Screening for delirium and cognitive impairment in older, acute care in-patients.

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Abstract

Background

Delirium, an acute neurobehavioral syndrome, occurs across all healthcare settings and is suggested to be the most common psychiatric condition experienced by older hospitalised patients. It affects around a fifth of those in general medical wards with higher prevalence in surgical and intensive care unit patients.

Delirium and chronic cognitive impairment share a complicated two-way relationship. Those with dementia are at greater risk of developing delirium while length of delirium episode is also associated with increased risk of long-term cognitive decline. Delirium is associated with a number of other serious negative outcomes including increased risk of falls, institutionalisation and mortality. Identification of delirium in hospitalised older patients is necessary to facilitate good patient care as well as to allow for the appropriate support for concerned relatives and carers.

Guidelines are in general agreement that screening for delirium and cognitive impairment is important in hospitalised, older patients. Identification of delirium is the first necessary step to then allow for the management of this syndrome. However, there are a wide range of screening tools available for cognitive impairment and delirium with limited research evidence or validation of these tools in large, representative cohorts. Furthermore, clinical awareness of delirium is low compared to many other conditions; this may be improved by implementing clear delirium screening guidelines along-side the necessary training.

Methodology

Before delirium screening tools can be implemented in routine practice, an evidence-based approach should be followed to assess feasibility and diagnostic accuracy within older in-patient cohorts.

In this thesis, I investigate screening for cognitive impairment systematically in a series of linked studies. I review the existing published evidence as well as investigating screening

for delirium in older, acute medical units locally and nationwide. I collate existing evidence for the use of brief screening tools for delirium, dementia and mild cognitive impairment (MCI) across healthcare settings. I also carry out analysis of an existing data set looking at the feasibility and accuracy of two single questions for delirium and dementia, separately. Furthermore I gather data relating to cognitive screening from lead clinicians across hospital sites within elderly acute care units in Scotland. I also carry out a local service evaluation to determine documented delirium prevalence as well as what tools were being used to screen for cognitive impairment and delirium. These results inform a diagnostic test accuracy evaluation of delirium and cognitive impairment screening tools recommended for routine clinical use with acute care in-patients. This evaluation is in a relatively large-scale, representative sample and assesses the feasibility as well as accuracy of these tools against a gold standard clinician diagnosis of delirium.

My diagnostic test accuracy evaluation was based on a clear local problem of lack of routine delirium screening in older in-patients and aimed to inform future recommendation policy by examining which tools are feasible and accurate within this setting. I also aimed to add to the existing delirium screening evidence base by examining a range of recommended tools within a large, consecutive patient cohort. This was contrary to much of the published literature which generally examine one screening tool and often within small or case-controlled patient samples.

This evaluation of screening tools for the assessment of possible delirium within the acute care setting examined the feasibility and test accuracy of cognitive tests which were recommended by clinical guidelines for both delirium and cognitive impairment. The tests evaluated were the Abbreviated Mental Test (AMT 10/4), the 4 A's Test (4AT), the brief Confusion Assessment Method (bCAM) (a rapid, operationalised version of the Confusion Assessment Method (CAM)) and the Single Screening Question in Delirium (SQiD). I also explored the performance of reciting months of the year backwards (MOTYB), present as part of both the 4AT and bCAM. All screening tests were compared to gold standard diagnosis using delirium criteria from the Diagnostic and Statistical Manual of Mental Disorders – fifth revision (DSM 5) which was completed by senior geriatricians.

Findings

My systematic literature review revealed heterogeneity of methods in the published evidence for very brief, single item cognitive screening tools. However my secondary data analysis revealed high sensitivity for a single informant question for dementia and reasonable sensitivity for a single question for delirium.

The clinician survey showed a lack of consensus regarding the choice of screening tools used for delirium and dementia at a national (Scottish) level. Within geriatric units in Scotland there appears to be notable variability in the way delirium screening is carried out. The clinician survey revealed a particular issue for delirium screening in the West of Scotland where there appears to be a lack of standardised tools used to screen for delirium. Furthermore, local ward service evaluation revealed a lack of documentation of delirium diagnosis with little awareness of delirium across acute elderly wards within a large teaching hospital in Glasgow.

Evaluation of cognitive impairment screening tools found that the AMT 10, AMT 4, 4AT and MOTYB were feasible and accurate tools for the assessment of delirium within a cohort of 500 acute in-patients age $\geq$ 65 years. The AMT 10 was found to have reasonable sensitivity at a cut point of $\leq$4/10 and the AMT 4 was found to have good sensitivity at a cut point of $\leq$3/4; use of the full 10-point AMT seemed to carry no substantial advantage over the shorter AMT 4. The bCAM was found to have poor sensitivity, missing 3 in 10 cases of delirium. I did not find the informant-based SQiD to be feasible in this population, with a return rate of 28%, but displaying a sensitivity of over 90%. These results suggest that a range of tools exist which display good diagnostic test accuracy and feasibility in an older, acute care in-patient cohort. These can all be completed quickly and are simple to administer. Informant information using a standardised single screening question (SSQ) such as the SQiD may still hold value in aiding the diagnosis of delirium when this can be obtained.

Conclusions

In conclusion, the studies in this thesis aim to add to the pool of literature available for the screening of delirium and cognitive impairment. I used a logical and informed ordering of the research conducted. The results from my systematic review, secondary

data analysis, clinician survey and service evaluation all fed in to the planning of my clinical patient evaluation of delirium screening. Results from my literature review and data analysis did not discount the use of a single question to screen for delirium but did suggest a need for further research with a gold standard clinician diagnosis for comparison. My clinical evaluation results revealed that relatively accurate screening of delirium is possible using existing, simple and brief screening tools which are already suggested in guidelines for routine clinical use.

Screening for delirium should be regarded as a first step in the care pathway for those who are identified as having possible delirium. The value of delirium screening depends on the implementation of specific care pathways for those who then go on to receive a clinical diagnosis of delirium. Patients with delirium have an increased risk of falls, dehydration and infection alongside the associated long-term complications. Good patient care should aim to cater to these patients' specific needs in the same way it does with other medical conditions.

Healthcare Improvement Scotland (HIS) recommends all older patients should be routinely screened for delirium but acknowledges that this is not the case, with delirium being 'frequently overlooked or misdiagnosed'. It may not be enough to make these recommendations without implementing a system of education to promote and raise awareness for the importance of screening for delirium.

I suggest that further research is needed to assess the accuracy and feasibility of delirium screening tools for older, acute care in-patients while implementing a care pathway for patients who are then diagnosed with delirium. This would inform the best possible future care for patients with delirium. The potential for improved outcomes for these patients is also of interest. Evaluation of interventions in large scale, representative patient samples are needed to further progress our knowledge of treatment of delirium as a serious and often overlooked disorder of the brain caused by physical illness.

Publications & Presentations

List of Publications

Hendry K, Hill E, Quinn TJ, Evans J, Stott DJ. Single screening questions for cognitive impairment in older people: a systematic review. Age and Ageing. 2015; 44:322-326.

Hendry K, Quinn TJ, Evans JJ, Stott DJ. Informant single screening questions for delirium and dementia in acute care- a cross-sectional test accuracy pilot study. BMC Geriatrics. 2015; 15:17.

Hendry K, Quinn TJ, Evans J, Scortichini V, Miller H, Burns J, Cunnington AL, Stott DJ . Evaluation of delirium screening tools in geriatric medical in-patients: A diagnostic test accuracy study. Age and Ageing. Forthcoming 2016.

List of Presentations

Table 1 List of local and national presentations completed during PhD

Year	Date	Conference/meeting title	Location	Presentation
1	April 2013	Steering group meeting	Glasgow	Oral- 20 minutes
1	July 2013	International Neuropsychological Society conference	Amsterdam	Poster
2	April 2014	British Geriatric Society Spring meeting	Manchester	Poster
2	September 2014	Young delirium researchers meeting	Birmingham	Oral- 30 minutes
2	September 2014	European Union Geriatric Society of Medicine conference	Rotterdam	Poster
2	October 2014	Grand Round	Glasgow	Oral- 20 minutes
3	March 2015	Student/clinician lecture speaker	Dundee	Oral- 1 hour
3	August 2015	Department presentation for visiting clinicians	Glasgow	Oral- 30 minutes
3	September 2015	EDA/BGS delirium meeting	London	Oral- 20 minutes
3	September 2015	European Union Geriatric Society of Medicine conference	Oslo	Poster

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Declaration

I declare that this thesis, submitted to the University of Glasgow for the degree of Doctor of Philosophy, is the result of my own research, except where otherwise acknowledged, and that this thesis has not been submitted for a higher degree to any other university or institution.

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List of Abbreviations

4AT	4 A's Test
6CIT	Six-item Cognitive Impairment Test
ACE	Addenbrooke's Cognitive Examination
AD8	Alzheimer's Disease-8
AMT	Abbreviated Mental Test
APA	American Psychiatric Association
APACHE	Acute Physiology and Chronic Health Evaluation
AUC	Area Under the Curve
bCAM	brief Confusion Assessment Method
BGS	British Geriatric Society
CAM	Confusion Assessment Method
CDR	Clinical Dementia Rating
CQUIN	England and Wales Departments of Health Commissioning for Quality and Innovation
CSI-D	Community Screening Interview for Dementia
CTR	Cognitive Test for Delirium
DSM	Diagnostic and Statistical Manual of Mental Disorders
GAU	Geriatric Assessment Unit
GPCOG	General Practitioner Assessment of Cognition
HIS	Healthcare Improvement Scotland

IADL	Index of Independence in Activities of Daily Living
ICD	International Classification of Diseases and Related Health Problems
IQCODE	Informant Questionnaire for Cognitive Decline in the Elderly
MCI	Mild Cognitive Impairment
MDAS	Memorial Delirium Assessment Scale
MMSE	Mini-Mental State Examination
MOCA	Montreal Cognitive Assessment
MOTYB	Months of the Year Backwards
MSQ	Mental Status Questionnaire
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
QUADAS	Quality Assessment Tool for Diagnostic Accuracy Studies
ROC	Receiver Operating Characteristics
SPSS	Statistical Package for the Social Sciences
SQiD	Single Question in Delirium
SSQ	Single Screening Question
STARDdem	Reporting Standards in dementia and cognitive impairment
WHO	World Health Organisation

Chapter 1: Background and literature review

1.1 What is delirium?

1.1.1 History of delirium

The word ‘delirium’ comes from the Latin word ‘deliro-delirare’ which translates as ‘to go out of the furrow’ **[1]**. Documentation of the terminology ‘delirium’ exists as far back as the first century AD in medical writings by Celcus **[2]**, to describe mental impairment occurring during fever and trauma to the head. Celcus gave insight in to the nature of delirium by describing that while the cause of the syndrome may be resolved, patients may still continue to appear ‘insane’ **[3]**.

