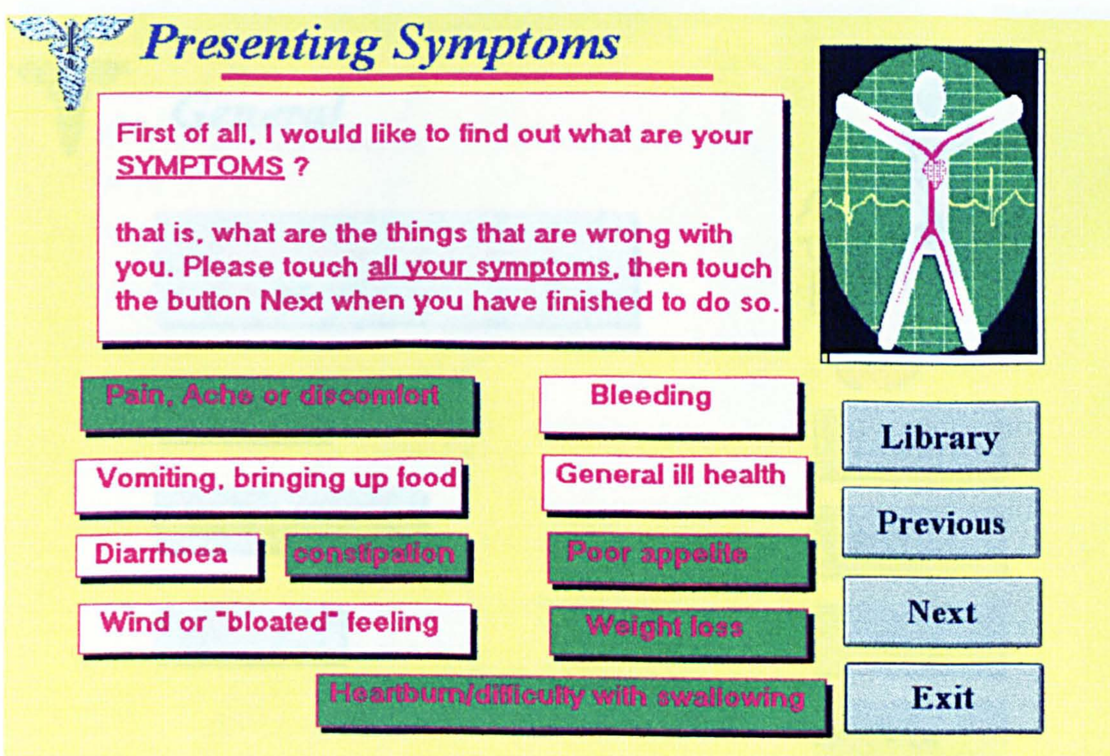
Screen 13



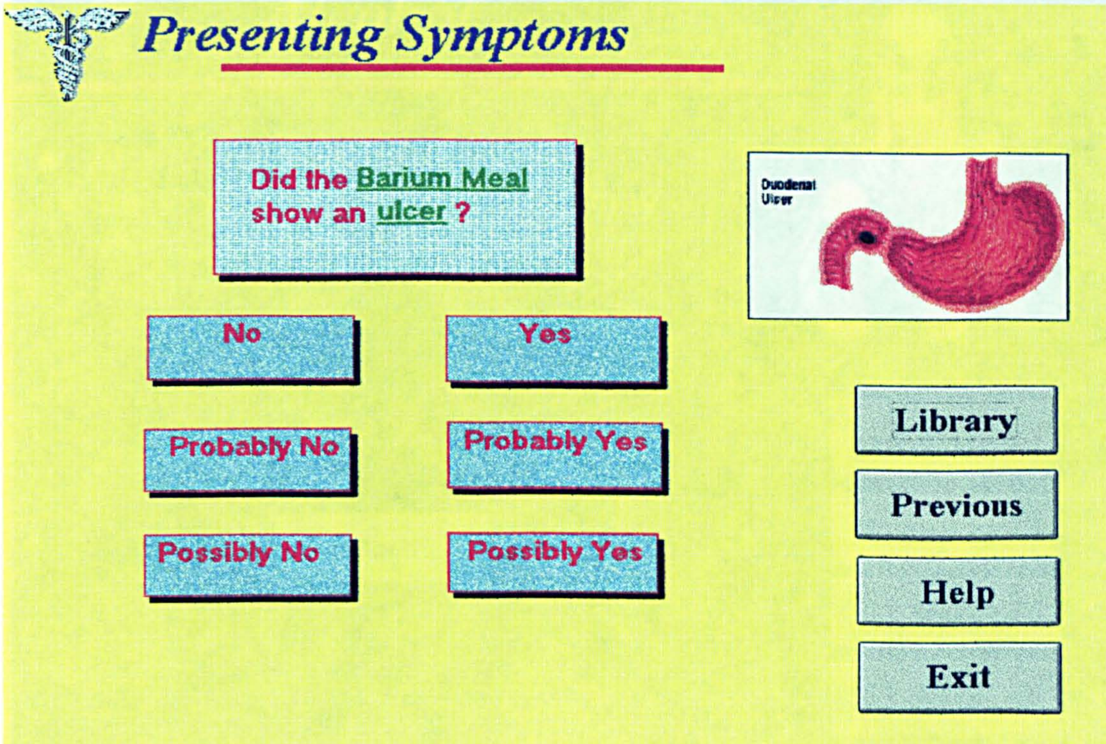
Screen 14



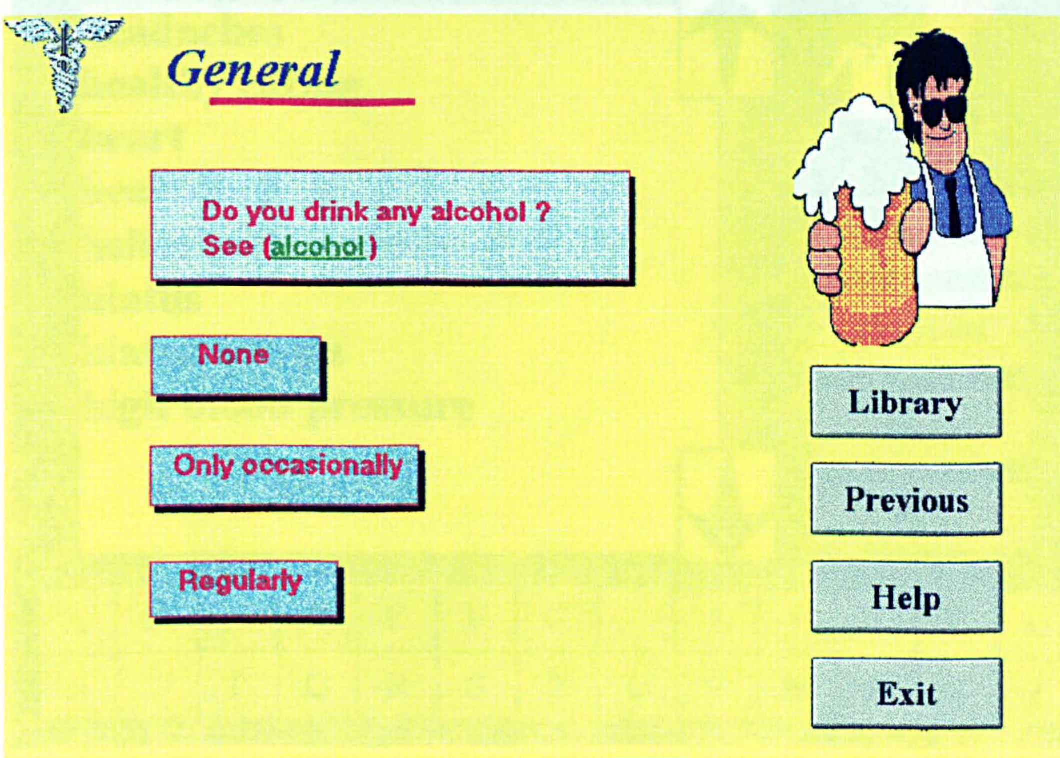
Screen 15



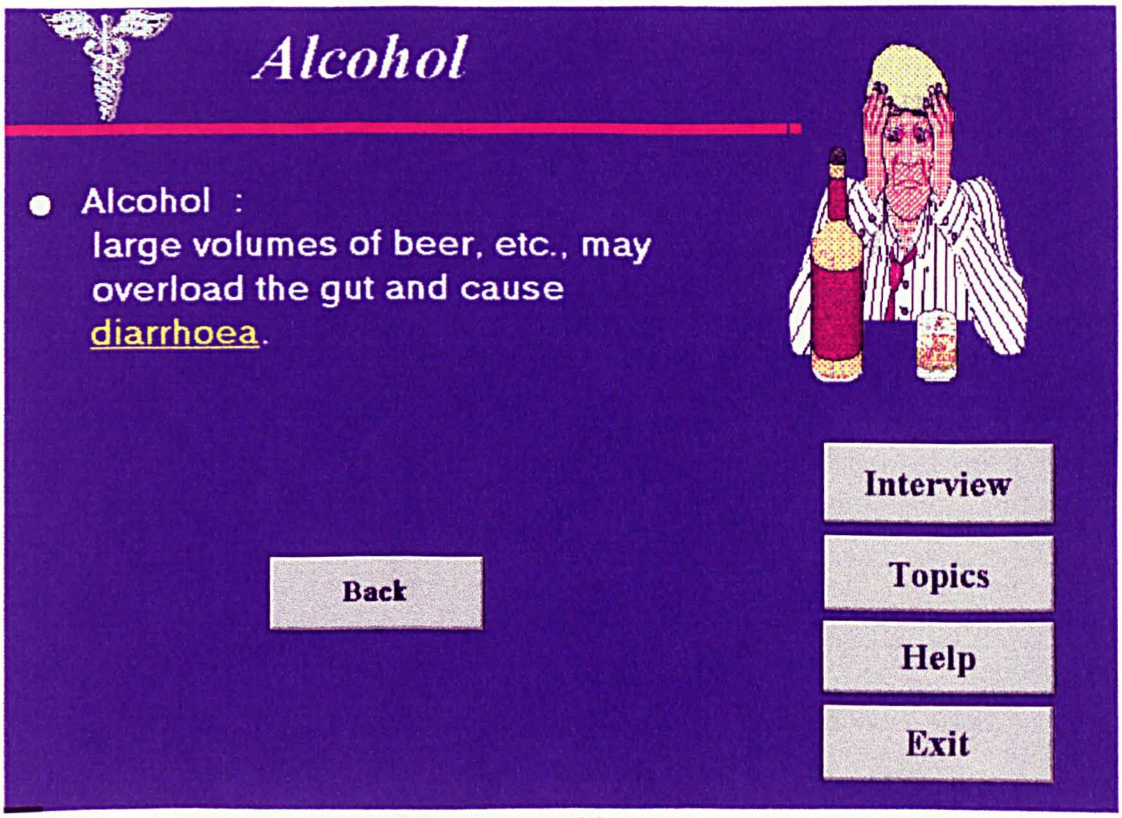
Screen 16



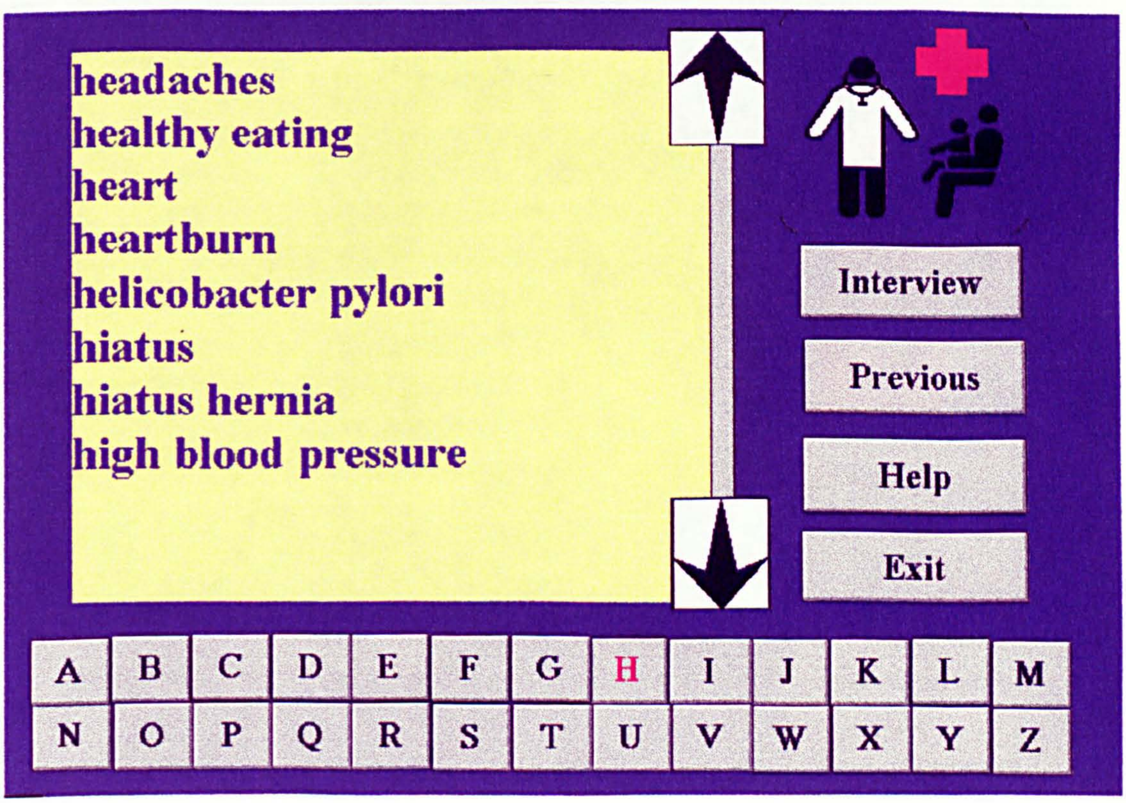
Screen 17



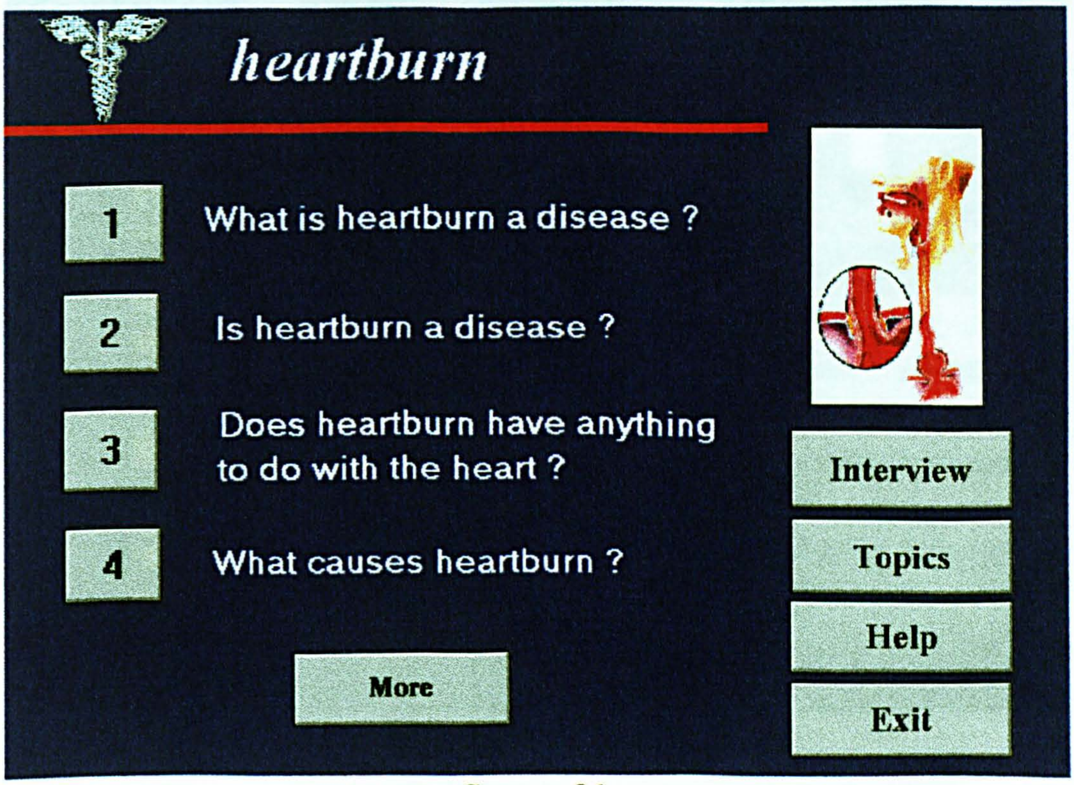
Screen 18



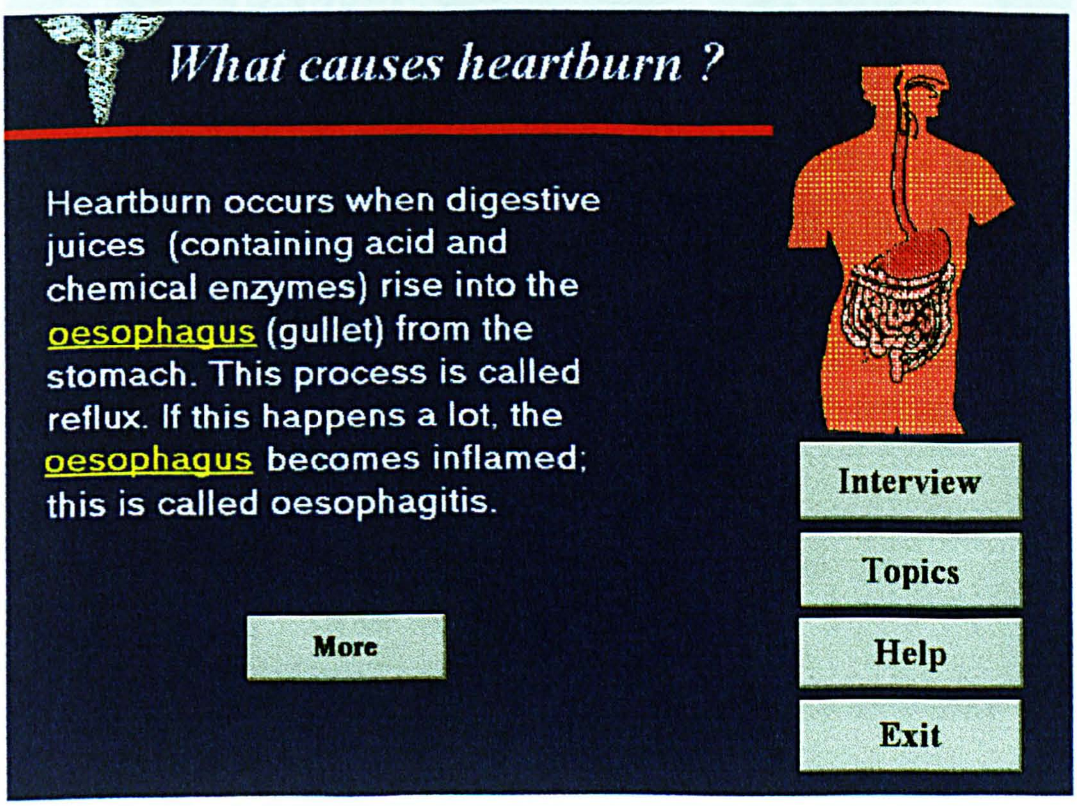
Screen 19



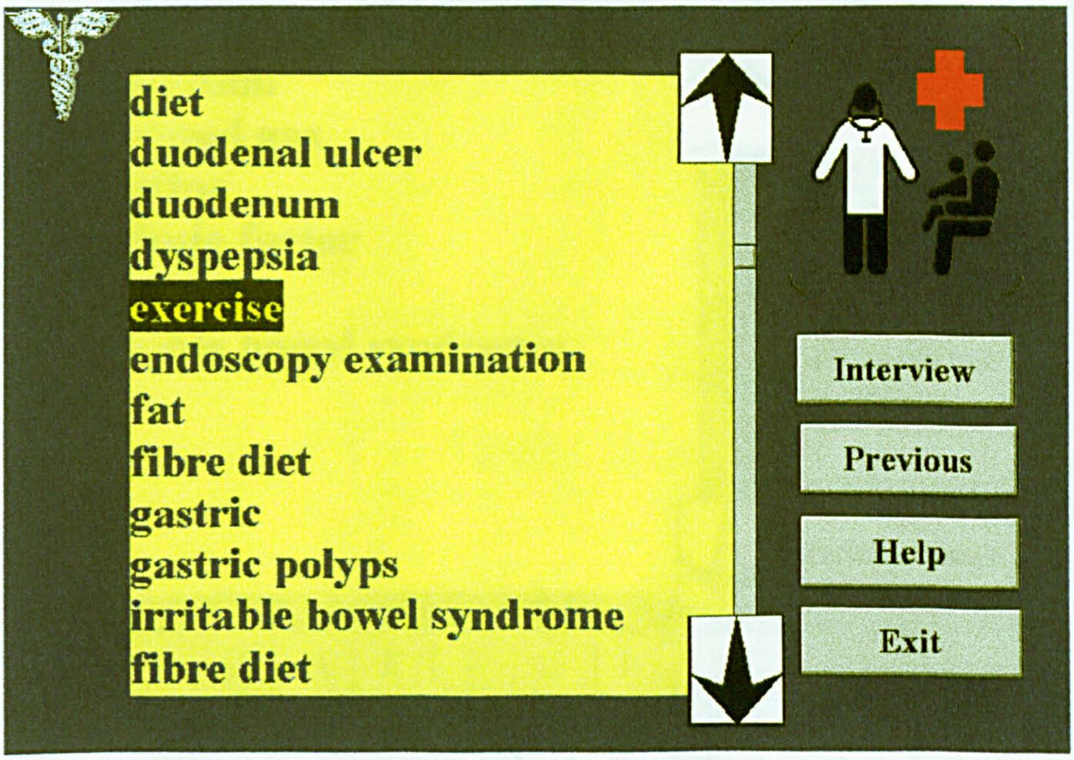
Screen 20



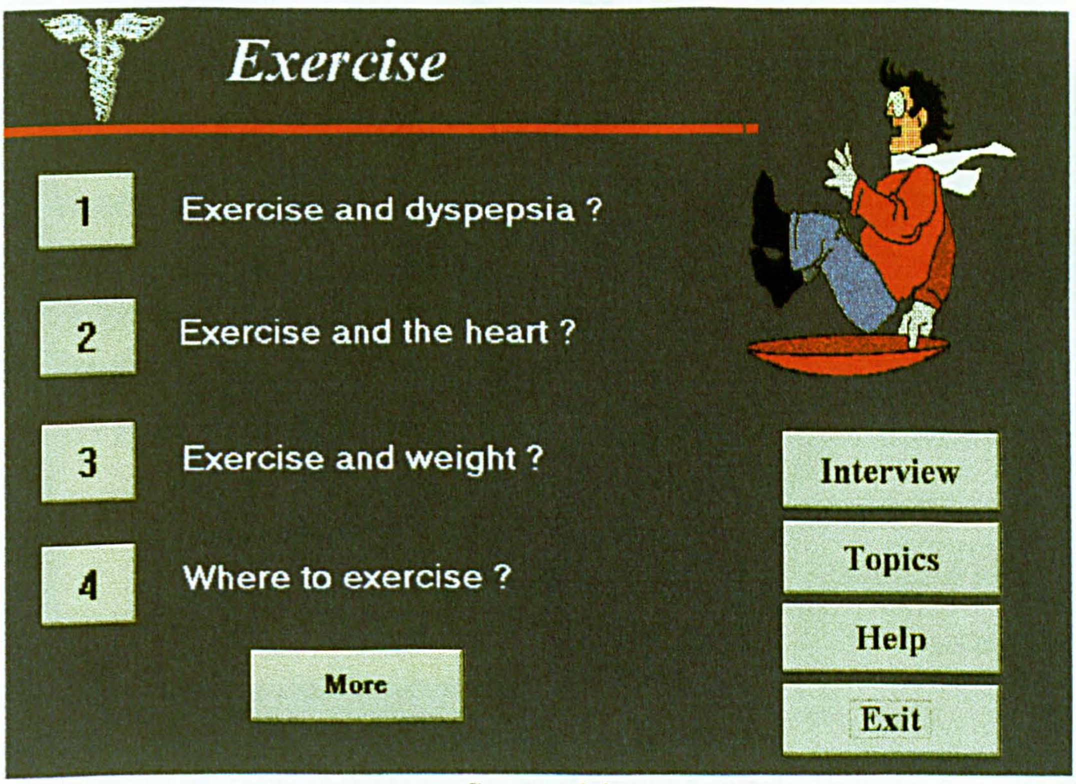
Screen 21



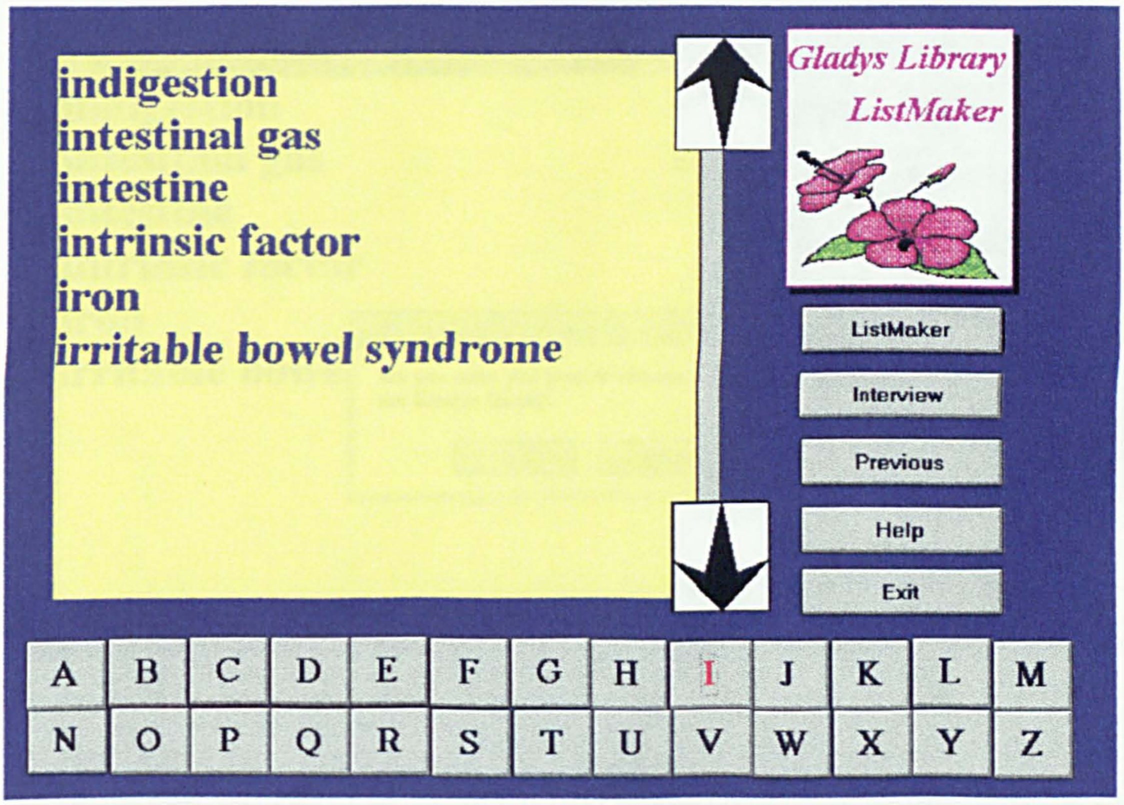
Screen 22



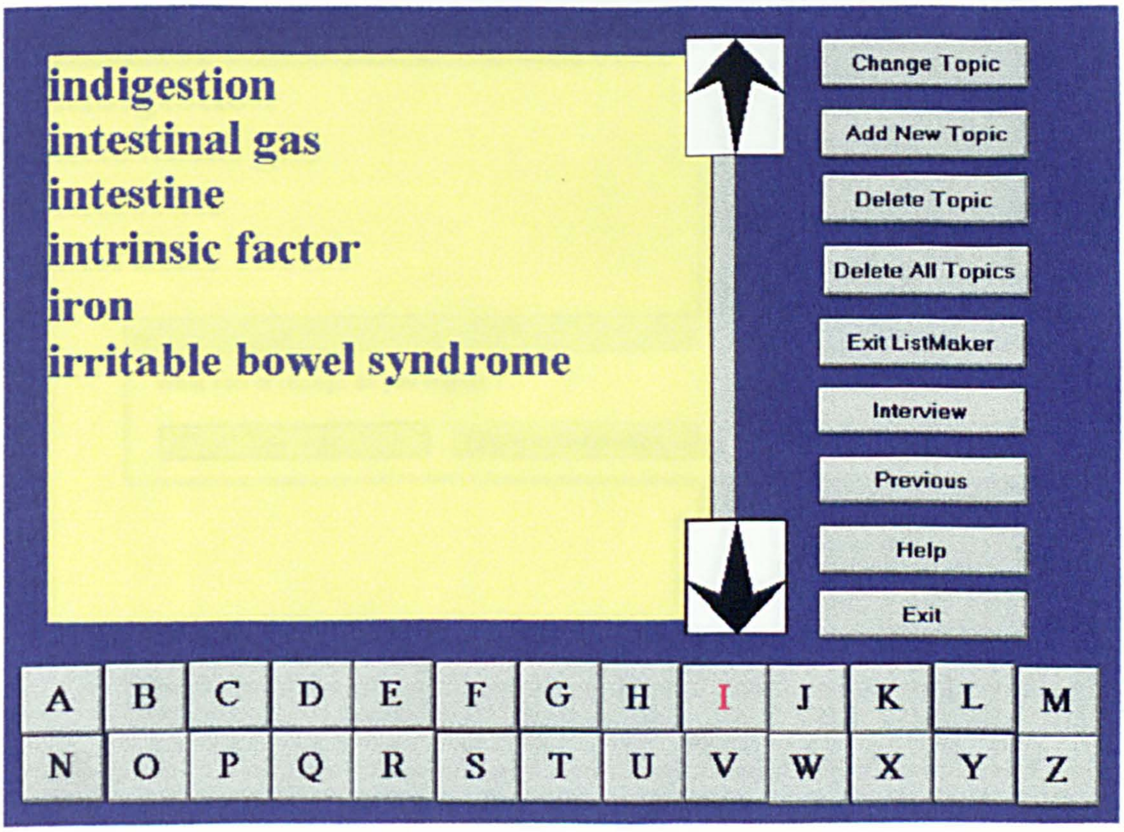
Screen 23



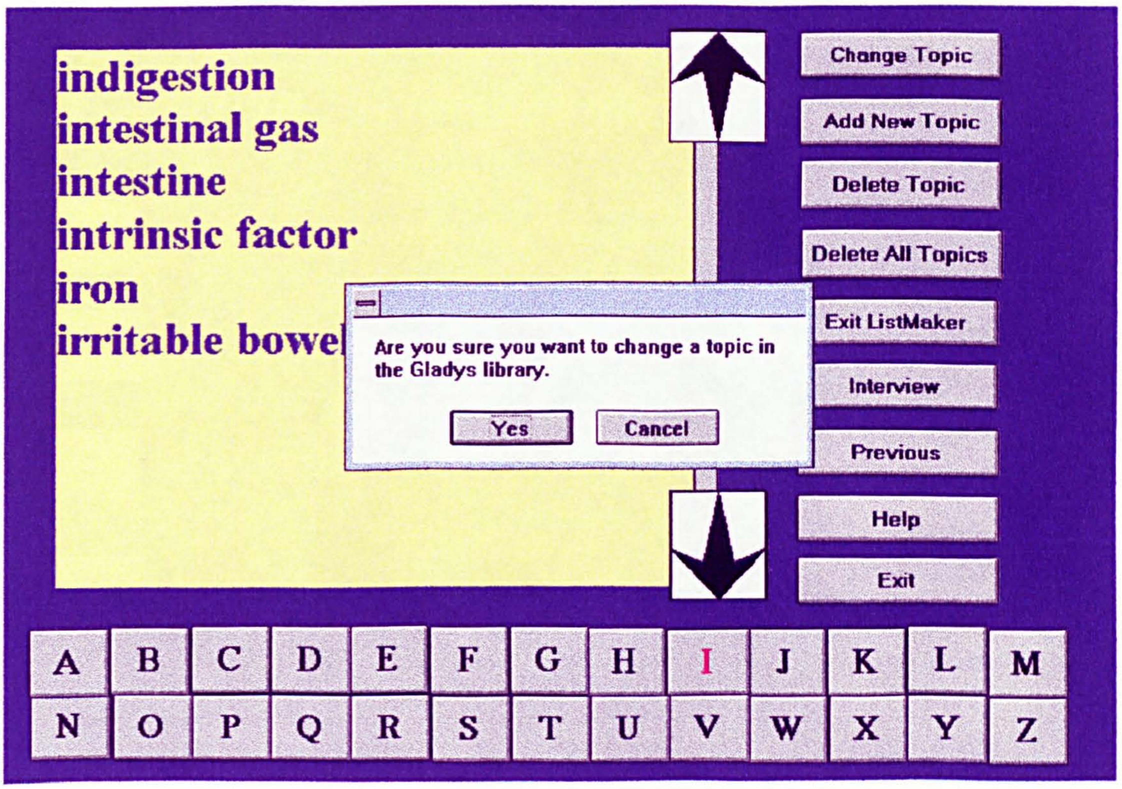
Screen 24



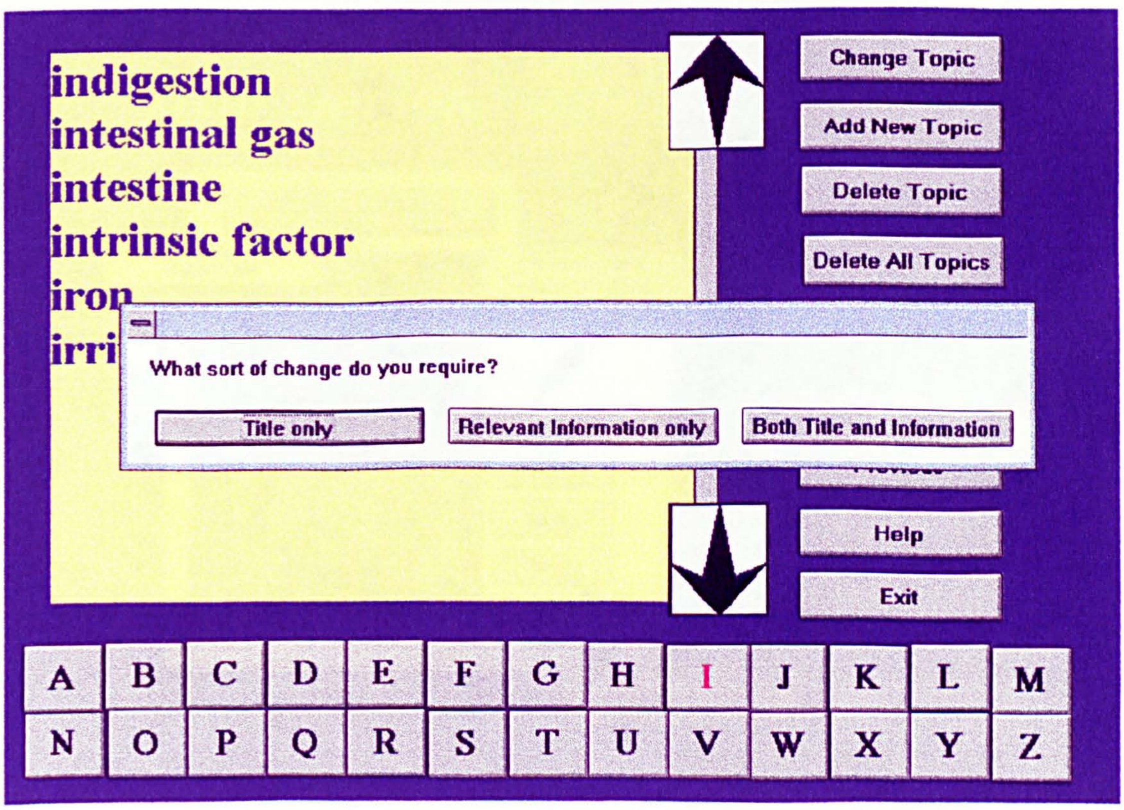
Screen 25



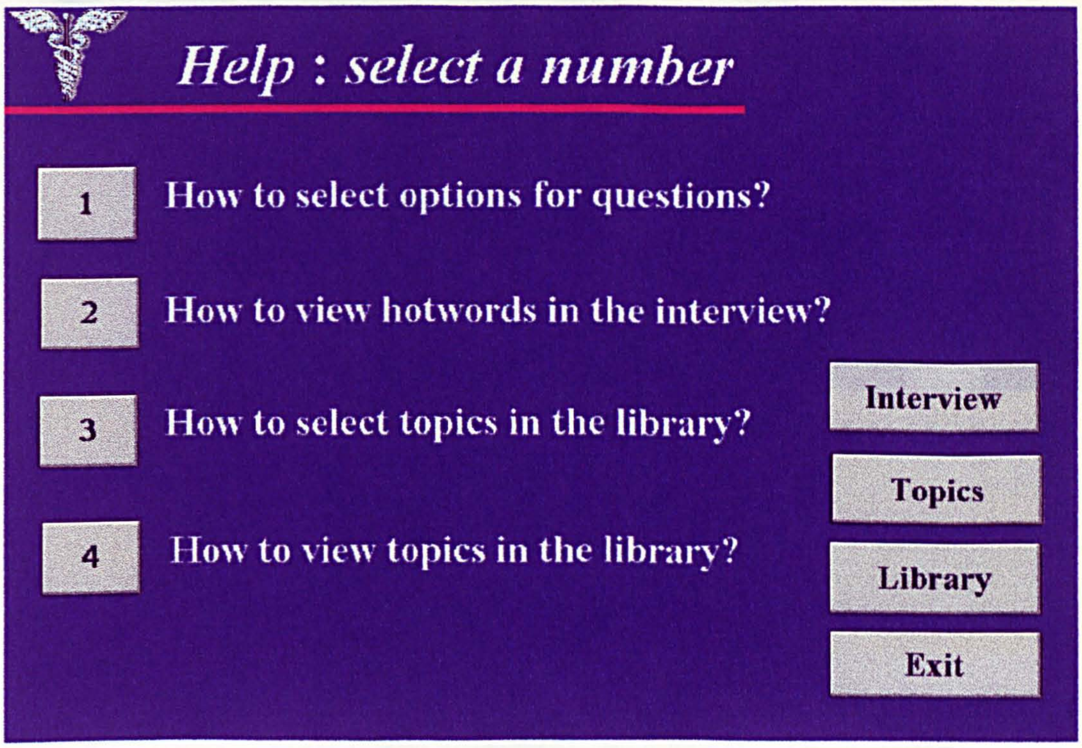
Screen 26



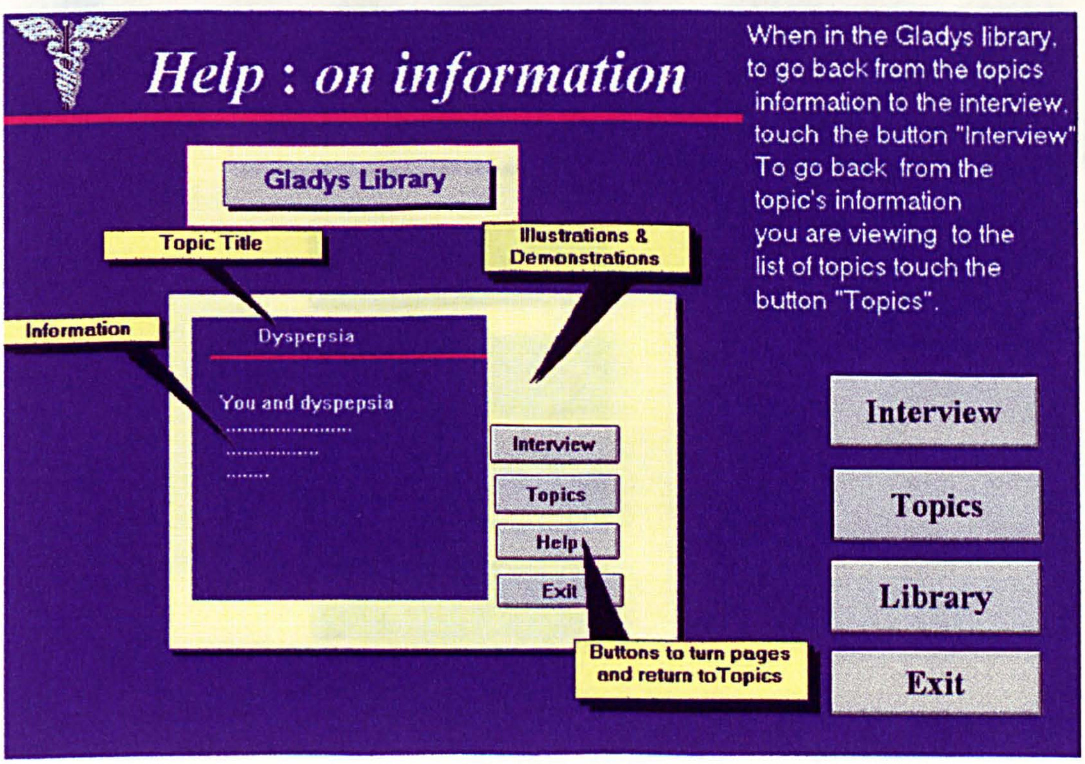
Screen 27



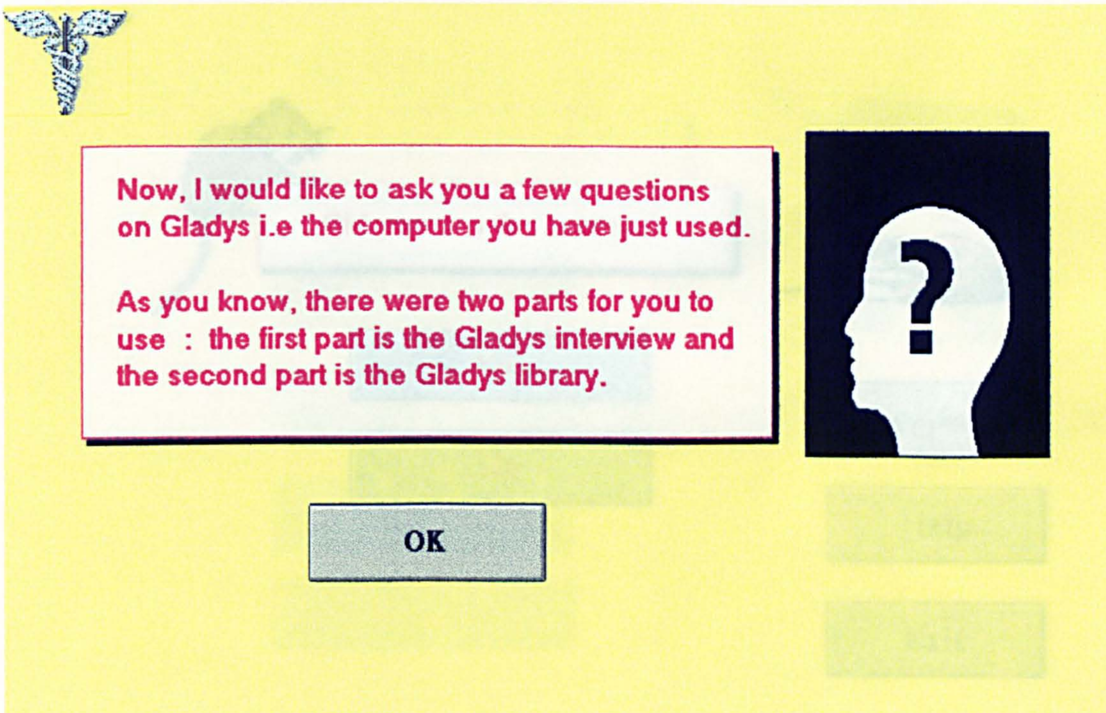
Screen 28



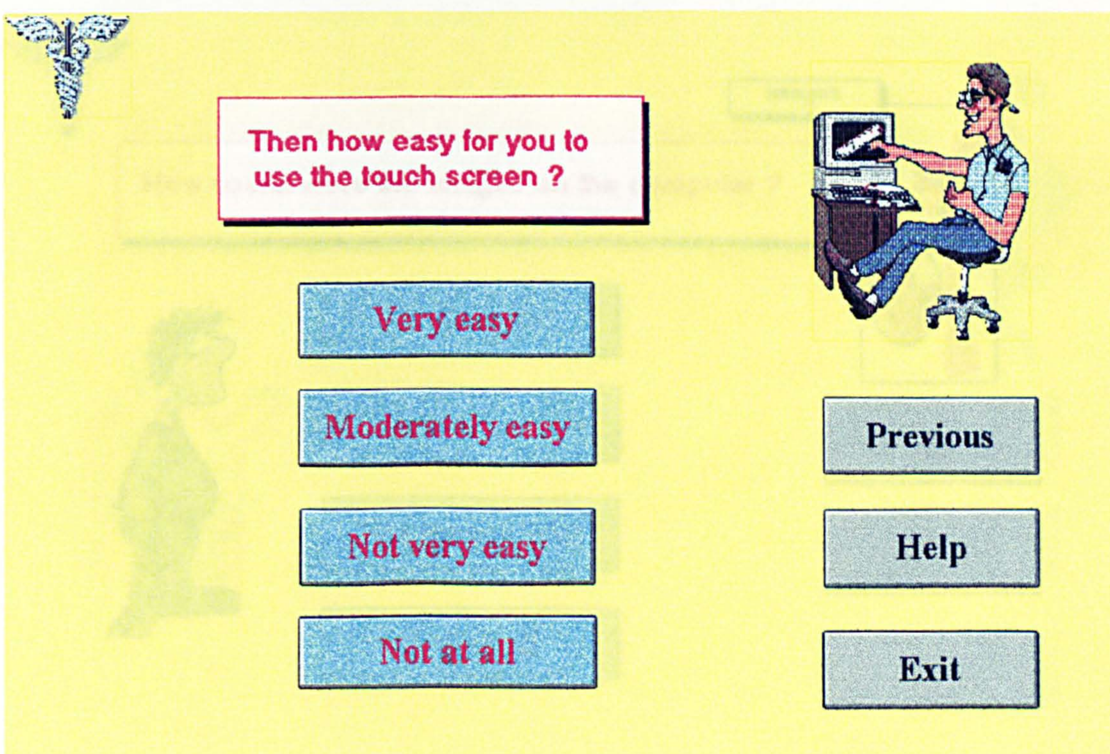
Screen 29



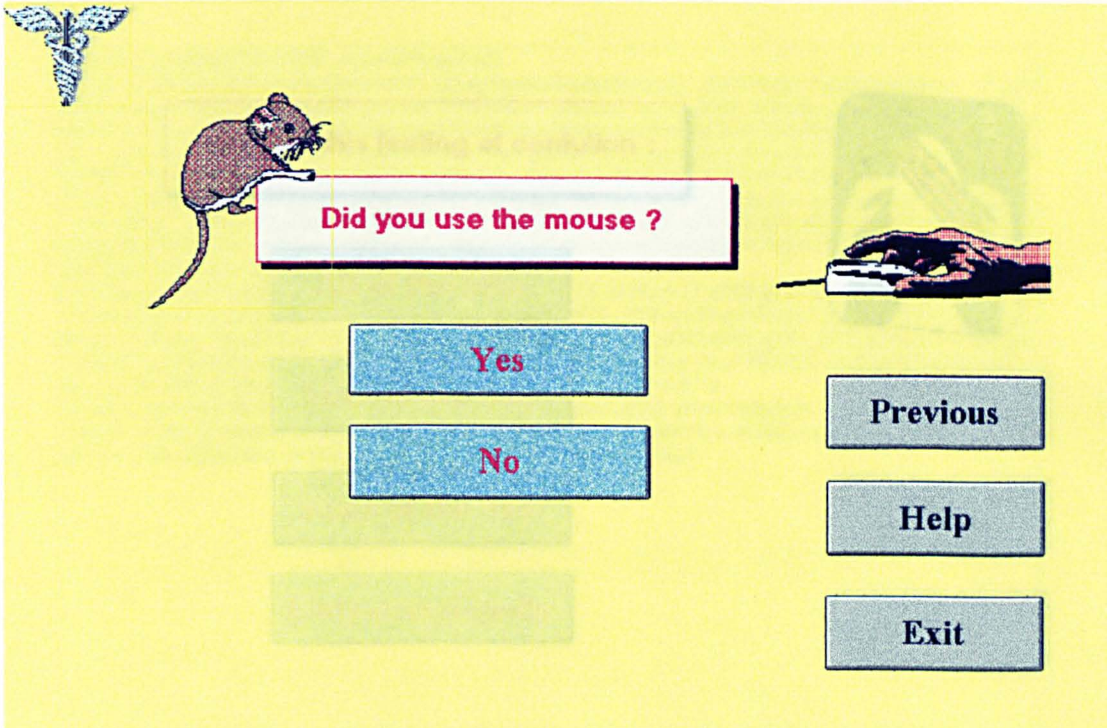
Screen 30



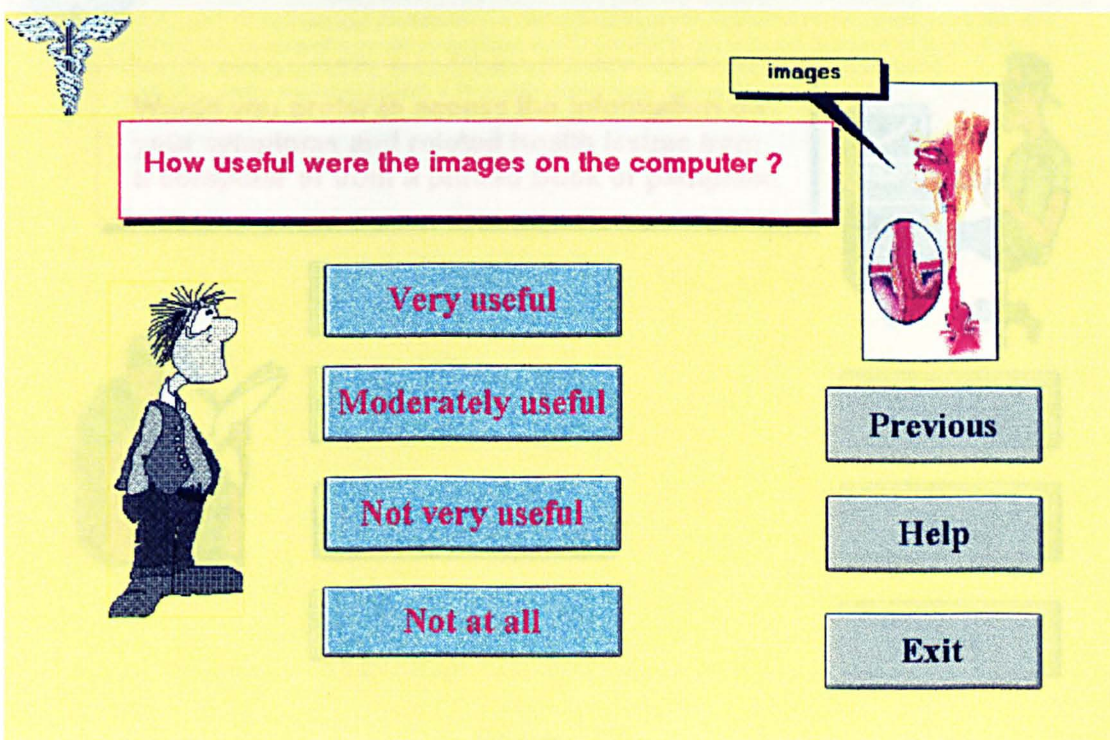
Screen 31



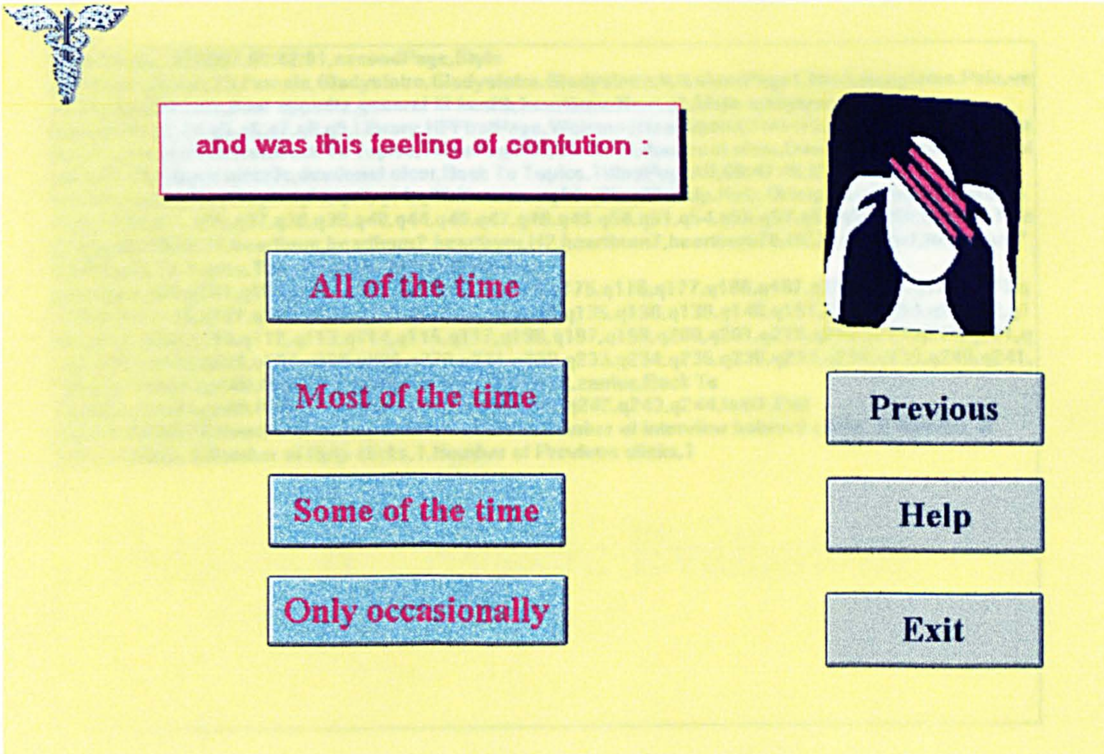
Screen 32



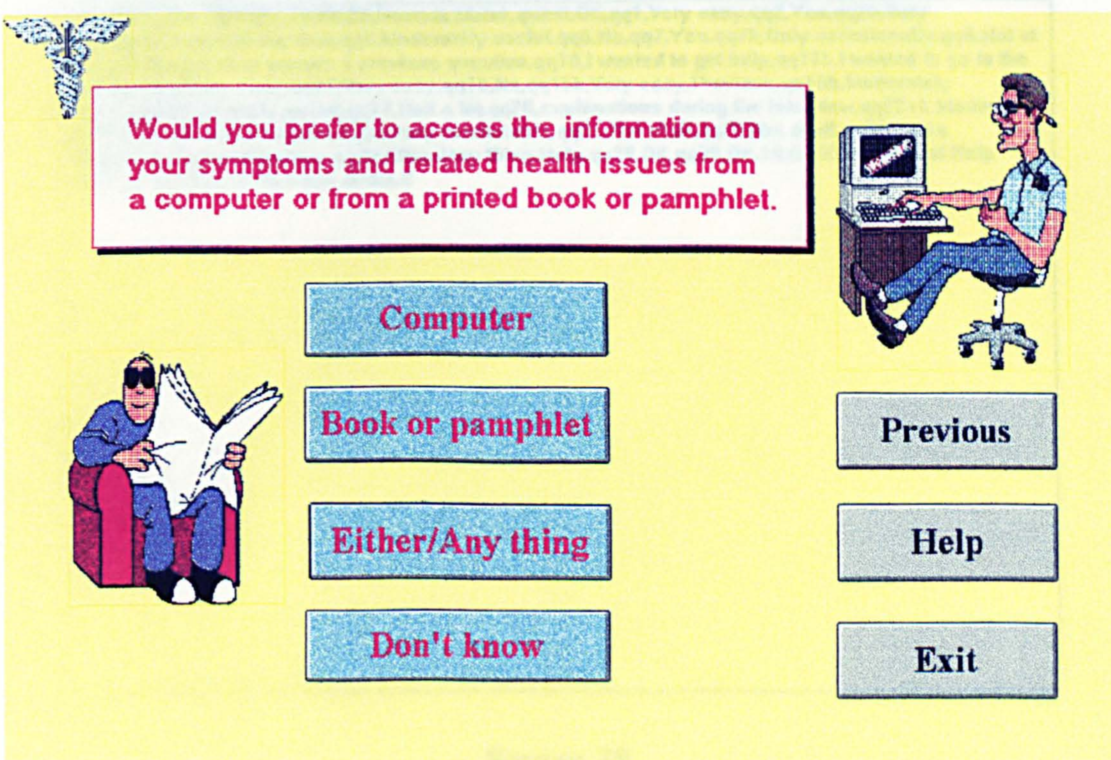
Screen 33



Screen 34



Screen 35



Screen 36

Real Study,10/09/97,09:42:01,secondPage,Style
B,Rastam,Malak,23,Female,GladysIntro,GladysIntro,GladysIntro,tt,tt,showPage1,Next,symptoms,Pain,vo
miting,weight loss,poor appetite,general ill health,heartburn,Next,q1,Main symptom
Heartburn,q2,q4,q5,q6,q7,q8,q9,Library,HPFirstPage,WelcomeHealthpoint,TitlesPageAB,09:46:07,ulcer,u
lcer1,ulcer,ulcer3,ulcer,Back To Topics,TitlesPageAB,09:46:59,duodenal ulcer,Duodenal ulcer3,Duodenal
ulcer3b,Duodenal ulcer3c,duodenal ulcer,Back To Topics,TitlesPageAB,09:47:48,Back to
Interview,q9,q10,q11,q12,q21,q23,q24,q25,Previous,q24,q25,q28,Help,Help,OHelp,Interview,q28,q29,q3
0,q33,q34,q35,q35,q37,q38,q39,q40,q44,q46,q47,q48,q49,q50,q51,q54,q56,q57,q58,q59,q60,Library,Title
sPageAB,09:52:37,heartburn,heartburn2,heartburn,H2,heartburn7,heartburn7b,H2,heartburn7,heartburn7
b,H2,Back To Topics,TitlesPageAB,09:53:42,Back to
Interview,q60,q161,q163,q170,q171,q172,q173,q174,q175,q176,q177,q186,q187,q206,q121,q122,q123,q
124,q125,q126,q127,q129,q130,q131,q132,q133,q134,q135,q138,q139,q140,q151,q153,q154,q91,q92,q1
06,q107,q108,q110,q112,q113,q114,q115,q117,q196,q197,q199,q200,q201,q216,q218,q219,q220,q221,q
222,q223,q224,q226,q227,q228,q229,q230,q231,q232,q233,q234,q235,q236,q237,q238,q239,q240,q241,
Library,TitlesPageAB,09:58:27,zantac,Zantac2,Zantac3,zantac,Back To
Topics,TitlesPageAB,09:59:42,Back To Interview,q241,q242,q243,q244,last1,Exit
Gladys,10:00:24,Number of library hotword clicks,4,Number of interview hotword clicks ,0,Number of
Library clicks,3,Number of Help clicks,1,Number of Previous clicks,1

Screen 37

Questionnaire,10/09/97,10:00:30,Rastam,Malak,quest,OK,qq1,Very easy,qq2,Yes,qq2b,Very
easy,qq3,No,qq4,All the time,qq5,Moderately useful,qq6,No,qq7,Yes,qq7b,Only occasionally,qq8,Not at
all,qq9,I wanted to re-answer a previous question,qq10,I wanted to get help,qq11b,I wanted to go to the
Library,qq12,Very easy,qq13,Very easy,qq18,No,qq15b,Very easy,Previous,qq15b,Moderately
easy,qq16,Moderately useful,qq17,Quit a lot,qq20,explanations during the interview,qq22ab,Moderately
relevant,qq23,tailored topics,qq24,Very comfortable,qq25,Not at all,qq26,Not at all,qq27,Quit a
lot,qq28,Computer,Previous,qq28,Either/Any thing,Help,qq29,OK,qq30,OK,10:04:32,Number of Help
clicks ,1,Number of Previous clicks,2

Screen 38

Chapter VI

Results II : System Evaluation

"Better knowledge of the user leads to an improved ability to fit the presentation of information to the users needs...., with the result that the user sees more useful information and less information that has little or no relevance to current needs."

Korfhage and Joseph (1991)

Contents

1 Introduction

This chapter will present a narrative of the research results together with the relevant tables and charts. In addition, a descriptive comparison of patients' characteristics and reactions will be presented. Comparisons of patients' characteristics and reactions across styles A, B and C (styles kept separate) and between styles A and combined styles (B and C), were classification are as follows:

- **Comparison (A vs B vs C)** : All patients : 100 patients from style A, 50 patients from style B and 50 patients from style C. This comparison was performed in order to examine the difference (if it exists) in the patient's response to either of the three styles A, B or C. The comparison examines the study objective of whether or not there are benefits (or drawbacks) of computer interrogation of the patient, and patient interrogation of the computer when the two styles of interaction are kept completely separate. Similarly, this comparison also examines the study objective of the benefits (or drawbacks) of providing patients with 'selected' topics related to their symptoms and the interviewing process, and providing them with 'general' health topics in the computer information system. Therefore, this comparison examines whether or not style C provides more 'patient satisfaction' than style B, which in turn provides more 'patient satisfaction' than style A. A higher score in patient satisfaction indicates better performance and more satisfaction.

- **Comparison (A and BC)** : All patients : 100 patients from style A, 100 patients from the combined styles B and C. This comparison examines the study objective of whether or not there are benefits (or drawbacks) of combining computer interrogation of the patient and patient interrogation of the computer, by allowing the patient to interrupt the computer interrogation to seek health information. Therefore, this comparison examines whether or not the combined styles B and C provide more 'patient satisfaction' by allowing access to the information system during the computer interview than style A, in which patients have no access to the information system except at the end of the interview. A higher score in patient satisfaction indicates better performance and more satisfaction.

Table 6.1.1 shows cross-tabulations between the months of the study trial and the number of patients within each style. Cross-tabulations between the months[1] of the study trial and number of patients within styles A and BC combined, showed no significant difference. Similarly, cross-tabulations between the months[2] of the study trial and the number of patients within the three styles A, B and C taken separately.

Table 6.1.1 : Cross-tabulations between the months of the study trial and the number of patients within each style.

	September No. (%)	**October** No. (%)	**November** No. (%)	**December** No. (%)	**January** No. (%)	**Total** No. (%)
A Vs B Vs C						
Style A	1 (1)	30 (30)	26 (26)	19 (19)	24 (24)	100 (100)
Style B	1 (2)	13 (26)	14 (28)	8 (16)	14 (28)	50 (100)
Style C	1 (2)	15 (30)	13 (26)	9 (18)	12 (24)	50 (100)
Total (%)	3 (2)	58 (29)	53 (26)	36 (18)	50 (25)	200 (100)
		$\chi^2 = 0.61$ (df=6) p = 1				
A Vs BC						
Style A	1 (1)	30 (30)	26 (26)	19 (19)	24 (24)	100 (100)
Styles BC	2 (2)	28 (28)	27 (27)	17 (17)	26 (26)	100 (100)
Total (%)	3 (2)	58 (29)	53 (26)	36 (18)	50 (25)	200 (100)
		$\chi^2 = 0.23$ (df=3) p = 1				

[1] Month was recorded to 4 items instead of the original 5 items for 5 months, patients of the months September and October were combined into 1 month.

[2] Same as 1.

2 Characteristics of patients

The characteristics of patients are classified under age, gender, patients' previous computer use, type of medical examination, emotional feelings by using the Zuckermann Affect Adjective Checklist (ZAAC), and levels of anxiety and depression by using the Hospital Anxiety and Depression Scale (HADS).

2.1 Age distribution

The mean age of the 200 patients was 54 (SD = 17), ranging from 16 to 89 years (Table 6.2.1). Using ANOVA (one way analysis of variance) there were no significant differences between the age of patients across styles (A vs B vs C). Similarly, using a *t*-test there were no significant differences between the age of patients between styles (A and BC) (t=-0.46, p=0.6).

Table 6.2.1: Frequency of patients' age in styles (A vs B vs C)[3]

Age	Style A (n=100) No. (%)	Style B (n=50) No. (%)	Style C (n=50) No. (%)	Total n=200 No. (%)
<=19	1 (1)	0 (0)	0 (0)	1 (1)
20-29	6 (6)	7 (14)	4 (8)	17 (8)
30-39	16 (16)	6 (12)	3 (6)	25 (12)
40-49	17 (17)	11 (22)	10 (20)	38 (19)
50-59	20 (20)	8 (16)	3 (6)	31 (15)
60-69	21 (21)	7 (14)	19 (38)	47 (24)
70-79	15 (15)	8 (16)	10 (20)	33 (17)
80-89	4 (4)	3 (6)	1(2)	8 (4)
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	
	53.9 (15.6)	52.5 (17.9)	57.4 (15.8)	
		F=1.18, p=0.3		

[3] Styles (A vs B vs C) are patients within styles A, B and C where styles are taken as separate.

2.2 Gender

Ninety-six patients (48%) were males, and 104 (52%) were females (Table 6.2.2). There were no significant differences between gender across styles (A vs B vs C), and between styles (A and BC).

Table 6.2.2 : Frequency of patients' gender.

Gender	Male No. (%)	Female No. (%)	Total No. (%)
A vs B vs C			
Style A	44 (44)	56 (56)	100 (100)
Style B	29 (58)	21 (42)	50 (100)
Style C	23 (46)	27 (54)	50 (100)
Total (%)	96 (48)	104 (52)	200 (100)
	$\chi^2 = 2.7$ (df=2) p = 0.3		
A vs BC			
Style A	44 (44)	56 (56)	100 (100)
Styles BC	52 (52)	48 (48)	100 (100)
Total (%)	96 (48)	104 (52)	200 (100)
	$\chi^2 = 1.3$ (df=1) p = 0.2		

2.3 Patients' previous computer use.

One hundred and thirty-seven patients (68%) had never used a computer before the study trial, 24 (12%) used a computer occasionally, 20 (10%) used a computer often and 19 (10%) used a computer daily (Table 6.2.3). There were no significant differences between patients' previous computer use across styles (A vs B vs C) and between styles (A and BC).

Table 6.2.3 : Frequency of patients' previous computer use

Computer frequency	Never No. (%)	Occa-sionally No. (%)	Often No. (%)	Daily No. (%)	Total No. (%)
A vs B vs C					
Style A	67 (67)	16 (16)	9 (9)	8 (8)	100 (100)
Style B	32 (64)	4 (8)	7 (14)	7 (14)	50 (100)
Style C	38 (76)	4 (8)	4 (8)	4 (8)	50 (100)
Total (%)	137 (68)	24 (12)	20 (10)	19 (10)	200 (100)
		$\chi^2 = 5.8$ (df=6) $p = 0.4$			
A vs BC					
Style A	67 (67)	16 (16)	9 (9)	8 (8)	100 (100)
Styles BC	70 (70)	8 (8)	11 (11)	11 (11)	100 (100)
Total (%)	137 (68)	24 (12)	20 (10)	19 (10)	200 (100)
		$\chi^2 = 3.4$ (df=3) $p = 0.3$			

Table 6.2.4 represents patients' assessment of themselves in computer competency for patients who were computer users. Of the 63 patients (32%) who used computers, cross-tabulations showed significant association between patients' previous computer use and patients' perceived self assessment of computer competence (p = 0.00001), indicating that patients who used computers daily or often were more likely to feel to be either 'very good' or 'moderately good' in computer use than patients who were occasional users. However, patients' perceived self assessment of computer competence may not only depend on a patient's previous use of computers but also on the patient's own self confidence, self image, and self esteem. Patients who were confident about themselves and had a positive self image may also have felt that they were competent in computer use

compared to patients who were less confident, and had a negative self image or a low self esteem.

Table 6.2.4 : Cross-tabulation of patients' previous computer use and patients' perceived self assessment of computer competence

	Patients' previous computer use			
	Occasionally No. (%)	**Often** No. (%)	**Daily** No. (%)	**Total** No. (%)
Computer competence[4]				
Not at all	2 (8)	0 (0)	0 (0)	2 (3)
Not very good	16 (67)	3 (15)	2 (11)	21 (33)
Moderately good	6 (25)	16 (80)	9 (47)	31 (49)
Very good	0 (0)	1 (5)	8 (42)	9 (14)
Total (%)	24 (100)	20 (100)	19 (100)	63 (100)

$\chi^2 = 25$ (df=2) p=0.00001

2.4 Long computer interview vs short computer interview

One-hundred and twenty patients (60%) were offered the long GLADYS interview and eighty patients (40%) were offered the short GLADYS interview (Table 6.2.5). There were no significant differences between the type of computer interview used across styles (A vs B vs C) and between styles (A and BC).

[4] Not applicable to 137 patients who had never used computers before the study trial

Table 6.2.5 : Frequency of patients using the long computer interview and the short computer interview.

	Long interview No. (%)	Short interview No. (%)	Total No. (%)
A vs B vs C			
Style A	59 (49)	41 (51)	100 (100)
Style B	30 (25)	20 (25)	50 (100)
Style C	31 (26)	19 (24)	50 (100)
Total (%)	120 (60)	80 (40)	200 (100)
	$\chi^2 = 0.13$ (df=2) p = 0.9		
A vs BC			
Style A	59 (49)	41 (51)	100 (100)
Styles BC	61 (51)	39 (49)	100 (100)
Total (%)	120 (60)	80 (40)	200 (100)
	$\chi^2 = 0.08$ (df=1) p = 0.8		

2.5 Patients' medical examination.

All patients were fasting and had to take a medical examination after the study trial (Table 6.2.6). Sixteen patients (8%) were waiting for breath tests, 59 (30%) were waiting for colonoscopies, and 125 (62%) were waiting for endoscopies. Most of the patients (n=185, 93%) were waiting to have their 'specified' examination for the first time and, only 15 (7%) were waiting to repeat the examination. There were no significant differences between the type of medical examination to be taken by the patient across styles (A vs B vs C) and between styles (A and BC).

Table 6.2.6 : Frequency of patients' medical examination.

Medical Examination	Breath test No. (%)	Colonoscopy No. (%)	Endoscopy No. (%)	Total No. (%)
A vs B vs C				
Style A	7 (7)	28 (28)	65 (65)	100 (100)
Style B	5 (10)	14 (28)	31 (62)	50 (100)
Style C	4 (8)	17 (34)	29 (58)	50 (100)
Total (%)	16 (8)	59 (30)	125 (62)	200 (100)
	$\chi^2 = 1.1$ (df=4) p = 0.8			
A vs BC				
Style A	7 (7)	28 (28)	65 (65)	100 (100)
Styles BC	9 (9)	31 (31)	60 (60)	100 (100)
Total (%)	16 (8)	59 (30)	125 (62)	200 (100)
	$\chi^2 = 0.60$ (df=2) p = 0.7			

2.6 Patients' emotional feelings.

Patients' emotional feelings were measured by the Zuckermann Affect Adjective Checklist (ZAAC). This checklist listed feelings which were classified as negative or positive, for example, 'nervous', where the patient was asked to choose only one of the items listed which identified his inner most feelings. Table 6.2.7 presents the checklist and its classifications of feelings, noting that 'thoughtful' was classified as positive here, although, a patient may also be 'thoughtful' with negative, worrying thoughts. In this study, it was necessary to find out which emotional feeling prevailed as most patients had negative feelings (73%). However, there was some degree of difference between a patient who was 'nervous' or 'worrying' and a patient who was 'terrified' or 'panicky', as patients' emotional feelings may have had an effect on patients' interaction with the computer.

One hundred and fifty-four patients were asked to fill in this checklist. Of the 154 patients, 112 patients (73%) had their feelings classified as 'negative' compared to only 42 patients (27%) whose feelings were classified as 'positive'. Most patients described themselves as 'nervous' (n=43; 28%), 'tensed' (n=32; 21%), or 'worried' (n=15; 10%), due to the medical examination they were waiting to take (Table 6.2.7).

Table 6.2.7 : Patients' feelings before the computer interview, as measured by the Zuckermann Affect Adjective Checklist.

Patients' feelings		**Style A** No. (%)	**Style B & C** No. (%)	**Total** No. (%)
Worrying	(negative)	8 (10)	7 (9)	15 (10)
Panicky	(negative)	3 (4)	2 (3)	5 (3)
Thoughtful	(positive)	5 (7)	4 (5)	9 (6)
Calm	(positive)	6 (8)	4 (5)	10 (6)
Tense	(negative)	16 (21)	16 (21)	32 (21)
Pleasant	(positive)	0 (0)	1 (1)	1 (1)
Nervous	(negative)	21 (27)	22 (29)	43 (28)
Loving	(positive)	0 (0)	1 (1)	1 (1)
Terrified	(negative)	0 (0)	3 (4)	3 (2)
Steady	(positive)	5 (6)	2 (3)	7 (5)
Frightened	(negative)	5 (7)	4 (5)	9 (6)
Contented	(positive)	8 (10)	11 (14)	19 (12)
Total (%)		77 (100)	77 (100)	154 (100)

Table 6.2.8 represents patients' feelings before the computer interview across styles (A vs B vs C) and between styles (A and BC), as measured by the ZAAC checklist. Cross-tabulations of patients' emotional feelings across patients of styles (A vs B vs C) and between styles (A and BC) showed no significant differences (Table 6.2.8). Similarly, there was no significant difference between patients' emotional feelings and gender (χ^2 = 1.04 ; df=1 ; p = 0.3) (Table 6.2.9), even though a larger percentage of the female patients (n=61; 76%) felt negative compared to the male patients (n=51; 69%). In addition, there was no significant difference between patients' emotional feelings and the type of medical examination (χ^2 = 3.64; df=2; p= 0.2).

Table 6.2.8 : Frequency of patients' feelings before the computer interview.

Emotional feelings	**Negative** No. (%)	**Positive** No. (%)	**Total** No. (%)
A vs B vs C			
Style A	56 (73)	21 (27)	77 (100)