A more detailed description of delirium was provided by historian Procopius **[4]** AD 542 when explaining a possible bubonic disease in Constantinople. He described what would likely be referred to as hyperactive delirium today; insomnia, violent outbursts, excitement, physical over-activity and shouting. He also explained a different subset of symptoms, resembling the modern day concept of hypoactive delirium; comatose state, long periods of sleep, unable to take care of basic needs such as food and water as well as forgetting familiar people. Procopius also explained that individuals often experienced hallucinations before the onset of this possible bubonic disease.

There have been many other writings and observations regarding delirium with a variety of different names throughout the ages. For example, Hippocrates used sixteen different names to refer to what we now understand to be the clinical syndrome of delirium including ‘leros’, ‘mania’, ‘lethargus’ and also ‘phrenitis’ which dates back as far as 500 BC **[5]**. ‘Phrenitis’ was also referenced in writings by Celcus as an alternative to delirium **[2]**. There was general consensus that this disorder of the mind was associated with poor clinical outcomes **[3]**. However, despite this long history of descriptions relating to delirium, it still remains a poorly understood and difficult to define disorder.

1.1.2 Other names for delirium

A range of other names are used for the syndrome of delirium. Such names include **[6]**;

- "Intensive Care Unit psychosis" - indicating the high incidence of delirium within this hospital setting.
- "Sundowning" – as it is said that delirium symptoms become more apparent when the patient is under stimulated, such as at night.
- "Acute confusional state" and "acute brain failure – commonly coined in the medical and psychiatric literature.

This lack of one solitary term may create uncertainty about the epidemiology of the syndrome.

1.1.3 Delirium subtypes

Delirium symptoms can be categorised in to three subtypes **[7]**;

- Hyperactive – The patient expresses heightened levels of arousal with possible restlessness, aggression and agitation.
- Hypoactive – The patient is withdrawn, quiet and tired.
- Mixed – The patient shows a combination of the symptoms associated with hypoactive and hyperactive delirium across the course of a delirious episode.

The identification of a subtype can have utility in the clinical setting as each subtype is met with its own unique complications. Patients with hyperactive delirium are at greater risk of falls while those with hypoactive delirium, in addition to falls, are also prone to hospital-acquired infections **[8]**. Hypoactive delirium is the most common presentation of the disorder; evidence suggests that hypoactive delirium may be associated with higher mortality than those with hyperactive or mixed delirium **[9]**. However, hypoactive delirium can often go undetected with 78.3% of hypoactive delirium cases missed within the emergency department setting, despite hypoactive delirium accounting for up to 92% of all cases of delirium **[10]**. Prevalence of hypoactive delirium varies widely between studies and across hospital settings **[11]** (**Table 2**).

Assessment tools exist for the assessment of delirium sub-type such as the Delirium Motoric Checklist **[12]** which contains four items relating to hyperactive delirium (including restlessness and wandering) and seven items relating to hypoactive (such as decreased amount of activity and decreased speed of actions) with two symptoms needed to meet subtype inclusion. A patient is considered to have mixed delirium if there are motor disturbance symptoms present from both categories.

1.1.4 Diagnostic classification

Gold standard diagnostic criteria provide a list of symptoms which can be operationalised in clinical practice to make a diagnosis of any given disorder. These criteria exist to allow for standardisation of diagnosis across settings. As such, it is may be deemed important that any screening test should reflect the gold standard. Below is a summary of the main published criteria used for the diagnosis of delirium.

Diagnostic and Statistical Manual of Mental Disorders – Fifth edition (DSM-5)

The Diagnostic and Statistical Manual of Mental Disorders is published by the American Psychiatric Association (APA) and serves as a mode of standardising diagnostic criteria for the classification of mental disorders. The first edition **[13]** was published in 1952, with the fifth and most recent revision published in 2012, namely the DSM 5 **[14]**.

The DSM 5 defines delirium using 5 criteria;

a) A disturbance of attention (directing, focusing & shifting) and awareness of the environment.

b) The disturbance develops acutely (within a few days) and is representative of a change from baseline in attention and awareness, with fluctuating course over any 24 hour period.

c) An additional disturbance of cognition is also apparent, such as memory problems, disorientation, language deficit or changes in perceptions.

d) A and C cannot be better explained by another disorder in cognition (pre-existing, established or evolving) and do not occur during an episode of severe reduction in level of arousal e.g. coma.

e) Evidence from the patient's history, physical exam or lab tests suggests that the disturbance is a direct physiological consequence of a medical condition, substance abuse/withdrawal, exposure to a toxin or multiple etiologies.

International Classification of Diseases and Related Health Problems- 10th Revision (ICD-10)

The ICD was developed by the World Health Organisation (WHO) as a standard tool for diagnosing a broad range of clinical conditions. The ICD-10 **[15]** describes delirium as being more common in those aged 60 and over, with a transient and fluctuating nature which tends to resolve within four weeks. This criterion defines delirium according to 5 domains;

a) Impaired consciousness and attention (shifting, sustained and focused).
b) A global disturbance of cognition including perceptual disturbances, delusions and hallucinations, impaired abstract thinking and comprehension, impaired immediate recall and recent memory, disorientation to time, place and/or person.
c) Psychomotor disturbance which can be over or under active with fluctuation between the two.
d) Sleep-wake cycle disturbance including insomnia and/or over sleeping.
e) Emotional disturbance such as depression, irritability, aggression or anxiety.

Confusion Assessment Method (CAM)

The CAM was developed as a tool which would allow non-psychiatric clinical staff to diagnose delirium with ease **[16]**. This development was based on systematic review and expert consensus and was originally validated against a now outdated version of the DSM, the DSM IIIR **[17]**. To assess for delirium, the CAM uses nine assessment criteria based on diagnostic features of delirium (**Table 3**). This diagnostic assessment tool relies on subjective clinician judgement on a range of cognitive abilities including inattention, disorientation and memory impairment and provides different formats of response

including rating scale and open-ended response. A shorter, four item CAM also exists for more brief assessment of delirium (highlighted within **Table 3**). Research suggests that the CAM has a high sensitivity and specificity when used by trained individuals and has shown to be popular for use within the clinical and research setting since its development **[18]**.

1.1.5 Risk Factors

Predisposing factors are those which render an individual vulnerable to becoming delirious. These include demographic factors such as old age, which is significantly associated with increased risk of delirium **[19-20]**. Dementia is also significantly associated with risk of becoming delirious across a range of settings **[21]**. There is evidence to suggest that patients with depression are significantly at risk of delirium **[22]**. Illness severity and co-morbidity, as measured by the assessment tool the Acute Physiology and Chronic Health Evaluation (APACHE II) scale, are commonly reported as significant delirium risk factors **[20, 23]**. Furthermore, functional impairment, specifically impairment in activities of daily living skills and immobility were also found to be significantly associated with risk of delirium although these impairments are not direct risk factors but reflect another causal factor such as infection or falls **[20-21]**.

Precipitating factors are newly introduced conditions which trigger onset of delirium. The precipitating factors found to most strongly associate with delirium were use of a urinary catheter, introduction of psychoactive medications and infection **[24]**.

1.1.6 Neuropsychology of delirium

Neuropsychological profiling of delirium involves using appropriate cognitive assessments to establish the cognitive domains affected before, during and/or after the course of a delirious episode. While it is accepted that disturbance of cognitive processes is a defining feature in those with delirium, few research publications exist examining the neuropsychological profile of delirium. Establishing this may allow for clinicians to correctly differentiate delirium from other disorders with overlapping symptoms such as

MCI, dementia and aphasia as well as detecting less severe delirium **[25]**. Thus, possibly reducing rates of misdiagnosis and increasing detection rates. Furthermore, delirium screening tests should measure the cognitive domains affected in delirious patients.

Most studies investigating impairment of cognition in delirium focus on that of fluid cognitive abilities. Fluid cognition involves the active processing, manipulating and maintaining of neural information such as tasks relying on the maintenance of attention, known to be impaired in delirium **[26]**. In contrast, crystallized cognition relies on information stored through previous learning and experience such as vocabulary, grammar and general knowledge **[27]**. Crystallized and fluid cognition are reliant on different areas of the brain and as such affected in different ways by neural events. Crystallized cognition is also shown to be more stable through-out the lifetime, compared to fluid cognition which shows steady decline in to old age **[27]**. Brown et al **[26]** attempted to establish if crystallized cognition is affected in patients with delirium, in comparison to fluid cognition. This was done by measuring crystallized and fluid cognition before and after planned cardiac surgery. It was found that while patients demonstrated extensive impairment on high demand tests of fluid cognition such as digit span and Stroop tests, crystallized abilities were preserved as measured by the National Adult Reading Test **[28]**. These results suggest crystallized intelligence may provide a measure of level of cognitive function prior to neural insult such as delirium. This may be particularly useful in cases where a relative or carer is not available to provide a history of the patient's baseline level of cognitive functioning.

A small number of studies exist which attempt to profile the neuropsychology of delirium by measuring domains of fluid cognitive abilities. Meagher at al. **[29]** and Leonard et al. **[30]** investigated the domains impaired in delirious patients using the Cognitive Test for Delirium (CTR) **[31]**; a tool which measures the patient's attention span, orientation, memory, comprehension/reasoning and vigilance. Both studies found impairments in the domains of attention, vigilance and orientation (visuospatial abilities). Longitudinal assessment of cognition revealed that impairments in attention, memory and working memory first became apparent 4 days prior to delirium diagnosis **[32]**.

Further investigation in to the neuropsychological profile of delirium across the course of delirium in a cohort of planned transplant patients found deficits in the domains of attention/working memory, psychomotor speed, memory as well as learning **[32]**. Patients were assessed 10 days pre-transplantation to establish baseline cognitive functioning as well as for the duration of their hospitalisation post-transplantation (up to 4 weeks). During the post-transplantation assessment phase, no patients who experienced a delirium returned to baseline cognitive functioning during this time. Cognitive performance across tests showed a mild decline directly prior to the onset of delirium and a sharp decline with delirium diagnosis and fluctuating performance following this. This evidence suggests that clinicians may be able to predict delirium onset through profiling of cognitive symptoms with possible implications for prevention. Changes in cognitive function of patients may aid the monitoring and early detection of delirium.

Impairment to attention is now accepted as a core diagnostic feature of delirium **[33]**. Research suggests that patients with delirium show impairment on various types of attention, including attention span, selective attention and sustained attention **[26, 34-35]**. However, there appears to be a particular deficit in sustained attention in these patients **[33]**. Sustained attention is the ability to attend to specified stimuli over a period of time **[36]**.

While inattention as a core feature of delirium is relatively well represented within the literature, level of arousal is less well documented. Abnormal level of arousal is important within the clinical setting as it is associated with increased illness severity, is a strong predictor of increased mortality **[37]** as well as an indicator of the presence of delirium **[36]**. Furthermore, abnormal level of consciousness is associated with poor performance on tasks of sustained attention **[36]**.

Posner's original model of attention developed over 30 years ago suggests that attention and arousal are closely linked and the model explains how the brain decides which stimuli it attends to within our stimuli-intensive environment **[38]**. Posner proposed that our attention network within the brain comprises of three separate but fully-integrated systems; Alerting, Orienting and Executive Function. It is explained that the Alerting

Network is responsible for maintaining optimal arousal and observes but is not responsible for taking action. When the alerting network switches from observing general environment changes to monitoring specific features, the Orienting Network is triggered. Posner explains that at this point all the senses are alerted and the orienting network is responsible for prioritising information received by the senses. This then triggers the Executive Network. Here it is decided if the individual should maintain focus on the selected stimuli and, if so, then the processing of other available targets slows down.

When thinking about delirium in terms of Posner's model of attention it would appear that individuals with delirium have a deficit to all three attention networks, displaying an inability to maintain focus during a task (alerting), an inability to prioritise sensory input (orienting) and the inability to maintain attention on a specific target while attending less to competing targets (executive control).

1.2 Why does delirium matter?

1.2.1 Psychological impact

Delirium can be a distressing experience for the patient as well as relatives, carers, friends and the staff responsible for the care of the patient.

The distress caused by delirium can continue for the patient once it has resolved as the individual recollects memories from delirious episodes, with the possibility that the patient is unable to differentiate between factual and delirious memories **[39]**. Furthermore, delirious recall may have further negative repercussions as it has been associated with symptoms of post-traumatic stress disorder **[40-41]** as well as anxiety and depression **[42-43]**.

From current literature, it is unclear what proportions of patients are able to recall memories following delirium due to small sample sizes, qualitative data collection and a wide variety of figures reported. For example, one study reported that the majority of patients did not recall memories of delirium **[44]** while others have stated that more than half of patients were able to recall some memories of being delirious when interviewed **[45-46]**. A study conducted within an oncology in-patient setting found that 54% of

patients who had been diagnosed with delirium were able to recall this episode. Of these patients, 80% rated this experience as severely distressing **[47]**. Evidence suggests that distress level is not affected by delirium sub-type **[47-48]**.

It is also important to consider the distress experienced by relatives and carers of patients with delirium. A study which assessed the occurrence of generalised anxiety in caregivers of patients with cancer found that the incidence of generalised anxiety was 3.5% **[49]**. Caregivers who reported the patient had recently had delirium were 12 times more likely to have generalised anxiety than those who had not experienced observing delirium or confusion. This relationship still existed when caregiver demand was adjusted for.

Delirium may also have a negative impact on nursing staff who are the individuals in closest contact with in-patients suffering from delirium. Literature reviews evaluating the effects of delirium on nursing staff identified themes emerging from qualitative studies **[50-51]**. These include; 'stress due to unpredictability of delirium and workload', 'issues of safety', 'difficulties reaching patients', 'care environment not meeting needs of older adults' and 'patients being suspicious of nursing staff'. Furthermore, a survey of 101 nursing staff responsible for the care of cancer patients with delirium found that 73% of staff suffered severe distress with the strongest predictors of distress experienced by nursing staff being delirium severity and perceptual disturbances **[47]**.

1.2.2 Cognitive impairment

Delirium is recognised as an indicator of increased risk of chronic cognitive impairment in older people and even those without prior cognitive or functional issues **[52]**. This is further explored in section 1.3.2.

1.2.3 Persistent delirium

Evidence suggests that delirium can continue up to six months following the patient's discharge **[53]**. Longitudinal analyses have revealed that for older patients diagnosed with delirium during hospitalisation delirium persisted in almost half of these patients at discharge, a third at one month, a quarter at three months and a fifth at six months post

discharge **[54]**. This suggests that in a substantial number of older patients, a full recovery may not be made from an episode or multiple episodes of delirium during hospitalisation. This may account, at least in part, for the poor outcomes of patients with delirium and supports the need for the prevention as well as quick detection of delirium.

1.2.4 Complications of health care

Patients with delirium are at a greater risk of suffering from a range of negative health care outcomes including falls, prolonged hospitalisation, pressure sores and dehydration during hospitalisation **[55]** and as a result greatly increased health care costs.

1.2.5 Functional impairment

Research has shown that those who recovered quickly from an episode of delirium had notably better functional recovery than those with persistent delirium in a sample of patients recovering from hip fracture assessed 2-7 days after the fracture occurred **[56]**.

Furthermore, duration of delirium is associated with poorer scores on Katz Index of Independence in Activities of Daily Living (IADL) **[57]** as a measure of the patient's functional ability on normal daily tasks including personal hygiene, feeding self, home maintenance and dressing self **[58]**.

Delirium is also associated with increased long-term nursing home placements following hospital discharge **[59]**.

1.2.6 Death

Mortality is high in those with delirium with up to 14% of those patients dying within a month of delirium diagnosis and rising to 22% after six months; twice that of patients with comparable medical conditions but absent of delirium **[60]**.

Furthermore, length of delirium episode has also been associated with mortality with research revealing that mortality increased by 11% per 48 hours of active delirium **[61]**.

1.3 How does delirium differ from other cognitive impairment?

1.3.1 Mild cognitive impairment (MCI)

MCI occurs when an individual presents with cognitive impairment which meets some but not all diagnostic criteria of dementia but is an impairment greater than that explained by normal cognitive ageing **[62]**. Unlike delirium, MCI does not have an acute onset and is thought to have a progressive nature. According to commonly used criteria **[63]**, to meet conditions for MCI, one must;

i) Present with memory problems
ii) Have normal activities of daily living
iii) Have normal general cognitive function
iv) Present with abnormal memory relative to age
v) Not meet dementia diagnostic criteria
vi) Show impairments in cognitive domains other than memory.

1.3.2 Dementia

Unlike delirium, dementia is a chronic, progressive form of cognitive impairment which represents a change in one or more cognitive domains reducing an individual's ability to carry out day-to-day tasks **[64]**. While delirium is characterised by fluctuations in the cognitive domains of inattention and level of consciousness, these domains usually remain intact until the later progression of dementia. However, a two way relationship exists where-by those with a pre-existing dementia are more likely to get delirium and, vice versa, patients whom experience delirium are more likely to go on to develop a dementia. The occurrence of delirium along-side dementia is high among hospitalised older adults (22-89%). **[65]**

However, the relationship between dementia and delirium is poorly understood. It is unclear why those who get delirium are more likely to go on to develop a dementia. Existing explanations include **[66]**;

i) Delirium may be symptomatic of a patient's vulnerability to dementia.
ii) Delirium may reveal an existing, unrecognised long term cognitive impairment.

iii) Delirium may lead to neuronal damage and thus be directly responsible for causing dementia. A number of ways in which neuronal damage could occur have been hypothesised. These include increased exposure to anti-psychotic drugs, chronic stress, inflammation, infection or ischemia.

It can often be difficult to differentiate between delirium and dementia in the clinical setting due to overlap in symptoms. This is particularly true in the case of Lewy body dementia with notable overlap in clinical presentation including hallucinations and fluctuation of the symptoms experienced as characteristic of both disorders.

1.4 Is delirium preventable?

Delirium is the result of an underlying medical condition and is suggested to be evidence of the vulnerability of the aging brain to bodily insults. The causes of delirium span across different levels and include **[53]**;

i) Pre-disposing factors such as chronic cognitive impairment, sensory impairment and immobility.
ii) Environmental factors such as lack of sleep due to noises from machines, staff and other patients through the night as well as lack of orientation to time.
iii) Acute physiological factors such as dehydration, infection (for example urinary tract infections and pneumonia), catheterisation and inflammatory response.

It would be logical to assume that if incidences of these factors are reduced or, better yet, prevented where possible then cases of delirium would also be reduced.

Systematic literature review was carried out to determine the effectiveness of non-pharmacological and pharmacological interventions aimed at the prevention and/or management of delirium in older individuals **[67]**. This review looked specifically at interventions published as randomised controlled trials (RCT), pivotal trials, systematic reviews or meta-analyses. The non-pharmacological studies highlighted by this review are summarised in **Table 4 [68-73]**.

Furthermore, a recent Cochrane review collated the available evidence from all randomised controlled trials of delirium prevention interventions **[74]**. Results revealed that multi-component interventions significantly reduced incident delirium compared to

usual care, although this effect was uncertain in patients with a prior dementia. This review provides strong evidence for the further exploration of multi-component delirium prevention interventions in representative samples.