Style B	30 (77)	9 (23)	39 (100)
Style C	26 (68)	12 (32)	38 (100)
Total (%)	112 (73)	42 (27)	154 (100)
	χ^2 = 0.7 (df=2)	**p = 0.7**	
A vs BC			
Style A	56 (73)	21 (27)	77 (100)
Styles BC	56 (73)	21 (27)	77 (100)
Total (%)	112 (73)	42 (27)	154 (100)
	χ^2 = 0 (df=1)	**p = 1**	

Table 6.2.9 : Cross-tabulation of patients' feelings before the computer interview and gender, as measured by the Zuckermann Affect Adjective Checklist.

Patients' feelings	Males No. (%)	Females No. (%)	Total No. (%)
Worrying	7 (10)	8 (10)	15 (10)
Panicky	0 (0)	5 (6)	5 (3)
Thoughtful	3 (4)	6 (8)	9 (6)
Calm	8 (11)	2 (3)	10 (6)
Tense	17 (23)	15 (18)	32 (21)
Pleasant	0 (0)	1 (1)	1 (1)
Nervous	21 (28)	22 (27)	43 (27)
Loving	1 (1)	0 (0)	1 (1)
Terrified	1 (1)	2 (3)	3 (2)
Steady	4 (5)	3 (4)	7 (5)
Frightened	2 (3)	7 (9)	9 (6)
Contented	10 (14)	9 (11)	19 (12)
Total (%)	74 (100)	80 (100)	154 (100)

2.7 Patients' HADS scores

Patients' anxiety and depression were measured by using the Hospital Anxiety and Depression Scale (HADS). Higher scores in the two HADS scores indicate that the patient is more anxious or more depressed. One-hundred and fifty-four patients were asked to fill in the HADS questionnaire, before using the computer.

2.7.1 Patients' anxiety scores

Seventy-six patients (49%) who filled in the HADS questionnaire, scored as 'not anxious', 48 patients (31%) scored as 'border-line', and 30 patients (20%) scored as 'anxious' (Table 6.2.10). There was an indication that female patients were likely to be more anxious than male patients (p = 0.02) (Table 6.2.11).

Table 6.2.10 : Frequency of patients' anxiety scores.

Anxiety score	**Not anxious** No. (%)	**Border-line** No. (%)	**Anxious** No. (%)	**Total** No. (%)
A vs B vs C				
Style A	41 (53)	22 (29)	14 (18)	77 (100)
Style B	20 (51)	14 (36)	5 (13)	39 (100)
Style C	15 (39)	12 (32)	11 (29)	38 (100)
Total (%)	76 (49)	48 (31)	30 (20)	154 (100)
	χ^2 = 4.2 (df=4) p = 0.4			
A vs BC				
Style A	41 (53)	22 (29)	14 (18)	77 (100)
Styles BC	35 (45)	26 (34)	16 (21)	77 (100)
Total (%)	76 (49)	48 (31)	30 (20)	154 (100)
	χ^2 = 0.94 (df=2) p = 0.6			

Table 6.2.11 : Cross-tabulation of patients' gender and anxiety score.

	Males No. (%)	**Females** No. (%)	**Total** No. (%)
Anxiety score			
Not anxious	45 (61)	31 (39)	76 (49)
Border-line	18 (24)	30 (38)	48 (31)
Anxious	11 (15)	19 (24)	30 (20)
Total (%)	74 (100)	80 (100)	154 (100)
	χ^2 = 7.5 (df=2) p = 0.02		

Similarly, patients who scored as being 'anxious' were more likely to have had negative feelings (p = 0.0004) (Table 6.2.12). Sixty-five patients (58%) who scored as being 'anxious' or at 'border-line' also had negative emotional feelings.

Table 6.2.12 : Cross-tabulation of patients' emotional feelings (ZAAC) and anxiety scores (HADS).

	Negative feelings No. (%)	Positive feelings No. (%)	Total No. (%)
Anxiety score			
Not anxious	47 (42)	29 (69)	76 (49)
Border-line	35 (31)	13 (31)	48 (31)
Anxious	30 (27)	0 (0)	30 (20)
Total (%)	112 (100)	42 (100)	154 (100)
	$\chi^2 = 16$ (df=2) p = 0.0004		

2.7.2 Patients' depression scores

One-hundred and fifty-four patients were asked to fill in the HADS questionnaire; of these, 127 patients (83%) scored as not being depressed, 19 patients (12%) scored at border-line, and only 8 patients (5%) scored as being depressed (Table 6.2.13). There was a strong association between patients' depression scores and patients' anxiety scores (p=0.0005) (Table 6.2.14). Patients who scored as not being anxious, were more likely to score as not being depressed. Seventy-three patients (47%) who scored as not being anxious, also scored as not being depressed, and 6 patients (4%) who scored as being anxious also scored as being depressed. However, there was no significant association between patients' depression scores (HADS) and patients' emotional feelings (ZAAC) (χ^2 = 3.16 ;

df=1 ; p=0.1). Similarly, there were no significant differences between patients' depression scores and gender (χ^2=0.01 ; df=1 ; p=1).

Table 6.2.13 : Frequency of patients' depression scores.

Depression score	Not depressed No. (%)	Border-line No. (%)	Depressed No. (%)	Total No. (%)
A vs B vs C				
Style A	64 (83)	10 (13)	3 (4)	77 (100)
Style B	34 (87)	5 (13)	0 (0)	39 (100)
Style C	29 (76)	4 (11)	5 (13)	38 (100)
Total (%)	127 (83)	19 (12)	8 (5)	154 (100)
	χ^2 = 1.6 (df=2) p = 0.4			
A vs BC				
Style A	64 (83)	10 (13)	3 (4)	77 (100)
Styles BC	63 (82)	9 (12)	5 (6)	77 (100)
Total (%)	127 (83)	19 (12)	8 (5)	154 (100)
	χ^2 = 0.04 (df=1) p = 0.8			

Table 6.2.14 : Cross-tabulation of patients' anxiety scores and depression scores.

	Depression score			
	Not depressed No. (%)	**Border-line** No. (%)	**Depressed** No. (%)	**Total** No. (%)
Anxiety score				
Not anxious	73 (58)	3 (16)	0 (0)	76 (49)
Border-line	34 (27)	12 (63)	2 (25)	48 (31)
Anxious	20 (16)	4 (21)	6 (75)	30 (20)
Total (%)	127 (100)	19 (100)	8 (100)	154 (100)
	χ^2 = 17 (df=1) p = 0.0005			

3. Use of the computer

3.1 Flexibility in navigation

The system monitored patients' responses, navigation, symptoms, topics chosen and the time spent by each patient using the computer. Patients in style A had no choice but to answer the questions first before they had a chance to ask the computer questions. Patients in styles B and C could move to the information system during the interview. Twenty patients (40%) from style B and 16 patients (32%) from style C chose to move to the information system in order to seek information during the computer interview. There were no significant differences between styles B and C for the proportion of 'movers' ($\chi^2 = 0.69$; df=1; $p = 0.4$). The internal monitor also recorded the number of times the Previous button and the Help button were used by each patient.

Multiple logistic regression analysis was performed to find out which patients' characteristics were significant predictors of seeking information or moving to the information system during the computer interview. Patients' characteristics were defined as independent variables, and these were age, gender, previous computer use, type of medical examination, patients' emotional feelings whether negative or positive, HADS anxiety and depression scores, and interview length. Two variables were found to be significant and these were age ($p = 0.002$) and previous computer use ($p = 0.03$), indicating that older patients who did not use a computer before the randomised study trial were least likely to move to the information system during the computer interview

3.2 Use of the Previous button.

To find out how many patients used the Previous button, patients were asked the following question[5]:

- Did you use the Previous button to go back to re-answer a question?

Besides patients being asked the above question, the computer also recorded and showed in the logs, patients' use of the Previous button. There were no significant differences between patients' use of the Previous button across styles (A vs B vs C) and between styles (A and BC) (Table 6.3.1).

Table 6.3.1 : Frequency of patients' use of the Previous button.

Previous button use	**No** No. (%)	**Yes** No. (%)	**Total** No. (%)
A vs B vs C			
Style A	67 (68)	32 (32)	99 (100)
Style B	29 (59)	20 (41)	49 (100)
Style C	27 (54)	23 (46)	50 (100)
Total (%)	123 (62)	75 (38)	198 (100)
Missing responses = 2		**$\chi^2 = 2.9$ (df=2) p = 2.4**	
A vs BC			
Style A	67 (68)	32 (32)	99 (100)
Styles BC	56 (57)	43 (43)	99 (100)
Total (%)	123 (62)	75 (38)	198 (100)
Missing responses = 2		**$\chi^2 = 2.6$ (df=1) p = 0.1**	

[5] The following question was for patients using the long interview only.

3.3 Previous button ease

To find out how easy it was to use the Previous button, patients were asked the following question[6]:

- If you used the Previous button to re-answer a question, was it easy to do so?

Of the 53 patients (45%)[7] within the long interview who used the Previous button, 40 patients (75%) felt that the Previous button was very easy to use and 13 patients (25%) felt that the Previous button was moderately easy to use.

3.4 Reasons for using the Previous button

To find out why some patients used the Previous button, patients were asked the following question[8]:

- While working with the computer, you did touch the 'Previous' button, then was this because:

  (a) I wanted to re-answer a previous question.

  (b) I wanted to know what the button did.

  (c) I touched the button by mistake.

  (d) I don't know/ I can't remember.

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[6] The following question was for patients using the long interview only.

[7] 45% of the 118 patients who responded to this question.

[8] The following question was for patients using the short interview only.

Of the total of 22 patients (28%)[9] within the short interview who used the Previous button, 21 patients (96%) used the button to re-answer a previous question and one patient (4%) used it by mistake.

3.5 Use of the Help button

To find out how many patients used the Help button, patients were asked the following question[10]:

- Did you use the Help button?

Besides patients being asked the above question, the computer also recorded and showed in the logs patients' use of the Help button. There were no significant differences between patients' use of the Help button and across styles (A vs B vs C) and between styles (A and BC) (Table 6.3.2).

[9] 28% of the 80 patients who used the short computer interview.

[10] The following question was for patients using the long interview only.

Table 6.3.2 : Frequency of patients' use of the Help button.

Help button use	No No. (%)	Yes No. (%)	Total No. (%)
A vs B vs C			
Style A	89 (90)	10 (10)	99 (100)
Style B	43 (88)	6 (12)	49 (100)
Style C	47 (94)	3 (6)	50 (100)
Total (%)	179 (90)	19 (10)	198 (100)
Missing responses = 2		**χ^2 = 1.2 (df=2) p = 0.6**	
A vs BC			
Style A	89 (90)	10 (10)	99 (100)
Styles BC	90 (91)	9 (9)	99 (100)
Total (%)	179 (90)	19 (10)	198 (100)
Missing responses = 2		**χ^2 = 0.06 (df=1) p = 0.8**	

3.6 Help button usefulness

To find out patients' feelings of how helpful the Help button was, patients were asked the following question[11]:

- If you used the Help button, was the information provided helpful?

Of the 14 patients (12%)[12] who used the Help button, 9 patients (64%) felt that the button was 'very helpful', 4 patients (29%) felt that it was 'moderately helpful' and one patient (7%) felt that it was 'not very helpful'.

[11] The following question was for patients using the long interview only.

[12] 12% of the 118 patients who responded to this question as having used the help button.

3.7 Reasons for using the Help button

To find out why patients used the Help button, they were asked the following question[13]:

- While working with the computer, you did touch the Help button, then was this because:

  (a) I wanted to get help.

  (b) I wanted to know what the button did.

  (c) I touched the button by mistake.

  (d) I don't know/ I can't remember.

Of the 5 patients (6%)[14] who used the Help button (short interview only), 3 patients (60%) used the button to get help, 1 patient (20%) wanted to know what it did, and 1 patient (20%) used it by mistake.

3.8 Ease in moving to the information system

To find out how easy it was to move to the information system, patients were asked the following question:

- Was it easy to move from the interview to the information system?

---

[13] The following question was for patients using the short interview only.

[14] 6% of the 80 patients who used the short computer interview.

One-hundred and ninety-eight patients responded to the above question. All respondents felt that it was either, 'very easy' or 'moderately easy' to move from the interview to the information system (Table 6.3.3).

Table 6.3.3 : Frequency of patients' ease in moving from the GLADYS computer interview to the information system.

Move to information system ease	**Not at all** No. (%)	**Not very easy** No. (%)	**Moderately easy** No. (%)	**Very easy** No. (%)	**Total** No. (%)
A vs B vs C					
Style A	0 (0)	2 (2)	20 (20)	78 (78)	100 (100)
Style B	0 (0)	0 (0)	8 (16)	41 (84)	49 (100)
Style C	0 (0)	0 (0)	8 (16)	41 (84)	49 (100)
Total (%)	0 (0)	2 (1)	36 (18)	160 (81)	198 (100)
Missing responses = 2				**$\chi^2 = 1$ (df=2)**	**p = 0.6**
A vs BC					
Style A	0 (0)	2 (2)	20 (20)	78 (78)	100 (100)
Styles BC	0 (0)	0 (0)	16 (16)	82 (84)	98 (100)
Total (%)	0 (0)	2 (1)	36 (18)	160 (81)	198 (100)
Missing responses = 2				**$\chi^2 = 1$ (df=1)**	**p = 0.3**

3.9 Ease in moving back to the interview

To find out how easy it was to move from the information system back to the interview, patients were asked the following question[15]:

- Was it easy to move back from the information system to the interview?

[15] The following question was applicable only to patients within styles B and C who moved to the information system during the interview.

Of the 36 patients who were 'movers', 30 patients (83%) felt that moving back to the interview was 'very easy', and 5 patients (14%) felt that it was 'moderately easy' (Table 6.3.4). There were no significant differences between patients' feelings about the ease of moving back, and patients within styles B and C who moved to the information system during the interview.

Table 6.3.4 : Frequency of patients' ease in moving from the information system back to the GLADYS computer interview.

Move to information system ease	Not at all No. (%)	Not very easy No. (%)	Moderately easy No. (%)	Very easy No. (%)	Total No. (%)
Movers					
Style B	0 (0)	1 (5)	2 (10)	17 (85)	20 (100)
Style C	0 (0)	0 (0)	3 (19)	13 (81)	16 (100)
Total (%)	0 (0)	1 (3)	5 (14)	30 (83)	36 (100)
Not applicable = 64[16]				$\chi^2 = 0.09$ (df=1)	$p = 0.7$

[16] Not applicable to the 64 patients who did not move to the information system during the Gladys interview.

3.10 Time spent by patients using the computer

6.4 Time

The time allocated for the study trials for each patient depended on several factors:

- computer interview length (whether short or long)
- patient's interest in the computer system
- patient's responses to the computer interview
- patient's age and computer literacy

To find out how long it took for each patient to use the computer, the researcher used the computer's internal monitor. The computer recorded the starting time and the finishing time. Similarly, the computer recorded the time when the GLADYS information system was accessed, and the time when it was left. From these figures, the time spent in the GLADYS interview and the time spent (in minutes) in the information system were calculated manually by the researcher for each patient. The total time patients spent for using the computer program and filling in the questionnaires varied from 20 to 40 minutes.

There was a significant difference between the total computer time spent by patients who used the long interview and those who used the short interview, (mean scores 24.6 minutes for long interview vs 18.3 minutes for short interview, t= 22.4, p=0.001). There was also a significant difference in the GLADYS interview time spent by patients, for patients who used the long interview and those who used the short interview (mean scores 19.2 minutes for long interview vs 12.3 minutes for short interview, t =27.7, p<0.001). Furthermore, there was an indication that patients who used the short interview were more likely to spent more time in the information system than those who used the long interview (mean scores 5.4 minutes for the long interview vs 6 minutes for the short interview, t = -2.5, p=0.01).

The mean time spent by patients to use the on-line questionnaire was 5.7 (SD=1.0) minutes. The mean time for patients of style A to use the on-line questionnaire was 5.6 minutes, and the mean time for patients of the combined styles B and C to use the on-line questionnaire was 5.7 minutes. There were no significant differences between patients in between styles (A and BC) and the time spent using the on-line questionnaire (t=0.51, p = 0.6).

Table 6.3.5, represents patients' mean time using the computer for patients across styles (A vs B vs C) and between styles (A and BC) for the long interview. There were no significant differences between the time spent in the GLADYS interview, the time spent in the information system, and the total computer time spent by patients, across styles (A vs B vs C) and between styles (A and BC). Similarly, Table 6.3.6 represents patients' mean time using the computer for patients across styles (A vs B vs C) and between styles (A and BC), for the short interview. There were no significant differences between the time spent in the interview, the time spent in the information system, and the total computer time, across styles (A vs B vs C) and between styles (A and BC).

Table 6.3.5 : Patients' mean time in minutes spent when using the computer, for patients using the long GLADYS interview.