Pharmacological interventions have been found to have varied success in both the prevention and treatment of delirium in older adults.

Meta-analysis revealed that the short-term use of anti-psychotic medications may reduce the incidence of delirium with no reported harmful effects **[75]**. Anti-psychotics have also been shown to have potential utility in reducing the severity and length of delirium episodes in older adults, reducing the need for physical restraints or further interventions **[76]**.

A meta-analysis of evidence relating to the preventative and treatment benefits of cholinesterase inhibitors in older people with delirium revealed this intervention was not beneficial compared to placebo **[77]**.

Furthermore, melatonin use may prevent episodes of delirium and has also been shown to be potentially beneficial in the management of symptoms **[78]**.

However, when weighing up the evidence of interventions in older people for the prevention of delirium, structured analyses of 10 RCT's has revealed no difference in the use of pharmacological vs. multi-component vs. one-component interventions **[79]**.

1.5 Assessing delirium in older patients

1.5.1 Criteria for an effective screening programme

To assess if a screening programme is a necessary step in any health-related disorder, a number of points should be considered. The World Health Organisation (WHO) has developed a list of criteria which should be met to ensure the validity of a screening program **[80]**. The condition should be;

- An important health concern
- Well understood
- Detectable at an early stage
- Treatable and treatment at an early stage should have more benefit than when the disorder has progressed further

Furthermore;

- There should be an existing screening tool which is suitable for detection of the disorder at an early stage
- It should be understood how often the screening test should be repeated
- It should be possible for measures to be put in place to manage the extra workload created by screening this condition
- The physical and psychological risks should be deemed less than the benefits
- The costs should be economical with respect to the costs of medical care as a whole

The UK national screening committee have outlined more detailed criteria for appraising the viability, effectiveness and appropriateness of a screening programme **[81]**. This takes in to account many of the aspects outlined by WHO as well as extra criteria relating to the condition, test, treatment and the screening programme itself. This set of criteria goes in to greater detail on the actual screening programme (including screening, diagnosis and treatment) and implementation of this for any specified disorder. It states there should be high quality empirical evidence in support of a screening programme showing reduction in mortality and morbidity; the programme should be clinically, socially and ethically acceptable; the screening programme should meet a set of quality assurance standards; patients should be provided with evidence-based information of the risks associated with this screening programme to allow them to make an informed decision.

1.5.2 Epidemiology of delirium

Delirium is a common, serious disorder within older adults in the acute care setting. Meta-analysis has revealed that in a non-selected cohort of older people, prevalence (the number of cases of delirium that are present in a selected population at any one time) of delirium is found to be uncommon in community dwelling individuals aged 65 and over at 1-2%, with this prevalence rising in those age 85 and over to 11-12% **[82]**. This suggests that the risk of delirium associated with older age ($\geq$65 years) is low within the community.

As well as those over 85, long-term care and dementia are also identified as groups of older individuals at high risk of delirium **[83]**. Another group of older people at higher risk of presenting with delirium are those in the acute care setting with a point-prevalence of approximately 20% and the disorder is particularly prevalent in those with a prior

dementia **[84]**. Older in-patients are at high risk of delirium with risk of delirium during admission found to be 3% for those under 65, 14% for those aged between 65 to 74 and rising to 36% for patients over 75 years old within the acute care setting **[85]**.

Incidence rates (the number of new cases of delirium that develop across a specified period of time) of delirium in acute care vary widely within the existing literature. Pooled findings of 11 studies concerned with delirium in the acute care setting found incidence rates to vary from 5-38% **[24]**.

Delirium is under-recognised and often misdiagnosed across hospital settings. One study described clinical staff correctly identifying only 23% of delirium cases **[86]**. The 'ideal' delirium screening tool for hospitalised patients should have a high level of sensitivity, be quick and require little/no training to be administered **[87]**.

1.5.3 Delirium screening guidelines within the United Kingdom

The National Institute for Health and Care Excellence (NICE) provide evidence based information resources to aid day-to-day medical practice. The NICE delirium guidelines provide a pathway with the aim to aid the detection, treatment and prevention of delirium **[7]**. Firstly, the pathway asks; 'Is the patient at risk of delirium?' NICE guidelines highlight 4 groups of individuals as at-risk of delirium;

i) Those 65 years and over
ii) Individuals with cognitive impairment/dementia
iii) Hip fracture patients
iv) Those with a severe/deteriorating illness

The pathway then goes on to ask; 'Does the patient show any indicators of delirium?' These indicators are highlighted as, a change in cognitive function such as lack of concentration or confusion, a change in physical abilities, a change in social functioning as well as auditory or visual hallucinations. The guidelines state that these indicators may be reported by the patient, carer or a relative. No specific screening tool is recommended for the assessment of these indicators. If any of these indicators are present then the NICE guidelines recommend that the patient receives a full diagnostic assessment. To do

this, NICE recommends using either the CAM or DSM-IV criteria (these guidelines were published before the currently most up-to-date criteria were published; DSM 5).

HIS worked in collaboration with the Scottish Delirium Association and National Health Service (NHS) Scotland to develop resources to be used by medical professionals in the clinical setting. One such resource developed by Healthcare Improvement Scotland (HIS) as part of the 'Older People in Acute Care Programme' and 'Think Delirium' initiative is the 'delirium toolkit' which provides a flow diagram on how to identify, manage and treat delirium, with particular recommendations on the tools to be used **[88]**;

- Step 1: Identify if there is a history of acute change in mental status.
- Step 2: Use local delirium screening tool (suggests 4AT or CAM).
- Step 3: Identify possible underlying cause (e.g. infection, medication)
- Step 4: Obtain informant history (e.g. IQCODE, AD8)
- Step 5: Record cognition/arousal level (e.g. MoCA, GPCOG, AMT 10, AMT 4)
- Step 6 onwards: Treatment/ management if necessary.

1.5.4 Screening tools for delirium

Prior to carrying out diagnostic assessment of delirium, which would be very time consuming and not feasible to complete on every patient, a brief screening tool should be used to identify those with possible delirium while excluding those not at risk of having delirium.

There are a wide range of screening tools for delirium available, which require direct patient assessment, clinician assessment, informant input or a combination of these. Many of these assessments have received some form of validation but the lack of consensus may make it difficult for clinicians to know which tool to use across different contexts. A recent systematic review identified validation studies of delirium screening tools used in hospital inpatient cohorts **[89]**. **Table 5 [90-107]** summarises the tools identified by this review, omitting screening tools developed specifically for the intensive care unit setting. The screening tools identified by this review ranged in length from a single question **[106]** to lengthy, multi-domain tools **[90-91, 95-96, 101,103]** with varying

demand on the patient, relatives and clinicians. These tools were validated across a range of hospital settings including the emergency department **[91]**, oncology **[106]**, rehabilitation **[95]** and geriatric in-patients **[108]** as well as across a number of countries making it difficult to generalise research findings across all patient cohorts and cultures. Thus, the existing evidence makes it difficult to select a single gold standard screening test for delirium. Of all the screening tests identified by this systematic review, the CAM was found to be the most commonly used delirium screening tool despite this assessment requiring extensive training to ensure good performance, often being regarded as a diagnostic tool as well as being based on out-dated delirium diagnostic criteria **[89]**.

1.6 Thesis summary and aims

The aims of this thesis are;

i) To systematically determine the existing research on very brief cognitive screening assessments.

ii) To determine what is currently used to screen for delirium and cognitive impairment locally and nationally.

iii) To evaluate the use of very brief screening tests for delirium and cognitive impairment in older patients in acute hospital care.

This will be investigated using a three part approach. The first part will look at existing research relating to the use of very brief screening tools (single questions) for delirium and cognitive impairment. The second part will focus on the evaluation of what is being done locally and nationally. The third part will evaluate delirium screening tools recommended by government and local guidelines for routine clinical use in older hospitalised individuals.

Chapter 2 and 3 will investigate the simplest form of screening assessment for delirium and cognitive impairment, SSQ's, through systematic review of the existing literature within this area (chapter 2) as well as analysis of an existing data set (chapter 3). Chapter 2 aims to give a more in-depth understanding of screening for delirium and cognitive

impairment while establishing if this can be effectively done through use of a very brief tool or if more complex assessment is necessary. Chapter 3 will further build on this through diagnostic test accuracy analyses of an SSQ for delirium and another for dementia.

Chapter 4 and 5 will evaluate what is currently being done to screen for delirium and cognitive impairment in older, acute care adults locally (chapter 4) and nationally within Scotland (chapter 5). This will establish if existing clinical guidelines are being followed.

Chapter 6 will evaluate the performance of delirium screening tools recommended for routine clinical use in a cohort of 500 consecutive older patients admitted to acute care wards in a large, urban teaching hospital.

Chapter 7 will discuss how the findings presented within this thesis add to the existing literature on screening for delirium in older, acute care in-patients as well as consider any clinical implications which stem from these evaluations and suggestions for future research.

Table 2 Prevalence of hypoactive delirium across all patients in different hospital settings (adapted from a systematic review by Peritogiannis, Bolosi, Lixouriotis & Rizos, 2015 [11])**.**

Setting	HD prevalence
Surgery (anesthesia & cardiac)	56-92%
Consultation-liaison psychiatric service	6-30%
Hip fractures	12-41%
Intensive Care Unit	36-100%
Internal medicine	18-65%
Palliative care	20-53%
Other (e.g. emergency, long-term care)	6-92%

Table 3 The criteria employed by the CAM to assess for delirium (adapted and abbreviated from Inouye et al.[16]).