Average time spent on the computer	**Interview time** Mean (SD)	**Information system time** Mean (SD)	**Total computer time** Mean (SD)	**Total Patients** n.
A vs B vs C				
Style A	19.3 (2.4)	5.5 (1.5)	24.8 (2.4)	59
Style B	18.6 (2.3)	5.5 (1.8)	24.3 (2)	30
Style C	19.5 (2.5)	5.1 (1.4)	24.7 (2.2)	31
Total time	19.2 (2.4)	5.4 (1.5)	24.6 (2.3)	120
F, p	**1.6, 0.3**	**0.90, 0.4**	**0.47, 0.6**	
A vs BC				
Style A	19.3 (2.4)	5.5 (1.5)	24.8 (2.4)	59
Styles BC	19.1 (2.4)	5.3 (1.6)	24.5 (2.1)	61
Total time	19.2 (2.4)	5.4 (1.5)	24.6 (2.3)	120
***t*, p**	**0.39, 0.7**	**0.76, 0.4**	**0.77, 0.4**	

Table 6.3.6 : Patients' mean time in minutes spent when using the computer, for patients using the short GLADYS interview.

Average time spent using the computer	**Interview time** Mean (SD)	**Information system time** Mean (SD)	**Total computer time** Mean (SD)	**Total Patients** n.
A vs B vs C				
Style A	12.3 (1.0)	6 (1.5)	18.4 (1.5)	41
Style B	12.2 (1.1)	5.7 (1.9)	17.9 (1.8)	20
Style C	12.3 (0.9)	6.3 (1.7)	18.7 (1.9)	19
Total (%)	12.3 (1)	6 (1.7)	18.3 (1.7)	80
F, p	**0.14, 0.9**	**0.80, 0.5**	**1.1, 0.3**	
A vs BC				
Style A	12.3 (1)	6 (1.5)	18.4 (1.5)	41
Styles BC	12.3 (1)	6 (1.8)	18.3 (1.9)	39
Total (%)	12.3 (1)	6 (1.7)	18.3 (1.7)	80
***t*, p**	**0.38, 0.7**	**0.07, 0.9**	**0.29, 0.8**	

4 General Reactions of Patients

4.1 Patients' use of the computer

To find out patients' feelings about how easy it was to use the computer, they were asked the following question:

- How easy was it for you to use the computer?

One hundred and twenty patients (60%) felt that the computer was 'very easy' to use, and 62 (31%) felt that it was 'moderately easy' (Table 6.4.1).

Table 6.4.1 : Frequency of patients' ease in computer use

Computer ease	**Not at all** No. (%)	**Not very easy** No. (%)	**Moderately easy** No. (%)	**Very easy** No. (%)	**Total** No. (%)
A vs B vs C					
Style A	1 (1)	9 (9)	26 (26)	64 (64)	100 (100)
Style B	0 (0)	3 (6)	17 (34)	30 (60)	50 (100)
Style C	1 (2)	4 (8)	19 (38)	26 (52)	50 (100)
Total (%)	2 (1)	16 (8)	62 (31)	120 (60)	200 (100)
		$\chi^2=2$ (df=2) $p = 0.3$			
A vs BC					
Style A	1 (1)	9 (9)	26 (26)	64 (64)	100 (100)
Styles BC	1 (1)	7 (7)	36 (36)	56 (56)	100 (100)
Total (%)	2 (1)	16 (8)	62 (31)	120 (60)	200 (100)
		$\chi^2 = 1.3$ (df=1) $p = 0.2$			

Multiple logistic regression analysis was performed to find out which patients' characteristics were significant predictors of ease in computer use. Patients' characteristics were defined as independent variables, and these were age, gender, previous computer use, type of medical examination, patients' emotional feelings whether negative or positive, HADS anxiety and depression scores, and type of interview length. 'Computer ease' was defined as a dependent variable, and these were categorical data of four options; 'very easy', 'moderately easy', 'not very easy', and 'not at all'. These were collapsed into two options of 'very easy' and 'not very easy', so as to fit the dichotomous requirement of a dependent variable for logistic regression. Two variables were found to be significant and these were age ($p<0.0001$) and gender ($p = 0.002$). Older patients who were females scored the least in 'computer ease', indicating that they were more likely to feel that the computer was not very easy to use.

4.2 Ease of Input device used by patients.

To find out which input device was used by the patients to interact with the computer, patients were asked the following questions:

- Did you use the touch screen?
- Did you use the mouse?

One-hundred and seventy-six patients (88%) used the touch screen, and 24 (12%) used the mouse (Table 6.4.2). Cross-tabulations between patients' use of the touch screen across styles (A vs B vs C) and between styles (A and BC) showed no significant difference.

Table 6.4.2 : Frequency of patients' touch screen use

Touch screen vs mouse	**Touch screen** No. (%)	**Mouse** No. (%)	**Total** No. (%)
A vs B vs C			
Style A	89 (89)	11 (11)	100 (100)
Style B	42 (84)	8 (16)	50 (100)
Style C	45 (90)	5 (10)	50 (100)
Total (%)	176 (88)	24 (12)	200 (100)
	$\chi^2 = 1$ (df=2) $p = 0.6$		
A vs BC			
Style A	89 (89)	11 (11)	100 (100)
Styles BC	87 (87)	13 (13)	100 (100)
Total (%)	176 (88)	24 (12)	200 (100)
	$\chi^2 = 0.19$ (df=1) $p = 0.7$		

4.3 Touch screen ease

To find out how easy it was to use the input device, patients were asked the following questions:

- If you used the touch screen, was it easy to use?
- If you used the mouse, was it easy to use?

Of the 176 patients who used the touch screen, 132 patients (75%) felt that the touch screen was 'very easy' to use, and 41 (23%) felt that it was 'moderately easy' (Table 6.4.3); while 100% of the 24 patients who used the mouse felt that the mouse was 'very easy' to use. Of these 24 patients, 14 used a computer daily and the other ten used computers frequently.

Table 6.4.3 : Frequency of patients' ease in touch screen use

Touch screen ease	Not at all No. (%)	Not very easy No. (%)	Moderately easy No. (%)	Very easy No. (%)	Total No. (%)
A vs B vs C					
Style A	0 (0)	1 (1)	25 (28)	63 (71)	89 (100)
Style B	0 (0)	0 (0)	9 (21)	33 (79)	42 (100)
Style C	0 (0)	2 (4)	7 (16)	36 (80)	45 (100)
Total (%)	0 (0)	3 (2)	41 (23)	132 (75)	176 (100)
Not applicable = 24[17]				χ^2=1.7 (df=2)	p = 0.4
A vs BC					
Style A	0 (0)	1 (1)	25 (28)	63 (71)	89 (100)
Styles BC	0 (0)	2 (2)	16 (19)	69 (79)	87 (100)
Total (%)	0 (0)	3 (2)	41 (23)	132 (75)	176 (100)
Not applicable = 24[18]				χ^2=1.7 (df=1)	p = 0.2

4.4 Ease in selecting a topic

To find out how easy it was to select a topic in the GLADYS information system, patients were asked the following question:

- Was it easy to select a topic from the 'GLADYS' information system's menu?

One-hundred and ninety-six patients responded to the above question. Of these, 154 patients (79%) felt that selecting a topic was 'very easy', and 40 patients (20%) felt that it was 'moderately easy' (Table 6.4.4).

[17] Not applicable to the 24 patients who used the mouse.

[18] Same as 17.

Table 6.4.4 : Frequency of patients' ease in selecting a topic

Touch screen ease	Not at all No. (%)	Not very easy No. (%)	Moderately easy No. (%)	Very easy No. (%)	Total No. (%)
A vs B vs C					
Style A	0 (0)	2 (2)	18 (18)	79 (80)	99 (100)
Style B	0 (0)	0 (0)	14 (29)	35 (71)	49 (100)
Style C	0 (0)	0 (0)	8 (17)	40 (83)	48 (100)
Total (%)	0 (0)	2 (1)	40 (20)	154 (79)	196 (100)
Missing responses = 4				**χ^2=2.2 (df=2)**	**p = 0.3**
A vs BC					
Style A	0 (0)	2 (2)	18 (18)	79 (80)	99 (100)
Styles BC	0 (0)	0 (0)	22 (23)	75 (77)	97 (100)
Total (%)	0 (0)	2 (1)	40 (20)	154 (79)	196 (100)
Missing responses = 4				**χ^2=0.2 (df=1)**	**p = 0.6**

Multiple logistic regression analysis was performed to find out which patients' characteristics were significant predictors of patients' perceptions of the ease in selecting a topic. Two variables were found to be significant and these were age (p=0.0006) and emotional feelings (p = 0.002). Older patients who felt negative scored the least in the 'ease in selecting a topic', indicating that they were more likely to feel that selecting a topic was not very easy.

4.5 Ease of use scores

Table 6.4.5 shows the mean scores with standard deviations of ease of use[19] for patients across styles (A vs B vs C) and between styles (A and BC). There was no

[19] Definition on page 189, section 7.3 in chapter IV.

significant difference in patients' ease of use scores between patients across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.5 : Patients' mean ease of use scores (the higher mean scores indicate a better performance, minimum=1, maximum=4)

Ease of use	Average	SD	n
A vs B vs C			
Style A	3.67	0.44	100
Style B	3.68	0.39	50
Style C	3.65	0.42	50
	F = 0.08 , p = 0.9		
A vs BC			
Style A	3.67	0.44	100
Styles BC	3.66	0.41	100
	***t* = 0.19, p = 0.8**		

4.6 Clarity of computer instructions

To find out how clear (easily understood) the computer instructions were, patients were asked the following question:

- Were the instructions on the screen clear (easily understood)?

Of the 197 patients who replied, 148 patients (75%) felt that the computer instructions were clear 'all the time', and 47 (24%) felt that they were clear 'most of the time' (Table 6.4.6).

Table 6.4.6 : Frequency of patients' perceptions of the clarity of the computer instructions

Clarity of instructions	Not at all No. (%)	Some of the time No. (%)	Most of the time No. (%)	All of the time No. (%)	Total No. (%)
A vs B vs C					
Style A	0 (0)	0 (0)	23 (23)	76 (77)	99 (100)
Style B	0 (0)	2 (4)	12 (25)	34 (71)	48 (100)
Style C	0 (0)	0 (0)	12 (24)	38 (76)	50 (100)
Total (%)	0 (0)	2 (1)	47 (24)	148 (75)	197 (100)
Missing responses = 3				**χ^2=0.6 (df=2)**	**p = 0.7**
A vs BC					
Style A	0 (0)	0 (0)	23 (23)	76 (77)	99 (100)
Styles BC	0 (0)	2 (2)	24 (24)	72 (74)	98 (100)
Total (%)	0 (0)	2 (1)	47 (24)	148 (75)	197 (100)
Missing responses = 3				**χ^2=0.3 (df=1)**	**p = 0.6**

Multiple logistic regression analysis was performed to find out which patients' characteristics were significant predictors of clarity of computer instructions. One variable was found to be significant and this was age (p=0.001). Older patients scored the least in the 'clarity of computer instructions', indicating that they were more likely to feel that the computer instructions were not very clear.

4.7 Clarity of computer instructions scores

Table 6.4.7 shows the mean scores with standard deviations of patients' perception of the clarity of the computer instructions for patients across styles (A vs B vs C) and between styles (A and BC). There were no significant differences between patients' perception of the clarity of computer instructions scores across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.7 : Patients' mean perception of the clarity of computer instructions scores (the higher mean scores indicate better clarity of instructions) minimum=1, maximum=4)

Clarity of instructions	Average	SD	n
A vs B vs C			
Style A	3.77	0.42	100
Style B	3.67	0.56	50
Style C	3.76	0.43	50
	F = 0.83 , p = 0.4		
A vs BC			
Style A	3.77	0.42	100
Styles BC	3.71	0.50	100
	***t* = 0.81, p = 0.4**		

4.8 Feelings of confusion

To find out how many patients felt confused when using the computer, patients were asked the following question:

- Did you feel confused while working with the computer ?

Of the 199 respondents, 137 patients (69%) were not confused, and 62 (31%) were confused (Table 6.4.8). Cross-tabulations showed no significant difference between patients' feelings of confusion across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.8 : Frequency of patients' perceptions of confusion when using the computer

Confused	No No. (%)	Yes No. (%)	Total No. (%)
A vs B vs C			
Style A	73 (74)	26 (26)	99 (100)
Style B	34 (68)	16 (32)	50 (100)
Style C	30 (60)	20 (40)	50 (100)
Total (%)	137 (69)	62 (31)	199 (100)
Missing responses = 1		**$\chi^2 = 3.0$ (df=2) p = 0.3**	
A vs BC			
Style A	73 (74)	26 (26)	99 (100)
Styles BC	64 (64)	36 (36)	100 (100)
Total (%)	137 (69)	62 (31)	199 (100)
Missing responses = 1		**$\chi^2 = 2.2$ (df=1) p = 0.1**	

Multiple logistic regression analysis was performed to find out which patients' characteristics were significant predictors of feelings of confusion. Three variables were found to be significant predictors; age ($p<0.0001$), interview length ($p=0.04$), and patients' previous computer use ($p=0.03$). Older patients with no previous computer use and using the long GLADYS interview were more likely to be confused.

4.9 How often did patients feel confused when using the computer?

To find out how often patients felt confused, they were asked the following question[20]:

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[20] This question was only for patients who felt that they were confused while interacting with the computer.

- If you felt confused while working with the computer, was this 'only occasionally', 'some of the time' ...... :

Of the 62 patients who reported to be confused, 56 patients (90%) reported to be confused either 'only occasionally' or 'some of the time' (Table 6.4.9).

Table 6.4.9 : Frequency of how often patients felt confused when using the computer

Confusion time	**Only occa-sionally** No. (%)	**Some of the time** No. (%)	**Most of the time** No. (%)	**All of the time** No. (%)	**Total** No. (%)
A vs B vs C					
Style A	12 (46)	12 (46)	2 (8)	0 (0)	26 (100)
Style B	9 (56)	5 (31)	2 (13)	0 (0)	16 (100)
Style C	12 (60)	6 (30)	1 (5)	1 (5)	20 (100)
Total (%)	33 (53)	23 (37)	5 (8)	1 (2)	62 (100)
Not applicable = 138[21]				**χ^2=0.94 (df=2)**	**p = 0.6**
A vs BC					
Style A	12 (46)	12 (46)	2 (8)	0 (0)	26 (100)
Styles BC	21 (58)	11 (31)	3 (8)	1 (3)	36 (100)
Total (%)	33 (53)	23 (37)	5 (8)	1 (2)	62 (100)
Not applicable = 138[22]				**χ^2=0.89 (df=1)**	**p = 0.3**

[21] Not applicable to the 138 patients who were not confused.

[22] Same as 21.

4.10 Patients' feelings of no control or not knowing what to do next, when using the computer.

To find out patients' feelings of no control, they were asked the following question:

- While working with the computer, did you feel at some stage that you did not know what to do next ?

Of the 199 respondents, 121 patients (61%) knew what to do next at all stages, however, 78 patients (39%) did not know what to do next, at some stage (Table 6.4.10). Cross-tabulations between not knowing what to do next across styles (A vs B vs C) and between styles (A and BC) showed no significant difference.

Table 6.4.10 : Frequency of patients' perceptions of not knowing what to do next, when using the computer

Confused	**No** No. (%)	**Yes** No. (%)	**Total** No. (%)
A vs B vs C			
Style A	65 (66)	34 (34)	99 (100)
Style B	30 (60)	20 (40)	50 (100)
Style C	26 (52)	24 (48)	50 (100)
Total (%)	121 (61)	78 (39)	199 (100)
Missing responses = 1		**χ^2 = 2.6 (df=2)**	**p = 0.3**
A vs BC			
Style A	65 (66)	34 (34)	99 (100)
Styles BC	56 (56)	44 (44)	100 (100)
Total (%)	121 (61)	78 (39)	1 99 (100)
Missing responses = 1		**χ^2 = 2 (df=1)**	**p = 0.2**

4.11 How often did patients not know what to do next, when using the computer?

To find out the frequency of patients' feelings of not knowing what to do next, when using the computer, they were asked the following question[23]:

- If you felt at some stage you did not know what to do next, then was this 'only occasionally', 'some of the time' ...... :

Of the 78 patients who reported not to have known what to do next, 35 patients (45%) reported 'only occasionally', while 39 patients (50%) reported 'some of the time' (Table 6.4.11).

Table 6.4.11 : Frequency of patients' perceptions of how often they felt 'not knowing what to do next', when using the computer

Confusion stage time	**Only occa-sionally** No. (%)	**Some of the time** No. (%)	**Most of the time** No. (%)	**All of the time** No. (%)	**Total** No. (%)
A vs B vs C					
Style A	16 (47)	16 (47)	2 (6)	0 (0)	34 (100)
Style B	9 (45)	9 (45)	2 (10)	0 (0)	20 (100)
Style C	10 (42)	14 (58)	0 (0)	0 (0)	24 (100)
Total (%)	35 (45)	39 (50)	4 (5)	0 (0)	78 (100)
Not applicable = 122[24]				**χ^2=0.16 (df=2)**	**p = 0.9**
A vs BC					
Style A	16 (47)	16 (47)	2 (6)	0 (0)	34 (100)
Styles BC	19 (43)	23 (52)	2 (5)	0 (0)	44 (100)
Total (%)	35 (45)	39 (50)	4 (5)	0 (0)	78 (100)
Not applicable = 122[25]				**χ^2=0.12 (df=1)**	**p = 0.7**

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[23] This question was only for patients who felt that they were lost at some stage while interacting with the computer.

[24] Not applicable to the 122 patients who knew what to next at all times.

[25] Same as 24.

4.12 Patients' feelings of confusion and no control scores

Table 6.4.12 shows the mean scores with standard deviations of feelings of confusion and no control[26] for patients across styles (A vs B vs C) and between styles (A and BC). There were no significant differences between feelings of confusion and no control scores across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.12 : Patients' mean confusion and mean no control scores (the higher mean scores indicate less confusion and more control) minimum=1, maximum=2

Confusion & no control	Average	SD	n
A vs B vs C			
Style A	1.74	0.44	100
Style B	1.68	0.47	50
Style C	1.60	0.49	50
	F = 1.5 , P = 0.2		
A vs BC			
Style A	1.74	0.44	100
Styles BC	1.64	0.48	100
	t = 1.5, p = 0.1		

[26] Definition on page 190, section 7.5 in chapter IV.

4.13 Feelings of comfort in computer interviewing

To find out patients' feelings of comfort while being interviewed by the computer, patients were asked the following question:

- Did you find being interviewed by the computer comfortable ?

One-hundred and ninety-eight patients responded to the above question. Of these respondents, 190 patients (96%) reported either to be 'very comfortable' or 'moderately comfortable' (Table 6.4.13).

Table 6.4.13 : Frequency of patients' feelings of comfort when being interviewed by the computer.

Computer comfort	**Not at all** No. (%)	**Not very comfortable** No. (%)	**Moderately comfortable** No. (%)	**Very comfortable** No. (%)	**Total** No. (%)
A vs B vs C					
Style A	0 (0)	3 (3)	24 (25)	71 (72)	98 (100)
Style B	0 (0)	4 (8)	7 (14)	39 (78)	50 (100)
Style C	0 (0)	1 (2)	11 (22)	38 (76)	50 (100)
Total (%)	0 (0)	8 (4)	42 (21)	148 (75)	198 (100)
Missing responses = 2				**χ^2=0.59 (df=2)**	**p = 0.7**
A vs BC					
Style A	0 (0)	3 (3)	24 (25)	71 (72)	98 (100)
Styles BC	0 (0)	5 (5)	18 (18)	77 (77)	100 (100)
Total (%)	0 (0)	8 (4)	42 (21)	148 (75)	198 (100)
Missing responses = 2				**χ^2=0.54 (df=1)**	**p = 0.5**

Multiple logistic regression analysis was performed to find out which variables predict patients' feelings of comfort when being interviewed by the computer. The only significant predictor for 'patients' comfort' was found to be age (p=0.001). Older patients scored the least, indicating that they were less likely to feel very comfortable when being interviewed by the computer.

4.14 Feelings of embarrassment when being interviewed by the doctor

To find out patients' feelings of embarrassment when being interviewed by the doctor, patients were asked the following question:

- Do you find being interviewed by the doctor about your present illness embarrassing?

Of the 197 respondents, 169 patients (86%) felt 'not at all' or 'not very' embarrassed when being interviewed by the doctor, and 28 (14%) felt 'moderately' or 'very' embarrassed (Table 6.4.14). Cross-tabulations between patients' perceived feelings of embarrassment when being interviewed by the doctor across styles (A vs B vs C) and between styles (A and BC) showed no significant difference. However, there was an indication that patients who were waiting for a colonoscopy examination were likely to feel more embarrassed when being interviewed by the doctor than patients waiting for an endoscopy examination or a breath test (p=0.03). (Table 6.4.15).

Table 6.4.14: Frequency of patients' feelings of embarrassment when being interviewed by the doctor.

Patient-Doctor embarrassment	Not at all No. (%)	Not very embarrassing No. (%)	Moderately embarrassing No. (%)	Very embarrassing No. (%)	Total No. (%)
A vs B vs C					
Style A	57 (59)	25 (26)	14 (14)	1 (1)	97 (100)
Style B	30 (60)	14 (28)	6 (12)	0 (0)	50 (100)
Style C	31 (62)	12 (24)	6 (12)	1 (2)	50 (100)
Total (%)	118 (60)	51 (26)	26 (13)	2 (1)	197 (100)
Missing responses = 3				**χ^2 = 0.14 (df=2)**	**p = 0.9**
A vs BC					
Style A	57 (59)	25 (26)	14 (14)	1 (1)	97 (100)
Styles BC	61 (61)	26 (26)	12 (12)	1 (1)	100 (100)
Total (%)	118 (60)	51 (26)	26 (13)	2 (1)	197 (100)
Missing responses = 4				**χ^2 = 0.10 (df=1)**	**p = 0.7**

Table 6.4.15 : Cross-tabulation of patients' feelings of embarrassment when being interviewed by the doctor, and the type of medical examination.

Doctor Embarrassment	Breath test No. (%)	Colonoscopy No. (%)	Endoscopy No. (%)	Total No. (%)
Very embarrassing	0 (0)	2 (3)	0 (0)	2 (1)
Moderately embarrassing	1 (6)	12 (21)	13 (11)	26 (13)
Not very embarrassing	2 (13)	16 (28)	33 (27)	51 (26)
Not at all	13 (81)	28 (48)	77 (63)	118 (60)
Total (%)	16 (8)	59 (30)	125 (63)	200 (100)

χ^2 = 6.7 (df=2) p = 0.03

4.15 Feelings of embarrassment when being interviewed by the computer

To find out patients' feelings of embarrassment when being interviewed by the computer, patients were asked the following question:

- Do you find being interviewed by the computer about your present illness embarrassing?

Of the 197 respondents, 195 patients (99%) felt 'not at all' or 'not very' embarrassed when being interviewed by the computer, and only 2 patients (1%) felt 'moderately' embarrassed (Table 6.4.16).

Table 6.4.16 : Frequency of patients' feelings of embarrassment when being interviewed by the computer

Patient-Computer embarrassment	Not at all No. (%)	Not very embarrassing No. (%)	Moderately embarrassing No. (%)	Very embarrassing No. (%)	Total No. (%)
A vs B vs C					
Style A	79 (81)	16 (17)	2 (2)	0 (0)	97 (100)
Style B	40 (80)	10 (20)	0 (0)	0 (0)	50 (100)
Style C	39 (78)	11 (22)	0 (0)	0 (0)	50 (100)
Total (%)	158 (80)	37 (19)	2 (1)	0 (0)	197 (100)
Missing responses = 3				**χ^2 =0.25 (df=2)**	**p = 0.8**
A vs BC					
Style A	79 (81)	16 (17)	2 (2)	0 (0)	97 (100)
Styles BC	79 (79)	21 (21)	0 (0)	0 (0)	100 (100)
Total (%)	158 (80)	37 (19)	2 (1)	0 (0)	197 (100)
Missing responses = 3				**χ^2 =0.19 (df=1)**	**p = 0.6**

Seventy-nine patients (40%) reported some degree of embarrassment when being interviewed by the doctor, compared to 39 patients (20%) who reported some degree of embarrassment when being interviewed by the computer (Table 6.4.17). Cross-tabulations of 'doctor embarrassment' with 'computer embarrassment' showed a significant association (p<0.00001).

Table 6.4.17 : Cross-tabulation of patients' perceived feelings of doctor embarrassment and computer embarrassment.

	Doctor embarrassment				
	Very embarr*[27] No. (%)	Moderately embarr* No. (%)	Not very embarr* No. (%)	Not at all No. (%)	Total No. (%)
Computer embarrassment					
Very embarrassing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Moderately embarrassing	0 (0)	1 (4)	0 (0)	1 (1)	2 (1)
Not very embarrassing	0 (0)	16 (62)	21 (41)	0 (0)	37 (19)
Not at all	2 (100)	9 (35)	30 (59)	117 (99)	158 (80)
Total (%)	2 (1)	26 (13)	51 (26)	118 (60)	197 (100)

χ^2=66 (df=1) p < 0.00001

[27] embarrassing

4.16 Patients' feelings of well-being scores

Table 6.4.18 shows the mean scores with standard deviations of feelings of well-being[28] for patients across styles (A vs B vs C) and between styles (A and BC). There were no significant differences between feelings of well-being across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.18 : Patients' mean feelings of well-being scores (the higher mean scores indicate more comfort and less embarrassment, minimum=1, maximum=4)

Feelings of well-being	Average	SD	Total
A vs B vs C			
Style A	3.74	0.37	100
Style B	3.75	0.41	50
Style C	3.76	0.38	50
	F = 0.03 , P = 0.9		
A vs BC			
Style A	3.74	0.37	100
Styles BC	3.76	0.39	100
	t = -0.23, p = 0.8		

[28] Definition on page 191, section 7.6 in chapter IV.

4.17 Usability scores

Table 6.4.19 shows the mean scores with standard deviations of usability[29] for patients across styles (A vs B vs C) and between styles (A and BC). There were no significant differences between patients' usability scores across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.19 : Patients' mean usability scores (the higher mean scores indicate better performance, minimum=1, maximum=4)

Usability	Average	SD	n
A vs B vs C			
Style A	3.21	0.33	100
Style B	3.18	0.32	50
Style C	3.17	0.32	50
	F = 0.24 , P = 0.8		
A vs BC			
Style A	3.21	0.33	100
Styles BC	3.18	0.32	100
	***t* = 0.66, p = 0.5**		

[29] Definition on page 187, section 7.2 in chapter IV.

4.18 Loss of interest

To find out the degree of loss of interest felt by patients while working with the computer, patients were asked the following question:

- While working with the computer, did you lose interest in it ?

One-hundred and ninety-eight patients responded to the above question. Of these respondents, 146 patients (74%) did not loss interest at all while working with the computer, 19 patients (9%) felt they lost interest 'not often', 31 patients (16%) 'sometimes' lost interest and only 2 patients (1%) lost interest 'many times' (Table 6.4.20). Cross-tabulations between patients' loss of interest across styles (A vs B vs C) and between styles (A and BC) showed no significant difference.

Table 6.4.20: Frequency of patients' loss of interest when using the computer

Loss of Interest	Not at all	Not often	Sometimes	Many times	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
A vs B vs C					
Style A	71 (71)	10 (10)	17 (17)	1 (1)	99 (100)
Style B	37 (76)	3 (6)	8 (16)	1 (2)	49 (100)
Style C	38 (76)	6 (12)	6 (12)	0 (0)	50 (100)
Total (%)	146 (74)	19 (9)	31 (16)	2 (1)	198 (100)
Missing responses = 2				$\chi^2 = 0.42$ (df=2)	p = 0.8
A vs BC					
Style A	71 (71)	10 (10)	17 (17)	1 (1)	99 (100)
Styles BC	75 (76)	9 (9)	14 (14)	1 (1)	99 (100)
Total (%)	146 (74)	19 (9)	31 (16)	2 (1)	198 (100)
Missing responses = 2				$\chi^2 = 0.41$ (df=1)	p = 0.5

Multiple logistic regression analysis was performed to find out which variables predicted patients' loss of interest. One variable was found to be significant and this was age (p=0.01). Older patients scored the least in 'loss of interest', indicating that they were more likely to feel that they lost interest while interacting with the computer.

Table 6.4.21 shows the mean scores with standard deviations of loss of interest for patients across styles (A vs B vs C) and between styles (A and BC). There were no significant differences between loss of interest across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.21 : Patients' mean loss of interest scores (the higher mean scores indicate more interest, minimum=1, maximum=4)

Interest	Average	SD	n
A vs B vs C			
Style A	3.53	0.81	100
Style B	3.55	0.84	50
Style C	3.64	0.69	50
	F = 0.35 , P = 0.7		
A vs BC			
Style A	3.53	0.81	100
Styles BC	3.60	0.77	100
	***t* = -0.63, p = 0.5**		

4.19 Patients' perceptions on the usefulness of images

To find out about patients' feelings on the usefulness of the images used in the computer, they were asked the following question:

- How useful were the images and graphics on the computer?

Of the 197 respondents, 186 patients (94%) felt that the images were either 'very useful' or 'moderately useful' when working with the computer, and 11 patients (6%) felt that the images were either 'not very useful', or 'not at all useful' (Table 6.4.22).

Table 6.4.22 : Frequency of patients' perception of the usefulness of images in the computer system.

Images usefulness	**Not at all** No. (%)	**Not very useful** No. (%)	**Moderately useful** No. (%)	**Very useful** No. (%)	**Total** No. (%)
A vs B vs C					
Style A	2 (2)	4 (4)	24 (24)	69 (70)	99 (100)
Style B	0 (0)	2 (4)	14 (29)	32 (67)	48 (100)
Style C	0 (0)	3 (6)	14 (28)	33 (66)	50 (100)
Total (%)	2 (1)	9 (5)	52 (26)	134 (68)	197 (100)
Missing responses = 3				$\chi^2 = 0.26$ (df=2)	p = 0.8
A vs BC					
Style A	2 (2)	4 (4)	24 (24)	69 (70)	99 (100)
Styles BC	0 (0)	5 (5)	28 (29)	65 (66)	98 (100)
Total (%)	2 (1)	9 (5)	52 (26)	134 (68)	197 (100)
Missing responses = 3				$\chi^2 = 0.25$ (df=1)	p = 0.6

4.20 Patients' perception of the usefulness of the information

To find out the patients' perception of the usefulness of the information provided by the GLADYS information system, patients were asked the following question:

- How useful was the information of the medical terms and health issues in the GLADYS information system?

Of the 197 who responded, 189 patients (95%) felt that the information was either 'very' or 'moderately' useful, and 8 patients (5%) felt that the information were either 'not very' or 'not at all' useful (Table 6.4.23).

Table 6.4.23 : Frequency of patients' perceptions of the usefulness of the information provided by the computer system.

Information usefulness	Not at all No. (%)	Not very useful No. (%)	Moderately useful No. (%)	Very useful No. (%)	Total No. (%)
A vs B vs C					
Style A	1 (1)	3 (3)	31 (31)	64 (65)	99 (100)
Style B	0 (0)	1 (2)	16 (33)	32 (65)	49 (100)
Style C	0 (0)	3 (6)	9 (18)	37 (76)	49 (100)
Total (%)	1 (1)	7 (4)	56 (28)	133 (67)	197 (100)
Missing responses = 3				$\chi^2 = 1.9$ (df=2)	p = 0.4
A vs BC					
Style A	1 (1)	3 (3)	31 (31)	64 (65)	99 (100)
Styles BC	0 (0)	4 (4)	25 (26)	69 (70)	98 (100)
Total (%)	1 (1)	7 (4)	56 (28)	133 (67)	197 (100)
Missing responses = 3				$\chi^2 = 0.7$ (df=1)	p = 0.4

Multiple logistic regression analysis was performed to find out which variables predicted patients' perception of the usefulness of the information provided in the GLADYS information system. Two variables were found to be significant and these were age (p=0.0008) and gender (p=0.03). Older patients who were females scored the least in the 'usefulness of the information', indicating that they were more likely to feel that the information provided was not very useful.

4.21 Patients' perceptions in their ability to remember information

To find out patients' perceptions in their ability to remember some of the information, they were asked the following question:

- Do you think you will be able to remember some of the information of the GLADYS information system when you have left this clinic?

Of the 195 respondents, 134 patients (69%) felt that they would remember the information either 'very much indeed' or 'quite a lot', while 62 patients (31%) felt that they would remember the information either 'not very much' or 'not at all' (Table 6.4.24). Cross-tabulations showed no significant difference between patients' feelings of being able to remember some of the information across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.24 : Frequency of patients' perceptions of their ability to remember the information after leaving the clinic.

Remember information	Not at all No. (%)	Not very much No. (%)	Quite a lot No. (%)	Very much indeed No. (%)	Total No. (%)
A vs B vs C					
Style A	3 (3)	27 (28)	56 (58)	11 (11)	97 (100)
Style B	0 (0)	17 (35)	28 (57)	4 (8)	49 (100)
Style C	0 (0)	14 (29)	31 (63)	4 (8)	49 (100)
Total (%)	3 (1)	58 (30)	115 (59)	19 (10)	195 (100)
Missing responses = 5				**$\chi^2 = 0.44$ (df=2)**	**p = 0.8**
A vs BC					
Style A	3 (3)	27 (28)	56 (58)	11 (11)	97 (100)
Styles BC	0 (0)	31 (32)	59 (60)	8 (8)	98 (100)
Total (%)	3 (1)	58 (30)	115 (59)	19 (10)	195 (100)
Missing responses = 5				**$\chi^2 = 0.01$ (df=1)**	**p = 0.9**

Multiple logistic regression analysis was performed to find out which variables predicted patients' perceptions in their ability to remember some of the information. Significant predictors were found out to be age (p=0.00004) and patients' emotional feelings (p=0.04). Older patients who had negative feelings scored the least in their perception in their ability to remember some of the information. That is, they were the most likely to feel unable to remember some of the information when they had left the clinic.

4.22 Patients' perception of having learned something new

To find out patients' perception of having learnt something new as a result of working with the computer, they were asked the following question:

- Do you feel that as a result of working with the computer, you have learned something new.

Of the 197 respondents, 144 patients (73%) felt that they had learned something new either 'very much indeed' or 'quite a lot', while 53 patients (27%) felt that they had learned something new either 'not very much' or 'not at all' (Table 6.4.25). Cross-tabulations showed no significant difference between patients' feelings of having learned something new after using the computer across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.25 : Frequency of patients' perceptions of having learned something new after using the computer system.

Remember information	**Not at all** No. (%)	**Not very much** No. (%)	**Quite a lot** No. (%)	**Very much indeed** No. (%)	**Total** No. (%)
A vs B vs C					
Style A	4 (4)	24 (25)	60 (62)	9 (9)	97 (100)
Style B	0 (0)	16 (32)	32 (64)	2 (4)	50 (100)
Style C	1 (2)	8 (16)	37 (74)	4 (8)	50 (100)
Total (%)	5 (3)	48 (24)	129 (65)	15 (8)	197 (100)
Missing responses = 3				χ^2 = **2.9 (df=2)**	**p = 0.2**
A vs BC					
Style A	4 (4)	24 (25)	60 (62)	9 (9)	97 (100)
Styles BC	1 (1)	24 (24)	69 (69)	6 (6)	100 (100)
Total (%)	5 (3)	48 (24)	129 (65)	15 (8)	197 (100)
Missing responses = 3				χ^2 = **0.37 (df=1)**	**p = 0.5**

Multiple logistic regression analysis was performed to find out which variables predicted patients' feelings of having learnt something new after using the computer. No significant predictor was found.

4.23 Perceived utility scores

Table 6.4.26 shows the mean scores with standard deviations of perceived utility[30] for patients across styles (A vs B vs C) and between styles (A and BC). There were no significant differences between utility scores across styles (A vs B vs C) and between styles (A and BC).

Table 6.4.26 : Patients' mean perceived utility scores (the higher mean scores indicate more perceived utility, minimum=1, maximum=4).

Perceived utility	Average	SD	n
A vs B vs C			
Style A	3.19	0.50	100
Style B	3.18	0.37	50
Style C	3.24	0.33	50
	F = 0.31 , P = 0.7		
A vs BC			
Style A	3.19	0.50	100
Styles BC	3.21	0.35	100
	t = -0.37, p = 0.7		

[30] Definition on page 191, section 7.8 in chapter IV.

4.24 Patients' perceptions of the relevance of topics

To find out patients' perception of how relevant to themselves were the topics provided by the GLADYS information system, they were asked the following questions:

- The topics provided in the GLADYS information system menu were selected from a wide range focusing on gastro-intestinal issues. Did you find these topics relevant to yourself?[31]

- The topics provided in the GLADYS information system menu were selected from a selection relating to you and your symptoms. Did you find these topics relevant to yourself?[32]

Of the 196 respondents, 193 patients (98%) felt that the topics provided in the information system were either 'very' or 'moderately' relevant, while only 3 patients (2%) felt that the topics provided were either 'not very' or 'not at all' relevant (Table 6.4.27).

[31] The following question was for patients using styles A and B only.

[32] The following question was for patients using style C only.

Table 6.4.27 : Frequency of patients' perception of the relevance of the topics in the information system

Topics relevance	Not at all No. (%)	Not very relevant No. (%)	Moderately relevant No. (%)	Very relevant No. (%)	Total No. (%)
A vs B vs C					
Style A	1 (1)	1 (1)	35 (36)	61 (62)	98 (100)
Style B	0 (0)	0 (0)	20 (40)	30 (60)	50 (100)
Style C	0 (0)	1 (2)	10 (21)	37 (77)	48 (100)
Total (%)	1 (1)	2 (1)	65 (33)	128 (65)	196 (100)
Missing responses = 4				$\chi^2 = 3.9$ **(df=2)**	**p = 0.1**
A vs BC					
Style A	1 (1)	1 (1)	35 (36)	61 (62)	98 (100)
Styles BC	0 (0)	1 (1)	30 (31)	67 (68)	98 (100)
Total (%)	1 (1)	2 (1)	65 (33)	128 (65)	196 (100)
Missing responses = 4				$\chi^2 = 0.81$ **(df=1)**	**p = 0.3**
AB vs C					
Style AB	1 (1)	1 (1)	55 (36)	91 (62)	148 (100)
Style C	0 (0)	1 (2)	10 (21)	37 (77)	48 (100)
Total (%)	1 (1)	2 (1)	65 (33)	128 (65)	196 (100)
Missing responses = 4				$\chi^2 = 3.9$ **(df=1)**	**p = 0.05**[33]

Although, not statistically significant, 37 patients (77%) in style C, who were provided with 'selected' topics, felt that the topics were 'very relevant' compared to 61 patients (62%) in style A and 30 patients (60%) in style B, who were provided with 'general' topics. However, there was no significant difference between feelings of the relevance of the topics provided in the information system and between styles (AB and C)[34] (p=0.05) (Table 6.4.27). On the other hand,

[33] Cross-tabulation for older patients $\chi^2 = 5.8$ (df=1) p = 0.01 (age>50 years).

[34] Cross-tabulations between combined styles (A and B) and style C.

cross-tabulation for older patients showed significant difference $\chi^2 = 5.8$ (df=1) p= 0.01.

Multiple logistic regression analysis was performed to find out which patients' characteristics predicted patients' feelings of the relevance of the topics provided by the GLADYS information system. No significant predictor was found[35].

4.25 Patients' perceptions of the relevance of topics scores

Table 6.4.28 shows the mean scores with standard deviations of topics relevance for patients across styles (A vs B vs C) and between styles (A and BC). There were no significant differences between the perceived topics relevance scores for patients across styles (A vs B vs C) and between styles (A and BC). However, there was some suggestion that patients within Style C who were provided with selected topics in the information system were more likely to perceive more relevance of the topics than patients within Styles A and B who were provided with general topics (p=0.06) (Table 6.4.28). There was evidence that older patients[36] within Style C were more likely to perceive more relevance of the topics provided than older patients within Styles A and B (p=0.008) (Table 6.4.28).

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[35] Although age was at p=0.05.

[36] Patients who were more than 50 years old.

Table 6.4.28 : Patients' mean perception of the relevance of the topics scores (the higher mean scores indicate more relevance of topics, minimum=1, maximum=4)

Topics relevance	Average	SD	Total
A vs B vs C			
Style A	3.59	0.57	98
Style B	3.60	0.49	50
Style C	3.75	0.48	48
	F = 1.55 , P = 0.2		
A vs BC			
Style A	3.59	0.57	98
Styles BC	3.67	0.49	98
	***t* = -1.07, p = 0.3**		
AB vs C			
Styles AB	3.59	0.54	148
Style C	3.75	0.48	48
	***t* = -1.87, p = 0.06**		
AB vs C (older patients)[37]			
Styles AB	3.51	0.53	84
Style C	3.77	0.43	31
	***t* = -2.75, p = 0.008**		

4.26 Patients' satisfaction scores

Table 6.4.29 shows the mean scores with standard deviations of patients' satisfaction for patients across styles (A vs B vs C) and between styles (A and BC). There were no significant differences between patients' satisfaction scores across styles (A vs B vs C) and between styles (A and BC).

[37] Patients who were more than 50 years old.

Table 6.4.29 : Patients' mean satisfaction scores (the higher mean scores indicate more satisfaction, minimum=1, maximum=4).

Patients' satisfaction	Average	SD	Total
A vs B vs C			
Style A	3.25	0.33	100
Style B	3.24	0.30	50
Style C	3.26	0.25	50
	F = 0.09 , P = 0.9		
A vs BC			
Style A	3.25	0.33	100
Styles BC	3.25	0.28	100
	***t* = -0.02, p =1**		

5 Terms not understood during the computer interview

To find out which terms patients did not understand while being interviewed by GLADYS, patients were asked the following question:

- While being interviewed by the computer were there any terms which you did not understand?

Table 6.5.1 shows the frequency of patients who did not understand the terms while being interviewed by GLADYS, for patients across styles (A vs B vs C) only. Almost all patients (n = 195 ; 98%), felt that they understood all the terms. A patient from style A commented in the paper questionnaire, not to have understood the term 'mucus', and another, also from style A, commented not to have understood the term 'barium meal'. One patient from style C commented not to have understood what the term 'nerves' meant within the text, and a fourth patient who was from style B answered 'yes' to the above question but did not comment in the paper questionnaire which term or terms he did not understand. Both patients from style B & C moved to the information system. All patients using the short interview, understood all the terms while being interviewed by GLADYS.

Table 6.5.1 : Frequency of the terms patients did not understand when being interviewed by the computer for patients across styles (A vs B vs C)

Terms not understood during interview	No No. (%)	Yes No. (%)	Total No. (%)
A vs B vs C			
Style A	97 (98)	2 (2)	99 (100)
Style B	49 (98)	1 (2)	50 (100)
Style C	49 (98)	1 (2)	50 (100)
Total (%)	195 (98)	4 (2)	199 (100)
Missing responses = 1		$\chi^2 = 0$ (df=2) p = 1	

6 Patients' preferences

Patients' were asked to determine their preferences and comparisons between preferences across styles (A vs B vs C) and between styles (A and BC) were performed.

6.1 Patients' preferences to accessing explanations during the interview

To find out whether or not patients would prefer to have access to explanations of the terms during the computer interview, they were asked the following question:

- During the GLADYS interview, would you prefer to have explanations of the medical terms available:

(a) At the end of the interview and not during the interview.

(b) During the interview and not at the end of the interview.

If your preference is other than the ones mentioned above, please specify.

One-hundred and seventy-nine patients chose to answer option (a) or (b) of the above question. Of these, 151 patients (84%) preferred to have access to explanations of the terms during the interview, compared with 28 patients (16%) who preferred to have access to the explanations at the end of the interview (Table 6.6.1). There were no significant differences between patients' preferences in accessing explanations during the interview across styles (A vs B vs C) and between styles (A and BC).

Table 6.6.1 : Frequency of patients' preferences in accessing explanations during the computer interview

Explanations preference	Explanations during interview No. (%)	Explanations at end of interview No. (%)	Total No. (%)
A vs B vs C			
Style A	68 (84)	13 (16)	81 (100)
Style B	43 (88)	6 (12)	49 (100)
Style C	40 (82)	9 (18)	49 (100)
Total (%)	151 (84)	28 (16)	179 (100)
Missing responses = 21		**χ^2 = 0.7 (df=2)**	**p = 0.7**
A vs BC			
Style A	68 (84)	13 (16)	81 (100)
Styles BC	83 (85)	15 (15)	98 (100)
Total (%)	151 (84)	28 (16)	179 (100)
Missing responses = 21		**χ^2 = 0.01 (df=1)**	**p = 0.9**

Of the 21 patients who did not choose to answer option (a) or (b), three patients, from style A, made the following comments on their questionnaire:

- "No preference"
- "explanations before interview"
- "explanations not needed"

Several patients from style A also commented verbally that it made no difference to them whether explanations were during, or at the end of the interview, as they understood all the terms used in the interview. Similarly, some of the patients from styles B and C, commented verbally, that although they preferred to have explanations during the interview, in order to help them if they came across any unknown terms or difficulties during the interview, the precedence of explanations made no difference to them, as they had understood all the terms used in the GLADYS interview.

There was evidence that younger[38] patients preferred to have access to the information system during the interview than did older patients (p=0.003). Sixty-seven younger patients (94%) preferred to have explanations during the interview, compared with 84 older patients (78%); while 4 younger patients (6%) preferred to have explanations at the end of the interview, compared with 24 older patients (22%).

6.2 Patients' preferences in the selection of topics

To find out which selection of topics patients preferred, the following question was asked:

- In the GLADYS information system, would you prefer to have:

(a) A 'tailored' selection of topics related to you and your symptoms.

(b) A wide selection of topics focusing on gastro-intestinal issues.

If your preference is other than the ones mentioned above, please specify.

[38] Patietns who were 50 years old or less.

Table 6.6.2 : Frequency of patients' preferences in the selection of the topics used in the information system.

Topics preference	Selected topics No. (%)	General topics No. (%)	Total No. (%)
A vs B vs C			
Style A	79 (81)	18 (19)	97 (100)
Style B	42 (86)	7 (14)	49 (100)
Style C	44 (92)	4 (8)	48 (100)
Total (%)	165 (85)	29 (15)	194 (100)
Missing responses = 6		**$\chi^2 = 2.7$ (df=2) p = 0.3**	
A vs BC			
Style A	79 (81)	18 (19)	97 (100)
Styles BC	86 (89)	11 (11)	97 (100)
Total (%)	165 (85)	29 (15)	194 (100)
Missing responses = 6		**$\chi^2 = 2$ (df=1) p = 0.2**	
AB vs C			
Style AB	121 (83)	25 (17)	146 (100)
Styles C	44 (92)	4 (8)	48 (100)
Total (%)	165 (85)	29 (15)	194 (100)
Missing responses = 6		**$\chi^2 = 2.2$ (df=1) p = 0.1**	

One-hundred and ninety-four patients chose to answer option (a) or (b) of the above question. Of these, 165 patients (85%) preferred 'tailored' or 'selected' topics, and 29 patients (15%) preferred 'general' topics (Table 6.6.2). Of the 6 patients who did not choose options (a) or (b), one commented that she would like to have both selections, and wrote in the questionnaire, "I would like to see both, (a) followed by (b)". Cross-tabulations between patients' preferences in the selection of topics across styles (A vs B vs C) and between styles (A and BC) showed no significant difference. However, there was an indication that female patients were more likely to prefer selected or 'tailored' topics than male patients

(χ^2=6, df=1, p=0.01). Ninety-two females (91%) preferred selected or 'tailored' topics compared with 73 males (78%), while 9 females (9%) preferred general topics compared with 20 males (22%).

6.3 Patients' preferences in the method of accessing health information

To find out which method of accessing health information the patients preferred, they were asked the following question:

- Would you prefer to access information about your symptoms and related health issues from the computer OR from a printed book or pamphlet.

Of the 195 respondents, 84 patients (43%) preferred 'a computer', 51 patients (26%) preferred 'anything', 51 patients (26%) preferred 'a book or pamphlet', and 9 patients (5%) 'did not know' (Table 6.6.3). Of the 5 patients who did not reply directly to the question, one commented in the questionnaire, "I prefer both, a computer first followed by a book or pamphlet". There were no significant differences between patients' preference in the method of accessing health information across styles (A vs B vs C) and between styles (A and BC). However, younger patients were more likely to prefer a computer to access health information than older patients ($p<0.00001$). Forty-nine younger patients (61%)[39] preferred a computer compared with 35 older patients (30%)[40]. Similarly, patients

[39] 61% of the patients who were 50 years old or less.

who were computer users were more likely to prefer a computer than those who were not computer users (p=0.004) (Table 6.6.4). Thirty-five patients (56%) who were computer users preferred a computer compared with 49 patients (37%) who were not computer users.

Table 6.6.3 : Frequency of patients' preferences in the method of accessing health information.

Preference in method of accessing information	Don't know No. (%)	Book or pamphlet No. (%)	Either/ anything No. (%)	Computer No. (%)	Total No. (%)
A vs B vs C					
Style A	5 (5)	27 (28)	25 (25)	41 (42)	98 (100)
Style B	3 (6)	9 (19)	12 (25)	24 (50)	48 (100)
Style C	1 (2)	15 (31)	14 (28)	19 (39)	49 (100)
Total (%)	9 (5)	51 (26)	51 (26)	84 (43)	195 (100)
Missing responses = 5				**$\chi^2 = 1$ (df=2) p = 0.6**	
A vs BC					
Style A	5 (5)	27 (28)	25 (25)	41 (42)	98 (100)
Styles BC	4 (4)	24 (25)	26 (27)	43 (44)	97 (100)
Total (%)	9 (5)	51 (26)	51 (26)	84 (43)	195 (100)
Missing responses = 5				**$\chi^2 = 0.32$ (df=1) p = 0.5**	

[40] 30% of the patients who were more than 50 years old.

Table 6.6.4 : Cross-tabulation of patients' computer frequency and preferences of method of health information access.

	Don't know No. (%)	Book or pamphlet No. (%)	Either/ Anything No. (%)	Computer No. (%)	Total No. (%)
Computer frequency					
Never	6 (67)	45 (88)	32 (63)	49 (58)	132 (68)
Occasionally	3 (33)	2 (4)	9 (18)	10 (12)	24 (12)
Often	0 (0)	3 (6)	6 (12)	11 (13)	20 (10)
Daily	0 (0)	1 (2)	4 (8)	14 (17)	19 (10)
Total (%)	9 (5)	51 (26)	51 (26)	84 (43)	198 (100)

$\chi^2 = 13$ (df=3) $p = 0.004$

7 The effect of the different styles of computer interactions

Comparisons of patients' characteristics and reactions within styles B and C who sought information or moved to the information system during the computer interview and those who did not move were performed. The classification of these comparisons is as follows:

- **Comparison (movers vs non-movers)** : All one-hundred patients from the combined styles B and C were used for this comparison. All patients were given access to the information system during the GLADYS interview. Thirty-six patients chose to seek information or move to the information system during the interview. These 36 patients will be referred as the '**movers**'. However, sixty-four patients did not seek information or move to the information system during the interview and these will be referred as the '**non-movers**'. This comparison examines the study objective of whether or not there are benefits (or drawbacks) in combining computer interrogation of the patient and patient interrogation of the computer, by allowing the patient to interrupt the computer interrogation to seek health information. A higher score in patient satisfaction indicates better performance and more satisfaction.

7.1 Characteristics of patients

The mean age of patients within Styles B and C who moved to the information system during the interview was 42 (SD = 15), ranging from 22 to 69 years, while the mean age of patients who did not move was 62 (SD = 14), ranging from 29 to 89 years (Table 6.7.1). There was evidence that patients who were 'movers' were more likely to be younger than 'non-movers' ($p<0.001$). Similarly, patients who were 'movers' were more likely to be computer users than 'non-movers' ($p<0.001$).

7.2 Long computer interview vs short computer interview

Twenty-three patients (64%) who were 'movers' used the long interview, and 13 patients (36%) used the short interview; while 38 patients (59%) who were 'non-movers' used the long interview, and 26 patients (41%) used the short interview (Table 6.7.2). There was no significant difference in the proportion of patients who were 'movers' by length of interview.

Table 6.7.1 Frequency of patients' characteristics, for patients who were 'movers' and 'non-movers'

	Non-movers n=64 No. (%)	Movers n=36 No. (%)	Total n=100 No. (%)
Age			
Mean (SD)	62 (13.9)	42 (14.8)	
	t = 6.60, p <0.001		
Gender			
Male	30 (47)	22 (61)	52 (52)
Female	34 (53)	14 (39)	48 (48)
Total	64 (100)	36 (100)	100 (100)
	χ^2 = 1.87 (df=1) p = 0.2		
Previous computer use			
Never	56 (87)	14 (39)	70 (70)
Occasionally	3 (5)	5 (14)	8 (8)
Often	5 (8)	6 (17)	11 (11)
Daily	0 (0)	11 (30)	11 (11)
Total	64 (100)	36 (100)	100 (100)
	χ^2 = 25.92 (df=1) p <0.001		
Medical Examination			
Breath test	8 (12)	1 (3)	9 (9)
Colonoscopy	19 (30)	12 (33)	31 (31)
Endoscopy	37 (58)	23 (64)	60 (60)
Total	64 (100)	36 (100)	100 (100)
	χ^2 = 2.67 (df=2) p = 0.3		
Emotional feelings			
Negative	35 (67)	21 (84)	56 (73)
Positive	17 (33)	4 (16)	21 (27)
Total	52 (100)	25 (100)	77 (100)
	χ^2 = 2.37 (df=1) p = 0.1		
Anxiety score			
Not anxious	23 (44)	12 (48)	35 (45)
Border-line	19 (37)	7 (28)	26 (34)
Anxious	10 (19)	6 (24)	16 (21)
Total	52 (100)	25 (100)	77 (100)
	χ^2 = 0.60 (df=2) p = 0.7		
Depression scores			
Not depressed	41 (79)	22 (88)	63 (82)
Border-line	8 (15)	1 (4)	9 (12)
Depressed	3 (6)	2 (8)	5 (6)
Total	52 (100)	25 (100)	77 (100)
	Fisher's exact test, p = 0.7		

Table 6.7.2 : Frequency of patients using the long computer interview and the short computer interview.

	Non-movers **n=64** No. (%)	**Movers** **n=36** No. (%)	**Total** **n=100** No. (%)
Interview lengths			
Long interview	38 (59)	23 (64)	61 (61)
Short interview	26 (41)	13 (36)	39 (39)
Total	64 (100)	36 (100)	100 (100)
	$\chi^2 = 0.20$ (df=1) $p = 0.7$		

7.3 Reactions of Patients

7.3.1 Ease of using the computer

There was evidence that patients who felt using the computer to be easy were more likely to be 'movers' than 'non-movers' ($p<0.00001$) (Table 6.7.3). Similarly, there was an indication that patients who used the mouse were more likely to be 'movers' than 'non-movers' ($p<0.0009$). Ten patients (28%) who used the mouse were 'movers', compared with 3 patients (5%) who were 'non-movers'; while 61 patients (95%) who used the touch screen were 'non-movers', compared with 26 patients (72%) who were 'movers'. In addition, there was an indication that patients who found selecting a topic 'very easy' were more likely to be 'movers' than 'non-movers' ($p=0.04$). Thirty-two patients (89%) who found selecting a topic was 'very easy' were 'movers', compared with 43 patients (71%) patients who were 'non-movers'.

Table 6.7.3 Frequency of patients' ease of use reactions for patients who were 'movers' and 'non-movers'.

	Non-movers n=64 No. (%)	Movers n=36 No. (%)	Total n=100 No. (%)
Computer ease			
Not at all	1 (1)	0 (0)	1 (1)
Not very easy	7 (11)	0 (0)	7 (7)
Moderately easy	33 (52)	3 (8)	36 (36)
Very easy	23 (36)	33 (92)	56 (56)
Total	64 (100)	36 (100)	100 (100)
		$\chi^2 = 29$ (df=1)	$p < 0.00001$
Input device used			
Touch screen	61 (95)	26 (72)	87 (87)
Mouse	3 (5)	10 (28)	13 (13)
Total	64 (100)	36 (100)	100 (100)
		$\chi^2 = 10$ (df=1)	$p = 0.0009$
Touch screen ease			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	2 (3)	0 (0)	2 (2)
Moderately easy	13 (21)	3 (11)	16 (19)
Very easy	46 (76)	23 (89)	69 (79)
Total	61 (100)	26 (100)	87 (100)
Not applicable responses = 13		$\chi^2 = 1.9$ (df=1)	$p = 0.2$
Selecting a topic ease			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	0 (0)	0 (0)	0 (0)
Moderately easy	18 (29)	4 (11)	22 (23)
Very easy	43 (71)	32 (89)	75 (77)
Total	61 (100)	36 (100)	97 (100)
Missing responses = 3		$\chi^2 = 4.3$ (df=1)	$p = 0.04$

7.3.2 Clarity of computer instructions

Table 6.7.4 shows the frequency of patients' perception of the clarity of the computer instructions for patients who were 'movers' and 'non-movers'. There was evidence that patients who felt that the computer instructions were clear were more likely to be 'movers' than 'non-movers' (p=0.005).

Table 6.7.4 : Patients' perceptions of the clarity of computer instructions, for patients who were 'movers' and 'non-movers'.

	Non-movers **n=64** No. (%)	**Movers** **n=36** No. (%)	**Total** **n=100** No. (%)
Clarity of instructions			
Not at all	0 (0)	0 (0)	0 (0)
Some of the time	2 (3)	0 (0)	2 (2)
Most of the time	17 (27)	7 (19)	24 (24)
All of the time	43 (70)	29 (81)	72 (74)
Total	62 (100)	36 (100)	98 (100)
Missing responses = 2		$\chi^2 = 29$ (df=1) p = 0.005	

7.3.3 Feelings of confusion and no control

There was an indication that patients who were 'non-movers' were more likely to be confused than 'movers' (p=0.0001) (Table 6.7.5). Thirty-two patients (50%) who were 'non-movers' felt confused, compared with 4 patients (11%) who were 'movers'. Although of the 36 patients within styles B and C who reported to be confused, 32 patients (89%) reported to be confused either 'only occasionally' or 'some of the time'.

Thirty-five patients (55%) who were 'non-movers' felt lost at some stage, compared with 9 patients (25%) who were 'movers' (Table 6.7.5). Patients who were 'non-movers' were more likely not to know what to do next than 'movers' ($p=0.004$), even though, most of the patients ($n=62$, 95%[41]) felt so 'only occasionally' or 'some of the time'.

7.3.4 Feelings of well-being

There was a significant difference between 'movers' and 'non-movers' for feelings of embarrassment when being interviewed by the computer ($p=0.01$) (Table 6.7.6). A higher percentage of 'movers' ($n = 33$, 92%) felt that being interviewed by the computer was 'not at all' embarrassing, compared with 'non-movers' ($n= 46$, 72%), even though, all the 100 patients of styles B and C either responded to 'not at all' or 'not very' embarrassing.

[41] 95% of the 64 patients within styles B and C reported not to have known what to do next, at some stage, while interacting with the computer.

Table 6.7.5 : Frequency of patients' perception of confusion and no control when using the computer, for patients who were 'movers' and 'non-movers'.

	Non-movers n=64 No. (%)	Movers n=36 No. (%)	Total n=100 No. (%)
Confused			
No	32 (50)	32 (89)	64 (64)
Yes	32 (50)	4 (11)	36 (36)
Total	64 (100)	36 (100)	100 (100)
Missing responses = 1		**χ^2 = 14.9 (df=1) p=0.0001**	
Frequency of confusion			
Only occasionally	18 (56)	3 (75)	21 (58)
Some of the time	10 (31)	1 (25)	11 (31)
Most of the time	3 (10)	0 (0)	3 (8)
All of the time	1 (3)	0 (0)	1 (3)
Total	32 (100)	4 (100)	36 (100)
Not applicable = 64[43]		**χ^2 = 0.5 (df=1) p=0.4**	
Lost at some stage			
No	29 (45)	27 (75)	56 (56)
Yes	35 (55)	9 (25)	44 (44)
Total	64 (100)	36 (100)	100 (100)
No missing responses		**χ^2 = 8.2 (df=1) p=0.004**	
Frequency of being lost			
Only occasionally	17 (39)	2 (22)	19 (43)
Some of the time	16 (36)	7 (78)	23 (52)
Most of the time	2 (5)	0 (0)	2 (5)
All of the time	0 (0)	0 (0)	0 (0)
Total	35 (100)	9 (100)	44 (100)
Not applicable = 64[44]		**χ^2 = 2 (df=1) p=0.1**	

[43] Not applicable to the 64 patients who were not confused

[44] Not applicable to the 64 patients who knew what to do next at all times

Table 6.7.6 : Frequency of patients' perception of well-being for patients who were 'movers' and 'non-movers'.

	Non-movers n=64 No. (%)	Movers n=36 No. (%)	Total n=100 No. (%)
Computer interviewing comfortable			
Not at all	0 (0)	0 (0)	0 (0)
Not very comfortable	5 (8)	0 (0)	5 (5)
Moderately comfortable	17 (27)	1 (3)	18 (18)
Very comfortable	42 (65)	35 (97)	77 (77)
Total	64 (100)	36 (100)	100 (100)
No Missing responses		$\chi^2 = 13$ (df=1)	$p = 0.0003$
Doctor-Patient embarrassment			
Not at all	35 (55)	26 (72)	61 (61)
Not very embarrassing	20 (31)	6 (17)	26 (26)
Moderately embarrassing	9 (14)	3 (8)	12 (12)
Very embarrassing	0 (0)	1 (3)	1 (1)
Total	64 (100)	36 (100)	100 (100)
No Missing responses		$\chi^2 = 2.9$ (df=1)	$p = 0.08$
Patient-Computer embarrassment			
Not at all	46 (72)	33 (92)	79 (79)
Not very embarrassing	18 (28)	3 (8)	21 (21)
Moderately embarrassing	0 (0)	0 (0)	0 (0)
Very embarrassing	0 (0)	0 (0)	0 (0)
Total	64 (100)	36 (100)	100 (100)
No Missing responses		$\chi^2 = 5.4$ (df=1)	$p = 0.01$

7.3.5 Interest

There was an indication that 'movers' were less likely to lose interest while working with the computer than 'non-movers' (p=0.005) (Table 6.7.7).

Table 6.7.7 : Frequency of patients' loss of interest when using the computer, for patients who were 'movers' and 'non-movers'.

	Non-movers n=64 No. (%)	Movers n=36 No. (%)	Total n=100 No. (%)
Loss of interest			
Not at all	42 (67)	33 (92)	75 (76)
Not often	7 (11)	2 (5)	9 (9)
Sometimes	13 (20)	1 (3)	14 (14)
Many times	1 (2)	0 (0)	1 (1)
Total	63 (100)	36 (100)	99 (100)
Missing responses = 1		**χ^2 = 7.8 (df=1) p = 0.005**	

7. 3.6 Perceived utility

Patients who were 'movers' were more likely to feel that they would able to remember more information than patients who were 'non-movers' (p=0.002) (Table 6.7.8).

Table 6.7.8 : Frequency of patients' perception of utility, for patients who were 'movers' and 'non-movers'.

	Non-movers **n=64** No. (%)	**Movers** **n=36** No. (%)	**Total** **n=100** No. (%)
Images usefulness			
Not at all	0 (0)	0 (0)	0 (0)
Not very useful	2 (3)	3 (8)	5 (5)
Moderately useful	16 (26)	12 (33)	28 (29)
Very useful	44 (71)	21 (59)	65 (66)
Total	62 (100)	36 (100)	98 (100)
Missing responses = 2		$\chi^2 = 1.6$ **(df=1)**	**p = 0.2**
Information usefulness			
Not at all	0 (0)	0 (0)	0 (0)
Not very useful	4 (7)	0 (0)	4 (4)
Moderately useful	17 (27)	8 (22)	25 (26)
Very useful	41 (66)	28 (78)	69 (70)
Total	62 (100)	36 (100)	98 (100)
Missing responses = 2		$\chi^2 = 1.5$ **(df=1)**	**p = 0.2**
Remember information			
Not at all	0 (0)	0 (0)	0 (0)
Not very much	27 (43)	4 (11)	31 (32)
Quite a lot	29 (47)	30 (83)	59 (60)
Very much indeed	6 (10)	2 (6)	8 (8)
Total	62 (100)	36 (100)	98 (100)
Missing responses = 2		$\chi^2 = 11$ **(df=1)**	**p=0.002**
Learned something new			
Not at all	1 (2)	0 (0)	1 (1)
Not very much	19 (29)	5 (14)	24 (24)
Quite a lot	39 (61)	30 (83)	69 (69)
Very much indeed	5 (8)	1 (3)	6 (6)
Total	64 (100)	36 (100)	100 (100)
Missing responses = 2		$\chi^2 = 3.7$ **(df=1)**	**p = 0.05**

7.3.7 Patients' perception on the relevance of topics

Table 6.7.9 represents patients' perception of the relevance of the topics provided by the GLADYS information system for patients who were 'movers' and 'non-movers'.

Table 6.7.9 : Frequency of patients' perception of the relevance of the topics used in the information system, for patients who were 'movers' and 'non-movers'.

	Non-movers n=64 No. (%)	Movers n=36 No. (%)	Total n=100 No. (%)
Relevance of topics			
Not at all	0 (0)	0 (0)	0 (0)
Not very relevant	1 (1)	0 (0)	1 (1)
Moderately relevant	19 (31)	11 (31)	30 (31)
Very relevant	42 (68)	25 (69)	67 (68)
Total	62 (100)	36 (100)	98 (100)
Missing responses = 2		$\chi^2 = 0.03$ (df=1)	p = 0.8

7.3.8 Patients' satisfaction scores

Table 6.7.10 represents the mean scores with standard deviations of patients' outcome scores for patients who were 'movers' and 'non-movers'. There was an indication that patients who found using the computer more easy were more likely to be 'movers' than 'non-movers' ($p<0.001$). Similarly, patients who were less confused and more in control while interacting with the computer were more likely to be 'movers' than 'non-movers' ($p<0.001$). Furthermore, patients who felt interacting with the computer more comfortable and less embarrassing were more likely to be 'movers' than 'non-movers' ($p<0.001$). Patients who were 'movers' were less likely to loss interest while interacting with the computer than 'non-movers' ($p=0.001$).

Finally, there was an indication that patients who felt more satisfied when interacting with the computer were more likely to be 'movers' than 'non-movers' ($p<0.001$).

Table 6.7.10 Patients' mean outcome scores (the higher mean scores indicate better performance, minimum=1; maximum=4), for patients who were 'movers' and 'non-movers'.

	Non-movers **n=64** Mean (SD)	**Movers** **n=36** Mean (SD)	*t*, p
Patient satisfaction			
Ease of use	3.54 (0.45)	3.88 (0.20)	-5.26, < **0.001**
Clarity	3.66 (0.54)	3.81 (0.40)	-1.50, 0.1
Confusion and no control[45]	1.48 (0.49)	1.82 (0.32)	-4.22, < **0.001**
Feelings of well-being	3.65 (0.44)	3.94 (0.16)	-4.82, < **0.001**
Usability	3.06 (0.33)	3.38 (0.12)	-6.87, < **0.001**
Interest	3.43 (0.81)	3.89 (0.40)	-2.22, **0.001**
Utility	3.17 (0.38)	3.28 (0.29)	-1.60, 0.1
Relevance of topics	3.66 (0.51)	3.69 (0.47)	0.32, 0.8
Overall Patient Satisfaction	3.16 (0.28)	3.41 (0.16)	-5.66, < **0.001**

[45] minimum = 1; maximum = 2

8 The effect of the different styles for patients of similar characteristics

Patients' characteristics and reactions within styles B and C who 'moved' to the information system during the computer interview ('movers') and patients of similar characteristics in style A who were not allowed access to the information system during the computer interview were compared. The 64 patients who did not move to the information system during the computer interview were also compared with the remaining 64 patients from style A who were not selected. The classification of this comparison was as follows:

- **Comparison (selected A vs movers)** : A total of 72 patients : 36 patients from the combined styles B and C, who moved to the information system during the interview are referred to as 'movers'; and another 36 patients who were selected from style A, by using a 'post hoc' match, are referred to as 'selected A'. Each of the 'selected' patients from style A was individually chosen to match a 'mover' from the combined styles B and C. Priority for the match was given to age, then to previous computer use, and finally to gender and the length of the computer interview. The mean age of the patients who were 'movers' was 42.4 years (SD=15), ranging from 22 to 69 years, and the mean age of the matched 'selected A' patients was 42.6 years (SD = 14), ranging from 16 to 69 years (Table 6.8.1).

- **Comparison (non-selected A vs non-movers)** : A total of 128 patients : 64 patients from the combined styles B and C, who did not move to the information system during the interview are referred to as 'non-movers'; and another 64 patients who were 'not selected' from style A, or 'non-selected A', when using a 'post hoc' match for the above mentioned 'selected A' patients.

8.1 Characteristics and Reactions of Patients

8.1.1 Patients' characteristics and Ease of using the computer

Tables 6.8.1 and 6.8.2 represent patients' characteristics and perception of how easy it was to use the computer for patients who were 'selected A' and 'movers', respectively. There was no significant difference in any of the characteristics and outcomes in ease of use represented in the tables between patients who were 'selected A' and 'movers'.

Table 6.8.1 Frequency of patients' characteristics, for patients who were 'selected A' and 'movers'.

	Selected A **n=36** No. (%)	**Movers BC** **n=36** No. (%)	**Total** **n=72** No. (%)
Age			
Mean (SD)	42.6 (14.5)	42.5 (14.8)	
	***t*-value = 0.04, p = 1**		
Gender			
Male	24 (67)	22 (61)	46 (64)
Female	12 (33)	14 (39)	26 (36)
Total	36 (100)	36 (100)	72 (100)
	χ^2 = 0.24 (df=1) p = 0.6		
Previous computer use			
Never	14 (39)	14 (39)	28 (39)
Occasionally	6 (17)	5 (14)	11 (15)
Often	8 (22)	6 (17)	14 (19)
Daily	8 (22)	11 (30)	19 (26)
Total	36 (100)	36 (100)	72 (100)
	χ^2 = 0.85 (df=1) p = 0.8		
Medical Examination			
Breath test	1 (3)	1 (3)	2 (3)
Colonoscopy	10 (28)	12 (33)	22 (30)
Endoscopy	25 (69)	23 (64)	48 (67)
Total	36 (100)	36 (100)	72 (100)
	χ^2 = 0.25 (df=1) p = 0.6		
Interview lengths			
Long interview	21 (58)	23 (64)	44 (61)
Short interview	15 (42)	13 (36)	28 (39)
Total	36 (100)	36 (100)	72 (100)
	χ^2 = 0.23 (df=1) p = 0.6		
Emotional feelings			
Negative	19 (73)	21 (84)	40 (78)
Positive	7 (27)	4 (16)	11 (22)
Total	26 (100)	25 (100)	51 (100)
	χ^2 = 0.89 (df=1) p = 0.3		
Anxiety score			
Not anxious	13 (50)	12 (48)	25 (49)
Border-line	6 (23)	7 (28)	13 (26)
Anxious	7 (27)	6 (24)	13 (25)
Total	26 (100)	25 (100)	51 (100)
	χ^2 = 0.17 (df=2) p = 0.9		
Depression scores			
Not depressed	24 (92)	22 (88)	46 (90)
Border-line	2 (8)	1 (4)	3 (6)
Depressed	0 (0)	2 (8)	2 (4)
Total	26 (100)	25 (100)	51 (100)
	Fisher's exact test, p = 0.2		

Table 6.8.2 Frequency of patients' reactions to 'ease of use' for patients who were 'selected A' and 'movers'.

	Selected A n=36 No. (%)	**Movers BC** n=36 No. (%)	**Total** n=72 No. (%)
Computer ease			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	2 (6)	0 (0)	2 (3)
Moderately easy	2 (5)	3 (8)	5 (7)
Very easy	32 (89)	33 (92)	65 (90)
Total	36 (100)	36 (100)	72 (100)
	Fisher's exact test, p = 0.7		
Input device used			
Touch screen	26 (72)	26 (72)	52 (72)
Mouse	10 (28)	10 (28)	20 (28)
Total	36 (100)	36 (100)	72 (100)
	$\chi^2 = 0$ (df=1) p = 1		
Touch screen ease			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	0 (0)	0 (0)	0 (0)
Moderately easy	3 (11)	3 (11)	6 (11)
Very easy	23 (89)	23 (89)	46 (89)
Total	26 (100)	26 (100)	52 (100)
Not applicable responses = 20		**$\chi^2 = 0$ (df=1) p = 1**	
Selecting a topic ease			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	0 (0)	0 (0)	0 (0)
Moderately easy	3 (8)	4 (11)	7 (10)
Very easy	33 (92)	32 (89)	65 (90)
Total	36 (100)	36 (100)	72 (100)
No Missing responses		**Fisher's exact test, p = 0.2**	

8.1.2 Clarity of computer instructions

Cross-tabulations showed no significant difference between patients' perception of the clarity of the computer instructions between patients who were 'selected A' and 'movers' (Table 6.8.3).

Table 6.8.3 : Patients' perception of the clarity of the computer instructions, for patients who were 'selected A' and 'movers'.

	Selected A **n=36** No. (%)	**Movers BC** **n=36** No. (%)	**Total** **n=72** No. (%)
Clarity of instructions			
Not at all	0 (0)	0 (0)	0 (0)
Some of the time	0 (0)	0 (0)	0 (0)
Most of the time	5 (14)	7 (19)	12 (17)
All of the time	31 (86)	29 (81)	60 (83)
Total	36 (100)	36 (100)	72 (100)
Missing responses = 2		$\chi^2 = 0.4$ (df=1)	$p = 0.5$

8.1.3 Feelings of confusion and no control

There was no significant difference in patients' feelings of confusion and no control outcomes between patients who were 'selected A' and 'movers' (Table 6.8.4).

Table 6.8.4 : Frequency of patients' perception of confusion and no control when using the computer, for patients who were 'selected A' and 'movers'.

	Selected A n=36 No. (%)	Movers BC n=36 No. (%)	Total n=72 No. (%)
Confused			
No	32 (89)	32 (89)	64 (89)
Yes	4 (11)	4 (11)	8 (11)
Total	36 (100)	36 (100)	72 (100)
No missing responses		$\chi^2 = 0$ (df=1)	p = 1
Frequency of confusion			
Only occasionally	1 (25)	3 (75)	4 (50)
Some of the time	3 (75)	1 (25)	4 (50)
Most of the time	0 (0)	0 (0)	0 (0)
All of the time	0 (0)	0 (0)	0 (0)
Total	4 (100)	4 (100)	8 (100)
Not applicable = 65[46]		$\chi^2 = 2$ (df=1)	p = 0.2
lost at some stage			
No	31 (86)	27 (75)	58 (81)
Yes	5 (14)	9 (25)	14 (19)
Total	36 (100)	36 (100)	72 (100)
No missing responses		$\chi^2 = 1.4$ (df=1)	p = 0.2
Frequency of feeling lost			
Only occasionally	3 (60)	2 (22)	5 (36)
Some of the time	2 (40)	7 (78)	9 (64)
Most of the time	0 (0)	0 (0)	0 (0)
All of the time	0 (0)	0 (0)	0 (0)
Total	5 (100)	9 (100)	14 (100)
Not applicable = 58[47]		$\chi^2 = 0.16$ (df=1)	p = 0.7

[46] Not applicable to the 65 patients who were not confused

[47] Not applicable to the 58 patients who knew what to do next at all times

8.1.4 Feelings of well-being

There was no significant difference in feelings of well-being between patients who were 'selected A' and 'movers' (Table 6.8.5).

Table 6.8.5 : Frequency of patients' perceptions of well-being for patients who were 'selected A' and 'movers'.

	Selected A **n=36** No. (%)	**Movers BC** **n=36** No. (%)	**Total** **n=72** No. (%)
Computer interviewing comfortable			
Not at all	0 (0)	0 (0)	0 (0)
Not very comfortable	0 (0)	0 (0)	0 (0)
Moderately comfortable	4 (11)	1 (3)	5 (7)
Very comfortable	32 (89)	35 (97)	67 (93)
Total	36 (100)	36 (100)	72 (100)
No Missing responses		$\chi^2 = 1.9$ (df=1)	$p = 0.2$
Doctor-Patient embarrassment			
Not at all	20 (55)	26 (72)	46 (64)
Not very embarrassing	10 (28)	6 (17)	16 (22)
Moderately embarrassing	6 (17)	3 (8)	9 (13)
Very embarrassing	0 (0)	1 (3)	1 (1)
Total	36 (100)	36 (100)	72 (100)
No Missing responses		$\chi^2 = 2.7$ (df=1)	$p = 0.1$
Patient-Computer embarrassment			
Not at all	29 (81)	33 (92)	62 (86)
Not very embarrassing	7 (19)	3 (8)	10 (14)
Moderately embarrassing	0 (0)	0 (0)	0 (0)
Very embarrassing	0 (0)	0 (0)	0 (0)
Total	36 (100)	36 (100)	72 (100)
No Missing responses		$\chi^2 = 1.9$ (df=1)	$p = 0.2$

8.1.5 Interest

There was an indication that patients who were given access to the information system during the interview and moved were less likely to lose interest while interacting with the computer than those who were not (p = 0.03) (Table 6.8.6). Thirty-five patients (97%) who were 'movers' did lose interest 'not at all' or 'not often' compared with 28 patients (78%) from selected style A.

Table 6.8.6 : Frequency of patients' loss of interest when using the computer, for patients who were 'selected A' and 'movers'.

	Selected A **n=36** No. (%)	**Movers BC** **n=36** No. (%)	**Total** **n=72** No. (%)
Loss of interest			
Not at all	26 (72)	33 (92)	59 (82)
Not often	2 (6)	2 (5)	4 (6)
Sometimes	8 (22)	1 (3)	9 (12)
Many times	0 (0)	0 (0)	0 (0)
Total	36 (100)	36 (100)	72 (100)
No missing responses		**χ^2 = 4.6 (df=1)**	**p = 0.03**

8.1.6 Perceived utility

There was no significant difference in patients' perception of utility outcomes between patients who were 'movers' and 'selected A' (Table 6.8.7). There was an indication that patients who were 'movers' were less likely to perceive the usefulness of images while working with the computer than patients who were 'selected A' (p=0.02). Although not statistically significant (p=0.08), there was some suggestion that patients who were 'movers' were more likely to perceive that they have learned something new than patients who were 'selected A'.

Table 6.8.7 : Frequency of patients' perceptions of utility, for patients who were 'selected A' and 'movers'.

	Selected A n=36 No. (%)	**Movers BC** n=36 No. (%)	**Total** n=72 No. (%)
Images usefulness			
Not at all	0 (0)	0 (0)	0 (0)
Not very useful	2 (6)	3 (8)	5 (7)
Moderately useful	4 (11)	12 (33)	16 (22)
Very useful	30 (83)	21 (59)	51 (71)
Total	36 (100)	36 (100)	72 (100)
No Missing responses			$\chi^2 = 5.4$ (df=1) p = 0.02
Information usefulness			
Not at all	0 (0)	0 (0)	0 (0)
Not very useful	0 (0)	0 (0)	0 (0)
Moderately useful	8 (22)	8 (22)	16 (22)
Very useful	28 (78)	28 (78)	56 (78)
Total	36 (100)	36 (100)	72 (100)
No Missing responses			$\chi^2 = 0$ (df=1) p = 1
Remember information			
Not at all	0 (0)	0 (0)	0 (0)
Not very much	7 (19)	4 (11)	11 (15)
Quite a lot	27 (75)	30 (83)	56 (78)
Very much indeed	2 (6)	2 (6)	5 (7)
Total	36 (100)	36 (100)	72 (100)
No Missing responses			$\chi^2 = 0.97$ (df=1) p = 0.3
Learned something new			
Not at all	0 (0)	0 (0)	0 (0)
Not very much	11 (31)	5 (14)	16 (22)
Quite a lot	22 (61)	30 (83)	52 (72)
Very much indeed	3 (8)	1 (3)	4 (6)
Total	36 (100)	36 (100)	72 (100)
No Missing responses			$\chi^2 = 2.8$ (df=1) p = 0.08

8.1.7 Patients' perception on the relevance of topics

There was no significant difference in patients' feelings in the relevance of the topics between patients who were 'selected A' and 'movers' (Table 6.8.8).

Table 6.8.8 : Frequency of patients' perception on the relevance of the topics used in the information system, for patients who were 'selected A' and 'movers'.

	Selected A n=36 No. (%)	**Movers BC** n=36 No. (%)	**Total** n=72 No. (%)
Topics relevance			
Not at all	0 (0)	0 (0)	0 (0)
Not very relevant	0 (0)	0 (0)	0 (0)
Moderately relevant	11 (31)	11 (31)	22 (31)
Very relevant	24 (69)	25 (69)	49 (69)
Total	35 (100)	36 (100)	71 (100)
Missing responses = 1		$\chi^2 = 0.006$ (df=1)	p = 0.9

8.1.8 Patients' satisfaction scores

There was no significant difference in the patients' overall satisfaction scores between patients who were 'selected A' and 'movers' (Table 6.8.9). However, there was an indication that patients who were given access to the information system during the interview and moved, were less likely to lose interest than those who were not given access to the information during the computer interview (p=0.02).

Table 6.8.9 : Patients' outcome scores (the higher mean scores indicate more satisfaction of patients, min. : 1, max. : 4), for patients who were 'selected A' and 'movers'.

	Selected A **n=36** Mean (SD)	**Movers** **n=36** Mean (SD)	***t*-value, p**
Patients satisfaction			
Ease of use	3.87 (0.29)	3.88 (0.19)	-0.16, 0.9
Clarity	3.86 (0.35)	3.81 (0.40)	0.63, 0.5
Confusion and no control[47]	1.87 (0.33)	1.82 (0.32)	0.73, 0.5
Feelings of well-being	3.85 (0.29)	3.94 (0.16)	-1.77, 0.08
Usability	3.37 (0.22)	3.38 (0.12)	-0.25, 0.8
Interest	3.50 (0.85)	3.89 (0.39)	-2.50, **0.02**
Utility	3.30 (0.33)	3.28 (0.29)	0.19, 0.8
Relevance of topics	3.68 (0.47)	3.69 (0.46)	-0.08, 0.9
Overall Patient Satisfaction	3.38 (0.19)	3.41 (0.16)	-0.73, 0.4

There were no significant differences between patients who were not selected in style A and those who did not move to the information system in styles B and C, for any of the outcome scores (Table 6.8.10).

Table 6.8.10 Patients' reactions (the higher mean scores indicate better performance, min. : 1; max. : 4), for patients who were 'non-selected A' and 'non-movers'.

	Non-selected A **n=64** Mean (SD)	**Non-movers** **n=64** Mean (SD)	***t*-value, p**
Patients satisfaction			
Ease of use	3.57 (0.48)	3.54 (0.45)	0.41, 0.7
Clarity	3.67 (0.53)	3.66 (0.54)	0.14, 0.9
Confusion and no control[48]	1.63 (0.56)	1.48 (0.49)	1.70, 0.09
Feelings of well-being	3.68 (0.41)	3.65 (0.44)	0.45, 0.7
Usability	3.12 (0.35)	3.06 (0.33)	0.91, 0.4
Interest	3.54 (0.80)	3.43 (0.88)	0.74, 0.5
Utility	3.14 (0.58)	3.17 (0.38)	-0.36, 0.7
Relevance of topics	3.53 (0.62)	3.66 (0.51)	-1.32, 0.2
Overall Patient Satisfaction	3.15 (0.40)	3.16 (0.29)	-0.07, 0.9

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[47] minimum = 1; maximum = 2

[48] Same as 47.

9 The effect of the different computer interview lengths

Comparisons of patients' characteristics and the reactions of the 120 patients who used the long computer interview with the 80 patients who used the short computer interview were performed. The classification of these comparisons is as follows:

- **Comparison (long vs short)** : All patients : 120 patients were given a long interview, and 80 patients were given a short interview. Both types of computer interviews had access to the same information system. This comparison examines the study objective of whether or not there are differences in patients' reactions when using a long computer interview, with those patients using a short computer interview.

9.1 Characteristics of patients

The mean age of patients who used the long interview was 55 years (SD = 18), ranging from 16 to 89 years, while the mean age of patients who used the short interview was 54 years (SD = 15), ranging from 24 to 84 years (Table 6.9.1). There were no significant differences between age, gender, previous computer use, awaited medical examination, emotional feelings, anxiety and depression scores, between patients who used the long interview and those who used the short interview.

9.2 Reactions of Patients

9.2.1 Ease of using the computer

There was no significant difference in any of the outcomes in ease of use between patients who used the long interview and the short interview (Table 6.9.2).

9.2.2 Clarity of computer instructions

There was no significant difference in patients' perceptions of the clarity of the computer instructions between patients who used the long interview and those who used the short interview (Table 6.9.3).

Table 6.9.3 : Patients' perceptions of the clarity of the computer instructions, for patients who used the long and the short interviews.

	Long Interview n=120 No. (%)	Short Interview n=80 No. (%)	Total n=200 No. (%)
Clarity of Instructions			
Not at all	0 (0)	0 (0)	0 (0)
Some of the time	2 (2)	0 (0)	2 (1)
Most of the time	29 (25)	18 (23)	47 (24)
All of the time	86 (73)	62 (77)	148 (75)
Total	117 (100)	80 (100)	197 (100)
Missing responses = 3		$\chi^2 = 0.41$ (df=1) $p = 0.5$	

Table 6.9.1 Frequency of patients' characteristics, for patients who used the long and the short interviews.

	Long Interview n=120 No. (%)	Short Interview n=80 No. (%)	Total n=200 No. (%)
Age			
Mean (SD)	55 (18)	54 (15)	
	$t = 0.16$, $p = 0.9$		
Gender			
Male	56 (47)	40 (50)	96 (48)
Female	64 (53)	40 (50)	104 (52)
Total	120 (100)	80 (100)	200 (100)
	$\chi^2 = 0.21$ (df=1) $p = 0.6$		
Previous computer use			
Never	76 (63)	61 (76)	137 (68)
Occasionally	19 (16)	5 (6)	24 (12)
Often	13 (11)	7 (9)	20 (10)
Daily	12 (10)	7 (9)	19 (10)
Total	120 (100)	80 (100)	200 (100)
	$\chi^2 = 5.1$ (df=3) $p = 0.2$		
Medical Examination			
Breath test	10 (8)	6 (8)	16 (8)
Colonoscopy	35 (29)	24 (30)	59 (30)
Endoscopy	75 (63)	50 (62)	125 (62)
Total	120 (100)	80 (100)	200 (100)
	$\chi^2 = 0.05$ (df=2) $p = 1$		
Emotional feelings			
Negative	52 (70)	60 (75)	112 (73)
Positive	22 (30)	20 (25)	42 (27)
Total	74 (100)	80 (100)	154 (100)
	$\chi^2 = 0.43$ (df=1) $p = 0.5$		
Anxiety score			
Not anxious	42 (57)	34 (43)	76 (49)
Border-line	22 (30)	26 (32)	48 (31)
Anxious	10 (13)	20 (25)	30 (20)
Total	74 (100)	80 (100)	154 (100)
	$\chi^2 = 4.3$ (df=2) $p = 0.1$		
Depression scores			
Not depressed	62 (84)	65 (81)	127 (83)
Border-line	8 (11)	11 (14)	19 (12)
Depressed	4 (5)	4 (5)	8 (5)
Total	74 (100)	80 (100)	154 (100)
	$\chi^2 = 0.01$ (df=1) $p = 1$		

Table 6.9.2 Frequency of patients' ease of use reactions, for patients who used the long and the short interviews.

	Long Interview n=120 No. (%)	**Short Interview n=80** No. (%)	**Total n=200** No. (%)
Computer ease			
Not at all	2 (2)	0 (0)	2 (1)
Not very easy	13 (11)	3 (4)	16 (8)
Moderately easy	36 (30)	26 (32)	62 (31)
Very easy	69 (57)	51 (64)	120 (60)
Total	120 (100)	80 (100)	200 (100)
	$\chi^2 = 0.78$ (df=1) $p = 0.4$		
Touch screen use			
Yes	106 (88)	70 (87)	176 (88)
No	14 (12)	10 (13)	24 (12)
Total	120 (100)	80 (100)	200 (100)
	$\chi^2 = 0.03$ (df=1) $p = 0.8$		
Touch screen ease			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	3 (3)	0 (0)	3 (2)
Moderately easy	23 (22)	18 (26)	41 (23)
Very easy	80 (75)	52 (74)	132 (75)
Total	106 (100)	70 (100)	176 (100)
Not applicable responses = 24		**$\chi^2 = 0.03$ (df=1) $p = 0.8$**	
Selecting a topic ease			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	1 (1)	1 (1)	2 (1)
Moderately easy	27 (23)	13 (16)	40 (20)
Very easy	88 (76)	66 (83)	154 (79)
Total	116 (100)	80 (100)	196 (100)
Missing responses = 4		**$\chi^2 = 1.2$ (df=1) $p = 0.2$**	

9.2.3 Feelings of confusion and no control

Patients who used the long interview were more likely to feel that they did not know what to do next, than patients who used the short interview ($p = 0.01$) (Table 6.9.4).

9.2.4 Feelings of well-being

There was an indication that patients who used the short interview were less likely to feel embarrassed when being interviewed by the doctor ($p=0.04$) and by the computer ($p=0.03$) compared to patients who used the long interview (Table 6.9.5).

Table 6.9.4 : Frequency of patients' feelings of confusion and no control when using the computer, for patients who used the long and the short interviews.

	Long Interview n=120 No. (%)	Short Interview n=80 No. (%)	Total n=200 No. (%)
Confused			
No	78 (66)	59 (74)	137 (69)
Yes	41 (34)	21 (26)	62 (31)
Total	119 (100)	80 (100)	199 (100)
Missing responses = 1		$\chi^2 = 1.5$ (df=1)	p = 0.2
Frequency of confusion			
Only occasionally	23 (56)	10 (48)	33 (53)
Some of the time	14 (34)	9 (43)	23 (37)
Most of the time	3 (7)	2 (9)	5 (8)
All of the time	1 (2)	0 (0)	1 (2)
Total	41 (100)	21 (100)	62 (100)
Missing responses = 138[50]		$\chi^2 = 0.4$ (df=1)	p = 0.5
Not knowing what to do next			
No	64 (54)	57 (71)	121 (61)
Yes	55 (46)	23 (29)	78 (39)
Total	119 (100)	80 (100)	199 (100)
Missing responses = 1		$\chi^2 = 6.1$ (df=1)	p = 0.01
Frequency of not knowing what to do next			
Only occasionally	25 (46)	10 (44)	35 (45)
Some of the time	27 (49)	12 (52)	39 (50)
Most of the time	3 (5)	1 (4)	4 (5)
All of the time	0 (0)	0 (0)	0 (0)
Total	55 (100)	23 (100)	78 (100)
Missing responses = 122[51]		$\chi^2 = 0.03$ (df=1)	p = 0.9

[50] Not applicable to the 138 patients who were not confused

[51] Not applicable to the 122 patients who knew what to do next at all times

Table 6.9.5 : Frequency of patients' perceptions of well-being, for patients who used the long and the short interviews.