Delirium criteria	How this is measured
1) Acute onset *	a) Evidence of acute change in mental status from baseline? b) (If yes) Describe change and information source.
2) Inattention	a) Patient showed difficulty focusing attention? E.g. being easily distracted. b) (If yes) Did this behaviour fluctuate during interview? I.e. increase and decrease in severity. c) (If yes) Describe behaviour.
3) Disorganised thinking *	a) Patient showed evidence of disorganised or incoherent thinking? E.g. rambling, illogical flow of ideas, subject switching. b) (If yes) Did this behaviour fluctuate during interview? I.e. increase and decrease in severity. c) (If yes) Describe behaviour.
4) Altered level of consciousness *	a) Rate patients level of consciousness (8 point rating scale) b) (If yes) Did this behaviour fluctuate during interview? I.e. increase and decrease in severity. c) (If yes) Describe behaviour.
5) Disorientation *	a) Patient disorientated during interview? E.g. disorientated to time/space. b) (If yes) Did this behaviour fluctuate during interview? I.e. increase and decrease in severity. c) (If yes) Describe behaviour.
6) Memory impairment	a) Patient showed memory problems during interview? E.g. difficulty remembering instruction. b) (If yes) Did this behaviour fluctuate during interview? I.e. increase and decrease in severity. c) (If yes) Describe behaviour.
7) Perceptual disturbance	a) Patient showed evidence of perceptual disturbance? E.g. hallucinations, illusions, misinterpretations. b) (If yes) Did this behaviour fluctuate during interview? I.e. increase and decrease in severity. c) (If yes) Describe behaviour.
8) Psychomotor disturbance	a) Increased/decreased level of motor activity during interview? E.g. restlessness, picking clothes, sluggishness, moving slowly. b) (If yes) Did this behaviour fluctuate during interview? I.e. increase and decrease in severity. c) (If yes) Describe behaviour.
9) Altered sleep/wake cycle	a) Evidence of disturbance of sleep/wake cycle. E.g. excessive day time sleepiness or insomnia. b) (If yes) Describe disturbance.

***** - highlights domains used within the short CAM

Table 4 Non-pharmacological interventions for the prevention of delirium and management of delirium risk factors adapted from a systematic review carried out by Tampi et al. (2015)

Study	Method	Results
Inouye et al. (1999) [68]	Multi-component targeted risk factor intervention strategy vs. usual care in patients age 70 and over. Patients in the intervention group received standardised care for the management of six delirium risk factors; cognitive deficits, sleep impairment, ambulatory difficulties, visual impairment, hearing deficits and dehydration.	Patients who received targeted management of risk factors were found to have lower incidence of delirium (OR=0.60), less delirious days in total (p=0.02) and lower number of episodes of delirium (p=0.03), compared to usual care. Delirium severity and recurrence rate were not found to differ significantly between the two groups.
Marcantonio et al. (2001) [69]	RCT in surgical patients age ≥65 years. Comparing patients receiving proactive geriatric consultation to usual care.	Proactive geriatric consultation was found to prevent one case of delirium in every 5.6 evaluated patients. Patients in the intervention group had a delirium incidence rate of 32% compared to 50% in the usual care group.
Caplan et al. (2006) [70]	Geriatric rehabilitation patients were randomised to either home rehabilitation or hospital ward rehabilitation.	Patients receiving home rehabilitation were found to have lower odds of becoming delirious (OR=0.17).
Millisen et al. (2005) [71]	Systematic review of delirium prevention strategies in older patients.	Prevention strategies found to reduce incidence, duration and severity of delirium in general and surgical patients in four indentified studies.
Clegg et al. (2014) [72]	Meta-analysis of the prevention of delirium in older, long-term care patients by discontinuing medications which may increase the risk of delirium.	One RCT met inclusion criteria. A computerised system was used to identify medications which may increase the risk of delirium. This was then followed by pharmacist review of the identified medications which were discontinued. This was found to result in a reduction of the incidence of delirium (HR=0.42).
Martinez et al. (2015) [73]	Meta-analysis of multi-component interventions aiming to reduce the incidence of delirium.	Analyses of data from seven identified studies revealed that multi-component interventions do reduce

		the incidence of delirium compared to usual care ($p<0.01$). No significant difference was found for delirium duration, length of hospitalisation or mortality rate.

Table 5 Summary of delirium screening tools with existing validation data based on a recent systematic review [89]. Listed alphabetically by full assessment test name.

Screening tool	Description	Direct patient testing	Informant-based	Clinician-based
4 A's Test (4AT) [90]	4 domains; 2 direct patient-directed & 2 clinician-directed. AMT 4, MOTYB, level of consciousness & acute change in mental function.	X		X
brief Confusion Assessment Method (bCAM) [91]	4 domains which rate the patients' level of disorientation and altered level of consciousness as assessed by the clinician as well as direct-patient assessment of inattention and disorganised thinking.	X		X
Clinical Assessment of Confusion (CAC) [92]	25 item tool which employs items specifically relating to psychomotor function.			X
Confusion Assessment Method (CAM) [93]	9 criteria tool based on DSM-III-R diagnostic criteria in delirium.	X		X
Delirium Detection Score (DDS) [94]	5 item scale which rates the patients' level of disorientation, hallucinations, agitation, anxiety and sudden (paroxysm) sweating.			X
Delirium Diagnostic Tool-provisional (DDT-Pro) [95]	3 domain tool. The first 2 require direct cognitive testing and comprise simple yes/no questions and an attention test. The 3rd item requires clinician evaluation and is based on the patient's sleep-wake cycle.	X		X

Delirium Observation Screening Scale (DOSS) [96]	25-item nurse-rated scale focusing on “typical behaviour patterns” of delirium.			X
Delirium Ratio Scale (DRS/DRS-R-98) [97,98]	10 items rated by a clinician with training in psychiatry. Evaluates patient’s behaviours in the last 24 hours. This tool was then revised and released a a 2 part tool with 13 items and a further 3 diagnostic items (DRS-R-98).			X
Delirium Symptom Interview (DSI) [99]	34 item patient interview, 26 of which are directed to the patient and 8 are answered by the clinician based on the behaviour of the patient during the interview.	X		X
Delirium Triage Screen (DTS) [91]	Clinician-based tool which assesses the patient’s level of consciousness and inattention.			X
Digit Span Test [100]	Direct-patient testing where-by the patient is asked to repeat a series of numbers, typically starting at a set of 3 numbers and increasing by 1 extra number with each testing sequence.	X		
Memorial Delirium Assessment Scale (MDAS) [101]	10 item clinician-based assessment which assesses 3 main domains; arousal and level of consciousness, cognitive functioning and psychomotor activity. Also provides a measure of severity.			X
Modified Richmond Agitation Sedation Scale (mRASS) [102]	The clinician objectively measures the patients’ level of consciousness and inattention on a 10 point rating scale.			X

Nursing Delirium Screening Checklist (Nu-DESC) [103]	Evaluates 5 domains of patient behaviour as completed by the nurse; disorientation, inappropriate behaviour, inappropriate communication, illusions/hallucinations, psychomotor disturbance.			X
Short Portable Mental Status Questionnaire (SPMSQ) [104]	10-item tool directed at the patient asking simple questions relating to such things as age, place of birth, day of week and mother's maiden name.	X		
Simple Question for Easy Evaluation of Consciousness (SQUEEC) [105]	Patient provides a narrative report relating to describing how they would carry out a journey, in some detail.	X		
Single Question in Delirium (SQiD) [106]	A single yes/no question to be asked of a close relative/friend/carer of the patient. The question asks; "Do you think X has been more confused lately?"		X	
Vigilance A Test [107]	The patient is read a series of 60 letters and the patient is asked to acknowledge only when the letter A is read out.	X		

Chapter 2: Systematic Review

2.1 Introduction

Cognitive impairment is a significant issue in older individuals with half of those over 85 years thought to suffer from some form of cognitive dysfunction, including MCI, dementia and delirium **[109]**.

A wide range of detailed, multi-domain assessments have been developed for the screening of cognitive impairment **[110]**. However, this is not always a feasible test strategy due to the time consuming nature of these tools, confusion regarding the vast number of screening tests available and inadequate training received by clinical staff to implement this form of cognitive impairment screening.

There is substantial interest in the potential of using a staged screening process with the first step utilising a simple, rapid screening assessment. The shortest possible tool is a single question, directed at either the patient or an informant.

The utility of a staged screening process for cognitive impairment is currently being investigated through the England and Wales Departments of Health Commissioning for Quality and Innovation (CQUIN) strategy **[111]**. This is a paid initiative which provides hospitals across England and Wales with a pathway of care with the aim of aiding the identification of cognitive impairment (

Figure 1). CQUIN provides a three step approach to cognitive impairment screening and detection; i) Find, ii) Assess & Investigate, iii) Refer, abbreviated as 'FAIR'. The first step of this staged process implements an SSQ which is to be asked to either the patient or a relative/carer; "Has the person been more forgetful in the past 12 months, to the extent that it has significantly affected their daily life?" This question should be asked within 72 hours of admission.

If the answer to this SSQ given by either patient or relative is 'yes' then the patient proceeds to step 2 where diagnostic assessment should be administer. Following diagnostic assessment, if a negative result is found then the patient does not undergo

further investigation. If diagnostic assessment reveals a positive result then appropriate referrals should be made and results should be fed back to the general practitioner. If results are inconclusive then this information should be fed-back to the patients' general practitioner.

Despite this approach being adopted across a large number of hospitals there is currently no validation for the SSQ used within the first step of the CQUIN strategy.

If effective, a single question screening tool for cognitive impairment has a number of benefits. In settings such as acute care where time is very limited, quick single question screening would be ideal to reduce pressure on clinicians work load. Administration of a single question screen requires virtually no training, unlike many of the most popular screens for cognitive impairment. Also, a single informant question is suitable for patients who are not suitable for direct cognitive testing due to severity of illness, for example.

2.2 Research Question

What is the evidence to support the use of single questions in screening for dementia and/or delirium?

2.3 Aim

To review and synthesise the evidence investigating the use of single question cognitive impairment screens for MCI, dementia and delirium.

2.4 Methods

The review methodology and reporting followed Cochrane Screening and Diagnostic Test Methods guidance **[112]**. Cochrane Library provides a resource of high quality reviews which aim to inform healthcare decisions and also provides guidelines on all aspects of the systematic review process. This review followed guidelines specifically developed for reviewing diagnostic test accuracy studies. Guidance included writing a protocol,

developing criteria for study inclusion, searching studies, assessing methodological quality and interpreting results.