	Long Interview n=120 No. (%)	Short Interview n=80 No. (%)	Total n=200 No. (%)
Computer interviewing comfortable			
Not at all	0 (0)	0 (0)	0 (0)
Not very comfortable	5 (4)	3 (9)	8 (4)
Moderately comfortable	26 (22)	16 (20)	42 (21)
Very comfortable	87 (74)	61 (76)	148 (75)
Total	118 (100)	80 (100)	198 (100)
Missing responses = 2		$\chi^2 = 0.2$ (df=1) $p = 0.7$	
Doctor-Patient embarrassment			
Not at all	63 (54)	55 (69)	118 (60)
Not very embarrassing	34 (29)	17 (21)	51 (26)
Moderately embarrassing	18 (15)	8 (10)	26 (13)
Very embarrassing	2 (2)	0 (0)	2 (1)
Total	117 (100)	80 (100)	197 (100)
Missing responses = 3		$\chi^2 = 4.4$ (df=1) $p = 0.04$	
Patient-Computer embarrassment			
Not at all	88 (75)	70 (88)	158 (80)
Not very embarrassing	27 (23)	10 (12)	37 (19)
Moderately embarrassing	2 (2)	0 (0)	2 (1)
Very embarrassing	0 (0)	0 (0)	0 (0)
Total	117 (100)	80 (100)	197 (100)
Missing responses = 3		$\chi^2 = 4.5$ (df=1) $p = 0.03$	

9.2.5 Interest

Cross-tabulations between patients' loss of interest for patients who used the long and the short interviews, showed no significant difference (Table 6.9.6).

Table 6.9.6 : Frequency of patients' loss of interest when using the computer, for patients who used the long and the short interviews.

	Long Interview n=120 No. (%)	Short Interview n=80 No. (%)	Total n=200 No. (%)
Loss of interest			
Not at all	86 (73)	60 (75)	146 (74)
Not often	14 (12)	5 (6)	19 (10)
Sometimes	17 (14)	14 (18)	31 (16)
Many times	1 (1)	1 (1)	2 (1)
Total	118 (100)	80 (100)	198 (100)
Missing responses = 2		$\chi^2 = 0.11$ (df=1) $p = 0.7$	

9.2.6 Perceived utility

Patients who used the short interview were more likely to feel that the information provided by the computer was more useful than patients who used the long interview (p = 0.03) (Table 6.9.7). Although not statistically significant, there was some suggestion that patients who used the short interview were more likely to perceive that they have learned something new after using the computer than those who used the long interview (p=0.07).

Table 6.9.7 : Frequency of patients' perceptions of utility, for patients who used the long and the short interviews.

	Long Interview n=120 No. (%)	**Short Interview** n=80 No. (%)	**Total** n=200 No. (%)
Images usefulness			
Not at all	1 (1)	1 (1)	2 (1)
Not very useful	5 (4)	4 (5)	9 (5)
Moderately useful	27 (23)	25 (31)	52 (26)
Very useful	84 (72)	50 (63)	134 (68)
Total	117 (100)	80 (100)	197 (100)
Missing responses = 3		$\chi^2 = 1.9$ (df=1) $p = 0.2$	
Information usefulness			
Not at all	0 (0)	1 (1)	1 (1)
Not very useful	5 (4)	2 (3)	7 (4)
Moderately useful	40 (34)	16 (20)	56 (28)
Very useful	72 (62)	61 (76)	133 (67)
Total	117 (100)	80 (100)	197 (100)
Missing responses = 3		$\chi^2 = 4.7$ (df=1) $p = 0.03$	
Remember information			
Not at all	3 (2)	0 (0)	3 (1)
Not very much	38 (33)	20 (25)	58 (30)
Quite a lot	63 (55)	51 (64)	114 (59)
Very much indeed	11 (10)	9 (11)	20 (10)
Total	115 (100)	80 (100)	195 (100)
Missing responses = 5		$\chi^2 = 2.5$ (df=1) $p = 0.1$	
learned something new			
Not at all	4 (3)	1 (1)	5 (3)
Not very much	33 (28)	15 (19)	48 (24)
Quite a lot	72 (62)	57 (71)	129 (65)
Very much indeed	8 (7)	7 (9)	15 (8)
Total	117 (100)	80 (100)	197 (100)
Missing responses = 3		$\chi^2 = 3.3$ (df=1) $p = 0.07$	

9.2.7 Patients' perception on the relevance of topics

There was no significant difference in patients' feelings of the relevance of the topics between patients who used the long and the short interviews (Table 6.9.8).

Table 6.9.8 : Frequency of patients' perceptions of the relevance of the topics in the information system, for patients who used the long and the short interviews.

	Long Interview n=120 No. (%)	Short Interview n=80 No. (%)	Total n=200 No. (%)
Topics relevance			
Not at all	0 (0)	1 (1)	1 (1)
Not very relevant	2 (2)	0 (0)	2 (1)
Moderately relevant	37 (32)	28 (35)	65 (33)
Very relevant	77 (66)	51 (64)	128 (65)
Total	116 (100)	80 (100)	196 (100)
Missing responses = 4		$\chi^2 = 0.14$ (df=1) $p = 0.7$	

9.2.8 Patients' satisfaction scores

Patients who used the short interview were more likely to feel that interacting with the computer more easier than patients who used the long interview (p = 0.03) (Table 6.9.9). Although not statistically significant, there was some suggestion that patients who used the short interview were more satisfied than those who used the long interview (p = 0.06).

Table 6.9.9 : Patients' mean outcome scores (the higher mean scores indicate more satisfaction of patients, minimum=1, maximum=4), for patients who used the long and the short interviews.

	Long Interview **n=120** Mean (SD)	**Short Interview** **n=80** Mean (SD)	*t*, p
Patients satisfaction			
Ease of use	3.63 (0.45)	3.72 (0.38)	-1.33, 0.2
Clarity	3.72 (0.49)	3.77 (0.42)	-0.88, 0.4
Confusion and no control[51]	1.60 (0.46)	1.73 (0.43)	-1.97, 0.05
Feelings of well-being	3.71 (0.40)	3.80 (0.35)	-1.59, 0.1
Usability	3.15 (0.33)	3.25 (0.30)	-2.14, **0.03**
Interest	3.57 (0.77)	3.55 (0.83)	0.16, 0.8
Utility	3.16 (0.42)	3.25 (0.45)	-1.37, 0.2
Relevance of topics	3.65 (0.51)	3.61 (0.56)	0.44, 0.7
Overall Patient Satisfaction	3.21 (0.28)	3.30 (0.32)	-1.84, 0.06

[51] minimum = 1; maximum = 2

10 A comparison of younger and older patients' reactions

Comparisons between the patients' characteristics and reactions of the 81 patients (41%), who were aged 50 years or less (age<=50years), and the 119 patients (59%), who were aged more than 50 years (age>50years), were performed.

10.1 Characteristics of patients

The mean age of patients who were less than 50 years was 37 (SD = 8), ranging from 16 to 50 years, while the mean age of patients who were more than 50 years was 66 (SD = 9), ranging from 51 to 89 years, ($p<0.001$) (Table 6.10.1). Cross-tabulations indicated that younger patients were more likely to move to the information system during the computer interview than older patients ($p<0.00001$). Similarly, younger patients were more likely to be computer users than older patients ($p<0.00001$). In addition, younger patients were more likely to have negative feelings than older patients ($p=0.03$) and that younger patients were more likely to be mouse users than older patients ($\chi^2 = 13$, df=1, $p=0.0004$).

Table 6.10.1 Characteristics of younger and older patients

	Age <= 50 years **n=81** No. (%)	**Age > 50 years** **n=119** No. (%)
Age		
Mean (SD)	37 (8)	66 (9)
	t = -23.97, p<0.001	
Gender		
Male	44 (54)	52 (44)
Female	37 (46)	67 (56)
	$\chi^2 = 2.2$ (df=1) p = 0.1	
Previous computer use		
Users	51 (63)	12 (10)
Non users	30 (37)	107 (90)
	$\chi^2 = 63$ (df=1) p < 0.00001	
Styles B and C		
Movers	26 (63)	10 (17)
Non-movers	15 (37)	49 (83)
Total[53]	41 (100)	59 (100)
	$\chi^2 = 23$ (df=1) p < 0.00001	
Medical Examination		
Breath test	3 (4)	13 (11)
Colonoscopy	24 (29)	35 (29)
Endoscopy	54 (67)	71 (60)
	$\chi^2 = 3.5$ (df=2) p = 0.2	
Emotional feelings		
Negative	51 (82)	61 (66)
Positive	11 (18)	31 (34)
	$\chi^2 = 4.8$ (df=1) p = 0.03	
Anxiety score		
Not anxious	25 (40)	51 (56)
Border-line	22 (36)	26 (28)
Anxious	15 (24)	15 (16)
	$\chi^2 = 3.5$ (df=2) p = 0.1	
Depression scores		
Not depressed	54 (87)	73 (79)
Border-line	4 (7)	15 (17)
Depressed	4 (6)	4 (4)
	Fisher's exact test, p = 0.7	

[53] Patients using Style A not included in the total.

10.2 Reactions of patients

Eighty patients (99%) who were 50 years old or less, felt that the computer was easy to use, compared with 102 patients (86%) who were more than 50 years old. There was evidence that younger patients were more likely to feel that using the computer was easier than did older patients ($\chi^2 = 36$; df=1 ; $p<0.00001$); ($p<0.001$, *t*-test, *Ease of use score*)[53] (Table 6.10.2). Similarly, younger patients were more likely to feel that the computer's instructions were clearer than did the older patients ($\chi^2 = 7$; df=1 ; $p=0.008$); ($p = 0.003$, *Clarity score*). Younger patients were more likely to perceive feelings of being able to remember more information when they have left the clinic than older patients ($\chi^2 = 9.6$; df=1; $p=0.002$).

Table 6.10.2 Patients' mean outcome scores (the higher mean scores indicate better performance, minimum=1; maximum=4), for younger and older patients.

	age<=50years **n=81** Mean (SD)	**age>50years** **n=119** Mean (SD)	*t*, p
Patients satisfaction			
Ease of use	3.87 (0.21)	3.53 (0.48)	7.03, **<0.001**
Clarity	3.85 (0.36)	3.67 (0.51)	2.96, **0.003**
Confusion and no control[54]	1.93 (0.24)	1.50 (0.47)	9.24, **<0.001**
Feelings of well-being	3.87 (0.29)	3.67 (0.41)	4.09, **<0.001**
Overall usability	3.39 (0.16)	3.06 (0.34)	9.43, **<0.001**
Interest	3.64 (0.73)	3.50 (0.83)	1.24, 0.2
Utility	3.29 (0.38)	3.14 (0.46)	2.59, **0.01**
Relevance of topics	3.70 (0.56)	3.59 (0.51)	1.57, 0.1
Overall Patient Satisfaction	3.40 (0.21)	3.14 (0.32)	6.94, **<0.001**

[53] Definition on page 189, section 7.3 in chapter IV.

[54] minimum = 1; maximum = 2

Similarly, younger patients were more likely to feel less confused than older patients when interacting with the computer ($\chi^2 = 40$; df=1; $p<0.00001$). Only 5 patients (6%) who were 50 years or less, felt confused compared with 76 patients (94%), who were more than 50 years old. Similarly, younger patients were less likely to feel confused and to be more in control when interacting with the computer than older patients ($p<0.001$, *t*-test, *Confusion and no control*)[56]. Furthermore, younger patients were likely to feel more comfortable and less embarrassed when being interviewed by the computer than older patients ($p<0.001$, *Feelings of well-being*). There was also a significant difference between younger patients and older patients in the overall usability scores ($p<0.001$, *Overall usability*).

Younger patients were likely to remember more information than older patients ($\chi^2 = 10$; df=1 ; $p = 0.001$). Sixty-six patients (81%) who were 50 years old or less felt that they would remember the information, either 'very much indeed' or 'quite a lot' compared to 68 patients (60%) who were more than 50 years old. Similarly, younger patients were likely to perceive more utility when interacting with the computer than older patients ($p = 0.01$, *Overall utility*). Finally, younger patients were likely to feel more satisfied than older patients when interacting with the computer ($p<0.001$, *Overall Patient Satisfaction*).

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[56] Definition on page 190, section 7.5 in chapter IV.

11 A comparison of male and female patients' reactions

Comparisons of patients' characteristics and reactions between the 96 male patients (48%) and the 104 female patients (52%) were performed.

11.1 Characteristics of patients

Twenty-two patients (61%) who moved to the information system during the computer interview were males, compared to 14 (39%) patients who were females. There was an indication that female patients were likely to be more anxious than male patients (p=0.02, *HADS anxiety scores*) (Table 6.11.1).

Table 6.11.1 : Characteristics of male and female patients.

	Male patients n=96 No. (%)	Female patients n=104 No. (%)
Age		
Mean (SD)	53.3 (17)	55.5 (16.6)
	$t = -0.94$, p=0.3	
Styles B and C		
Movers	22 (42)	14 (29)
Non-movers	30 (58)	34 (71)
Total	52 (100)	48 (100)
	$\chi^2 = 1.9$ (df=1) p = 0.2	
Previous computer use		
Users	31 (32)	32 (31)
Non users	65 (68)	72 (69)
	$\chi^2 = 0.05$ (df=1) p = 0.8	
Medical Examination		
Breath test	7 (7)	9 (9)
Colonoscopy	31 (32)	28 (27)
Endoscopy	58 (60)	67 (64)
	$\chi^2 = 0.73$ (df=2) p = 0.7	
Emotional feelings		
Negative	51 (69)	61 (76)
Positive	23 (31)	19 (24)
	$\chi^2 = 1.04$ (df=1) p = 0.3	
Anxiety score		
Not anxious	45 (61)	31 (39)
Border-line	18 (24)	30 (38)
Anxious	11 (15)	19 (24)
	$\chi^2 = 7.5$ (df=2) p = 0.02	
Depression scores		
Not depressed	62 (84)	65 (81)
Border-line	8 (11)	11 (14)
Depressed	4 (5)	4 (5)
	$\chi^2 = 0.01$ (df=1) p = 1	

11.2 Reactions of patients

Sixty-nine male patients (72%) felt that the computer was very easy to use, compared with 51 female patients (49%). There was evidence that male patients were more likely to feel that interacting with the computer was easier than female patients (χ^2 =10 ; df=1 ; p=0.0009); (p=0.008, *Ease of use*) (Table 6.11.2)[57]. Similarly, there was a significant difference between male patients and female patients in the overall usability scores (p=0.01, *Overall usability*). In addition, there was evidence that male patients were likely to feel less embarrassed while being interviewed by the computer than female patients (χ^2 =5 ; df=1 ; p = 0.02). Only 30 male patients (32%) had some degree of embarrassment compared to 49 female patients (48%).

Table 6.11.2 Patients' mean outcome scores (the higher mean scores indicate better performance, minimum=1; maximum=4), for male and female patients.

	Males **n=96** Mean (SD)	**Females** **n=104** Mean (SD)	*t*, p
Patients satisfaction			
Ease of use	3.75 (0.38)	3.59 (0.45)	2.67, **0.008**
Clarity	3.76 (0.43)	3.72 (0.49)	0.57, 0.6
Confusion and no control[58]	1.70 (0.43)	1.60 (0.47)	1.66, 0.1
Feelings of well-being	3.79 (0.38)	3.71 (0.39)	1.35, 0.2
Overall usability	3.25 (0.31)	3.14 (0.33)	2.57, **0.01**
Interest	3.55 (0.82)	3.57 (0.76)	-0.15, 0.9
Utility	3.19 (0.43)	3.20 (0.44)	-0.14, 0.9
Relevance of topics	3.60 (0.56)	3.67 (0.51)	-0.93, 0.4
Overall Patient Satisfaction	3.28 (0.31)	3.22 (0.30)	1.37, 0.2

[57] However, although male patients scored higher than female patients in clarity of computer instruction, in feelings of confusion and no control, and feelings of well-being, there was no significant difference between the genders.

[58] minimum = 1; maximum = 2

12 The effect of previous computer use to patient computer interaction

Comparisons between the patients' characteristics and the reactions of the 137 patients (68%) who were non-computer users, and the 63 patients (32%) who were computer users were performed.

12.1 Characteristics of patients

One-hundred and thirty-seven patients (68%) had never used a computer before the randomised study trial; 24 patients (12%) had used a computer occasionally; 20 patients (10%) had used a computer often; and 19 patients (10%) had used a computer daily. Younger patients were more likely to be computer users than older patients ($p<0.001$) (Table 6.12.1). Similarly, computer users within styles B and C were more likely to move to the information system, during the computer interview, than non-computer users ($p<0.00001$). In addition, computer users were more likely to be mouse users than non-computer users ($\chi^2 = 59$, df=1, $p<0.00001$).

Table 6.12.1 : Characteristics of patients who were computer users and those who were not computer users.

	Computer users n=69 No. (%)	Non-computer users n=131 No. (%)
Age		
Mean (SD)	40.8 (12.4)	60.7 (14.7)
	$t = 9.34$, $p<0.001$	
Gender		
Male	31 (49)	65 (47)
Female	32 (51)	72 (53)
	$\chi^2 = 0.05$ (df=1) $p = 0.8$	
Styles B and C		
Movers	22 (73)	14 (20)
Non-movers	8 (27)	56 (80)
Total	30 (100)	70 (100)
	$\chi^2 = 26$ (df=1) $p < 0.00001$	
Medical Examination		
Breath test	3 (5)	13 (9)
Colonoscopy	18 (28)	41 (30)
Endoscopy	42 (67)	83 (61)
	$\chi^2 = 1.5$ (df=2) $p = 0.5$	
Emotional feelings		
Negative	34 (76)	78 (72)
Positive	11 (24)	31 (28)
	$\chi^2 = 0.26$ (df=1) $p = 0.6$	
Anxiety score		
Not anxious	19 (42)	57 (52)
Border-line	16 (36)	32 (29)
Anxious	10 (22)	20 (18)
	$\chi^2 = 1.3$ (df=2) $p = 0.5$	
Depression scores		
Not depressed	41 (91)	86 (79)
Border-line	2 (5)	17 (16)
Depressed	2 (4)	6 (5)
	$\chi^2 = 3.9$ (df=2) $p = 0.1$	

12.2 Reactions of patients

Computer users were more likely to feel that interacting with the computer was easier than non-computer users (p<0.001, *Ease of use*) (Table 6.12.2). Similarly, computer users were more likely to feel that the computer instructions clearer than non-computer users (p = 0.006, *Clarity*).

Table 6.12.2 Patients' mean outcome scores (the higher mean scores indicate better performance, minimum=1; maximum=4), for patients who were computer users and those who were non-computer users.

	Computer users **n=63** Mean (SD)	**non users** **n=137** Mean (SD)	*t*, p
Patients satisfaction			
Ease of use	3.88 (0.21)	3.57 (0.46)	-6.45, **<0.001**
Clarity	3.86 (0.35)	3.69 (0.50)	-2.76, **0.006**
Confusion and no control[58]	1.94 (0.23)	1.51 (0.47)	-8.50, **<0.001**
Feelings of well-being	3.85 (0.29)	3.70 (0.41)	-3.03, **0.003**
Usability	3.38 (0.16)	3.10 (0.34)	-7.83, **<0.001**
Interest	3.62 (0.73)	3.53 (0.82)	-0.71, 0.5
Utility	3.26 (0.41)	3.17 (0.44)	-1.38, 0.2
Relevance of topics	3.65 (0.60)	3.62 (0.50)	-0.33, 0.7
Overall Patient Satisfaction	3.38 (0.22)	3.19 (0.32)	-5.11, **<0.001**

Three patients (5%) who were computer users felt confused compared to 59 patients (43%) who were non-computer users. There was evidence that patients who were computer users were less likely to be confused and more likely to be in control when interacting with the computer than patients who were non-computer users (p<0.001, *Feelings of confusion and no control*) (Table 6.12.2). Moreover, computer users were likely to feel more comfortable and less embarrassed while

[58] minimum = 1; maximum = 2

being interviewed by the computer than non-computer users ($p<0.01$, *Feelings of well-being*). Similarly, there was a significant difference in the overall usability scores between patients who were computer users and those who were not computer users ($p<0.001$, *Overall usability*).

Finally, computer users were likely to feel more satisfied when interacting with the computer than non-computer users ($p<0.001$, *Overall patient satisfaction*).

13 The effect of patients' emotional feelings to patient-computer interaction

Comparisons of patients' characteristics and reactions for the 112 patients (73%) who had negative feelings, and the 42 patients (23%) who had positive feelings were performed.

13.1 Characteristics and reactions of patients

Of the 154 patients who were given the Zuckermann Affect Adjective Checklist (ZAAC)[59], 112 patients' (73%) feelings were classified as 'negative' compared to only 42 patients (27%) whose feelings were classified as 'positive'. Most patients described themselves as nervous 43 (28%), tensed 32 (21%), or worried 15 (10%), due to the medical examination for which they were waiting for. There was an indication that the patients who felt negative were more likely to be younger (p=0.002) (Table 6.13.1) and more likely to be anxious (p=0.00004). However, there were no significant differences between patients' emotional feelings and any of the patient reaction outcome scores (Table 6.13.2).

[59] More information on ZAAC is on page 179 in chapter IV.

Table 6.13.1 : Characteristics of patients who had negative feelings and those who had positive feelings.

	Negative feelings n=112 No. (%)	Positive feelings n=42 No. (%)
Age		
Mean (SD)	52.4 (17.3)	61 (14.6)
	t = -3.12, p=0.002	
Gender		
Male	51 (46)	23 (55)
Female	61 (54)	19 (45)
	χ^2 = 0.21 (df=1) p = 0.6	
Previous computer use		
Users	34 (30)	11 (26)
Non users	78 (70)	31 (74)
	χ^2 = 0.26 (df=1) p = 0.6	
Styles B and C		
Movers	21 (37)	4 (19)
Non-movers	35 (63)	17 (81)
Total	56 (100)	21 (100)
	χ^2 = 2.4 (df=1) p = 0.1	
Medical Examination		
Breath test	9 (8)	2 (5)
Colonoscopy	42 (38)	10 (24)
Endoscopy	61 (54)	30 (71)
	χ^2 = 3.6 (df=2) p = 0.2	
Anxiety score		
Not anxious	47 (42)	29 (69)
Border-line	35 (31)	13 (31)
Anxious	30 (27)	0 (0)
	χ^2 = 16 (df=2) p = 0.0004	
Depression scores		
Not depressed	88 (79)	39 (93)
Border-line	16 (14)	3 (7)
Depressed	8 (7)	0 (0)
	χ^2 = 5 (df=2) p = 0.08	

Table 6.13.2 Patients' mean outcome scores (the higher mean scores indicate better performance (minimum=1; maximum=4), for patients who had negative feelings and patients who had positive feelings.

	Negative feelings **n=112** Mean (SD)	**Positive feelings** **n=42** Mean (SD)	*t*, p
Patients satisfaction			
Ease of use	3.67 (0.45)	3.60 (0.41)	0.85, 0.4
Clarity	3.75 (0.45)	3.60 (0.54)	1.69, 0.1
Confusion and no control[61]	1.66 (0.46)	1.56 (0.47)	1.23, 0.2
Feelings of well-being	3.74 (0.38)	3.83 (0.31)	-1.52, 0.1
Usability	3.19 (0.34)	3.18 (0.28)	0.27, 0.8
Interest	3.47 (0.84)	3.63 (0.73)	-1.19, 0.2
Utility	3.20 (0.46)	3.26 (0.39)	-0.74, 0.5
Relevance of topics	3.61 (0.58)	3.60 (0.50)	0.10, 0.9
Overall Patient Satisfaction	3.24 (0.33)	3.26 (0.26)	-0.39, 0.7

14 Patients' symptoms and topics viewed

Usually, patients who suffered from gastric related symptoms were selected for the randomised study trial[62]. The system's 'internal monitor' registered the patient's main symptom and any other symptoms (Screen 37). The researcher also asked the patient about his/her symptoms and listed them on the 'Introductory' questionnaire paper (Appendix VI). Asking the patient about his health and symptoms was normally a 'good' way to start a conversation with the patient and to make the patient feel 'relaxed' and in a 'friendly' environment. During such conversations, the researcher observed that most patients liked to talk about their symptoms and health concerns.

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[61] minimum = 1; maximum = 2

[62] However, one patient had no symptoms but was due to take an endoscopy examination as a check up.

Table 6.14.1 shows the frequency distribution of patients' main symptoms, with most patients (n=54; 27%) suffering from pain as their main symptom. Other patients suffered from heartburn (n=46; 23%); diarrhoea (n=38; 19%); vomiting (n=25; 12%); bleeding (n=15; 8%); wind (n=12; 6%) while the remaining (n=9; 6%) suffered from constipation, weight loss, poor appetite and general ill health. Most patients (n=162; 81%) suffered from several other symptoms besides their main symptom. The table also indicates the number of patients suffering from each symptom, in which this number also includes patients' main symptom. The majority of patients (n=134; 26%) suffered from pain, other prominent symptoms were heartburn (n=128; 25%), wind (n=83; 16%), and diarrhoea (n=52; 10%).

Table 6.14.1 : Frequency distribution of patients' main symptoms and the number of patients suffering from each symptom.

Symptoms	Main symptom No. (%)	Symptoms No. (% of 200)
Pain	54 (27)	134 (67)
Heartburn	46 (23)	128 (64)
Diarrhoea	38 (19)	52 (26)
Vomiting	25 (12)	29 (15)
Bleeding	15 (8)	21 (11)
Wind	12 (6)	83 (42)
Constipation	3 (2)	24 (12)
Weight loss	3 (2)	22 (11)
Poor appetite	2 (1)	9 (5)
General ill health	1 (1)	21 (11)
Total (100)	199 (100)[63]	523 (266)

[63] Usually only patients with symptoms were asked to participate in the study trial, however, one patient had no symptoms.

Of the 200 patients; 121 patients (61%) looked at a topic in the GLADYS information system which was the same as their main symptom; 124 patients (62%) looked at a topic which was one of their symptoms and this included their main symptom; and 120 patients (60%) looked at a topic which was about the medical examination the patient was waiting for at the clinic, either an endoscopy examination or a colonoscopy examination.

Patients viewed 47 topics (21%) of the 228 topics provided in the GLADYS information system for styles A and B[64]. The majority of patients (n=72, 36%) viewed 2 topics; 68 patients (34%) viewed one topic; 40 patients (20%) viewed 3 topics; 14 patients (7%) viewed 4 topics; 5 patients (3%) viewed 5 topics and one patient viewed 8 topics. However, the amount of information within each topic differed from that within other topics: for example, 'heartburn' had several screens of information while 'appendix' had only one screen. Similarly, patients' characteristics differed. For example, some patients quickly browsed through the topics for interest or curiosity to see what was offered, while others took time to read the contents of each screen on a particular topic. Table 6.14.2 represents the frequency of the topics viewed by patients. Popular topics viewed by patients were: heartburn (n=68; 16%); endoscopy examination (n=50; 12%); diarrhoea (n=41; 10%); wind (n=34; 8%); and colonoscopy examination (n=32; 7%).

[64] Topics were chosen according to patients' symptoms and responses for style C.

Table 6.14.2 : Frequency of the topics viewed by patients in the information system

Topics	Number of times viewed No. (% of 200)
Heartburn	68 (34)
Endoscopy examination	50 (25)
Diarrhoea	41 (21)
Wind	34 (17)
Colonoscopy examination	32 (16)
Ulcer	17 (9)
Irritable bowel syndrome	17 (9)
Duodenal ulcer	16 (8)
Constipation	15 (8)
Vomiting	14 (7)
Dyspepsia	14 (7)
Gastric ulcer	13 (7)
Stress	11 (6)
Fibre diet	10 (5)
Hiatus hernia	9 (5)
Barium meal	7 (4)
Antacids	5 (3)
Zantac	4 (2)
Drugs	3 (2)
Exercise	3 (2)
Bowels	3 (2)
Crohn's disease	3 (2)
Abdominal pain	3 (2)
Alcohol	2 (1)
Food poisoning	2 (1)
Beer	2 (1)
Diet	2 (1)
Indigestion	2 (1)
Ulcerative colitis	2 (1)
Helicobacter pylori	2 (1)
Weight loss	2 (1)
Fat	2 (1)
Gaviscon	2 (1)
Total (%)	412 (206)

The following were the topics which were viewed only once : gastric, colitis, peptic ulcer, windcheaters[65], cereals, appendix, high blood pressure, oesophagitis,

[65] Windcheaters is the name of a medication that is sold at the pharmacy, Boots, which helps to reduce tummy gas.

headaches, digestion, peptic ulcer, abdomen, stoma ulcer, gastric polyps, oesophagus, barium, gastritis.

Heartburn was the second main symptom from which 46 patients (23%) suffered. Heartburn was also one of the symptoms from which most patients (n=128; 25%) suffered. Moreover, heartburn was the topic which was viewed by most patients (n=68; 16%). Popular topics which were viewed, such as diarrhoea (n=41; 10%), and wind (n=34; 8%), were also one of the symptoms suffered by many patients; 83 patients (16%) suffered from wind, while 52 patients (10%) suffered from diarrhoea. Other popular topics viewed were endoscopy examination (n=50; 12%), and colonoscopy examination (n=32; 7%) (Table 6.14.2), where 125 patients (62%) were waiting for an endoscopy examination and 59 patients (30%) were waiting for a colonoscopy examination. It may be suggested therefore, that patients were more likely to view topics which were related to their health issues, such as symptoms and medical examinations.

15 Patients' evaluation of questionnaires

Comparisons of patients' evaluations between the 120 patients who used a paper questionnaire and the 80 patients who used an on-line questionnaire were performed.

15.1 Patients' evaluation of the questionnaires

To compare patients' evaluations of the questionnaires for the 120 patients who used the paper questionnaire and the 80 patients who used the on-line questionnaire, patients were asked to fill in a standard paper questionnaire entitled, 'Patient's evaluation of questionnaire' (Appendix IX). Patients were asked to fill in this questionnaire after they had answered the 'Study Trial' standard paper questionnaire or the on-line questionnaire. Patients were selected by the researcher depending on the availability of the time remaining and the willingness of the patient. Fifty patients who used the 'Study Trial' paper questionnaire and another 50 patients who used the on-line questionnaire were selected.

Table 6.15.1 represents the patients' responses to both the paper and the on-line questionnaires. The majority of the patients (n=81, 81%), felt that the questions in both types of questionnaires were 'very easy' to understand. Most of the patients (n=73, 73%), felt that the questions were 'very relevant', and 76 patients (76%) indicated that the questions were 'not at all' difficult. Patients who used the paper questionnaire were likely to feel that it took a longer time, compared with those who used the on-line questionnaire (p=0.00004). Most of the patients (n=80, 80%) indicated that the questions were 'not at all' confusing. There was evidence that patients who were given the on-line questionnaire were likely to feel less confused than those who were given the paper questionnaire (p=0.04). Patients who were given the on-line questionnaire were likely to prefer a computer questionnaire than patients who were given the paper questionnaire (p=0.02). Thirty patients (61%)

Table 6.15.1 : Frequency of patients' views of the paper questionnaire and the on-line questionnaire.

	Paper questionnaire No. (%)	On-line questionnaire No. (%)	Total No. (%)
Questionnaire easy to understand ?			
Very easy	42 (84)	39 (78)	81 (81)
Moderately easy	8 (16)	10 (20)	18 (18)
Not very easy	0 (0)	1 (2)	1 (1)
Not at all	0 (0)	0 (0)	0 (0)
Total (%)	50 (100)	50 (100)	100 (100)
	$\chi^2 = 0.6$ (df=1)	$p = 0.4$	
Options for answers relevant?			
Very relevant	34 (68)	39 (78)	73 (73)
Moderately relevant	16 (32)	10 (20)	26 (26)
Not very relevant	0 (0)	1 (2)	1 (1)
Not at all	0 (0)	0 (0)	0 (0)
Total (%)	50 (100)	50 (100)	100 (100)
	$\chi^2 = 1.6$ (df=1)	$p = 0.2$	
Questionnaire difficult to answer?			
Very difficult	0 (0)	0 (0)	0 (0)
Moderately difficult	2 (4)	2 (4)	4 (4)
Not very difficult	13 (26)	7 (14)	20 (20)
Not at all	35 (70)	41 (82)	76 (76)
Total (%)	50 (100)	50 (100)	100 (100)
	$\chi^2 = 1.9$ (df=1)	$p = 0.1$	
Questionnaire too long?			
Very long	1 (2)	0 (0)	1 (1)
Moderately long	10 (20)	3 (6)	13 (13)
Not very long	19 (38)	7 (14)	26 (26)
Not at all	20 (40)	40 (80)	60 (60)
Total (%)	50 (100)	50 (100)	100 (100)
	$\chi^2 = 17$ (df=1)	$p = 0.00004$	
Questionnaire confusing to answer?			
Very confusing	0 (0)	0 (0)	0 (0)
Moderately confusing	1 (2)	2 (4)	3 (3)
Not very confusing	13 (26)	4 (8)	17 (17)
Not at all	36 (72)	44 (88)	80 (80)
Total (%)	50 (100)	50 (100)	100 (100)
	$\chi^2 = 4$ (df=1)	$p = 0.04$	
Which style of questionnaire do you prefer?			
Paper questionnaire	9 (18)	6 (12)	15 (15)
Computer questionnaire	16 (32)	30 (61)	46 (47)
Interviewed verbally	12 (24)	9 (19)	21 (21)
Any style or don't know	13 (26)	4 (8)	17 (17)
Total (%)	50 (100)	49 (100)	99 (100)[66]
	$\chi^2 = 10$ (df=3)	$p = 0.02$	

[66] One patient who used the on-line questionnaire commented that she preferred both styles of questionnaires, first a computer questionnaire, then a paper questionnaire.

who were given the on-line questionnaire preferred a computer questionnaire compared to 16 patients (32%) who were given the paper questionnaire.

Cross-tabulations showed significant differences between younger[67] and older[68] patients and the ease in understanding questions (χ^2=9; df=1; p=0.003); and the difficulty in answering the questions (χ^2 = 5; df=1; p=0.02). Younger patients were also likely to prefer a computer questionnaire than a paper questionnaire (χ^2= 22.7; df=3; p<0.00001). Twenty-nine patients (30%) who were younger preferred the computer questionnaire, compared to 17 patients (17%) who were older. Whereas, older patients were more likely to prefer to be verbally interviewed compared to younger patients. Nineteen patients (19%) who preferred to be verbally interviewed were older, compared to 2 patients (2%) who were younger. In addition, older patients were more likely to prefer to answer a paper questionnaire than younger patients. Thirteen patients (13%) who were older preferred to answer in a paper questionnaire compared to 2 patients (2%) who were younger. Moreover, 10 patients (10%) who were older preferred any style of interviewing, or did not have any particular preference, compared to 7 patients (7%) who were younger who had the same preference.

[67] Patients who were 50 years or less.

[68] Patients who were more than 50 years.

16 Patients' comments

The following are patients' comments which were extracted from the questionnaires. The comments are divided into six aspects according to their relevance. These are usability, interest, perceived utility, topics' relevance, patient satisfaction and miscellaneous. For each patient, gender, age and the style of computer interaction used is noted.

Usability

- "The language terminology, colours and the ability to touch the screen made it very simple." Female, 31 years, Style A

- "Method of interview was rather relaxing." Female, 61 years, Style A.

- "Very interesting, I got to be quite good at it." Female, 78 years, Style C. (Non Mover)

- "Computer interviewing is less embarrassing than being asked by the doctor. Patients have less inhibitions towards a machine than towards a doctor on questions such as passing wind." Female, 64 years, Style B. (Non Mover)

- "Interesting, simple and very easy to understand." Male, 59 years, Style B. (Non Mover)

- "Not sure how patients with no computer knowledge or little English would cope" Female, 49 years, Style B. (Mover)

- "I got to be quite good with this computer" Male, 36 years, Style C. (Mover)

Interest

- "Interesting, but I am no computer buff." Male, 33 years, Style A.

- "Enjoyed the experience. Very nice design, holds patient's attention." Male, 33 years, Style B. (Mover)

- "The whole interview was very interesting." Male, 65 years, Style A.

- "Very interesting, good and professional work." Female, 44 years, Style A.

- "It was quite interesting and good. I enjoyed that." Female, 72 years, Style C. (Non Mover)

- "Very interesting." Female, 73 years, Style C. (Non Mover)

- "Its quite interesting, kept my mind away from the examination." Female, 54 years, Style B. (Non Mover)

- "Very interesting." Female, 59 years, Style B. (Non Mover)

Perceived Utility

- "Very interesting and useful, the computer had a lot of useful information I didn't know." Male, 43 years, Style A.

- "Very interesting, I found interesting details about my illness." Female, 51 years, Style C. (Non Mover)

- "This package was most useful." Female, 40 years, Style B. (Mover)

- "The information in the computer was very interesting and useful." Male, 25 years, Style B. (Mover)

- "The system is very good and was a great help." Male, 42 years, Style C. (Mover)

- "I enjoyed using the computer. It was very helpful." Female, 22 years, Style C. (Mover)

Topics relevance

- "The idea of getting information on your illness is very helpful." Female, 24 years, Style B. (Mover)

- "Its very interesting and good, I wish I had loads of time to look at more topics." Female, 57 years, Style A.

- "Its very interesting. It reminds you of all the things you forget to ask the doctor." Male, 62 years, Style C. (Mover)

- "Its terrific, a lot of questions you would like to ask the doctor have been displayed in front of you, and the ease of access to redeem the information is excellent." Male, 47 years, Style B. (Non Mover)

Patient satisfaction

- "I had great fun with the computer" Female, 69 years, Style A.

- "Very clever, a marvellous idea to be questioned by the computer." Female, 67 years, Style A.

- "It takes your mind off your examination." Male, 32 years, Style A.

- "Thoroughly enjoyed using the computer." Female, 49 years, Style C. (Non Mover)

- "I liked the computer, it was very good and very helpful." Female, 70 years, Style C. (Non Mover)

- "Its pleasant, helps to pass the waiting time." Female, 67 years, Style C. (Non Mover)

- "I think its most pleasant. I liked this system." Female, 45 years, Style C. (Non Mover)

- "Enjoyed working with the computer; good programme, kept my mind away from the endoscopy examination." Female, 33 years, Style B. (Non Mover)

- "Enjoyed the computer." Male, 43 years, Style C. (Non Mover)

- "Enjoyed working with the program." Male, 44 years, Style C. (Mover)

- "I think its great, very good." Male, 66 years, Style C. (Mover)

- "Very interesting, enjoyed the experience." Female, 67 years, Style C. (Mover)

- "Its very good, if I had the cash I'll buy it." Male, 52 years, Style B. (Non Mover)

- "Its pleasant, helps to pass the waiting time." Female, 67 years, Style C. (Non Mover)

Miscellaneous

- "I'll get GLADYS for Christmas." Female, 52 years, Style A.

- "Would have found it easier in a different environment. I was tensed up and this affected my concentration and attitude towards the exercise." Male, 67 years, Style C. (Mover)

- "If by filling in a computer interview, it will cut down the load for doctors, I am all in favour for computer interviewing." Female, 64 years, Style A.

- "A computer is better than a book, because it is interactive, you learn more by being interactive." Male, 22 years, Style B. (Mover)

- "More time is needed to use the computer." Male, 62 years, Style B. (Mover)

- "lack of time" Female, 68 years, Style C. (Non Mover)

- "Very interesting, its a pleasure, I would have found it better if I had the time." Male, 68 years, Style C. (Non Mover)

Chapter VII

Discussion

"There is no doubt that if we introduce technology crudely and insensitively then we will get it wrong. But if we introduce it step by step, carefully watching progress and identifying mistakes then we can realistically hope for a technological evolution which is acceptable."

Fox and Frost (1985)

Contents

1. Introduction

Computer patient interviewing, and in this particular case an interview about dyspepsia, has been successfully used for many years (Jones and Knill-Jones, 1994). Computer interviewing has been found highly acceptable to patients (Al-Barwani et al., 1997; Carr and Gosh, 1983; Dove et al., 1977; Lucas, 1976; Lucas et al., 1977; Fawdry, 1989) and there is some evidence that the replies given may be more truthful and accurate than in a conventional interview (Lucas et al., 1977; Holt, 1992). Patient education has also been successfully achieved using computers (Gillispie and Ellis, 1993; Kahn, 1993; Skinner et al., 1993; Anderson-Harper, 1994; Chambers and Frisby, 1995). It would seem sensible then to try to at least develop similar interfaces so that patients, the majority of whom in Scotland in 1996 have not had any contact with computers, will find these systems easy to use. Some of the existing computer interviews may be too long and patients may have questions they want to ask during the computer interrogation or may lose interest. Moreover, patient compliance is a significant problem and is strongly correlated with patients' understanding of common medical terms used in medical consultations and of their condition and prescribed treatment (Eraker et al, 1984; Byrne and Edeani, 1983; Spiro and Heidrich, 1983; Ley, 1988). Since doctors typically do not have adequate time to educate patients (Wilson, 1992), and impersonal, written materials for patients may be largely ineffective and misunderstood (Davis et al., 1990; 1994; Jolly et al., 1993), the use of a patient workstation which combines computer interviewing and computer-based information system to generate tailored interactive information to communicate with patients, was proposed in this study.

2 General discussion

The new Toolbook GLADYS system was evaluated from the perspective of the user. Measuring patient acceptability has been used in numerous evaluation studies of clinical interview and information systems (Jones et al., 1996b; Lucas, 1977; Card and Lucas, 1981; O'Connor et al., 1989; Mercer and Sweeney, 1995; Levitan et al., 1991; Mathisen et al., 1987; Wetstone et al., 1985; Kinzie et al., 1993). Lucas (1977) suggested that the attitudes of patients, who are the users, are of the utmost importance in the evaluation of computer interviews. An earlier GLADYS version was evaluated by measuring '*patients' acceptability*'[1], which was one of the criteria suggested by Card and Lucas (1981) in the evaluation of computer interrogation systems.

Evaluating the new GLADYS system from the perspective of the patients' viewpoint was essential when investigating the design and the use of a patient workstation in a gastro-enterology clinic. In particular while investigating patient-computer interaction which combined computer interrogation of the patient with patient interrogation of the computer. The question that this study addressed was

[1] The other two criteria suggested by Card and Lucas (1981) in the evaluation of computer interrogation systems were: the *accuracy* of the system and the *cost* to develop and implement the system. However, these two criteria were not used for this study as they were irrelevant.

whether patients should be offered more 'freedom' in their interaction such that, they could stop or 'interrupt' the interview to find out information.

2.1 Potential advantage of style B approach

Most patients understood all the terms in the GLADYS interview[2] because the questions have been developed over many years and much consideration has been given to the development of the questionnaire. It might be reasonable to assume that, if this study had taken the same *existing* interviewing system but changed the text within the questions where explanations of the terms were eliminated, then the number of terms not understood by patients, while being interviewed by the system, most probably would have increased. This would have encouraged more patients to move to the information system in search of explanations of the terms and thereby change the results of the study where it would be even more 'better' to have access to the information system during the interview. By being 'better' in this context is by scoring more, not only in interest (Table 6.8.6 and Table 6.8.9), but also in 'perceived utility' for patients who interrupted the computer interview and seeked information. Therefore, a *style B* approach may be much more important to a *new system* than an *existing* interviewing system, where there might be still doubt as to whether or not patients understood all the terms. A *style B* approach would be useful when constructing the computer interview, where developers could take advantage of the *style B* approach to filter frequently misunderstood terms when piloting the computer interview. In addition, *style B*

[2] Only four patients within this study had not understood all the terms (Table 6.5.1).

might create more interest among patients both to *new systems* and to *existing systems*, where the computer interviews may be too long and patients may have questions they want to ask during the computer interrogation.

2.2 The average patient and style B approach

We are in the 'information' age, with rapid changes and advances in information technology, and, although, the microcomputer is only about two decades old, there is rapid increase in computer literacy among patients in the developed countries. The *Internet* has also become the 'information superhighway' with over 50 million computer users world-wide, and with a growing number of new users between one and two million per month (Brettle, 1997; Jimison and Sher, 1996; Benjamin et al., 1996). Multitasking and hypertext links, providing specific information helpful to the user, have become popular for regular computer users. They have become accustomed to 'multitasking', for example switching from word-processing to the use of a spreadsheet and back, and to hypertext links. It might seem logical, therefore, to allow the 'facility' of being able to interrupt a computer interrogation as patients too may have questions to ask the computer. It has also been suggested that many of the major changes that will take place in medicine over the next decade will be in response to the information revolution and the accompanying advances in information technology (McManus, 1991).

The findings of this study have demonstrated that although the *average* patient in a gastro-enterology clinic in Glasgow, and probably the United Kingdom, is more likely to be computer illiterate, there was significant difference between younger and older patients in computer literacy. Younger patients were more likely to be computer literate than older patients. However, within a few years the *average* patient would be computer literate just as today's younger patient and/or computer user. This is due to the rapid technological advancements and increase in computer literacy in general, especially within developed countries.

We may consider that this is the time of transition. The time of moving from designing computer interviews with *style A* approach to designing computer interviews with *style B* approach. Furthermore, the design of computer interviews for the year 2000 and beyond, need to be flexible and adaptive to the needs and preferences of different individuals with numerous opportunities for user interaction, and available to participants at the time of need and place of convenience. However, in order to design computer interviews for the user, we first need to know the user. Therefore, not only do we need a stylistic presentation to help guide future research, but also a theory for respondents. That is, in what ways do individuals differ, that make some receptive to one approach and others receptive to a different approach? The efficacy of patient interviewing systems depend crucially on the content of the computer questionnaire, the health information provided, the type of patient and the style of interaction. As we are entering the new millennium, the concept of a 'patient workstation' is a worthwhile goal to pursue.

2.3 Validity and limitations of the study

This study has provided useful baseline information in determining the best approach to style of interaction, in identifying the potential user, and in factors affecting successful patient-computer interaction. However, there were a number of limitations to the study. This is because the randomised study trial was developed under difficult circumstances, with problems of work and time pressures within the gastro-enterology unit, at the Victoria Infirmary. Changes had to be made during the study to avoid time constraints, as time within the unit was crucial. Therefore, in order to continue working at the unit, it was necessary to adapt the study to the unit's environment. Other limitations included the recruitment of patients and the size of the population sample.

2.3.1 Changes made

Patients at the gastro-enterology unit were asked to use the computer while waiting to take an endoscopy or a colonoscopy medical examination, and therefore they were slightly uncomfortable, anxious and with limited time. After three weeks of the randomised study trial, it was felt that within such an environment, it was necessary to measure the patients' levels of anxiety and emotional feelings, since anxiety and depression can influence patients' ability to retain information and their motivation to learn (Phillips, 1986). Therefore, it was assumed that patients' emotional feelings might have an adverse affect on their performance and attitude towards the computer. The remaining 154 patients were given the Hospital Anxiety and Depression Scale (HADS) (Zigmond and Snaith, 1983) and the Zuckerman

Affect Adjective Checklist (ZAAC) (Zuckerman and Lubin, 1965). These two standard measures were very short (Appendices IV and V), and although the total time spent by the patient with the study would have increased slightly, this was unlikely to have an impact on the study findings. Moreover, there was no evidence that patients' emotional feelings had an affect on any of the patients' reaction outcome scores (Table 6.13.2).

Besides patients being slightly uncomfortable, anxious and with limited time, the staff too were under problems of work and time pressures. To avoid time constraints and to help create a more relaxed atmosphere, changes had to be made during the study trial so as to shorten the time period of the trials. With the longer GLADYS computer interview, some patients, especially the older ones, needed more time than was available. Moreover, the nurses were sometimes annoyed from waiting for such patients, because they had to prepare them for their medical examinations, and time was critical. From such incidents the researcher observed that, not only the nurses felt irritated, but also the patients felt rushed to finish the study trials, and some may have avoided to look at more information within the GLADYS system. To avoid such constraints and to create a more tolerable atmosphere, after two months of the randomised study trial, the remaining 80 patients had to be given a shorter version of the GLADYS interview and an on-line 'Study Trial' questionnaire. From the researchers observations and findings, these two changes shortened the time spent for each study trial (Tables 6.3.5 and 6.3.6), and this was found to be more satisfactory among the patients and the medical staff. The on-line questionnaire also helped to avoid missing responses among some of the patients who used the paper 'Study Trial' questionnaire (Appendices VII and VIII), as well as reduce time and confusion (Table 6.15.1).

However, these two changes had no impact in determining the best approach to style of interaction, which is the main objective of this study. There were no significant differences between the type of computer interview (long vs short) used across styles (A vs B vs C) and between styles (A and BC) (Table 6.2.5), and in the proportion of patients who were 'movers' and 'non movers' by length of interview (Table 6.7.2). There was also no significant difference in the overall patients' satisfaction between patients who used the long and the short interviews. However, there was significant difference in usability between the two groups (Table 6.9.8). Patients who used the short interview were more likely to feel that interacting with the computer was more easier than patients who used the long interview. There was also significant difference between the total computer time spent by patients who used the long interview and those who used the short interview (Tables 6.3.5 and 6.3.6). However, all these differences had no impact in determining the overall patients' satisfaction between the styles, and therefore in determining the best approach to style of interaction.

2.3.2 Selection of patients

Another limitation of the study was with the selection of patients. Patients were selected for the randomised study trial while they were waiting for their medical examination. However, the numbers of patients who refused to participate in the study were not defined. This is because the nurses were not asked to keep a record of patients' refusals, and had no systematic method in the style of asking the patients. It was decided by the medical staff at the unit, that only the nurses would ask the patients if they were willing to participate in the randomised study trial. There were several nurses (four or five) who asked the patients whether or not they would like to participate in the randomised study trial depending on who was on duty. However, the nurses were working under problems of work and time pressures. To recruit sufficient patients, the researcher had to work with two patients using two computers within the 'tea' room, and therefore was unable at the same time to be at the reception area, where the patients were asked by the nurses, to keep a record of patients' refusals. However, this was not funded research, which if otherwise would probably have had more people working for the research within the gastro-enterology unit.

Therefore, the selection of patients was from a convenience sample, which was then randomised to one of the three styles. Not all the patients who attended the unit were asked to participate in the randomised study trial. On a normal day, usually the first two patients who were due for their medical examination were not asked, and only patients who had some waiting time period before their medical examination were asked. There was some indication from the nurses that most patients were willing to participate in the study, and that refusals were very few. The most common reason for refusals was due to fasting, as some patients did not feel well enough to interact with the computer. Other reasons for refusals included that some patients had forgotten their reading glasses, or lacked interest in participating with the study. Some patients may have had some reading difficulties, and may have exempted themselves from the study. However, reasons due to reading difficulties were never mentioned by the nurses.

2.3.3 Sample Size

Perhaps the most important finding of this study was that, there was no difference in patients' satisfaction between computer interrogation of the patient, and patient interrogation of the computer kept completely separate and when combined, by allowing the patient to interrupt the computer interrogation to seek health information. However, sample sizes were calculated on the basis of a comparison between style A and styles B and C combined for any one of the characteristics investigated (for example feelings of confusion). The sample size was based on the difference in two proportions. Sample sizes of 100 for style A and 100 for B and C combined gave an 80% power to detect a difference of 20% between the two proportions at the 5% level of significance (Machin and Campbell, 1987). However, if the power was 80% then Beta (β), the type 2 error, would be 20%. This meant that there was a 20% chance in the study of failing to detect differences between the two styles which would be important in practice. Therefore, it would have been better from the statistical point of view to have a much larger sample size than 200, with sample sizes larger than 100 in each style, so that smaller differences than 20% would have been detected between the two styles. Therefore, larger sample sizes within each style would have had an impact on the study findings and conclusions. Similarly, differences between styles B and C were investigated, but with sample sizes of 50 from each style only larger differences of, for example between 30% and 57% were detected as significant. However, due to practical constraints it was not feasible to achieve larger sample sizes. The study may indicate that differences may exist, and would then be worthy of further study.

2.3.4 Other limitations

Another limitation of the study findings is that, it is extremely difficult to generalise across medical clinics and patient groups. This is because the type of patients vary within different clinics. For example, the study findings would vary between patients at an antenatal clinic who may react more like patients classified as younger patients (age<=50 years) within this study, and patients at a lung cancer unit who may react more like patients classified as older patients (age>50 years)[3]. Moreover, patients within different socio-economic background may also differ in computer literacy. For example, we may assume that, in general poorer patients may be less computer literate than wealthier patients. Similarly, patients who attend a gastro-entroenterology clinic at a private hospital may be more computer literate than patients who attend a gastro-entroenterology clinic at a public hospital. Moreover, not only computer literacy may differ between patients within different

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[3] Patients at an antenatel clinic would normally be women at child bearing age and lung cancer is normally a disease of the elderly people.

clinic, but also their reading ability. Davis (1990) found that there was significant difference in the reading ability between patients within different clinics. The mean reading comprehension among patients tested ranged from 5th grade 4th month in the community clinic to 10th grade 8th month in the private practice. Forty percent of all public clinic patients tested were reading below a 5th grade level and could be considered severely illiterate. In contrast, only one (3%) of the private patients was reading at this level.

Perhaps the most important finding of this study was that, there was no difference in patient satisfaction between computer interrogation of the patient, and patient interrogation of the computer kept completely separate, and when combined by allowing the patient to interrupt the computer interrogation to seek health information. However, there was evidence that some patients, mostly younger and computer users, would use the facility to seek information during the computer interview, and this will enable them to be more interested with the resultant interaction. The study findings showed that, there was no significant difference between patients who were offered the 'interrupt' facility during the computer interview, but chose not to use it, and patients who were not offered the 'interrupt' facility. These patients were mostly older and non-computer users, which indicated that *Style A* approach would be more appropriate to such patients. Such patients were more likely to prefer to focus on learning how to do 'one thing at a time', rather than having to learn 'several things at a time'.

We may assume that if the patients perceive interacting with the computer to be of more interest or value, they will continue to use the package. Studies have also shown that by involving patients actively in consultations can maximise their fullest potential in self-care and that patient care should encourage the patient to take an active role in the consultation process (Street et al., 1995; Skinner et al, 1993; Armstrong, 1989; Greenfield, 1985).

The findings of this study, that only 36% of the patients chose to seek information during the computer interview, may vary in future studies. Variation may occur not only between patients within different clinics, but also:

a) If the text within the interviewing system did not provide explanations to terms or the interviewing system was *originally designed* to accommodate the information system. Within such a design 'perceived utility' between *style A* and *style B* would likely be significant when allowing patients in *style B* the facility to interrupt the computer interview to seek information in the information system. For example, in the case of GLADYS, the system was originally designed to work independently from the 'interrupt facility'. However, if the GLADYS questions were to be redesigned to eliminate explanations currently embedded in many of them, explanations would depend on the information system. There then might be significant differences in perceived utility between styles A and B in having an interrupt facility. Such a system not only would provide more interest amongst patients, but also flexibility where patients could ask the computer questions they may have felt either embarrassed to ask the doctor, or have forgotten to ask due to lack of time.

b) Within a new system which was *originally designed* to accommodate a facility to seek information. For example, the *Cancer* system (Jones et al., 1996b) is an information retrieval system only, and is quite unlike GLADYS, where more 'technical' terms were used in the system as the starting point for explanation. Therefore, it would be reasonable to assume that the findings of the evaluation study[4] of the *Cancer* system would be different from the findings of this study. Another point worth considering, is that, since the *Cancer* system is for information retrieval only, while using the system, the patient's mind would be normally focused on seeking information. On the other hand, while interacting with the GLADYS interview system, the patient's mind would normally be focused on responding to the computer interrogation.

From the study findings we can conclude that computer interviews with a *style B* approach, where a patient can 'interrupt' the computer interview to seek information, is an acceptable method for obtaining patients' information needed by clinical staff, and for enhancing interest for patients while being interrogated by the computer, and for providing relevant health education needed by the patients. In addition, the study has provided useful baseline information in identifying the potential patient and in factors affecting successful patient-computer interaction.

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[4] Evaluation study of the *Cancer* system is in progress at the Beaton Oncology clinic, Western Infirmary, Glasgow.

However, in determining the best style of interaction, it should be taken into account in future applications that it is extremely difficult to generalise across medical clinics and patient groups, as the type of patients would vary within different clinics; for example, in age, computer literacy, and reading ability. Nevertheless, as demonstrated later within this chapter, that in designing computer interfaces for computer interviews, an adaptive[5] *style B* approach can be considered 'better' than a *style A* approach, and that an adaptive *style C* approach can be considered even 'better' than an adaptive *style B* approach.

2.4 Potential advantage of the new GLADYS system

The new GLADYS system with *style B* approach, might prove to be an efficient way to enhance the doctor-patient interaction, by eliciting information from the patient and at the same time providing educational information to the patient before consultation. Patients' knowledge and understanding will be enhanced by using the GLADYS system (Table 6.4.25), and this will hopefully enhance patient-doctor consultation. The aim is that, doctors whose patients use the GLADYS program would have more time available to concentrate on aspects of the patient consultation, which require the expertise and flexibility that only a human being can offer. Further research is needed to measure the effectiveness of using the new GLADYS system with *style B* approach to patient-doctor consultation. This would of course, require evaluation of the system in routine practice with more patients and within a longer period of time. Probabilities for diagnoses and suggested

[5] A system which adapts itself to the user's needs and preferences. For example, an adaptive style B system can adapt itself to a style A system.

therapy of the patients should be provided by the system. Here future advantages and disadvantages of the GLADYS system might be revealed in areas such as, the effectiveness of the system to help patients gain an accurate understanding of their symptoms and treatments before meeting with physicians, and, the accuracy and effectiveness of the information produced by the system and future research selection processes.

A previous study by Street et al. (1995), which measured the effectiveness of a multimedia program on early breast cancer, showed that the multimedia program proved to be an effective clinical strategy for helping patients gain an accurate understanding of their treatment options before meeting with physicians. Patients tended to learn more about breast cancer treatment after using the multimedia program than after reading the brochure, even though, there was no significant difference in the knowledge retention of patients who used a multimedia program about breast cancer treatment and those who were provided with a brochure. The new GLADYS system using *style B* approach system, when used in routine practice, would not be intended to replace the patient-clinician interaction but rather to enhance it by asking routine questions once only by the computer, and providing the patient access to information relevant to his symptoms and life-style behaviour.

3 Patient acceptability

The new GLADYS system was designed to have a consistent and simple interface that could be easily grasped by inexperienced computer users. This allowed patients to concentrate on answering the questions and obtaining relevant health information rather than on using the computer program. Patients' comments suggested that the goal of designing a simple, interesting and colourful interface, which held patients' attention during computer interaction was achieved. Patients' comments also indicated that they enjoyed working with the program and the touch screen technology. Also indicated by patients' comments, the friendly, simple and personalised style of the interface helped to remove some of the alienation and anxiety of which some of the patients felt at the clinic.

The GLADYS system was well accepted by patients of all ages in a gastro-enterology clinic, even though younger patients and computer users were more favourable towards the system than older patients and non-computer users. Patients could choose to use the mouse or the touch screen as input device. Both the mouse and the touch screen proved to be acceptable and required minimal instruction. Younger patients and computer users preferred to use the mouse compared to older patients and non-computer users[6]. Similarly, Ostroff and Shneiderman (1988) and Karat et al. (1986) found that computer users preferred to use the touch screen compared to the keyboard or the mouse. Paterson and Adamson (1992) found that older adults' comments about the mouse showed

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[6] These two findings are independent of each other.

restrictions in its use. Jones et al. (1993b) and Williams et al. (1995) found that touch-sensitive systems were well accepted by adults of all ages.

This study has confirmed the general acceptability of computer interaction by patients. The high level of patients' positive attitudes towards computer interviewing and computer-based education in previous studies has been supported by the findings of this study. The GLADYS system was well accepted by patients of all ages in a gastro-enterology clinic, and even by patients who had never used a computer (Table 6.11.2). The findings supported patient acceptance of computers as a method of elicitation of life-style data and of learning. All patients completed the study trial, and all mean scores on all evaluation questions tended to be rather positive. Only a small minority of the patients, usually from the older group, indicated some minor problems in their interaction with the computer. These findings corroborate with the results of previous studies with medical patients, which suggest that in general patients respond well to computer interviews and computer-based education systems (Beck, 1982; Carr and Ghosh, 1983; Spunt et al., 1996; Cole et al., 1976; Greist et al., 1973a; 1973b; 1983; Slack and Van Cura, 1968; Spinhoven et al., 1993; Taenzer et al., 1996; Luker and Caress, 1991; 1992; O'Connor et al., 1989; Williams et al., 1995; Wise et al., 1996; Lucas et al., 1976; Lucas, 1977; Biermann and Mehnert, 1990). The high level of favourability has now been qualified by the findings in this study.

Slack and Van Cura (1968), who were the first to attempt to assess patient acceptability, found that over 90% of patients thought computer interrogation was "Interesting", "Likeable", and "Not Difficult", and over 80% thought it was "Enjoyable". Similarly, Lucas et al. (1976) reported that 82% of patients had favourable attitudes towards computer interrogation. Spunt et al. (1996) reported that the majority of patients rated the computer program as 'very good' or 'excellent' in understandability (84%) and interest (64%).

Williams et al. (1995) found that 89% patients reported that they were either 'very satisfied' or 'satisfied' with *HealthTouch*. In addition, 98% 'strongly agreed' or 'agreed' that it was easy to use; 84% that *HealthTouch* was a valuable tool for the physician; 89% that *HealthTouch* was a valuable tool for the patient; and 46% strongly agreed or agreed that *HealthTouch* had changed their thoughts about prevention. Similarly, Biermann and Mehnert's (1990) high level of favourability findings with patients who used *DIABLOG* [7], where the system was well accepted even by patients with no previous computer experience. Luker and Caress (1991; 1992) in an evaluation study of computer-assisted instruction (CAI) programs for chronic renal insufficiency or chronic renal failure, revealed 80% of the patients, whose mean age was 50.9 years, and from diverse socio-economic backgrounds, described the experience of interacting with the programs as 'very useful'. Similarly, Beck (1982) found that 86% of the users stated that they learned at least something new, and 72% liked the 'quiz' program.

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[7] A simulation program of insulin-glucose dynamics for education of diabetics.

Age had a significant effect on patients' perceptions on the recall of information but gender had no effect. Older patients were less likely to remember information when they had left the clinic than younger patients (p=0.002). The Multiple logistic regression analysis also indicated that older patients who had negative feelings were more least likely to remember information when they had left the clinic. These findings were similar to that of Wicke et al.'s (1994), who found that patients aged over 60 years were less likely (p=0.002) to recall topics on notice-boards displayed in waiting rooms in a UK general practice, whereas, gender had no affect on the recall of information.

The study findings revealed that more than half of the patients (n=131, 68%) were first time computer users. This included a majority of the elderly patients (Table 6.10.1). These findings are in agreement with that of O'Connor (1989) who reported that 60% of the patients in a UK practice were first time computer users of which the majority were the elderly. Nevertheless, the study findings suggested that the GLADYS system was accepted by patients of all ages (Table 6.10.2), and that even among older patients interaction with a computer system was highly acceptable. The study findings are similar to those in previously published studies of computer interviews and computer-based patient education (Lampham et al., 1991; McNeely, 1991; Locke et al., 1992; Rippey et al., 1987). For example, Rippey et al. (1987) demonstrated that older persons (age range 52-88) with osteoarthritis can use a computer-based patient education for osteoarthritis with significant increase in knowledge gain and self-reported beneficial behaviour changes. However, also in agreement with other studies, the findings revealed that younger patients were more favourably disposed towards the computer than older patients (Lucas et al., 1976; Cruickshank, 1982; 1984).

Patients preferred to be interviewed by the computer than the doctor, and felt less embarrassed by the computer (Table 6.4.17). Moreover, patients who were waiting for a colonoscopy examination felt more embarrassed when being interviewed by the doctor than patients who were waiting for an endoscopy examination or a breath test (Table 6.4.15). Patients' comments also indicated that some patients may feel less embarrassed when being asked by the computer than by the doctor, as they have less inhibitions towards a machine than towards a doctor when answering questions such as those about passing wind. Patients also remarked that the computer reminds you of all the things one forgets to ask the doctor.

The findings on patients' feelings of less embarrassment towards the computer compared to the doctor (Table 6.4.17) and comfort towards the computer (Table 6.4.13), are similar to those of previous studies. Millstein et al. (1983) found that adolescents interviewed by the computer on sexual behaviour, preferred a computer interview (40%) to a human interviewer and reported that being interviewed by the computer was more comfortable. Moreover, the adolescents perceived the method of computer interviewing as being fun, interesting, confidential, private, and easy. Similarly, Holt (1992) found that patients may be more apt to tell more about adverse life-style to the computer than to a physician during a clinical interview, thereby implying that patients may be more comfortable and less embarrassed when being interviewed by the computer than the doctor. O'Connor et al. (1989) found that the majority of 60 neuro-otological outpatients (81%) preferred a computer assessment to a human interviewer. Gerbert et al. (1996) reported high levels of patient acceptability and perceived comfort when patients were interviewed by an interactive multimedia sexual risk assessment. Most respondents (99%) reported that they had answered the questions truthfully, 74% reported that they had felt comfortable answering the questions, and 79% stated that they would use the program again. Card and Lucas (1981) found that 82% of patients suffering from dyspepsia had favourable attitudes toward computer interrogation and 49% had more favourable attitudes toward the computer than toward the interview with a doctor. While for patients with alcohol related illnesses, the corresponding figures were 75% favourable and 50% more favourable to the computer interview (Lucas, 1977).

4 The interrupt facility

Thirty-six of the 100 patients within styles B and C chose to use the 'interrupt facility' during the GLADYS computer interview; they were younger and more likely to have used computers before than the other 64 patients (Table 6.7.1). Compared with 36 matched patients from style A they differed only in interest (Tables 6.8.6 and 6.8.9). There was no difference between the remaining 64 patients within styles B and C and the non-selected patients within style A (Table 6.8.10). However, although the patients who used the information facility were younger, they still had a mean age of 42, and 14 out of 36 of them had never used a computer before (Table 6.7.1). As more patients obtain experience in using computers the demand for such a facility may be likely to increase.

The main question of the research is whether a patient workstation which combines a structured interview with the provision of related health information is 'better' than a system which has these elements separate. The issue relates to whether or not patients should have access to an information system during a computer interview. Should future computer interviews be designed as *Style A* (the computer interview followed by an information system, if needed) or *Style B* (the user has access to an information system while being interviewed by the computer). For this particular question, the answer is "It depends".

To find an answer to the main question of the research, GLADYS was used as an *existing* computer interview. The system had been carefully developed and evolved over many years (Knill-Jones et al., 1990). When designing the questions, the developers of GLADYS, had aimed at 95% level of comprehension, with the program text at a sixth-grade or seventh-grade reading level (Lucas et al., 1981). This was necessary so as to facilitate understanding among all patients. GLADYS uses short phrases, avoiding technical terms and providing explanations of terms whenever necessary (Knill-Jones et al., 1988; 1990). The language is both simple and of a chatty style using local Glaswegian terms where appropriate. The GLADYS interview included definitions for each indicant used on the corresponding paper questionnaire (Knill-Jones et al., 1990), and within the questions, explanations were provided to terms which were thought likely to be misunderstood or not known to the patient. Examples of such questions where explanations were embedded are the following :

- Have you ever had an 'ENDOSCOPY examination' that is a tube put down your throat to look at your stomach?

- I want to find out if you ever get a burning pain behind your breastbone - most people call a burning pain there in the front of your chest "HEARTBURN" - do you suffer from heartburn?

- Now I would like to ask you some questions about your bowel movements. First of all, do you get "CONSTIPATED" (are there times when you don't open your bowels as often as usual, or when your stools, your motions, become much harder than usual) ?

However, there are several other factors which have to be considered before determining whether or not it would be 'better' to eliminate explanations of the terms within the existing interviewing system and allow the patient to have access to the information system. A *style B* approach system may be appropriate to patients who are usually younger and those with previous computer experience (Table 6.7.1). It may be more interesting to such patients (Table 6.8.9). However, *style A* approach may be more appropriate to patients who are older and have never used computers (Table 6.8.9). Such patients are more likely to prefer to focus on learning how to do 'one thing at a time' rather than having to learn 'several things at a time'. Although, the findings revealed that there was no significant difference between patients who were offered *style B* approach but chose not to use the 'interrupt' facility and patients of similar characteristics of *style A* (Table 6.8.10), we may consider the following example. Within a Windows environment, on a person's first day of using a computer, it would be more appropriate to provide only instructions of how to use Word for Windows to the person rather than instructions on how to use several programs within Windows, such as Word and Excel. The person on his first day of using a computer not only learns how to use Word but also how to use an input device. Even if it is a touch screen one may feel uncomfortable in touching the screen, or may have difficulties in overcoming hidden fears of computer-phobia. How to read text or simple instructions on the screen, and many other things that may seem to be so simple and taken for granted to a computer user might have to be learned by a non-computer user. Therefore, it might be too much for a person on his first day with a computer to be provided with instructions of, how to use Word and Excel, and how to move from Word to Excel and vice versa. Even if the person chooses not to use Word and Excel at the same time, but uses only one package, for example Word, the more instructions provided to use more facilities, the more confusion and misunderstanding may result. Using Word, Excel and moving from one to the other, may seem to be very simple for a person even with little experience with computers, but may be too challenging for a person on his first day using a computer and with a limited amount of time. Office workers are different from patients, as office workers are more likely to be in an environment where computers are used, may have more time available to learn how to use them, and may have more interest towards using computers.

Another point worth considering is that when one asks another person a question, the other person's mind is usually focused on how to answer the question and not to ask another question unless he misunderstood the question or needs more information in order to answer the question. For example, when a doctor asks a patient a question on his symptoms, the patient's mind would naturally focus on how to answer the question. The patient would, therefore, answer the question unless the patient did not understand the question or is unclear about something. The misunderstanding of the patient may have been raised due to unknown terms used by the doctor, or the patient needed more information before he can answer the question. Therefore, within an existing interviewing system, such as GLADYS, if a patient moved to the information system during the interview, it would be either (a) to find the explanation of a particular term or terms, (b) get more information in order to answer the question or (c) due to interest or curiosity or both. Within this study, almost all patients understood the questions provided by GLADYS, and therefore most patients who moved to the information system during the interview did so because of interest or curiosity. Patients who accepted such a 'challenge' of moving between the interview and the information system were usually patients who used computers before, or were younger. Patients who previously used computers, normally have built in confidence with computers, and know how to use simple things within the computer environment, and therefore, accept the challenge of moving to the information system during the interview as an information seeker. Such patients may feel much more at ease and be more interactive with computers and ready to try new things than patients who have never used computers.

Previous research has shown that younger and more educated patients generally are more interactive with health providers. They ask more questions, offer more solutions, and believe more strongly in participating in decision-making than older and less educated patients (Street, 1992; 1991; Skinner et al., 1985b; Ende et al., 1989; Roter et al., 1988). Therefore, it would be reasonable to assume that younger patients would be more interactive with computers than older patients. In addition, as the findings of this study reveal that younger patients are likely to be more familiar with computers than older patients (Table 6.10.1) and therefore may be assumed to be more interactive with computers. Previous studies have also indicated that younger patients felt more favourable and were more interactive towards computers than older patients. Cruickshank (1984) for example found that patients in general, were sceptical of clinical diagnostic computers. However, younger patients, males, and those with previous computer experience felt more positive towards computers. Similarly, Williams et al. (1995) found that *HealthTouch* users were younger on average than the overall patient population, and Pingree et al. (1993) found that the *CHESS* system (a computerised health enhancement support system for HIV-Positive people), was more heavily used by younger participants.

Nevertheless, whether or not it would be better to provide a patient access to an information system during a computer interview, the answer remains "It depends". Based on the findings and experiences gained through the study, we not only need a theory for stylistic presentation to help guide future research, but also a theory for respondents. That is, in what ways do individuals differ that make some receptive to one approach and others receptive to a different approach? The rule of thumb is that for novice computer users and non information literate people, *Style A* may be more preferable than *Style B*, while for those who are computer users and information literate people, *Style B* may be more preferable than *Style A*.

But who are information literate people? Breivik (1991) defines information literate people as those who (1) know when they have a need for information, (2) can identify information needed to address a given problem or issue, (3) can find needed information, and (4) can evaluate and organise information to effectively address the problem at hand. Within this study, we may define information literate people as those people qualifying only for the first three items. Understanding words in context is a complex process involving several aspects such as language and experience. Moreover, computer interrogation, unlike the doctor, is normally denied all non verbal expressions, and therefore can not adapt the questioning process accordingly when a patient express non verbally when misunderstanding or misconceptions arise. Therefore, to ensure patients' comprehension, we need to ensure simplicity of language when developing a computer interview and we need to know the user. We need to know how well patients understand, accept, and follow oral and written instructions, and at what reading level should the content of computer interviews be to ensure patients' comprehension, and at the same time interest.

Previous research indicated significant misconceptions of medical terms were common among patients and the inability to understand common written instructions. Gibbs et al. (1987) reported that a large number of adult patients tested did not understand common medical terms. Nearly 50% defined the word 'hypertension' as meaning nervous or easily upset and 25% thought 'orally' meant how often one takes medicine. Similarly, Spiro and Heidrich (1983) demonstrated that significant misconceptions of medical terms were common among patients. Of 166 patients of all ages and educational background, who were questioned about their understanding of the terms hypertension, virus, strep throat, herpes, tumour, Pap smear, and uterus, significant misconceptions were noted. A positive association of educational level and knowledge was demonstrated. Smeltzer (1980) also found that race, education, and age predicted a significant level of understanding of medical terminology and that patients may recognise some of the terms used by the health providers, but may not be able to correctly define them.

While in the United States, Davis et al. (1994) reported that the reading ability of most parents tested in a paediatric health setting was below the reading level required for parent education materials and instructions. In an earlier study for reading comprehension of 151 adult primary care patients in five different ambulatory care settings, Davis (1990) found that there was a 5- to 7-year discrepancy between the reading comprehension of the average public clinic patient and the ability levels needed to read most patient education materials. Moreover, there was a significant difference in the reading ability between patients within different clinics. Jolly et al. (1993) found that emergency department patients educated beyond high school demonstrated higher levels of success in reading and understanding written materials than did those with less education. A trend was noted that younger patients performed better than older patients.

Therefore, unless we can identify patients who are information literate[8], then a flexible, user adaptive style approach may be more appropriate. Patients may have misconceptions on simple terms, for example, within the following GLADYS question:

- I want to find out if you ever get a burning pain behind your breastbone - most people call a burning pain there in the front of your chest "HEARTBURN" - do you suffer from heartburn?

[8] Only the first three points which Breivik (1991) identifies are required for patients to information literate here (1) know when they have a need for information, (2) can identify information needed to address a given problem or issue, (3) can find needed information.

If the explanations for the term 'heartburn' were to be eliminated, some patients may have misconceptions of the term. They may perceive that they know the meaning of the term and, therefore, may not seek explanations of the term in the information system. Thus, eliminating the explanations within the question may result to incorrect responses from some patients due to misconceptions. At the same time, when considering the following GLADYS question:

- Now I would like to ask you some questions about your bowel movements. First of all, do you get "CONSTIPATED" (are there times when you don't open your bowels as often as usual, or when your stools, your motions, become much harder than usual) ?

The majority of patients in gastro-enterology clinics may know the meaning of 'constipation', and it may be reasonable to assume that it would be rare to have misconception of the word 'constipated' when the patient has been suffering from gastric problems. Eliminating the explanations for 'constipated' and other similar, simple 'well-known' terms will shorten the length of the interview and, hence, create a much more interesting computer-patient interaction. But how can you define a 'well known' term? As Davis (1990) found out that there was significant difference in the reading ability between patients within different clinics. Therefore, what may be a simple 'well-known' term for patients within one clinic, may not be so for patients within another clinic.

Several other factors are worth to be considered in determining whether or not it would be better to provide a patient with access to an information system during a computer interview. For example:

a) Previous GLADYS versions worked perfectly well without the information system (Lucas and Card, 1981, Knill-Jones et al., 1990). Most patients understood all the terms in the GLADYS interview because the questions have been developed over several years and much considerations have been given in the development of the questionnaire. A style B approach may be much more important to a new system, where there might be still doubt as to whether or not patients understood all the terms, than to an existing system.

b) The majority of patients in this study (n=131, 68%) have never used a computer before. Asking patients with no computer experience to use a computer in a clinical environment with limited time, is a challenge by itself. These patients may be already under stress because of their condition or anticipated treatment and so may prefer to 'do one thing at a time'. In the United States patients may be more computer literate but may not be information literate (Jolley et al., 1993; Davis et al., 1990; 1993) and their reading abilities differ within different clinics (Davis et al., 1990).

c) Clinical time and facilities such as the number of computers available in the clinic should also be considered. In providing patient access to an information system during a computer interview, one must also provide more time for the patient to use the computer, and hence more computers in the clinic. However, some patients may wish to spend more time within the information system than the time available per patient. Therefore, the time spend by each patient using the computer must be controlled by the clinical staff. In contrast, when using an existing interviewing system with no access to an information system, the time spend by the patient using the computer is usually controlled by the system, that is a patient can not play around looking for terms due to interest or curiosity. However, in the future, the problems of clinical time and facilities may be reduced, as some patients may be connected to a patient workstation from their homes through the *Internet*, cable or computer networks. Patients would be able to complete a computer interview, see their medical record and browse through the information system for related information whenever needed in the privacy and convenience of their own homes.

Based on the findings and experiences gained through the study, we can, therefore, conclude that this study has provided important information to future designers of systems to be used by patients. However, it is extremely difficult to generalise across patient groups in determining whether or not we should try to build patient workstations which mix computer patient interviewing with information provision. Younger patients and computer users preferred a *style B* approach interface. These patients would normally use the 'interrupt facility' and the style of interaction would be more interesting to such patients. As for older patients and non-computer users, who were also offered the 'interrupt' facility, but did not use it, had the same reactions towards the system as similar patients within *style A* approach (Table 6.8.10). Therefore, both style A or B had no different affect on them. Whereas, for younger and computer users, *Style B* approach is 'better' than *style A* approach. Therefore, *Style B approach is 'better' than style A approach, but the difference will only be noticed if the majority of users were younger and computer users.* However, within a few years and as computer literacy is increasing rapidly, both at school and at home, the average patient will soon be today's younger patient or computer user. Therefore, as more patients obtain experience in using computers, the demand for a facility to interrupt the computer interview and obtain information is likely to increase. Since it is impossible to determine the type of respondents, it would be necessary to design systems as to *style B* approach but flexible and adaptive to the user's needs and preferences. For example, if the user chooses not to 'interrupt' the computer interview, the system should act as *style A* approach and should offer the patient the opportunity to browse through the information system at the end of the computer interview.

5 Personalisation of information

A subordinate question to the main question is that, within the combined system is a 'tailored' or an adaptive type of information provision is 'better' than a more general type. Tailoring or personalisation of information was provided by presenting patients in style C (that is half of the patients from style B) with a selected range of information in gastro-enterology. The topics of the information system were adapted to some degree to patients' own characteristics, symptoms and their computer interview responses. In general, the program was designed to be adaptive to the users' responses, style of interaction, and to anticipate users' needs.

The advantage of on-line access to personalised information is that it provides patients with relevant educational information and offers them the opportunity to expand explanations of the information provided. Tailoring could be achieved in various ways. For example, Spunt et al.'s (1996) interactive videodisc multimedia system for low back pain patients, gives tailored information according to each patient's age and diagnosis. Jones et al. (1992c) suggested that tailoring could be enhanced by using the medical record, for example the *Cancer system* (Jones et al., 1996b; Cawsey et al., 1995), however, the medical record may not necessarily identify what type of information the patient wants to see. Jones et al. (1996b) suggested a better method would be the combination of using the medical record and a 'user model'[9]. An example of an information system which uses a 'user

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[9] This would usually be by asking patients questions at the beginning the computer interaction and then identifying users' responses to questions and choices on the system.

model' is the migraine system by Buchanan et al. (1992, 1995) and Carenini et al. (1994). However, there are no systems found in the literature which tailor information by combining the patient's medical record and a 'user model'.

The study findings showed that a majority of the patients (n=165, 85%) preferred 'tailored' or 'selected' topics (Table 6.6.4). In addition, although not significant (p=0.06, *t*-test, Table 6.4.28), it can be suggested that more patients within style C, who were provided with 'selected' topics, felt that the topics were more relevant compared to patients within styles A and B, who were provided with 'general' topics. Whereas older patients within style C felt that the topics were more relevant than older patients within styles A and B (Table 6.4.28). From the findings (Tables 6.14.1 and 6.14.2) it may be suggested that patients were more likely to look at topics which were related to their symptoms and health issues such as symptoms and medical examinations. Patients' comments too supported the suggestion that patients are more inclined to view topics related to their own health issues. Patients' comments indicated that some patients felt getting information on their illnesses is very helpful and interesting and that a lot of questions one would like to ask the doctor were displayed, and that the ease of access to redeem the information was excellent.

Based on the study findings, younger patients and computer users preferred the *style B* approach, which provided more control than the *style A* approach. There was an indication that younger patients and computer users were more in control, was an indication that younger patients and computer users were more in control, could interrupt the computer interview to seek information, and had no preference in the range of topics provided in the information system. Whereas, older patients and non-computer users preferred a *style A* approach but with a *style C* approach interface of the 'Topics Menu' screen (Screen 23, page 231), which was simpler to use and provided less flexibility, less topics, and less control. The topics in *style C* approach interface were already selected and the interface demanded less patient interaction to select a topic compared to a *style B* approach interface. Therefore, older patients appreciate a simpler interface and a more restricted personalised topics menu, and prefer to continue with the computer interrogation before seeking information. As for younger patients and computer users, the difference was not significant in patients' perceptions of the relevance of the topics provided within styles B and C. Therefore, an *adaptive style C* approach is 'better' than *style B* approach for older patients and non-computer users, and as for the younger patients and computer users, styles B or C make no difference. An *adaptive style C* system, therefore, is the best. The system provides control and flexibility for younger patients and computer users, and as for older patients and non-computer users, the system provides the simplicity of the interface design of the 'Topics Menu' screen of *style C* approach. An *adaptive style C* system can also adapt it self to *style A approach*, if needed, which proved to be a more appropriate approach to older patients.

6 Factors affecting patients' interaction with computers

Based on the findings and experiences gained through the study, it is clear that a large number of factors will influence the way patients will interact with computers. These factors include: patients' age, previous use of computers, general anxiety, desire for information, time available and clinical environment.

6.1 Patient characteristics

Patient characteristics proved to be related to a certain extent to successful patient-computer interaction. The study findings showed that age (Table 6.10.2), sex (Table 6.11.2) and previous computer use (Table 6.12.2) had a significant effect on patient computer interaction. Younger patients and those with previous computer experience tended to react more favourably to the computer, and male patients felt interacting with the computer was easier than female patients. Previous research also suggested a relationship between computer interaction with age (Lucas et al., 1976; Cruickshank, 1984; Ellis et al., 1991; Slack et al., 1988; O'Connor et al., 1989), sex (Cruickshank, 1984; Lucas et al., 1976; Spinhoven et al., 1993; Ellis et al., 1991), education (Mathisen et al., 1985; Spinhoven et al., 1993; Slack et al., 1988); previous computer experience (Cruickshank, 1984; Lucas et al., 1976; Spinhoven et al., 1993), and attitudes toward computer use (Reis and Wrestler, 1994).

Lucas et al. (1976), for example, reported that men had more favourable attitudes than women ($p<0.001$), younger patients had more favourable attitudes than older patients ($p<0.001$), and manual workers had more favourable attitudes than non-manual workers ($p<0.05$). O'Connor et al. (1989), in evaluating a computer interview system for use with neuro-otology patients, reported that older patients had more difficulties and took longer than younger patients. Cruickshank (1984) found that patients were sceptical of clinical diagnostic computers, and that younger patients, males and those with previous computer experience felt more positive towards computers. Spinhoven et al. (1993) found that male patients, patients with a higher education level, patients with a more positive attitude toward computers, and patients with previous experience with computers felt more relaxed during a computer health assessment. Moreover, Spinhoven et al. (1993) demonstrated that patients' education and computer experience were related significantly to ease of computer use. More educated patients and patients with previous experience with computers had less difficulty with the computerised assessment. Ellis et al. (1991) reported that older patients ($p<0.0001$) and females ($p<0.05$) took significantly longer to use a computer-based health risk appraisal than younger and male patients. Research is needed to identify the causes that affect women's interactions with computers, especially to investigate their emotional state in relation to their ability to interact with computers. Reis and Wrestler (1994) found that compared with computer users, non-computer users preferred personal contact with their physicians and felt less favourable towards computerised health assessments. Slack et al. (1988) found that the time to respond to questions in a computer-based medical interview was related both to the subjects' age and to their formal education. Older women responded more slowly than their younger counterparts, and, women with less formal education took longer to respond among women between 18 and 30 years of age. Mathisen et al. (1985) found no relationship between age and ease of use but did find a relationship with education level and previous computer experience, that is, less educated and inexperienced patients in computer use had more difficulties.

Although emotional feelings did not significantly influence patient-computer interaction (Table 6.13.2), it seems reasonable to suppose that in a more relaxed environment patients may feel more interested and favourable towards the computer. Cruickshank (1982) found that computers were least welcomed by highly stressed or nervous patients. Relaxed patients might be more favourable towards a computer and may be more receptive to health advice given by the computer. The findings of this study indicated that women were more anxious than men (Table 6.2.11) and that women scored less in usability compared to men (Table 6.11.2), that is, female patients felt interacting with the computer was less easier than male patients. Previous research (Cruickshank, 1984; Lucas et al., 1976; Spinhoven et al., 1993; Ellis et al., 1991) also showed that males did 'better' when interacting with computers and were more favourable towards computers compared to females. We may then question, is there a connection between women's emotional state and their interaction with computers? Further research is needed to investigate the relation between women's emotional state and their ability to interact with computers.

However, Fawdry (1989) found that the computer interview had a noticeably relaxing affect on anxious mothers. In agreement to Fawdry (1989), the GLADYS system also had a noticeably relaxing affect on some of the anxious patients and that the general acceptability of the technique was confirmed by the patients. Several patients commented within this study, that interacting with GLADYS was interesting, enjoyable and rather relaxing, and that the system kept their minds away from the medical examination and helped pass the waiting time.

6.2 Interview length

There was a significant difference between reactions of patients who used the long computer interview and those who used the shorter computer interview in terms of the overall usability (Table 6.9.9). In general, patients felt that the shorter interview was easier to use, less confusing, less embarrassing, and more comfortable to use, than the long interview. The short interview also had significant shorter administration time.

The average time taken on the computer using the long GLADYS version was 25 minutes. Normally the average gastro-enterology clinic throughout would be 60-80 patients per day. Application of the computer on routine basis would, therefore, require minimal rescheduling to clinic appointment time (to allow for 30 or more minutes for completion) and at least 8-10 machines available in shielded screened locations for use. However, some of the other existing interviews are longer and may take between 45 to 60 minutes (Sanders et al., 1994) or even 90 minutes

(Dove et al., 1977). Therefore, long interviews may be a problem in busy clinics as more space and machines would be needed. Also, some patients may become restless after a short period of time with the computer interrogation. Hence it would be logical to find ways to minimise the time needed for computer interviews. One way to do this would be by connecting the computer interview to patients' electronic medical records. Using this method, questions which identify patients' characteristics and medical history, in general, within the computer interview could be eliminated, and thereby, the time needed for the interview would be reduced. Moreover, by connecting patients' electronic medical records to the computer interview, the medical records could be updated after the computer interview, where patients' new symptoms and new life style behaviours would be recorded.

In a study to determine whether a short computer interview could be used in place of a full diagnostic interview to obtain psychiatric diagnoses, Bucholz et al. (1996) examined the short interview's sensitivity, specificity, and diagnostic agreement with the full interview. Patients were interviewed in two sessions, one in which a full diagnostic interview was used and the other in which a short computer interview was used. Based on diagnoses derived from both interviews, the short interview had high sensitivity and specificity and excellent diagnostic agreement with the full interview for most disorders. It also had a significantly shorter administration time. However, it missed a substantial percentage of patients' symptoms and lifetime psychiatric status. Although the authors had suggested that with few exceptions, the short interview may be substituted for the full interview when such information is not important or not needed, by connecting the computer interview to patients' electronic medical records such information can be easily achieved by the computer at the start of the interview.

6.3 Environment

Environment plays an important factor in the success of patients' interaction with computers. These include :

a) Space or location of where the computer is situated. Aspects such as surrounding noise may affect a patient's concentration and therefore interest. For example, one of the patients in the study commented that he would have found interacting with GLADYS easier in a different environment, as he was tensed up and this might have affected his concentration and attitude towards the system.

b) Clinical activities, for example, if the patients were waiting for medical examinations, such as an endoscopy or a colonoscopy, before the computer interaction, may affect their emotional feelings, concentration and interest. Therefore, their interaction with the computer may be affected. Within this study some patients described themselves as nervous or worried (Table 6.7.2) and women were more anxious than men (Table 6.2.11), which might have affected their interaction with the GLADYS system as women scored less in usability than men (Table 6.11.2).

c) Time allocated for the patient to interact with the computer plays an important factor in the success of patients' interaction with computers. Naturally, the more time allowed will result to a longer interaction between the patient and the computer. Some patients commented[10] that they would prefer to have more time to interact with the system, and that they would have looked at more topics in the GLADYS information system if they had had the time.

7 Patients' reactions to questionnaires

7.1 Paper and on-line questionnaires

As mentioned in Chapter II, structure and specificity are some of the advantages of using a computer questionnaire compared to a paper questionnaire. In addition, although, structure can be provided by written questionnaires, it is much easier to impose structure on a computer than on a human being. Compared with a paper questionnaire, a computer interview increases data integrity by avoiding incomplete responses, which may be due to patients' carelessness, forgetfulness, or some other reasons. However, with the on-line questionnaire, the computer questionnaire did not move to the next question until the patient responded to a previous one. This ensured completeness of the questionnaires.

[10] Patients' comments on page 369.

By using a computer questionnaire, inconsistency amongst patients can also be reduced, and the computer can provide a level of flexibility that paper questionnaires cannot. The system can be programmed to ask follow-up questions for problems that respondents report, and to skip follow-up questions for areas that respondents indicate are not a problem. For example, the computer can be programmed to skip subsequent questions on a certain symptom for a patient who does not suffer from the symptom. The computer's decision making about questions to be asked can be dependent on responses to prior and/or current questions and/or multiple conditions. This branching capability can be somewhat 'messy' when using a paper questionnaire.