2.4.1 Search Strategy

I performed an electronic database search over several, cross-disciplinary databases; MEDLINE (OvidSP), EMBASE (OvidSP), ISI Web of Knowledge, PsychINFO (EBSCO) and CINAHL (EBSCO). All were searched from inception to March 2013 with no language restrictions. In addition to our electronic search, I contacted research groups who have published on cognitive screening for details of recent or in-press papers. Our chosen databases include conference reports and so I did not perform additional searches for recently presented data.

I used a concepts approach to create strings of search terms that I combined with Boolean operators. Search terms were categorised under three headings; “cognitive impairment/dementia”, “screening” and “common cognitive assessment tools”. Where possible I used search terms previously validated by the Cochrane Dementia and Cognitive Improvement Group and supplemented these with controlled vocabulary for terms relevant to single questions, delirium and MCI. Suitable search strategies were formed and run for each database searched (Appendix A).

To assess internal validity of our search strategy, a sample list of papers relevant to the study question (n=5 papers) (Appendix B) were compiled by one researcher prior to and independent of the creation of the search terms. I assessed whether our electronic search identified all the pre-specified papers and planned to review the search strategy if more than one target paper was not included in initial searches.

Once the search strategies had been run in the relevant databases, two researchers screened all titles for relevance. Following this, abstracts of all potential titles were reviewed. Full papers were obtained for abstracts which met inclusion criteria. Reference lists of relevant papers were scanned to identify any additional papers, repeating the process until no new papers were found.

2.4.2 Inclusion and exclusion criteria

Our target papers were either;

i) Studies implementing an SSQ for any form of cognitive impairment.

ii) Studies that investigated the individual items of a multi-item cognitive assessment tool.

Our target index test was any SSQ for cognitive impairment. These could be directed to the patient, informant or clinician. The single question had to include a change in cognition from a higher level of functioning. There was no set response format for the single question.

Our reference standard included clinical diagnosis of cognitive impairment (MCI, dementia and delirium) using standard criteria such as the ICD **[15]** or the DSM **[113]** criteria. I also allowed for cognitive impairment to be defined by validated, multi-domain assessment tools with accepted cut-points such as the Mini-Mental State Examination (MMSE) score <24/30 **[114]**, Montreal Cognitive Assessment (MoCA) score <26/30 **[115]** and Addenbrooke's Cognitive Examination III (ACE-III) score <88/100 **[116]**.

No restrictions were set on where patient cohorts were obtained (e.g. community samples, primary/secondary healthcare and long-term-care), age of participants, sample size or publication language. I only included those studies that had been published in a peer reviewed scientific journal.

Any disagreement over study inclusion was resolved by discussion.

2.4.3 Data extraction and assessments

I transferred data from included studies to pre-specified pro-formas (Appendix C). Two reviewers independently performed data extraction and inconsistencies were resolved by further review of source data. Data extracted consisted of: study setting, patient selection method, number of patients, mean age, reference standard and index test. We extracted data on diagnostic test accuracy using sensitivity, specificity, positive and negative predictive value, Area Under the Curve (AUC) (where available). Other relevant statistical information was also recorded e.g. correlation coefficients, factor analysis.

We assessed eligible papers for risk of bias and external validity using the quality guidance template described in the second iteration of QUADAS-2 as recommended by the Cochrane Collaboration **[117]**. This tool asks questions relating to each study across 4 domains; patient selection, index test, reference standard and patient flow. We developed a set of anchoring statements for QUADAS-2 suitable for assessment of dementia screening tools **[118]**. In diagnostic test accuracy studies, case control populations or populations "enriched" with additional cases can exaggerate test properties and so I pre-specified that we would consider studies using such a methodology separately from those with representative patient sampling.

2.5 Results

Once duplicates were removed, our initial combined search returned 884 papers (**Figure 2**). These papers were then screened by title and abstract which left 65 papers to be reviewed in full text form. 11 papers were found to be eligible for inclusion in the final review **[104, 119-128]**. 1 paper was flagged as unsure for inclusion by the researches due to the correlation analyses reported **[127]** and was decided to be eligible following discussion between the two researchers. Our assessment of internal validity suggested our search strategy was adequate as all 5 pre-selected papers were returned when the search was run.

There was substantial heterogeneity evident in the final 11 papers at multiple levels. Format and application of the index test (SSQ) varied between studies. A primary single question for cognitive impairment was evident in five studies and the remaining six studies used single item analysis derived from multi-item tools. Reference standard (assessment of cognitive function) also varied between studies with seven papers using gold-standard, diagnostic criteria **[121-122, 124-128]** and four papers using multiple item screening tools AMT **[129]**; the Alzheimer's Disease-8 (AD8) **[130]**; the MoCA **[115]**; CAM **[91]**; the MMSE **[114]** and the Memorial Delirium Assessment Scale (MDAS) **[101]**). Heterogeneity of clinical setting was also evident. Considering studies which used a representative sample of the general population, clinical settings included community

dwelling older adults, oncology patients, stroke unit in-patients and memory clinic referrals.

Heterogeneity was also identified between those papers that used a primary SSQ on three levels; who the question was administered to, the type of cognitive impairment the question was attempting to identify and the method of response. Questions were given to relatives / informal carers in two studies **[106, 122]**, patients in two studies **[119, 123]** and health care workers in one study **[120]**. Two studies used a single question to screen for dementia **[119, 123]**. Two studies used a single question to screen for cognitive impairment (dementia/MCI/delirium) **[120, 122]**. One SSQ screened for delirium **[106]**. One study used a Likert scale to quantify response **[106]**; the other four studies used a dichotomised yes or no response **[119, 120, 106, 123] (Table 6).**

Given the broad range of heterogeneity I believed it more appropriate to present our findings as a narrative review rather than meta-analysis.

The QUADAS-2 **[117]** tool was employed to assess each of the 11 papers for risk of bias and applicability concerns. The domains assessed for each paper were patient selection, index test, reference standard and flow & timing. This revealed that four **[106, 119-121]** of the 11 papers had low risk on all domains. The remaining seven studies had unclear or high risk in at least one domain **[122-128]**. Risk of bias was most common in the patient section procedures employed by the studies, with six papers being assessed as high or uncertain risk **[122-126, 128]**. **Table 7** provides an illustration by individual paper of the risk of bias for each assessment domain. **Figure 3** collates this analysis to show the proportion of each level of risk of bias (low, high and unclear) present within each domain.

Considering specifically the studies which used a component analysis of multi-item instruments **[121, 124-128]** there was some consistency in the types of single items favoured. Questions using the wording “decline in memory function” and “change in ability to think/ reason” performed well, as seen in the Community Screening Interview for Dementia (CSI-D) or Clinical Dementia Rating (CDR) **[121, 124, 126]**.

Four studies recruited representative patient samples with the other seven papers having “enriched” samples where-by either preferential recruitment of patients with cognitive

impairment (n=4) **[122, 125-127]** or case-control methodology (n=3) **[123, 124, 128]** was used. Also, source data from the Informant Questionnaire for Cognitive Decline in the Elderly (IQCODE) **[127-128]** revealed that "general change in intelligence" was the favoured item. As the included papers presented their results using differing and non-interchangeable measures (Receiver Operating Characteristics (ROC); correlation coefficients; conventional significance testing and classical test accuracy metrics) I was unable to perform direct comparisons. **Table 8** further illustrates the best performing single items derived from multi-question screening tools, separated by individual paper.

Evidence tables of the 11 studies included within this review are presented in **Table 9** and **Table 10**. The presented evidence is tabulated separately by sampling method with Table 9 illustrating studies which used a consecutive/representative patient sample and **Table 10** showing studies which used case control/stratified patient samples.

The studies which used a representative sampling frame revealed that an informant-based screening question for delirium had both good sensitivity and specificity in an oncology setting **[106]** but sensitivity was less good in a stroke setting **[120]**; also, an SSQ for dementia given directly to the patient correlated weakly but significantly with informant AD8 score (Spearman $r=0.25$, $p<0.001$) **[119]**. There were no papers that presented test accuracy data on a single question for clinical diagnosis of dementia. For those papers using a case control or enriched sampling approach, test properties were generally good. Where classical test accuracy data were available, sensitivity ranged from 65% to 96% and specificity 45% to 99%.

2.6 Discussion

This systematic review focused on studies which compared single question screens with either a clinical diagnosis of cognitive impairment or validated assessment for cognitive impairment. A modest number of studies were available; of these only five included a specific SSQ and of these only three avoided a case-control approach. Based on our review I would have to conclude that while certain single questions show promise, robust evidence supporting a single question approach to cognitive screening is currently lacking.

The heterogeneity in application of a single question screening strategy was striking. The questions employed varied in wording, exploring general impressions of memory, confusion and cognitive function, with no clear advantage to any particular form of words. Questions were posed to carers, healthcare staff and the patients themselves and were used to screen for a spectrum of cognitive diagnoses across a variety of healthcare settings. The data available do not allow us to make any recommendations on how to best use the single question format.

Despite the heterogeneity I can still make some broad conclusions from the available data. Although none of the studies directly compared different sources of information for single questions such as carer versus patient versus health care worker, indirect comparisons suggested that administering screening questions to a close friend or relative performed more accurately **[122]** than directing question to the patient **[123]** or to ward-based multidisciplinary team **[120]**.

While the primary interest of this review was studies of single questions, I recognise the potential of generating useful single questions from component analysis of multi-item cognitive assessments and included studies that employed this approach. Across six studies general questions on cognition, for example referring to a decline in memory or intellectual function, seem to perform as well as or better than questions on specific abilities such as being “unable to handle financial transactions”. If long multi-domain assessments can be reduced to single questions without substantial loss of diagnostic accuracy then this should be explored as it will allow for more efficient testing and reduce patient burden.

The majority of included studies had issues relating to internal or external validity. Sampling was the primary driver to the risk of bias with only four studies recruiting a representative sample. Non-representative sampling included using enriched sampling methods **[122, 125-127]** to increase the proportion of subjects with cognitive problems compared to the general population and using case-control methodology **[123-124, 128]**. Both of these sampling methods are likely to favourably exaggerate the performance of any tool and the test accuracy data from these studies must be treated with caution. At best I would consider these studies as providing useful preliminary data on the potential

utility of different screening methods that would require confirmation in “real world” consecutive clinical samples.

Although our systematic review can neither support nor refute the accuracy of a single question; as a low cost, low effort tool for large-scale initial assessment the single question approach remains attractive. SSQ’s have been useful for other mental health disorders such as the validated single item from the Yale-Brown obsessive compulsive scale **[131]** as a depression screen **[132]** and the Distress Thermometer that is used to screen patients with cancer for stress **[133]**. The NHS in England and Wales have proposed large scale dementia screening that uses a single question as the first step in the assessment pathway. The screening method proposed in the NHS CQUIN is claimed to be based on a similar existing screening method for detecting delirium, the Single Question in Delirium (SQiD), which asks the patients friends or family; “Do you think [name of patient] has been more confused lately?” **[106]**. While the results of this systematic review suggest there may be some value to a single question screening approach for cognitive impairment (delirium and dementia), the available data are weak and neither of these questions have been fully validated. I would encourage health care professionals to embed test accuracy studies within the usual standard practice of the CQUIN to help evaluate this approach and inform future policy and guidance.

This systematic review was strengthened by the use of QUADAS-2 **[117]** quality assessment software on all included studies. This approach allowed us to identify clearly that the main risk of bias lay with patient selection, which prompted us to separate studies by recruitment type. This then allowed us to make more accurate conclusions based on the results of representative sample studies while applying more caution to conclusions drawn from results of stratified or case control studies. This review was also strengthened by the use of two independent researchers evaluating the inclusion/exclusion of all identified studies.

A possible limitation of this systematic review is that it has not addressed the literature on patient’s subjective memory complaints, which could also be considered as a single patient-response item. This may be a literature area of value for future systematic review.

2.7 Conclusion

In conclusion, our data suggest that a single informant screening question assessing a general cognitive domain such as memory decline may be a promising initial screening method for dementia. However, study quality and heterogeneity preclude any more definitive statements. Further research studies are required including representative samples of older adults to test accuracy data across a variety of settings. Ongoing work to improve and standardise dementia test accuracy studies such as the Reporting Standards in Dementia and Cognitive Impairment (STARDdem) initiative **[134]** may raise the standards and utility of future single question studies. Without further high quality test accuracy studies, I would not recommend large scale screening using a single item approach. However, I would recommend the implementation of SSQ's for cognitive impairment in to research studies assessing other screening tools, to gain a clearer idea of the utility of SSQ's for delirium and/or dementia.

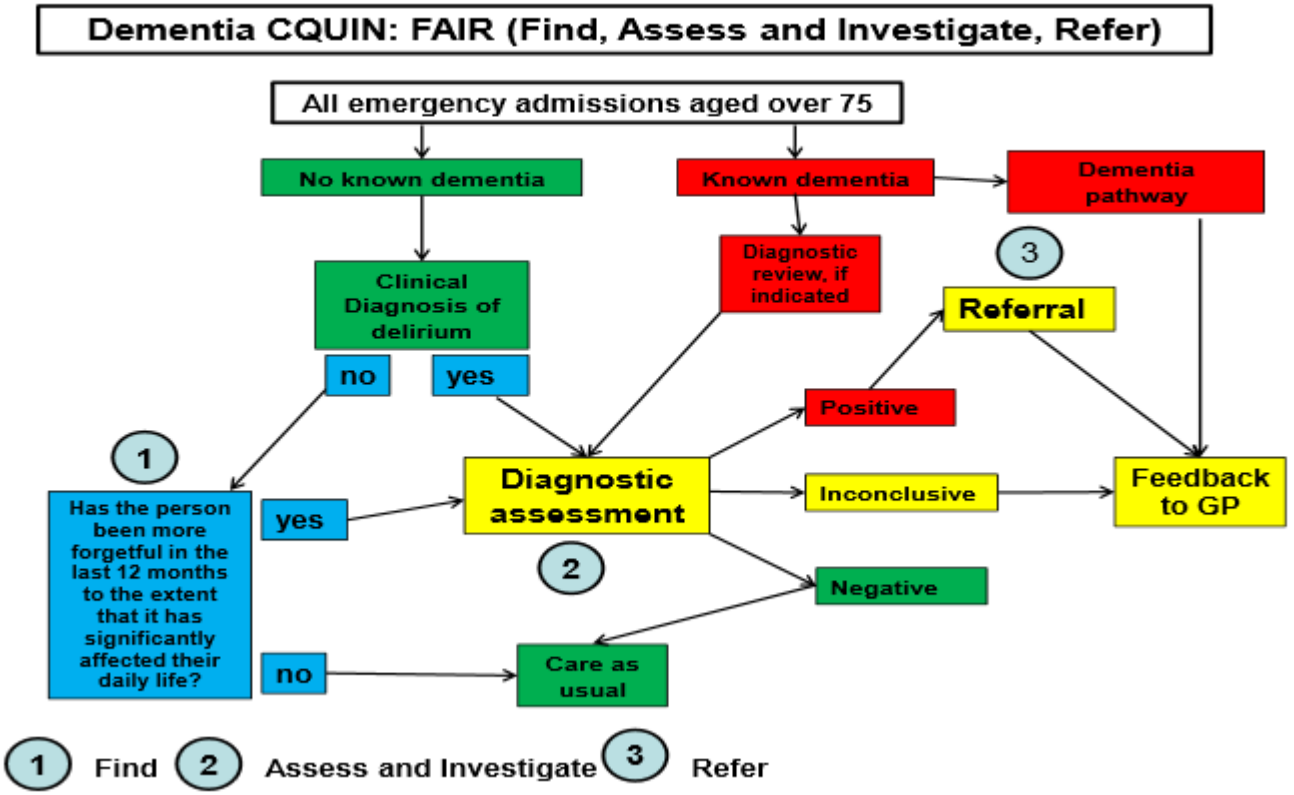


Figure 1 England and Wales Departments of Health Commissioning for Quality and Innovation (CQUIN) strategy.

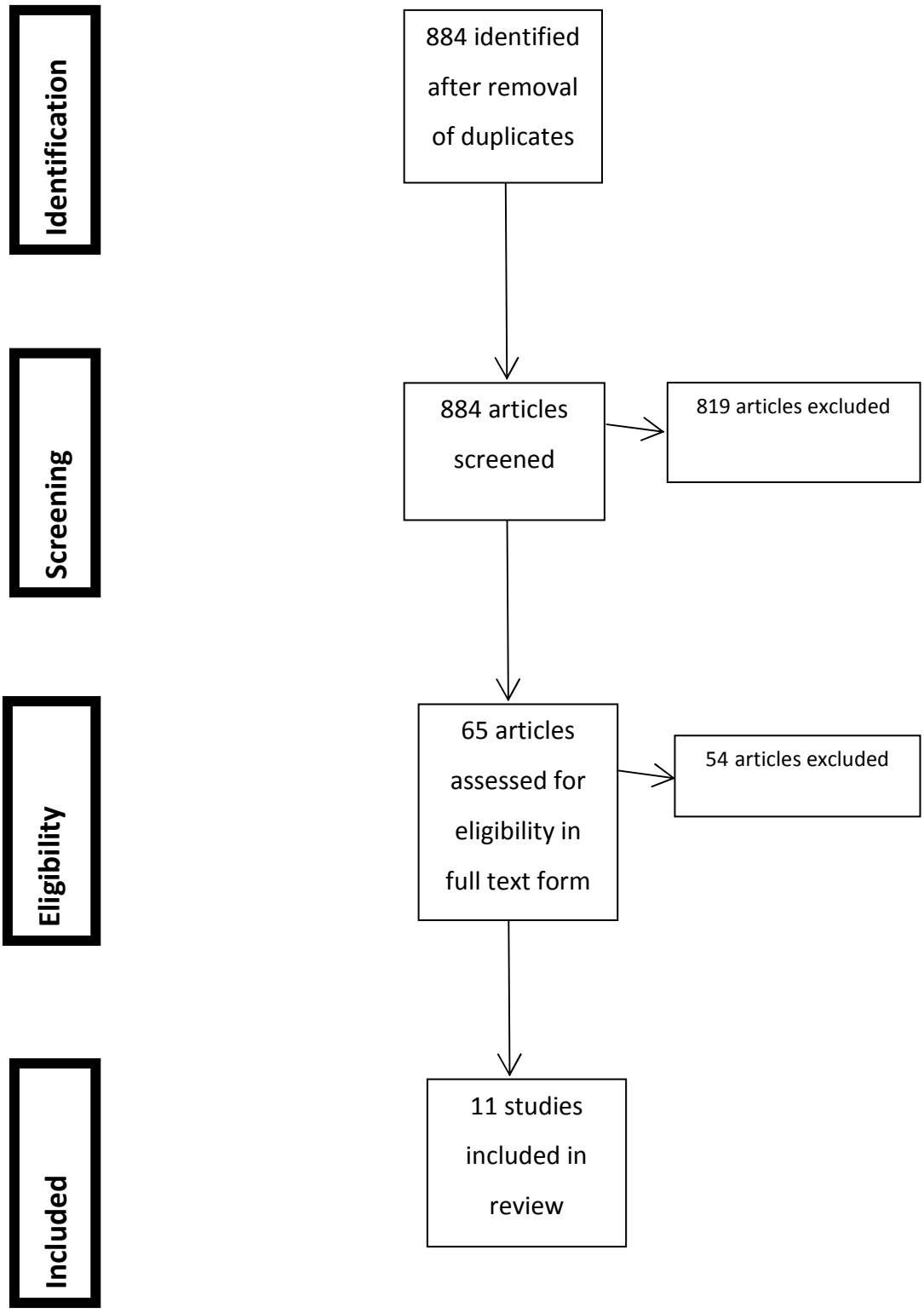


Figure 2 Flow chart illustrating the search process to identify suitable studies for the systematic review.

Table 6 Wording and application of SSQ's for cognitive impairment.