7.2 Patients' evaluation of questionnaires

There was a significant difference between reactions of patients who used a paper questionnaire and those who used an on-line questionnaire in the length of the questionnaire and their preferences in the method of assessment (Table 6.15.1). Patients who used the paper questionnaire felt that the questionnaire was longer than patients who used the on-line questionnaire. It would be reasonable to assume that, due to the computer's branching capability in skipping questions which are not relevant to the patient, the computer questionnaire would ask the patient only relevant questions and, therefore, would seem to be shorter than the paper questionnaire.

The study findings indicated that the majority of the 100 patients who filled the patients' evaluation questionnaire (n=46, 47%) preferred a computer interview, 21 (21%) preferred a face-to-face interview, 15 (15%) preferred a paper interview and the rest 17 (17%) did not mind which method they used (Table 6.15.1). This is in agreement with Fawdry (1989) who found that most patients (n=46) preferred an antenatal computer interviewing system to the traditional medical interview. However, contrary to the findings of this study, Fawdry found that 45 women did not mind which method they used and only nine expressed a preference for the midwife to ask the same questions. Therefore, to be interviewed verbally was the method least preferred by the women. Fawdry's findings were in contrary to that of Montazeri et al.'s study (1996) whose patients (n=82) were given the options 'fill in a questionnaire', 'to be interviewed', 'either', or 'don't know'. Montazeri et al. (1996) found that the majority (n=56, 68%) of the lung cancer patients preferred to be verbally interviewed than to fill in a questionnaire by themselves (n=8, 10%) or expressed no preference (n=18, 22%). However, Montazeri et al.'s patients would be classified as older patients (age>50 years) within this study, whereas Fawdry's patients would be classified as younger patients (age<=50). Therefore, the findings of this study which suggests that older patients were more likely to prefer to be interviewed verbally than younger patients, whereas younger patients were more likely to prefer a computer interview than older patients, are in agreement to both Montazeri et al. (1996) and Fawdry (1989). Another interesting finding of this study was that the majority of patients whether being given a paper questionnaire or an on-line questionnaire preferred a computer interview (Table 6.15.1). This is in agreement to that of O'Connor et al. (1989) who reported that the majority of patients (81%) who used a paper questionnaire and those who used an on-line questionnaire, preferred computer assessment.

The findings of this study indicated that patients' acceptance of computers may be favourably influenced by direct experience with a computer. Patients' experience with computers positively influenced patients' preference for it, and acceptance by patients of computers would increase as they have experience with computers. The findings indicated that patients who were given an on-line questionnaire were more likely to prefer the computer questionnaire than the paper questionnaire, while patients who were given a paper questionnaire were more inclined to prefer other methods (Table 6.15.1). These findings are in agreement to that of Suitor and Gardner (1992), Skinner et al. (1985) and Bungey et al. (1989).

Suitor and Gardner (1992) reported that when initially asked about a preference for paper and pencil questionnaire, 37 of 64 patients (58%) reported a preference for paper and pencil. However, after using a computerised questionnaire, the reported post-test preference was 87% for the computer version. A similar question concerning personal interview versus computer-based interview was also asked; computer use was preferred by 45.4% before and 73.5% afterwards. Skinner et al. (1985) found that although, the interview was initially preferred by most participants, patients who completed a computer assessment showed a significant increase (13% to 43%) in their preference for the computer assessment after using it. Similarly, Bungey et al. (1989) in a study to compare assessment methods of a computer with face-to-face interview and paper and pencil questionnaire, found that, although the face-to-face interview method was strongly preferred overall, patients' preference for the computer increased significantly after use. Therefore, it would be reasonable to assume that the study finding that younger patients were more likely to prefer a computer questionnaire than a paper questionnaire corresponded to the finding that younger patients were more likely to be computer users than older patients (Table 6.10.1).

Chapter VIII

Conclusions & Recommendations

"All virtue is one thing, knowledge."

Plato

1 Conclusions

1 The GLADYS system was well-accepted by patients of all ages in a gastro-enterology clinic. There was evidence that some patients, mostly younger and computer users, would use the facility to seek information during the computer interview, and this will enable them to be more interested with the resultant interaction. There was no significant difference between patients who were offered the 'interrupt' facility during the computer interview, but chose not to use it, and patients who were not offered the 'interrupt' facility. These patients were mostly older and non-computer users, which indicated that S*tyle A* approach would be more appropriate to such patients. Such patients were more likely to prefer to focus on learning how to do 'one thing at a time', rather than having to learn 'several things at a time'.

The results from this study provide important information to future designers of systems to be used by patients. However, it is extremely difficult to generalise across patient groups in determining whether or not we should try to build patient workstations which mix computer patient interviewing with information provision. Results showed that *Style B* approach is 'better' than *style A* approach, for younger patients and computer users, but the difference will only be noticed if the majority of patients were younger and computer literate. However, within a few years and as computer use is increasing rapidly both at school and at home, the average patient will soon be today's younger patient or a computer user. Therefore, as more patients obtain experience in using computers, the demand for a facility to interrupt the computer interview and obtain information is likely to increase. Since it is impossible to determine the type of respondents, it would be necessary to design systems as to *style B* approach, but flexible and adaptive to the user's needs and preferences.

2 A *style B* approach would be much more important than *style A* approach to a *new system* than to an *existing system*, where there might be still doubt as to whether or not patients understood all the terms. A *style B* approach interface would be useful when constructing the computer interview, where developers could take advantage of the *style B* approach to filter frequently misunderstood terms when piloting the computer interview. Also, when the computer interview is fully developed, the *style B* approach would be useful to create more interest and provide relevant health education to patients while they interact with the system.

3 The majority of patients preferred tailored information, that is, 'selected' topics. Although there was no significant difference in patients' perceptions of the relevance of the topics provided, there was evidence that older patients who were provided with 'selected' topics felt that the topics were more relevant to them compared to older patients who were provided with 'general' topics.

Younger patients and computer users preferred a *style B* approach interface and were more in control. Whereas, older patients and non-computer users preferred a *style A* approach interface but with a *style C* approach interface topic's menu, where the topics were selected and personalised, and the interface was simpler to use, but provided less flexibility and less control. Therefore, an *adaptive style C* approach is 'better' than *style B* approach for older patients and non-computer users, and as for the younger patients and computer users, styles B or C make no difference. An *adaptive style C* system, therefore, is the best. The system provides control and flexibility for younger patients and computer users, and as for older patients and non-computer users, it provides the simplicity of *style C* approach interface[1] topic's menu and, at the same time, if needed, it can adapt itself to *style A approach.*

4 This study has provided useful baseline in identifying the potential user of a patient workstation, and in identifying factors affecting patient-computer interaction. Patient characteristics are related to a certain extent to successful patient-computer interaction. Younger patients and patients with previous computer experience tended to react more favourably to the computer and were more satisfied compared to older patients and non-computer users. Female patients felt interacting with the computer less easier than male patients. However, although emotional feelings showed no significant affect towards patient-computer

[1] Interface design of the 'Topics Menu' screen (Screen 23, page 232).

interaction, it may seem reasonable to assume that, in a more relaxed environment patients may feel more interested and more favourable towards the computer.

5 Patients characteristics, and not the style of interaction, determine patients' feelings of control and confusion while interacting with a computer. Younger patients and patients with previous computer experience felt less confused and were more in control while interacting with the computer compared to older patients and non-computer users.

6 Patients reported a higher degree of embarrassment when being interviewed by the doctor than when being interrogated by the computer. The majority of the patients felt that, they would be able to remember some of the information they gained after using the computer. However, age had a significant affect on the recall of information gained. Older patients felt that they would remember less information after they had left the clinic than younger patients. The majority of the patients also felt that, they had gained knowledge after using the computer, although patients' characteristics did not determine the difference in knowledge gain.

7 The majority of the patients preferred to have access to health information by using a computer. However, younger patients preferred to have access to health information from a computer compared to older patients. Similarly, patients who

were computer users preferred a computer to access health information compared to non-computer users.

8 Patients who used the short GLADYS interview[2] felt that the computer interview was easier, less confusing, and more comfortable to use, compared to patients who used the long GLADYS interview[3].

9 Patients who used the on-line questionnaire felt that the questionnaire was shorter compared to patients who used the paper questionnaire. The majority of patients preferred an on-line questionnaire, than a face-to-face interview, and least a paper questionnaire. Patients who were given an on-line questionnaire were more inclined to prefer an on-line questionnaire than a paper questionnaire, whereas patients who were given a paper questionnaire were more inclined to prefer other methods. Younger patients and computer users were also more likely to prefer an on-line questionnaire.

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[2] About half of the questions of the GLADYS interview were eliminated to shorten the computer interview.

[3] The GLADYS interview as it was, with approximately 200 questions.

2 Recommendations

As we are entering the new millennium, the concept of a 'patient workstation' is a worthwhile goal to pursue. Further efforts towards integrating patient interviewing and information provision need to be carried out. This study has provided useful baseline information for further studies. Based on the findings and experiences gained through the study, the following are recommendations for further research in the development of a 'patient workstation'.

1 Future computer interviews need to be designed to give access to the patient to be able to 'interrupt' the computer interview to seek information. However, when designing the computer interview questions, it would be necessary to be cautious in avoiding misconceptions of the terms used in the computer questionnaire. The advantage of *style B* approach is that, not only it would enhance interest towards the computer interview among patients, but also a *style B* approach interface would be much more important to a *new* system than an *existing* system such as GLADYS, where there might be still some doubt as to whether or not patients understood all the terms.

2 To ensure patient acceptability, the design of computer interviews for the year 2000 and beyond need to be flexible and adaptive to the needs and preferences of different individuals. Computer interviews should provide numerous opportunities for user interaction, should require little reading ability and should offer the potential to increase levels of health education to patients. The systems

should also be available to patients at the time of need and place of convenience. In order, to be adaptive to patients' needs and preferences, GLADYS should be re-designed, not only to be connected to patients' medical records, but also to consist 'user models'[4].

3 The GLADYS interview needs to be continuously evaluated and updated to meet the ever changing needs, characteristics and expectations of the patients at a gastro-enterology clinic. As technology moves forward, patients' computer literacy and expectations also increase. During the re-designing of the GLADYS questions, an adaptive *style C* approach interface would be useful to help avoid misconceptions of the terms. The new revised system would enhance interest amongst patients while being interrogated by the computer, and, at the same time allow patients to elicit individualised health educational material related to them from the computer.

4 Further research is needed to measure the potential of integrating patients' medical records to interviewing systems. Integrating patients' medical records to computer interviewing systems will enable software developers to design shorter computer interviews. With long computer interviews, patients may become restless after a short period of time, and clinical time and space may be a problem. By connecting the computer interview to patients' electronic medical records, questions which identify patients' characteristics and past illnesses could be

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[4] This would normally be, by asking patients questions at the beginning of the computer interaction, and then by identifying users' responses to questions or choices on the system.

eliminated, and therefore, the time needed for the computer interview would be shortened. Moreover, patients' medical records could be automatically updated after patients' use of the computer interview, where patients' new symptoms and new life style behaviours would be recorded.

5 The study findings indicated that women were more anxious than men and that women scored less in usability compared to men. Research is needed to identify the causes that affect women's interactions with computers, especially to investigate their emotional state in relation to their ability to interact with computers.

6 As the software and hardware costs decrease in the marketplace, the use of multimedia technology in the health care field is likely to increase. The potential benefits of using interactive multimedia techniques within computer interviews should be measured. This could be achieved by redesigning the GLADYS system to involve multimedia techniques and then measuring the benefits of the provision of the multimedia techniques.

7 A disadvantage of offering patients the facility to 'interrupt' the computer interview to search for information may probably be cost-effectiveness. Clinical time and facilities such as the number of computers available in the clinic must be considered when implementing a *style C* approach. Research is needed to examine the cost-effectiveness of implementing a *style C* approach compared to the

GLADYS interview with out the information system. However, considerations should be taken that as technology advances patients' expectations, needs and computer literacy increase. In addition, future advancements may also allow patients to complete a computer interview which uses *style C* approach within the privacy and convenience of their own homes connected through the *Internet*, cable or computer networks.

8 Future patient interaction with the GLADYS system should include the printing of a leaflet or a paper feedback for the patient to take home as an option. A summary of key information of the topics browsed by the patient and of the diagnosis and therapy suggested could be included in the leaflet.

9 This study should be repeated within different clinics, where the findings may vary. For example, patients at an antenatal clinic may react more like the younger patients[5] within this study, whereas patients at a lung cancer unit may react more like the older patients[6]. Furthermore, patients in a different environment, for example, where there is less time pressure or less anxiety, may feel more relaxed to spend time browsing information.

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[5] Patients who are aged 50 years or less.

[6] Patients who are older than 50 years.

Chapter IX

A Pilot Study in Oman

Oman - the beautiful.
The land of immense natural beauty
and tremendous history.

Contents

1 Introduction

A pilot study of 37 patients using the Arabic GLADYS was carried out in an Omani gastro-enterology clinic, at the Royal hospital in Muscat, the Sultanate of Oman. The objectives of the pilot study were :

- To determine the feasibility and acceptability of the Toolbook Arabic GLADYS.
- To determine the level of understanding and the suitability of the Arabic language terminology used in the Arabic GLADYS for Arabic speaking patients, in an Omani gastro-enterology clinic.
- To investigate the feasibility of introducing a patient workstation into an Omani gastro-enterology clinic.

As an Omani researcher I am interested in promoting innovations in the field of medical informatics in Oman. However, no studies in patient-computer interaction have yet been carried out in Oman. The results of this research will be valuable in assisting the use of advanced patient information systems together with interviewing and diagnostic systems into the Omani health service.

2 Oman : General Features

The Sultanate of Oman is the second largest country in the Arabian Peninsula, covering an area of 300,000 square kilometres with a coastline that extends for 1,700 square kilometres. Islam is the religion of the entire Omani population and

Arabic is the national language. Omani society consists of four basic categories: the people of the sea who live by fishing, seafaring and trading; the agriculturists of the Batinah coast in the South, and those of the Interior who employ the 'aflaaj'[1] system of irrigation; the mountain people of Dhofar and Musandam; and the Bedouin of the desert area (Graz, 1982).

Oman enjoyed great prosperity from its sea trade and became a colonial power in the first half of the 19th century. However, by 1888, the great days of Omani overseas empire were over and several disasters eroded the power of the Sultans in Muscat. New hope for Oman came in 1960's when oil was discovered. The economy from then on became heavily dependent on oil which accounts for approximately 90% of the national revenue. However, high priority has been given to private enterprise, particularly in manufacturing, banking, agriculture and fisheries in order to diversify the economy.

The total population was estimated at 2,018,074 in 1993 (Ministry of Development, 1993)[2], with an average annual growth rate of 3.5 percent, with 73.5% of the total population consisting of Omanis. However, the largest part of the non-Omani population (47.4%) is concentrated in the capital area, Muscat, where 46% of the total population live. The results of the census also showed that 51.6% of the Omani population belongs to the age group 0-14 years, 45.4% to the

[1] The 'aflaaj' system of irrigation is where water for irrigation is obtained from man-made subterranean channels.

[2] General Census of Population, Housing and Establishments, 1993.

age group 15-64 years and only 3% are above 65 years old. The proportion of children below 15 years (52%) is higher than in most countries. The international average does not exceed 32%. The illiteracy rate among the Omani population between the ages of 15 and 29 years does not exceed 4.5% among males and 21% among females. However, as shown in Table 9.2.1 these percentages increase significantly for other age groups. The total illiteracy rate for Omanis and non-Omanis is 31% of the population, with the number of illiterate females being twice that of males.

Table 9.2.1 : Illiteracy Rate by Age Group and Sex within the Omani population (General census of Population, Housing and Establishments 1993).

Age groups	Males	Females
15-29	4.5 %	21%
30-49	38.8%	82.2%
50+	79.5%	97.6%
Total	29%	54.1%

2.1 Modernisation and Education

When Sultan Qaboos came to power in 1970, Oman had only three schools (all for boys) (Al-Dhahab, 1987), two hospitals (Al-Kharusi, 1995), ten kilometres of surfaced road and electricity in only a few Muscat homes. The Sultan immediately embarked on a comprehensive programme of economic and social development, and within less than 20 years, Oman moved from being the 'unknown Oman' into a position within the 20th century as a prominent thriving nation. This period was termed as the 'renaissance' where great advances were made in providing free education to all Omanis, free health services, transportation, roads, housing and social welfare, telecommunications and television services, agriculture and fisheries and many other aspects. Education, in particular, benefited. By early 1990, the number of pupils in schools grew to over 250,000, with almost equal numbers of boys and girls (Khan, 1991). Several colleges opened for vocational training, teachers' training, health sciences, businesses; and the Sultan Qaboos University which opened in 1986, constituted of several colleges in Medicine, Education, Agriculture, Science, Religious studies, and Business.

2.2 Patient care and health education

The progress and success achieved by the health services along with health care in the Sultanate of Oman during the last 20 years is amazing. From only two hospitals in 1970, by 1985 there were more than 30 hospitals and 70 dispensaries (Al-Mughairy, 1985), and by 1995, there were 51 hospitals and 115 health centres (Ministry of Information in Oman, 1995). The importance of preventive services and health education has always been stressed since the introduction of the health services in 1970, with the Director General of Preventive Services to the Ministry of Health being responsible for the running of all primary health care programmes including public health. Other institutions in the public sector, such as the Sultan Qaboos University, are also responsible for promoting awareness in health education among the communities. The Sultan Qaboos University's College of Medicine, in particular, is also involved in community studies programmes which train young doctors and medical staff to communicate more effectively with patients and communities in order to promote health education (Sarhan, 1990).

However, Oman relies heavily on expatriate medical staff to operate its health system, and although, expatriates have helped in the efficient running of the Omani health services, difficulties with language may occur between patients and medical staff. These language barriers not only hinder communication but also the ability to pass health education messages effectively to patients. Another hindrance to patient education in Oman, is due to the high illiteracy rate among the Omani population. Colourful posters of health awareness with very little text, and many graphics and pictures, are often used in hospital clinics and health institutions in order to reach the illiterate. Similarly, in most hospital clinics, television sets are used to show films, to promote health awareness and education to patients waiting to see the doctor. The mass media, radio and television in Oman is also involved in promoting health education (Ministry of Information, 1995; Elbualy and Al-Manthary, 1986).

2.3 Patient-Computer Interaction

The Sultanate of Oman, in keeping with technological advancement and the wide-spread use of computers, has computerised all its ministries, hospitals, banks, and other public and private sectors. Computer education is now taught in all higher education institutes and in many private and public schools.

Computers are often used in the management of the health services, such as finance and personnel. Patients' histories are also recorded on computers, where the medical staff are in charge of inputting the information. However, although with the expansion of the health services the Ministry of Health has strengthened its use of health information systems, patient computer interviewing is unknown in Oman and has never been documented.

3 The translation process

3.1 Characteristics of the Arabic language used in the system

The Arabic language used in the GLADYS system is similar to that used in the local Arabic newspapers and in family magazines of any Arabic speaking country. The language used is simplified classical language and is designed to be easily understood by the local people in any Arabic speaking country. The gender used in the GLADYS system was male as this was more suitable. Hitti's New English-Arabic Medical Dictionary (Hitti and Al-Khatib, 1989) was used to translate the English GLADYS interview medical terms into Arabic. Appendix XI shows the GLADYS interview questions translated into Arabic, and Appendix XVIII shows the GLADYS interview questions translated back from the Arabic translation into English again by another translator. Appendix XIII shows the Arabic translation of the GLADYS information system which consists of the topics presented in Appendix XII. The information of the topics in Appendix XIII is the same as that of the English version.

3.2 A suggestive reminder

To encourage the patient to move to the information system during the interview within the text of the GLADYS interview, that is, after certain questions, a suggestive reminder was added. This reminder suggested to the user to see the GLADYS information system for particular words. For example, for question 6 in the GLADYS interview:

Q6. Have you ever had a BARIUM MEAL examination?

The suggestive reminder added underneath the question was:

For more information see Barium and Barium meal in the GLADYS information system.

3.3 Options

There were 6 options to choose from as the suitable answer for most of the questions in the English version of the GLADYS interview. These were : 'yes', 'no', 'probably yes', 'probably no', 'possibly yes', and 'possibly no'. However, within the Arabic version the options 'possibly yes' and 'possibly no' have been eliminated, as there is no apparent distinction between the words 'probably' and 'possibly' in Arabic. Thus the options of most of the questions are as follows: 'yes', 'no', 'probably yes' and 'probably no'. The use of this choice of options reduces confusion to a patient who is not sure of whether or not to select the option of 'probably' or 'possibly'.

3.4 English or local Glaswegian phrases and terms

English or local Glaswegian phrases and terms, which are not used in Arabic, such as ; 'rabbity motion', 'water brash', 'dry bolk', etc., have not been translated literally into Arabic but in such a way, so that the general meaning of the phrase or term remains the same. For example GLADYS's questions:

Q174. In your recent spell of illness, have you ever tried to vomit but not actually brought anything up; some people call this "retching" or "dry bolk", has this happened to you?

The translated version is:

Q174. During your last illness, did you feel that you wanted to vomit but couldn't do it. Did that happen to you?

3.5 Weight and measurements

Within the Arabic version all units were translated into the metric system. Since, in the Arabic world the metric system is used. Therefore, for the GLADYS interview questions where stones are used, Kilograms are used instead. For example:

Q207 Have you lost as much as half-a-stone, 7 pounds, in the last 6 months?

The translated version is:

Q207 Did your weight decrease by more than 3 Kilograms in the last six months?

3.6 Heartburn and the heart

In the Arabic language the two words 'heartburn' and 'heart' are not similar. Therefore, question 3 of the topic 'heartburn' in the GLADYS Information System English version, was deleted in the Arabic GLADYS information system.

Q3 Does heartburn have anything to do with the heart?

3.7 Alcohol

In some Arabic speaking countries, especially in the Gulf, alcohol is forbidden in public, and some patients may feel embarrassed to admit to drinking alcohol. Nevertheless, alcohol products within the GLADYS interview have been translated into Arabic using the same product's word. For example question 235:

Q235 On an average weekday, how much do you drink of any spirits like whisky, vodka, gin, rum and so on?

The translated version is:

Q235 What is the quantity of alcoholic drinks like whisky, vodka, gin, rum etc., which you take in any day of the week?

4 Materials and methods

The GLADYS system was translated into Arabic and redeveloped like the English version. The Arabic system interacted with the patient using Style B only. Screens 39 to 58 are examples of the system. The main program specifications were the same as that of the study in Glasgow (Chapter 4, Section 2, page 158). Although the system was designed to interact directly with patients using the touch screen, patients for the pilot study used a mouse instead[3].

The software and hardware required to run the Arabic GLADYS system are the same as the English version, although the Microsoft Windows used for the Arabic GLADYS system must support Arabic. However, Asymetrix Toolbook for Windows does not support Arabic and treats Arabic text as pictures and not as Text. Therefore, Arabic text could not be typed directly into the Toolbook system. Microsoft Arabic Word version 6 was used to type in the Arabic text and then parts of the text were copied and pasted into the Arabic GLADYS system. This was very time consuming, and even editing any text had to be done first in the Arabic Microsoft Word before it could be transferred into the Arabic GLADYS system.

[3] This is due to the lack of a touch screen for the pilot study in Oman.

4.1 General features of the Arabic GLADYS system

The new Arabic Toolbook GLADYS system has the similar general features as that of the English version. The system's questions and options are the same as that of the English version. Like the English version, the Arabic system was also designed to run together with the Excel version. The new Arabic GLADYS requires more than 16 Mega Bytes (14 disks) and contains 446 screens.

Dark blue, red and yellow remain the main colours of the Arabic GLADYS system. The background of the system shows the medical logo. Scanned images, graphics and drawings were used throughout the GLADYS system[4] to facilitate clearer understanding and interest among users. Humour was also included within the Arabic GLADYS system. Screens 41 to 42, screens 49 to 50 and screen 54 are examples illustrating humour.

The Arabic GLADYS system can be 'run' for both the patient and the clinician. All the screen examples shown are from the patient mode. One of the 'welcoming' screens of the system asks the user to identify himself/herself. If the user is a clinician, the system provides him/her a menu scroll bar so that it can be updated. The 'Gladys Library ListMaker' facility is not offered in the Arabic system. However, the internal monitoring is the same as that of the English version, which helps to measure patients' reactions, responses and the demand for the 'interrupt' facility.

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[4] Same images and graphics as the English version.

Like the English version, the system is divided into three main parts; (a) the GLADYS interview; (b) the information system; (c) the on-line questionnaire. The on-line questionnaire is the same as that of the English version (Screens 57 and 58 are examples). The following is a brief description of the GLADYS interview and the information system.

4.1.1 The GLADYS Interview

The Arabic GLADYS interview (the first part of the program) consists of 205 screens (Screens 39 to 48 are examples). Eight screens of these are not part of the GLADYS interview but are 'welcoming' screens (Screens 39 to 42 are examples). Same as the English version, the Arabic GLADYS interview consists of 9 sections. (Structure diagram Figures 1 and 2) with the same questions for each section (Appendix XI). The system goes through all the sections but branches to a particular section according to the patient's main symptom. Although all the patients for the pilot study used a short interview, the system was designed to have all the questions of the original GLADYS interview. Appendix III shows the flowcharts of all the 9 sections of the long version of the GLADYS interview[5].

All the buttons for navigation within the Arabic GLADYS interview are the same as that of the English version, except for the 'Library' button which was named as 'Index', which was found to be a more suitable name for the button.

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[5] This original GLADYS interview had the same questions as the Excel version.

4.1.2 The information system

The GLADYS information (the second part of the program) consists of 241 screens. Appendix XII illustrates the topics used and Refinement Diagrams Figures 4 to 30, Appendix I, represent the design of the topics' information. Screens 49 to 56 are examples of screens in the information system. There are 3 'welcoming' screens for the GLADYS information system (Screens 49 to 50 are examples). Like the English version, all the topics information screens consist of the same three colours and fonts[6] (Screens 52 to 56), except for the 'welcoming' screens (Screens 49 to 50) and the 'Topics Menu' screen (Screen 51).

There are 44 topics in the information system (Appendix XII), which were selected to be of interest to patients at a gastro-enterology clinic. Although the 'Topics Menu' screen was designed to be the same style as that of style C 'Topics Menu' screen (Screen 23), the topics were not selected as in style C, that is from a range of information about gastro-enterology adapted in some degree to the patients' own characteristics and interview responses. This is because Asymetrix Toolbook does not support Arabic, and therefore Arabic text could not be used within the program scripts. The information provided for each topic was the same as that of the English, although there were very few changes made. For example, for the English version the question 3 of the topic 'heartburn' was:

- Does heartburn have anything to do with the heart?

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[6] Not including the colours of the images used.

This question was deleted in the Arabic GLADYS information system as the two words 'heartburn' and 'heart' are not similar in the Arabic language.

The same buttons for navigation within the Arabic information system are used as that of the English system. However, unlike the English version of the information system, these buttons are placed underneath the text instead on the right hand side of the text (Screens 52 to 56). Again this is because Toolbook does not support Arabic and some difficulties had risen in placing the buttons on the right hand side of the text.

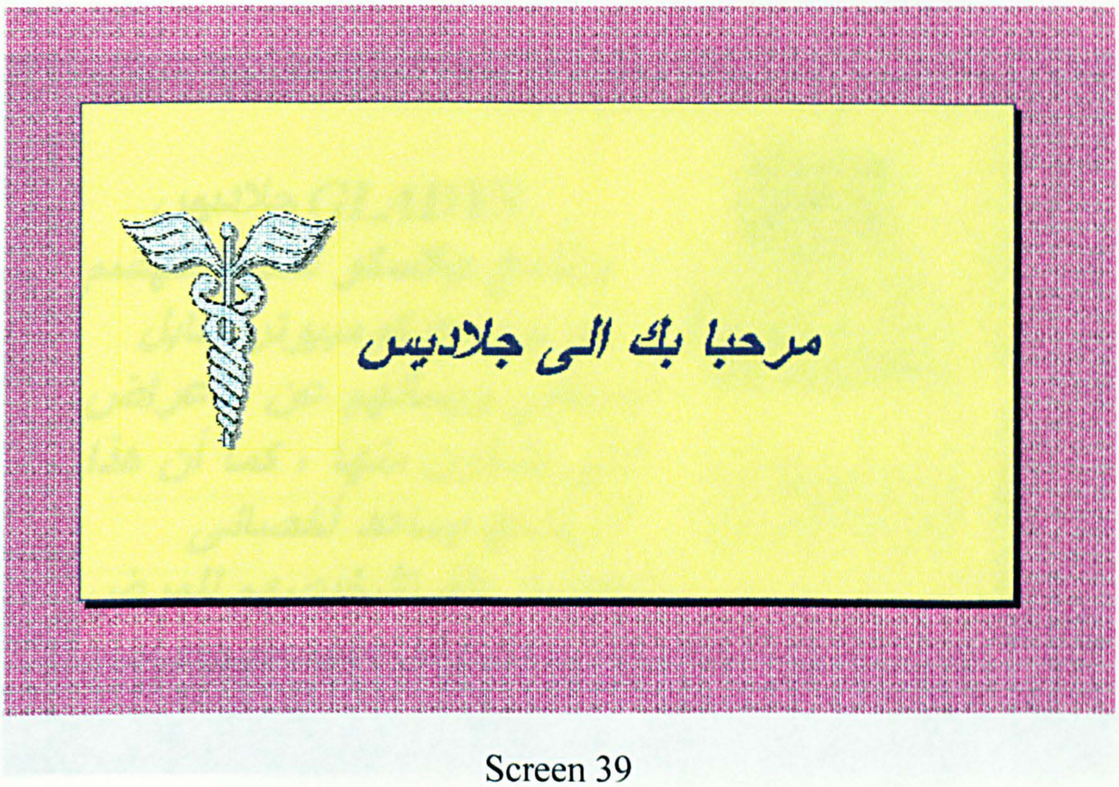
4.1.3 Hotwords

Since Toolbook does not accept Arabic as text but as pictures, hotwords could not be used in the Arabic GLADYS. Therefore to encourage the patient to move to the information system during the interview, after certain questions within the text of the GLADYS interview, a suggestive reminder was added. This reminder suggested to the user to see the GLADYS information system for particular words. For example, for question 6 in the GLADYS interview:

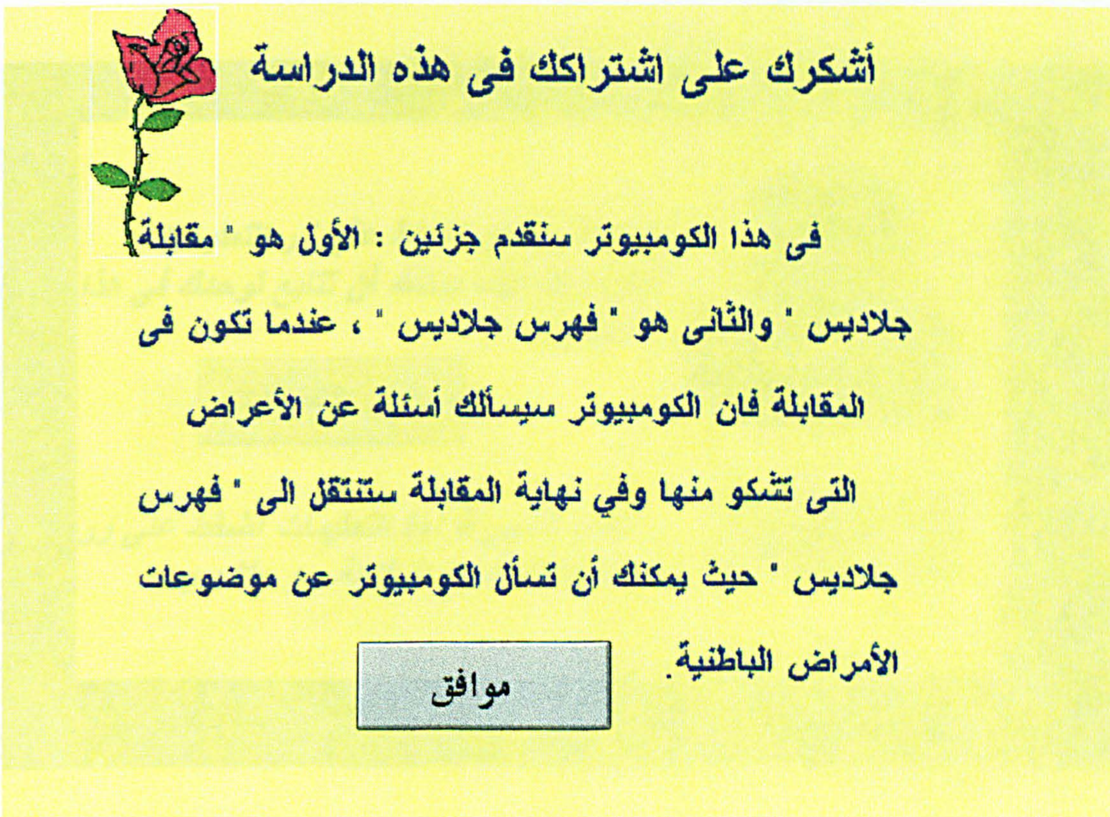
- Have you ever had a BARIUM MEAL examination?

The suggestive reminder added underneath the question was:

For more information see Barium and Barium meal in the GLADYS information system.

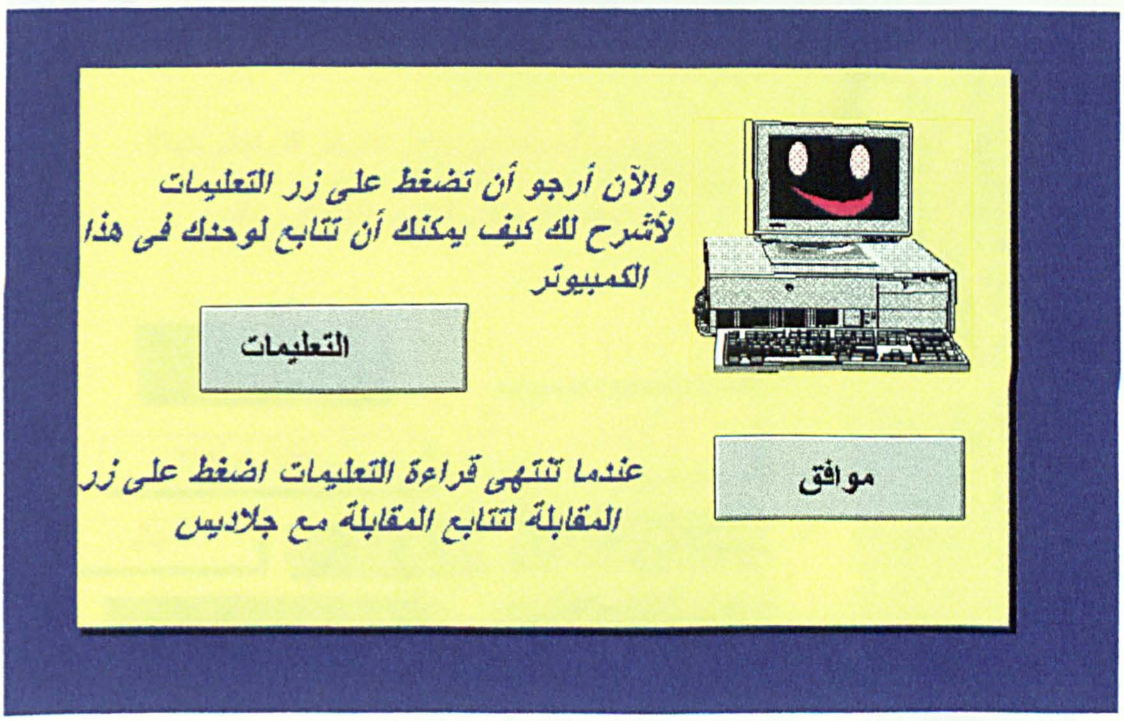


Screen 39



Screen 40

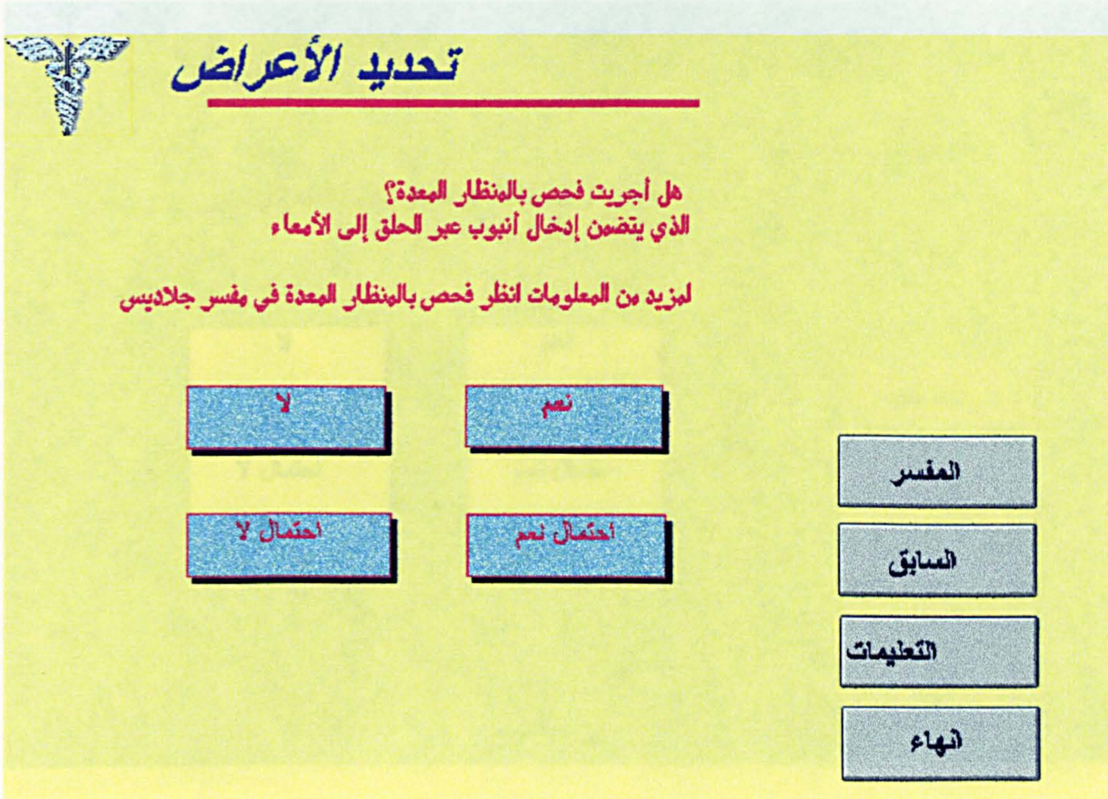
Screen 41



Screen 42

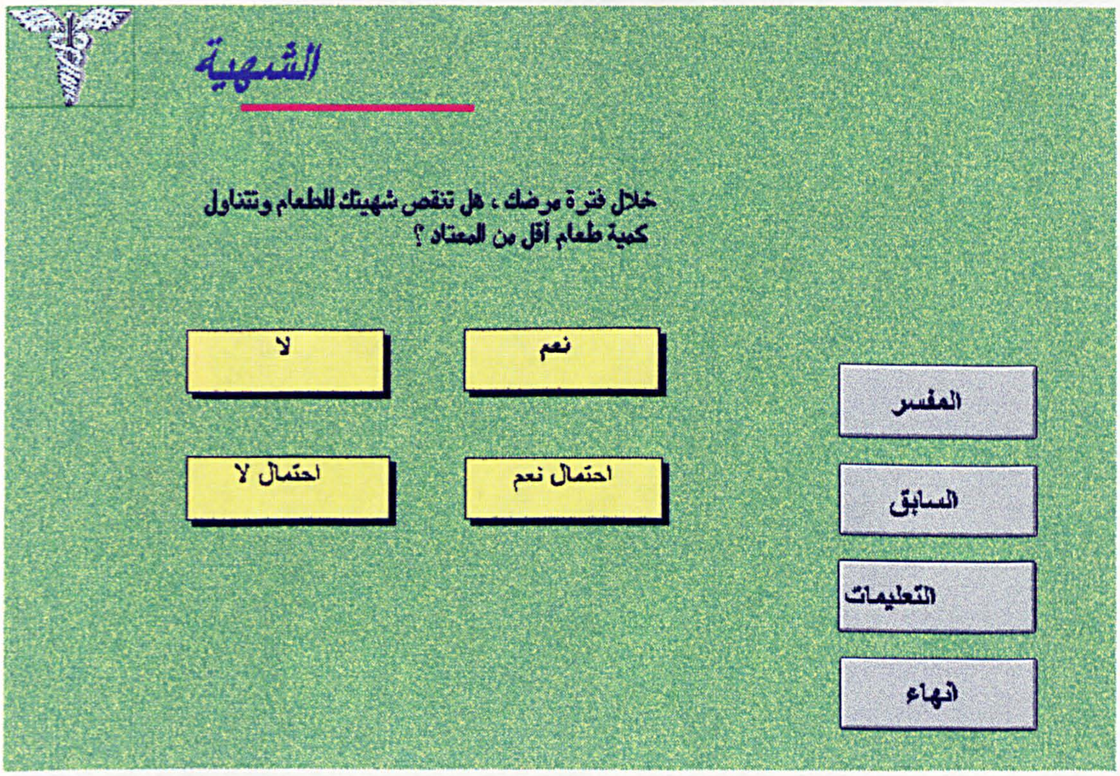
Screen 43

Screen 44



Screen 45

Screen 46

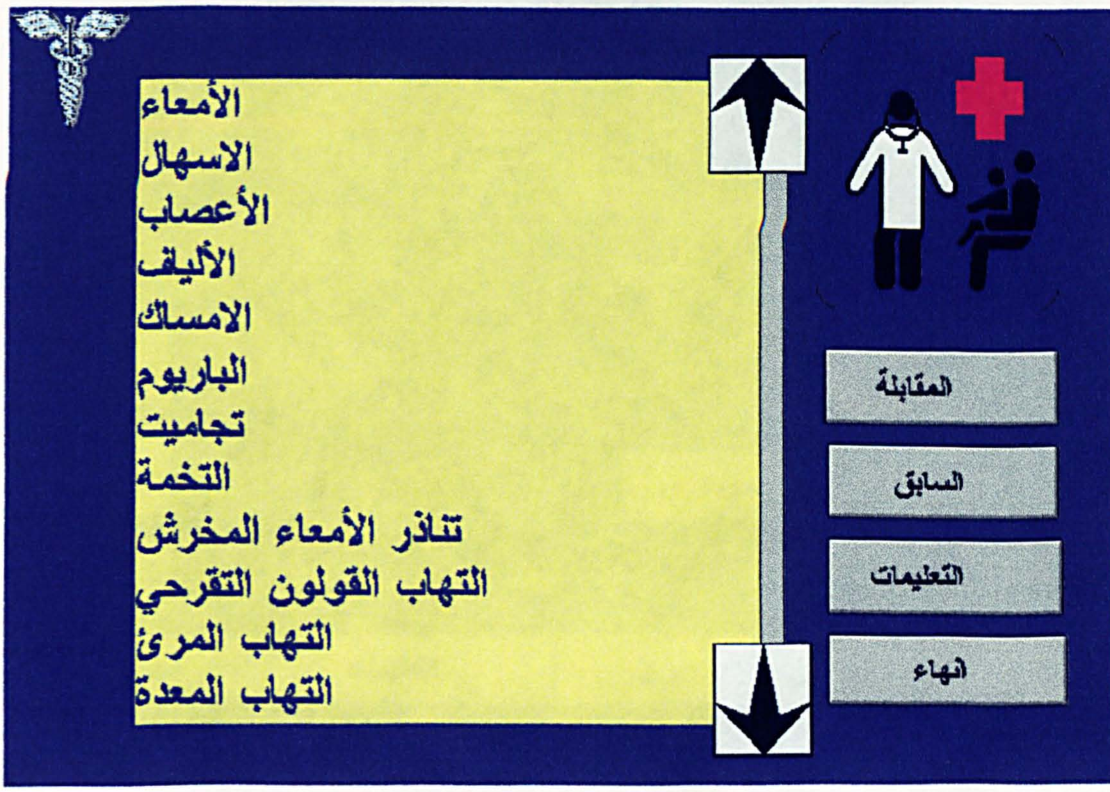


Screen 47

Screen 48

Screen 49

Screen 50



Screen 51

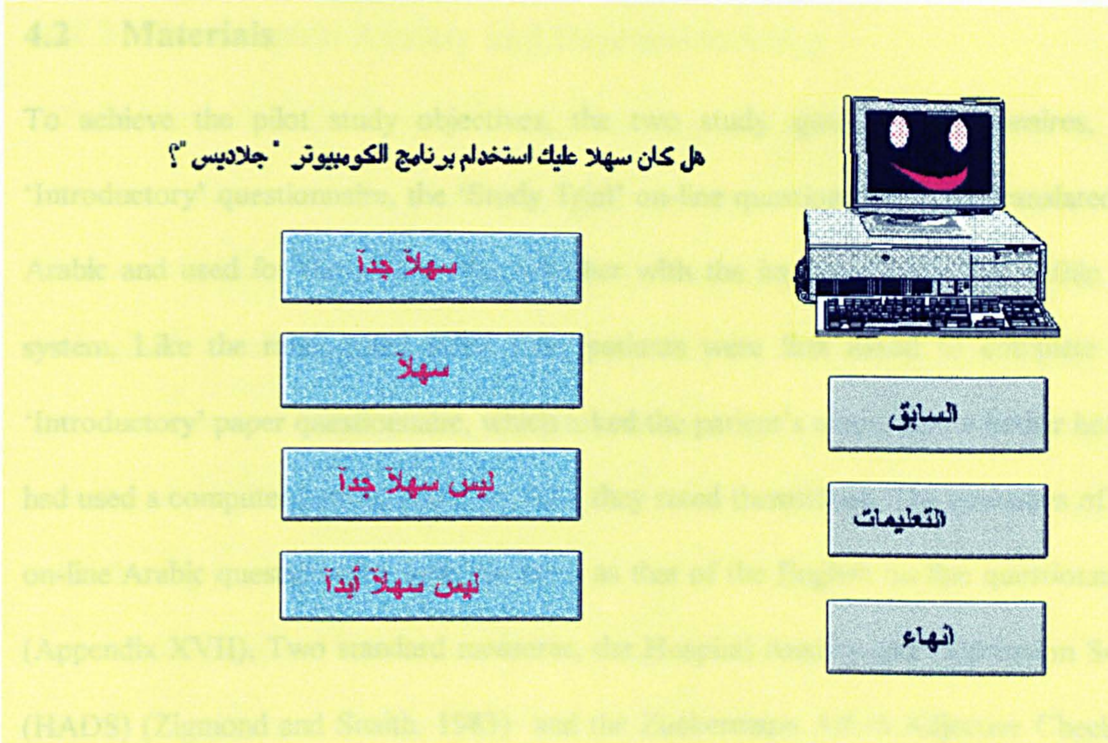
Screen 52

Screen 53

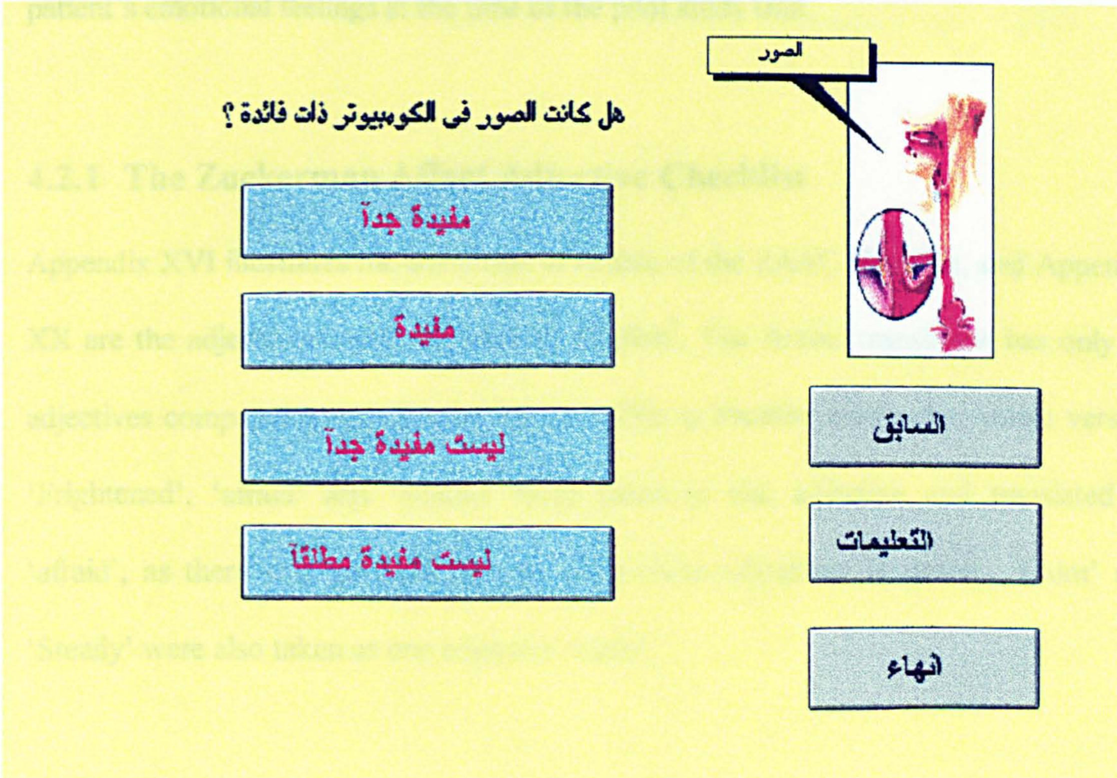
Screen 54

Screen 55

Screen 56



Screen 57



Screen 58

4.2 Materials

To achieve the pilot study objectives, the two study specific questionnaires, the 'Introductory' questionnaire, the 'Study Trial' on-line questionnaire were translated to Arabic and used for the pilot study, together with the internal monitoring within the system. Like the randomised study trial, patients were first asked to complete the 'Introductory' paper questionnaire, which asked the patient's name, age, whether he/she had used a computer before, and if so, how they rated themselves. The questions of the on-line Arabic questionnaire were the same as that of the English on-line questionnaire (Appendix XVII). Two standard measures, the Hospital Anxiety and Depression Scale (HADS) (Zigmond and Snaith, 1983) and the Zuckermann Affect Adjective Checklist (ZAAC) (Zuckerman and Lubin, 1965) were also translated and used to identify the patient's emotional feelings at the time of the pilot study trial.

4.2.1 The Zuckerman Affect Adjective Checklist

Appendix XVI illustrates the adjectives in Arabic of the ZAAC checklist, and Appendix XX are the adjectives translated back to English[7]. The Arabic translation has only 18 adjectives compared to the English version. This is because within the Arabic version 'Frightened', 'afraid' and 'Fearful' were taken as one adjective and translated as 'afraid', as there was no difference between these adjectives in Arabic. 'Calm' and 'Steady' were also taken as one adjective 'Calm'.

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[7] The translator did not see the original English version and had no idea that the Arabic version of ZAAC was a translation of an original English version.

4.2.2 The Hospital Anxiety and Depression Scale

All the items within the Hospital Anxiety and Depression Scale (HADS) and the response options were the same as that of the English version. Appendix XV illustrates the items in Arabic, and Appendix XIX are the questions translated back to English[8]. Local English phrases and terms which are not used in Arabic, have not been translated literally into Arabic but in such a way, so that the general meaning of the phrase or term remains the same. Difficulties were experienced with the following phrases:

Item 1: I feel tense and 'wound up' was translated as 'I feel tensed'.

Item 9: 'I get a sort of frightened feeling like 'butterflies' in the stomach' was translated as 'I feel afraid'.

Item 13: 'I get sudden feelings of panic' was translated as 'I suddenly get worried'.

4.2.3 The on-line questionnaire

All the questions were the same as that of the English version, appendix XVII are the questions in Arabic. Screens 57 and 58 are example of screens of the on-line questionnaire[9]. Categorisation of variables of the 'Study Trial' on-line questionnaire was the same as that of the English version (Chapter 4, Section X part 3). Similarly, data analysis, and the coding and the re-coding of the questionnaires were the same. The Statistical Package for Social Sciences (SPSS)

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[8] Same method as 7.

[9] The English version has the same screens.

for Windows was used to analyse data. Epi6 software for Windows was also used to carry out the Fisher's exact test for small numbers.

5 The Pilot study

5.1 The Setting

The gastro-enterology clinic at the Royal Hospital in Muscat, operates twice a week on Sundays and Wednesdays from 8.30 a.m. to 2.30 p.m. This is a very busy clinic and on normal clinic days patients may average 70, with the number of doctors varying from three to four. The researcher was given a room situated at the clinic for the study, and was also given the opportunity to talk freely to the patients and select those who were suitable and willing to participate.

5.2 The Patients

Thirty-seven patients participated in the pilot study from the period of the 3rd of March to the 27th of March 1996. Selection of the patients was from eight clinical days, making an average of between four and five patients per day. Only patients who were willing and literate participated in the pilot study. The waiting time for each patient varied from half an hour to two hours. This time usually depended on the patient's appointment time and the number of doctors available on that particular day. While waiting to see the doctor, patients were asked by a nurse or the researcher whether or not they would like to participate in the pilot study. Initially, the nurses asked the patients, but later, the researcher herself made the request. This was more practical as she was more aware of the suitability of the patients. There was a substantial percentage of patients at the clinic who were not suitable for the pilot study mainly because of illiteracy, but also because they did not wish to participate in the study. However, there was a keen interest among the younger patients, generally in the use of the computer. The selected willing patients were usually young (average age 26) years. The researcher identified herself and then gave a short informal description of the research, describing it to see how the patients would interact with the computer.

Only Arabic speaking patients were selected for the pilot study, even though, there were English speaking patients at the clinic, such as British, Pakistanis and Indians. The selected patients were one Sudanese (Male), one Jordanian (Female), one Egyptian (Male), and 34 Omanis. Twenty-four of the Omanis were males and 10 were females.

5.3 Patients' activities at the clinic

Before being examined by the doctor, patients at the gastro-enterology clinic waited at the reception area in the main hall. They were then called by the receptionist into the gastro-enterology clinic, where a nurse would take their weight. The patient would then wait for a doctor. During this time, if suitable, the patient was asked to participate in the pilot study.

Participating patients were then asked to:

a) complete the paper identification questionnaire (Appendix XIV);

b) fill in the Arabic version of Hospital Anxiety and Depression Scale (Appendix XV);

c) fill in the Arabic version of the ZAAC checklist (Appendix XVI);

d) interact with the Arabic GLADYS computer program;

e) complete the On-line study questionnaire.

5.4 Time

The time range for the pilot study was between 17 minutes to 29 minutes[10]. For each patient the time allocated for the pilot study varied depending on the patient's interest in the computer system, the desire to learn something new, response time, time to be seen by the doctor and other reasons (Table 9.5.1).

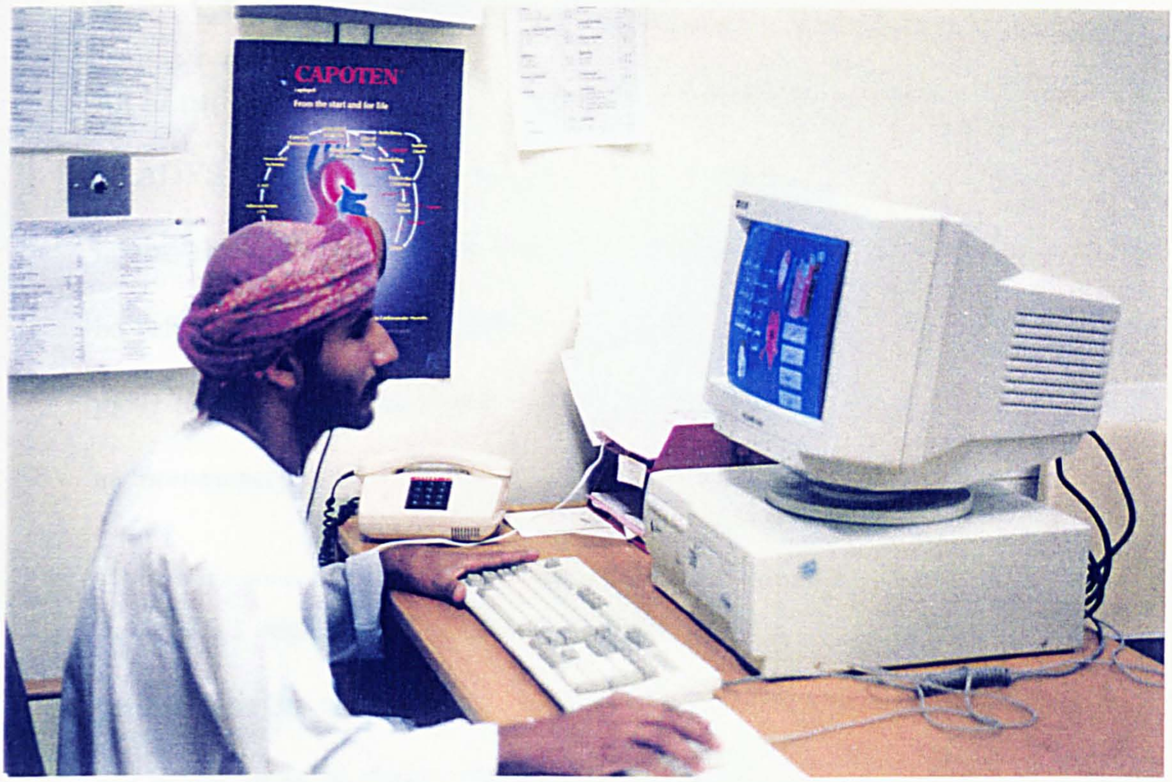
Table 9.5.1 : Frequency of patients' time (in minutes) spent in using the computer, for patients using the short Arabic interview.

Average time spent with the computer n = 37	Computer interview time	Information system time	Total interview and information system time	Total On-line questionnaire
Mean (SD)	12.4 (1.3)	5.4 (1.4)	17.8 (1.9)	5.5 (0.9)
Minimum	10	3	13	4
Maximum	15	9	22	7

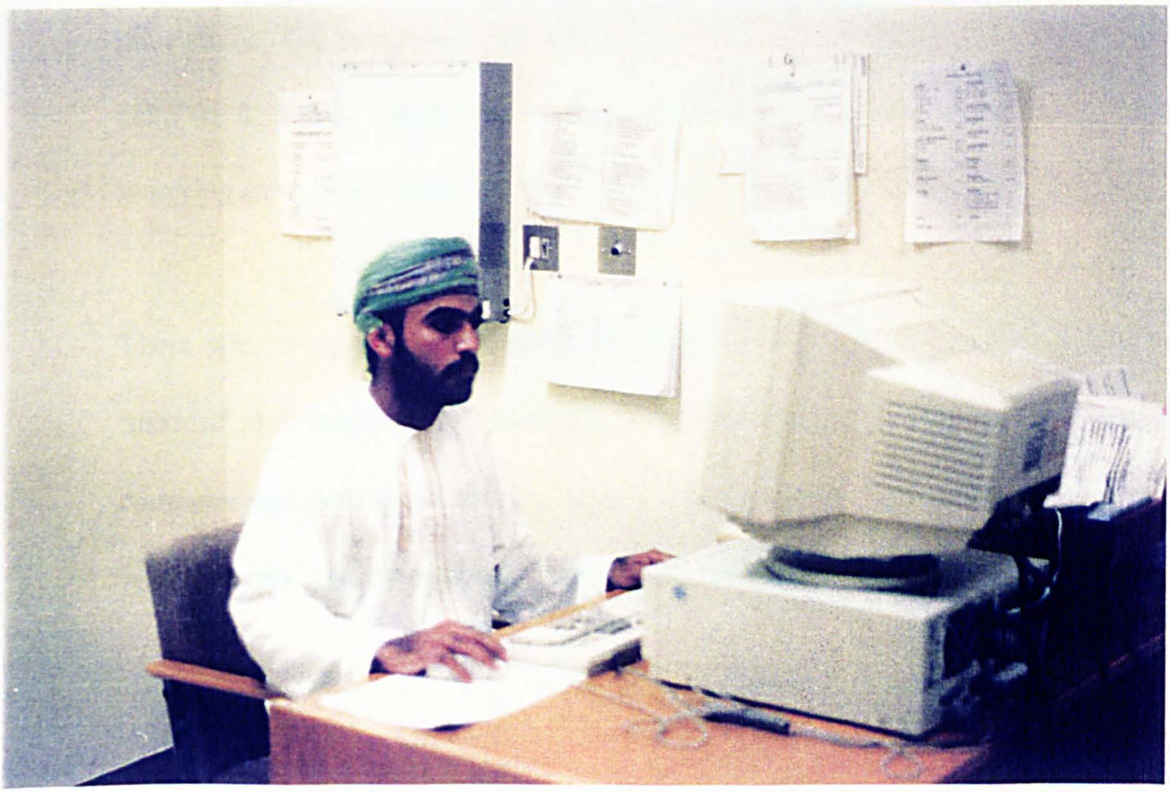
[10] Patients using the short GLADYS interview.

Patients waiting at the reception area

Patients waiting at the gastro-enterology clinic



Patients using Gladys



6 Characteristics of patients

All 37 patients were given access to the information system during the short Arabic GLADYS interview. Thirty patients chose to seek information or move to the information system during the Arabic GLADYS interview. These 30 patients will be referred to as '*movers*'. The seven patients who did not seek information or move to the information system during the computer interview will be referred to as '*non-movers*'.

Table 9.6.1 represents the characteristics of the patients. The mean age of the patients was 26, ranging from 18 to 45. Twenty-four patients (65%) were in the age group 20 to 29 years, 3 patients (8%) were less than 20 years and 7 patients (23%) were between 30 years and 45 years. The majority of the patients (n=27, 73%) were males, and most patients (n=24, 65%) had used computers before the pilot study. The majority of the patients[11] (n=15, 40%) felt contented, others felt calm (n=8, 22%), secure (n=3, 8%), thoughtful (n=3, 8%), happy (n=3, 8%), worrying (n=1, 3%), desperate (n=2, 5%), afraid (n=1, 3%) and upset (n=1, 3%).

There was no significant difference between the mean age for patients who were 'movers' and 'non-movers'. Similarly, cross tabulations between gender, previous computer use, emotional feelings, anxiety and depression scores, and patients who were 'movers' and 'non-movers', showed no significant differences.

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[11] Patients' responses to the Arabic version of the Zuckermann Affect Adjective Checklist

Table 9.6.1 : Patients' characteristics.

	Non-movers n=7 No. (%)	Movers n=30 No. (%)	Total n=37 No. (%)
Age			
Mean (SD)	28 (6.9)	26 (6.8)	26 (6.8)
	t-value = 0.86, p = 0.4		
Gender			
Male	4 (57)	23 (77)	27 (73)
Female	3 (43)	7 (23)	10 (27)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 1.1$ (df=1) p = 0.4		
Previous computer use			
Never	3 (43)	10 (33)	13 (35)
Occasionally	3 (43)	8 (27)	11 (30)
Often	0 (0)	5 (17)	5 (14)
Daily	1 (14)	7 (23)	8 (21)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.23$ (df=3) p = 0.7		
Emotional feelings			
Negative	1 (14)	5 (17)	6 (16)
Positive	6 (86)	25 (83)	31 (84)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.02$ (df=1) p = 1		
Anxiety score			
Not anxious	4 (57)	15 (50)	19 (51)
Border-line	1 (14)	10 (33)	11 (30)
Anxious	2 (29)	5 (17)	7 (19)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.52$ (df=1) p = 0.4		
Depression scores			
Not depressed	5 (72)	25 (83)	30 (81)
Border-line	1 (14)	2 (7)	3 (8)
Depressed	1 (14)	3 (10)	4 (11)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.11$ (df=1) p = 0.7		

7 Reactions of Patients

7.1 Ease of use

Most patients (n=35, 95%), felt that working with GLADYS was either 'very easy' or 'moderately easy' (Table 9.7.1). Similarly, most patients (n=36, 97%) felt that using the mouse was either 'very easy' or 'moderately easy'. There was no significant difference in computer ease between patients who were 'movers' and 'non-movers'.

7.2 Clarity of computer instructions

All 37 patients felt that the computer instructions were either clear 'all the time' or 'most of the time' (Table 9.7.2). There was no significant difference in patients' perception of the clarity of the computer instructions between patients who were 'movers' and 'non-movers'.

Table 9.7.2 : Patients' perceptions of clarity of the computer instructions.

	Non-movers **n=7** No. (%)	**Movers** **n=30** No. (%)	**Total** **n=37** No. (%)
Clarity of computer instructions			
Not at all	0 (0)	0 (0)	0 (0)
Some of the time	0 (0)	0 (0)	0 (0)
Most of the time	1 (14)	7 (23)	8 (22)
All the time	6 (86)	23 (77)	29 (78)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.27$ (df=1) p = 0.6		

Table 9.7.1 : Patients' perception of ease of use when interacting with the computer.

	Non-movers n=7 No. (%)	Movers n=30 No. (%)	Total n=37 No. (%)
Ease of using the computer			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	0 (0)	2 (7)	2 (6)
Moderately easy	2 (29)	8 (26)	10 (27)
Very easy	5 (71)	20 (67)	25 (68)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.17$ (df=1) p = 0.7		
Ease of using the mouse			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	0 (0)	1 (3)	1 (3)
Moderately easy	2 (29)	9 (30)	11 (30)
Very easy	5 (71)	20 (67)	25 (67)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.06$ (df=1) p = 0.8		
Ease of selecting a topic			
Not at all	0 (0)	0 (0)	0 (0)
Not very easy	1 (14)	0(0)	1 (3)
Moderately easy	2 (29)	8 (27)	10 (27)
Very easy	4 (57)	22 (73)	26 (70)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.71$ (df=1) p = 0.4		

7.3 Feelings of confusion and no control

Eight patients (22%) felt confused while working with the computer, although most of them (n=6, 75%) felt only occasionally confused (Table 9.7.3). Similarly, 13 patients (35%) felt lost at some stage. However, most of them (n=9, 69%) felt only occasionally lost. There was no significant difference in patients' feelings of confusion and no control between patients who were 'movers' and 'non-movers'.

7.4 Feelings of well-being

Patients felt either 'very comfortable' or 'moderately comfortable' while being interviewed by the computer (Table 9.7.4). Also, all the patients felt that being interviewed by the doctor was 'not at all' or 'not very embarrassing'. Similarly, all patients felt that being interviewed by the computer was 'not at all' or 'not very embarrassing'. Although, however, there were more patients who felt 'not at all' embarrassed while being interviewed by the computer (n=35, 95%) compared with the doctor (n=29, 78%). There was no significant difference in patients' perceived feelings of well-being outcomes between patients who were 'movers' and 'non-movers'.

Table 9.7.3 : Patients' feelings of confusion and no control when interacting with the computer.

	Non-movers n=7 No. (%)	Movers n=30 No. (%)	Total n=37 No. (%)
Confused			
No	6 (86)	23 (77)	29 (78)
Yes	1 (14)	7 (23)	8 (22)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.27$ (df=1) p = 0.6		
Confusion time			
Only occasionally	1 (100)	5 (71)	6 (75)
Some of the time	0 (0)	2 (29)	2 (25)
Most of the time	0 (0)	0 (0)	0 (0)
All of the time	0 (0)	0 (0)	0 (0)
Total	1 (100)	7 (100)	8 (100)
	Fisher's exact test, p =1		
Lost at some stage			
No	5 (71)	19 (63)	24 (65)
Yes	2 (29)	11 (37)	13 (35)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.16$ (df=1) p = 0.7		
Lost at some stage			
Only occasionally	2 (100)	7 (64)	9 (69)
Some of the time	0 (0)	4 (36)	4 (31)
Most of the time	0 (0)	0 (0)	0 (0)
All of the time	0 (0)	0 (0)	0 (0)
Total	2 (100)	11 (100)	13 (100)
	Fisher's exact test, p = 1		

Table 9.7.4 : Patients' feelings of well-being when interacting with the computer.

	Non-movers n=7 No. (%)	Movers n=30 No. (%)	Total n=37 No. (%)
Computer interviewing comfortable			
Not at all	0 (0)	0 (0)	0 (0)
Not very comfortable	0 (0)	0 (0)	0 (0)
Moderately comfortable	2 (29)	6 (20)	8 (22)
Very comfortable	5 (71)	24 (80)	29 (78)
Total	7 (100)	30 (100)	37 (100)
$\chi^2 = 0.25$ (df=1) $p = 0.6$			
Doctor-Patient embarrassment			
Not at all	6 (86)	23 (77)	29 (78)
Not very embarrassing	1 (14)	7 (23)	8 (22)
Moderately embarrassing	0 (0)	0 (0)	0 (0)
Very embarrassing	0 (0)	0 (0)	0 (0)
Total	7 (100)	30 (100)	37 (100)
$\chi^2 = 0.27$ (df=1) $p = 0.6$			
Patient-Computer embarrassment			
Not at all	7 (100)	28 (93)	35 (95)
Not very embarrassing	0 (0)	2 (7)	2 (5)
Moderately embarrassing	0 (0)	0 (0)	0 (0)
Very embarrassing	0 (0)	0 (0)	0 (0)
Total	7 (100)	30 (100)	37 (100)
$\chi^2 = 0.49$ (df=1) $p = 0.5$			

7.6 Interest

Most patients (n=33, 89%) felt that they did not lose interest at all while interacting with the computer (Table 9.7.5). Cross tabulations in patients' loss of interest between patients who were 'movers' and 'non-movers' showed no significant difference.

Table 9.7.5 : Patients' loss of interest when interacting with the computer.

	Non-movers **n=7** No. (%)	**Movers** **n=30** No. (%)	**Total** **n=37** No. (%)
Loss of Interest			
Not at all	6 (86)	27 (90)	33 (89)
Not often	0 (0)	2 (7)	2 (5)
Sometimes	1 (14)	1 (3)	2 (6)
Many times	0 (0)	0 (0)	0 (0)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.11$ (df=1) $p = 0.7$		

7.7 Perceived utility

Most patients (n=35, 95%) felt that the images used in GLADYS were either 'very useful' or 'moderately useful' (Table 9.7.6). Similarly, all patients felt that the information was either 'very useful' or 'moderately useful'. Twenty-eight patients (76%) felt that they would remember the information 'quite a lot' when they had left the clinic. Similarly, 30 patients (81%) felt that they had learned something new after using the computer. There was no significant difference in patients' perceived feelings of utility outcomes between patients who were 'movers' and 'non-movers'.

Table 9.7.6 : Patients' perception of perceived utility.

	Non-movers n=7 No. (%)	Movers n=30 No. (%)	Total n=37 No. (%)
Images usefulness			
Not at all	0 (0)	0 (0)	0 (0)
Not very useful	0 (0)	2 (6)	2 (5)
Moderately useful	3 (43)	8 (27)	11 (30)
Very useful	4 (57)	20 (67)	24 (65)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.23$ (df=1) $p = 0.6$		
Information usefulness			
Not at all	0 (0)	0 (0)	0 (0)
Not very useful	0 (0)	0 (0)	0 (0)
Moderately useful	2 (29)	5 (17)	7 (19)
Very useful	5 (71)	25 (83)	30 (81)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.52$ (df=1) $p = 0.4$		
Remember information			
Not at all	0 (0)	0 (0)	0 (0)
Not very much	2 (29)	7 (23)	9 (24)
Quite a lot	5 (71)	23 (77)	28 (76)
Very much indeed	0 (0)	0 (0)	0 (0)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.08$ (df=1) $p = 0.8$		
learned something new			
Not at all	0 (0)	0 (0)	0 (0)
Not very much	1 (14)	6 (20)	7 (19)
Quite a lot	6 (86)	23 (77)	29 (78)
Very much indeed	0 (0)	1 (3)	1 (3)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 0.12$ (df=1) $p = 0.7$		

7.8 Patients' perception on the relevance of the topics

Thirty-five patients (94%) felt that the topics in the Arabic GLADYS information system were either 'very relevant' or 'moderately relevant' (Table 9.7.7). There was no significant difference in patients' perception of the relevance of the topics between patients who were 'movers' and 'non-movers'.

Table 9.7.7 : Patients' perception of the relevance of the topics provided by the information system.

	Non-movers **n=7** No. (%)	**Movers** **n=30** No. (%)	**Total** **n=37** No. (%)
Relevance of topics			
Not at all	0 (0)	0 (0)	0 (0)
Not very relevant	0 (0)	2 (6)	2 (6)
Moderately relevant	4 (57)	8 (27)	12 (32)
Very relevant	3 (43)	20 (67)	23 (62)
Total	7 (100)	30 (100)	37 (100)
	$\chi^2 = 1.4$ (df=1) p = 0.2		

7.9 Patients' satisfaction scores

There was no significant difference in patients' outcome scores between patients who were 'movers' and 'non-movers' (Table 9.7.8).

Table 9.7.8 Patients' outcome scores (the higher mean scores indicate better performance (min. : 1; max. : 4).

	Non-movers **n=7** Mean (SD)	**Movers** **n=30** Mean (SD)	***t*-value, p**
Ease of use	3.62 (0.56)	3.66 (0.47)	-0.18, 0.9
Clarity	3.86 (0.38)	3.77 (0.43)	0.51, 0.6
Confusion and no control[12]	1.79 (0.39)	1.70 (0.43)	0.48, 0.6
Feelings of well-being	3.86 (0.18)	3.83 (0.24)	0.24, 0.8
Usability	3.25 (0.27)	3.23 (0.30)	0.13, 0.9
Interest	3.71 (0.76)	3.87 (0.43)	-0.72, 0.5
Utility	3.21 (0.30)	3.26 (0.26)	-0.39, 0.7
Relevance of topics	3.43 (0.54)	3.60 (0.62)	-0.67, 0.5
Overall Patient Satisfaction	3.29 (0.17)	3.31 (0.21)	-0.31, 0.8

7.10 Terms not understood by patients

All patients (n = 37 ; 100%), felt that they did not understand some of the terms in the Arabic GLADYS interview. Additional messages were added to the original GLADYS interview questions, which were composed of relevant technical terms to the questions of the GLADYS interview. These messages were added since, unlike the English GLADYS, 'hotwords' could not be used in the Arabic GLADYS. Also, they were used as a remainder to encourage the user to seek

[12] minimum = 1; maximum = 2

information in the GLADYS information system during the computer interrogation. For example:

Original GLADYS interview question:

- "Did the Barium Meal[13] show an ulcer?"

Same question in the Arabic GLADYS interview:

- "Did the Barium Meal show an ulcer?

For more information see ulcer, duodenal ulcer, gastric ulcer, and peptic ulcer in the GLADYS information system"

Similarly, terms such as 'endoscopy examination' and 'barium meal' were unknown to some patients. For example, the term used for 'endoscopy examination' was a classical term from the medical dictionary and not the term normally used by clinicians at a gastro-enterology clinic. However, 7 patients (19%) did not seek information during the interview, yet were able to answer the question because the GLADYS questions contained explanations of the terms. For example the question:

"Have you ever had an ENDOSCOPY examination, that is a tube put down your throat to look at your stomach?"

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[13] Both underlined words 'Meal' and 'Ulcer' are 'hotwords' or activated words in the English GLADYS version but not in the Arabic version.

After the pilot study, a few of the terms were changed to suit the terminology used by clinicians at a gastro-enterology clinic such as the term 'endoscopy examination'. In addition, messages such as:

"For more information see ulcer, duodenal ulcer, gastric ulcer, and peptic ulcer in the GLADYS information system"

were changed to:

"For more information see ulcer in the GLADYS information system".

This is because it was found that some patients will continue with the computer interview as long as they understand the question and not necessarily the technical terms in the messages attached to the questions. Messages as the above will lengthen the computer interview and not necessarily encourage all the patients to interrupt the interview. A simple message as a reminder such as:

"For more information see ulcer in the GLADYS information system";

was felt to be better as within the topic 'ulcer' there will be another reminder message to the topics 'duodenal ulcer', 'gastric ulcer', and 'peptic ulcer' and the patient if so wishes may explore the topics.

8 Patients' preferences

Patients were asked to determine their preferences in the selection of topics and in the method of accessing health information. Twenty-four patients (65%) preferred 'selected' topics, 9 patients (24%) preferred 'general' topics and 4 patients (11%)

felt 'no difference'[14] between the two options. Also, 17 patients (46%) preferred 'a computer', 15 patients (41%) had no special preference and 5 patients (13%) preferred a 'book or pamphlet'.

9 Patients' symptoms and topics viewed

Patients who suffered from gastric-related symptoms were selected for the pilot study. Table 9.7.9 represents the frequency distribution of patients' main symptom. Most patients (n=22; 59%) suffered from pain as their main symptom. Other patients suffered from heartburn (n=4; 11%), vomiting (n=5; 13%), wind (n=4; 11%), weight loss (n=1; 3%), and constipation (n=1; 3%).

Table 9.7.9 : Frequency distribution of patients' main symptoms and number of patients suffering from each symptom.

Symptoms	**Main symptom** No. (%)	**Symptoms** No. (% of 37)
Pain	22 (59)	33 (89)
Heartburn	4 (11)	16 (43)
Diarrhoea	0 (0)	0 (0)
Vomiting	5 (13)	8 (22)
Bleeding	0 (0)	0 (0)
Wind	4 (11)	12 (32)
Constipation	1 (3)	1 (3)
Weight loss	1 (3)	4 (11)
Poor appetite	0 (0)	4 (11)
General ill health	0 (0)	5 (14)
Total (100)	37 (100)	83 (224)

[14] Two options 'no difference' and 'I don't know' were added into the Arabic GLADYS on-line questionnaire

The majority of the patients suffered from several other symptoms besides their main symptom. Table 9.7.9 also represents the number of patients suffering from each of the symptoms[15]. Most patients (n=33; 89%) suffered from pain, other prominent symptoms were heartburn (n=16; 43%), wind (n=12; 32%), and vomiting (n=8; 22%). Of the 37 patients; 10 patients (27%) looked at a topic in the Arabic GLADYS information system which was their main symptom; and 24 patients (65%) looked at a topic which was one of their symptoms including their main symptom.

Patients viewed 23 topics (52%) of the 44 topics provided in the Arabic GLADYS information system. The majority of the patients (n=13, 35%) viewed 2 topics; 6 patients (16%) viewed one topic; 11 patients (30%) viewed 3 topics; 4 patients (11%) viewed 4 topics; 2 patients (5%) viewed 5 topics; and one patient (3%) viewed 7 topics. However, the information within each topic differed from the information within other topics. For example, within the topic 'heartburn' a patient could view several screens of information while within the topic 'appendix' a patient could only view one screen. Also, patients' characteristics and interests differ. For example, some patients browsed quickly through the topics for interest or curiosity to see what was being offered by the system, while others took time reading the contents of each screen of a particular topic. Table 9.7.10 represents the frequency of the topics viewed by patients. Popular topics viewed by patients

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[15] Also includes patients' main symptom

were: endoscopy examination (n=14; 38%), heartburn (n=13; 35%), wind (n=9; 24%), barium meal (n=8; 22%) ; vomiting (n=7; 19%) and ulcer (n=7; 19%).

Table 9.7.10 : Topics viewed by patients in the Arabic GLADYS information system.

Topics	Number of times viewed No. (% of 37)
Heartburn	13 (35)
Endoscopy examination	14 (38)
Diarrhoea	3 (8)
Wind	9 (24)
Ulcer	7 (19)
Irritable bowel syndrome	3 (8)
Duodenal ulcer	4 (11)
Constipation	5 (14)
Vomiting	7 (19)
Dyspepsia	2 (5)
Gastric ulcer	2 (5)
Stress	5 (14)
Fibre diet	2 (5)
Barium meal	8 (22)
Cereals	1 (3)
Zantac	2 (5)
Appendix	3 (8)
Barium	1 (3)
Bowels	2 (5)
Nerves	1 (3)
Gastritis	1 (3)
Ulcerative colitis	2 (5)
Gaviscon	1 (3)
Total (%)	98 (265)

10 Discussion

The objectives of this pilot study were primarily to investigate the feasibility of introducing a patient workstation into an Omani gastro-enterology clinic. In addition to investigate the feasibility and acceptability of the Toolbook Arabic GLADYS and to determine the understanding and the suitability of the Arabic language terminology used in the Arabic GLADYS to Arabic speaking patients in an Omani gastro-enterology clinic.

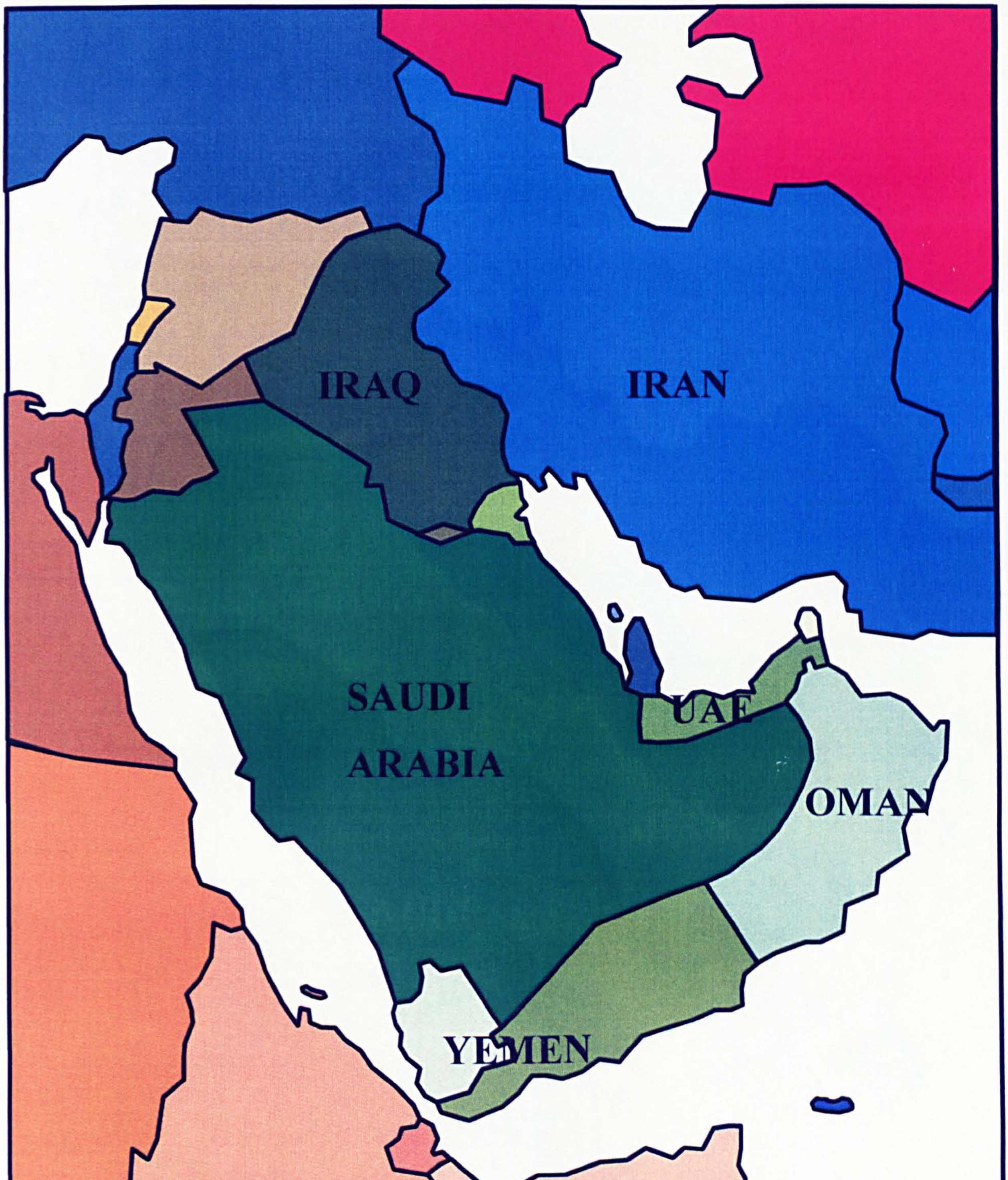
The Toolbook Arabic GLADYS system was well accepted by patients. The findings supported the feasibility of introducing a patient workstation into an Omani gastro-enterology clinic and the suitability of the Arabic language terminology used in the Arabic GLADYS to Arabic speaking patients in an Omani gastro-enterology clinic. Patients accepted the computer as a method of elicitation of life-style data and of learning. All patients completed the study trial, and all mean scores on all evaluation questions tended be rather positive. The high level of computer favourability corroborates with the results of previous studies with medical patients, which suggest that in general patients respond well to computer interviews and computer-based education systems (Beck, 1982; Carr and Ghosh, 1983; Spunt et al., 1996; Cole et al., 1976; Greist et al., 1973a; 1973b; 1983; Slack and Van Cura, 1968; Spinhoven et al., 1993; Taenzer et al., 1996; Luker and Caress, 1991; 1992; O'Connor et al., 1989; Williams et al., 1995; Wise et al., 1996; Lucas et al., 1976; Lucas, 1977; Biermann and Mehnert, 1990).

Furthermore, most of the patients were younger (average age 26 years) than the average patient at the clinic and more were males (n=27, 73%). The patients were volunteers with motivation and interest towards interacting with the computer and the majority were computer users (n=24, 65%). This may explain the high percentage (n=30, 81%) of patients who interrupted the computer interview and seeked information. Older patients may not have participated in the pilot study due to illiteracy or lack of interest.

Effectiveness of the system in routine use would, of course, require evaluation of the system in a longer period with more patients. However, due to the high illiteracy rate[16], multimedia techniques would have to be incorporated into the GLADYS system so that the illiterate would be able to use the system. For example, interactive multimedia which uses a 'video doctor' to question patients about their gastric problems, and the patient responding by choosing coloured options such as green for 'yes', red for 'no'. Free speech input, where the patient enters his basic symptoms by engaging in a dialogue with the program, has also been successfully explored (Johnson et al., 1992), and may be explored in Oman with the illiterate and with patients with low readability levels. Here future advantages and disadvantages of computer interviewing systems in an Omani clinic with high illiteracy rates might be revealed. The potential of introducing computer interviews to illiterate populations may also be investigated.

[16] The total illiteracy rate for Omanis and non-Omanis is 31% of the population, with twice as many females illiterate compared to males.

However, the illiteracy rate may vary considerably within different Omani gastro-enterology clinics. For example, if we consider three hospitals within the capital area, Muscat, (a) the Royal hospital, a public hospital; (b) the Sultan Qaboos University hospital, a medical school hospital; and (c) the Quraam Beach hospital, a private hospital. The Royal Hospital where this pilot study was performed would most probably have the highest illiteracy rate, with half of the patients may be illiterate. Second is the Sultan Qaboos University hospital, where most of the patients are University related, either students, staff or their families. Whereas, virtually all patients who attend the private hospital, Quraam Beach, would probably be literate, as there is likely to be a relation between socio-economic background and literacy. In addition, a higher percentage of foreign employees may attend this hospital than the other two. Therefore, the Arabic GLADYS system would probably be more feasible in the University hospital and the private hospital than the Royal hospital, and multimedia techniques may not always be a necessity.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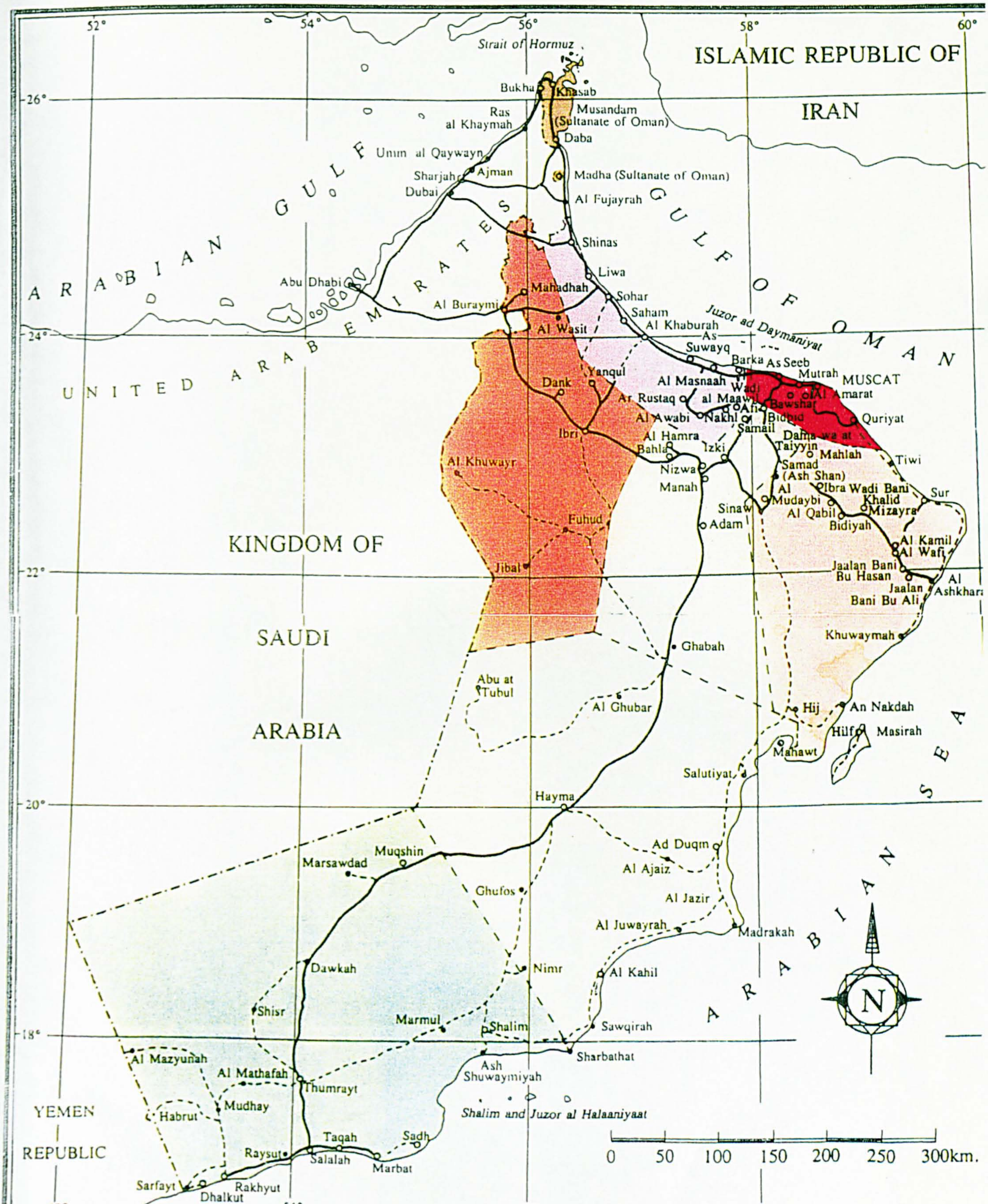

Produced by the Ministry of Information, September 1994

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This map is not an authority on international boundaries

o Wilayat

• Village / Town

------ Graded Road

—— Metalled Road

-·-·- International Boundary