Author	SSQ	Respondent	Cognitive Impairment
Ayalon [122]	How would you rate your friend or relatives memory at the present time? (5 point scale)	Relative / informal carer	MCI Dementia
Sands et al. [106]	Do you think [patient's name] has been more confused lately? (yes/no)	Relative / informal carer	Delirium
Chong et al. [123]	Participants asked about their experience of progressive forgetfulness (yes/no)	Patient	Dementia
Galvin et al. [119]	Asked whether they had a problem with memory (yes/no)	Patient	Dementia
Lees et al. [120]	Does this patient have cognitive issues? (yes/no)	Multidisciplinary stroke team	All cause cognitive impairment Delirium

Table 7 QUADAS table addressing risk of bias and applicability concerns.

Study	RISK OF BIAS				APPLICABILITY CONCERNS		
	PATIENT SELECTION	INDEX TEST	REFERENCE STANDARD	FLOW AND TIMING	PATIENT SELECTION	INDEX TEST	REFERENCE STANDARD
Ayalon	☹	☺	☺	?	☺	☺	☺
Chong	☹	☺	☹	?	☺	☺	☺
Douglas	☹	?	?	?	☺	☺	☺
Erkinjuntti	☹	?	☺	☺	☺	☺	☺
Galvin	☺	☺	☺	☺	☺	☺	☺
Hall	☹	☺	?	☹	☺	☺	☺
Lees	☺	☺	☺	☺	☺	☺	☺
Morales	?	☺	☺	☺	☺	☺	☺
Perroco	☹	☺	?	?	☺	☺	☺
Prince	☺	☺	☺	☺	☺	☺	☺
Sands	☺	☺	☺	☺	☺	☺	☺

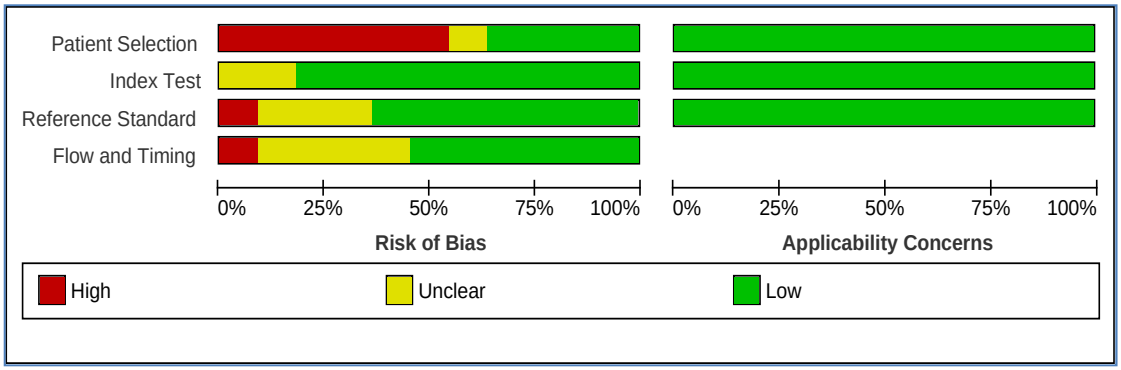


Figure 3 Illustrative summary of risk of bias and applicability concerns of studies included in this review using the QUADAS-2 tool.

Table 8 Best performing items from component analysis of multi-item cognitive assessment tools.

Author	Index Test	Useful items
Prince et al. [121]	CSI-D	• 'decline in memory functioning' • 'change in ability to think/reason' • 'forgetting where have put things' • 'forgetting current location' • 'difficulty dressing' • 'forgetting day before'
Hall et al. [126]	CSI-D	• 'Decline in memory function' • 'Change in ability to think/reason' Sensitivity
Douglas et al. [124]	CDR	• 'Problems with memory or thinking'
Erkinjuntti et al. [125]	Blessed dementia scale	• 'Inability to perform household tasks' • 'Inability to remember short lists of items'
Morales et al. [127]	IQCODE	• 'General change in intelligence'
Perroco et al. [128]	IQCODE	• 'General change in intelligence' • 'General change in memory' • 'General change in ability to learn new things'

CDR =community dementia rating; CSI-D =Community Screening Interview for Dementia ; IQCODE = Informant Questionnaire for Cognitive Decline in the Elderly

Table 9 Data from included studies, representative cohorts of consecutive/semi-consecutive unselected patients.

Study & Setting	Patient selection	N	Mean age (years)	Reference Tool	Screening Tool	Results
Galvin et al. (2007) USA [119]	Community based, consecutive sample	325 CDR ≥ 1 = 23%	76.8 (± 8.9)	AD8	Account of memory problems (patient)	• SSQ correlated to informant AD8 ρ =0.25, p<0.001; Patient AD8 ρ=0.49, p<0.001
Lees et al. (2013) UK [120]	Stroke patient, consecutive sample	111 MoCA < 26 = 86%	74.0 (IQR 64 – 85)	MoCA CAM	Single screening question (asked of professionals at stroke multidisciplinary team meeting)	• SSQ for any cognitive impairment- sensitivity 26%, specificity 100% • SSQ delirium- sensitivity 58% specificity 85%
Prince et al. (2011) Latin America, India and China [121]	Population based sample	15,022	No information on age	DSM-IV CDR	CSI-D (informant)	• Extracted 6 best performing informant items from CSI-D; • See table 3
Sands et al. (2010) Australia [106]	Oncology inpatients consecutively admitted on nominated days	19 Psychiatric interview identified 5 cases delirium (26%)	53.2 (Range 30-79)	Psychiatrist interview CAM MMSE MDAS	SQiD (informant)	• SQiD for delirium • Sensitivity- 80% Specificity- 71% NPV- 80% PPV- 91%

Table 10 Data from included studies, Case–control and stratified or enriched sample studies

Enriched sampling refers to studies which recruit larger numbers of cognitively impaired individuals than is representative to that sample, thus threatening validity of results as this form of sampling is likely to exaggerate performance of any tool used

Study & Setting	Patient selection	N	Mean age (years)	Reference Tool	Screening Tool	Results
Ayalon (2011) USA [122]	Stratified sample from population-based study	256 controls 185 MCI 206 dementia	77.4 controls 80.5 MCI 83.7 dementia	Psychiatrist/Neurologist diagnosis DSM-III-R & DSM-IV	Single-Item Question (Informant)	• Dementia; Sensitivity- 95.7% Specificity- 75.3% • MCI Sensitivity- 81.1% Specificity- 75.3%
Chong et al. (2006) China [123]	Community-based study; case control sample (progressive forgetfulness, low AMT & control group)	128 cognitive impairment 49 controls	66.8	AMT	Single question test on progressive forgetfulness (patient)	• Patient SSQ versus AMT • Sensitivity- 95.7% Specificity- 45.1%
Douglas et al. (2011) USA [124]	Memory clinic; Case control study	180 controls 104 MCI 309 dementia	65 controls 73 MCI 72 dementia	Neurologist diagnosis	CDR (informant)	• Identified 5 best predictor items from CDR of a clinical diagnosis of chronic cognitive impairment; • See table 3
Erkinjuntti et al. (1988) Finland [125]	Community-based; Stratified random sample	123 controls 105 dementia	66.0 controls 68.6 dementia	DSM-III diagnosis	Blessed dementia scale (informant)	• Inability to perform household tasks – sensitivity 64.8% specificity 99.2% • Inability to remember short lists of items – sensitivity 68.9% specificity 97.6%
Hall et al. (1996) USA & Nigeria [126]	Stratified enriched sample from large community samples (USA 2212 Nigeria 2494). Community screen of CSI-D stratified based on	**USA** Controls 286 Dementia 65 **Nigeria** Controls 395	74.0 + 7.0 (USA) 72.3 + 7.5 (Nigeria) Age only given for	DSM-III ICD-10 CDR	CSI-D (informant)	USA data • Remembering is a problem – sensitivity 81.6% specificity 45.2% • Decline in mental

	performance with 100% poor performers included (N= 341), 50% intermediate performers (N=181) and 5% good performers (N=190)	Dementia 28	entire community samples			functioning- Sensitivity 77.6% Specificity 63.8% • Change in ability to think & reason- Sensitivity 76.0% Specificity 61.4%
Morales et al. (1995) Spain [127]	Community based sample; stratified by age and sex. Restricted sampling augmented those with cog problems	61 controls 7 dementia	73.1	DSM-III neurologist diagnosis	Spanish-IQCODE (informant)	• Correlations between individual items and total S-IQCODE scores; • 'In general, intelligence changed' R=0.86 • 'In general, memory for recent happenings' R=0.69 • 'In general, change in ability to learn new things' R=0.64
Perroco et al. (2009) Brazil [128]	Memory clinic; Cross-sectional case control study	58 controls 34 dementia	69.2 controls 73.7 dementia	ICD-10 SRQ-20 AMTS	IQCODE traditional and revised short form version (informant)	• ROC curve for each IQCODE item • Learning new things (AUC=0.92), Memory for recent happenings (AUC=0.86), Intelligence changed (AUC=0.82).

AD8= Alzheimer's Disease 8; AMT= Abbreviated Mental Test; CAM= Confusion Assessment Method; CDR =community dementia rating ; CSI-D =Community Screening Interview for Dementia ; DSM= Diagnostic and Statistical Manual of Mental Disorders; IQCODE = Informant Questionnaire for Cognitive Decline in the Elderly; MCI= Mild cognitive impairment; MDAS= Memorial Dementia Assessment Scale ; MoCA= The Montreal Cognitive Assessment; SSQ= Single screening question; SQiD= Single Question in Dementia

Chapter 3: Secondary data analysis of single screening questions used in acute care.

3.1 Overview

'Cognitive impairment' is a term covering a range of disorders from those with chronic cognitive impairment characterised by a gradual, progressive course encompassing the varying forms of dementia to disorders with rapid, acute onset such as delirium and sub-syndromal delirium.

Cognitive impairment is common in acute care with 40-70% of elderly patients in UK hospitals thought to have dementia **[135]**. However, less than half of these patients have an existing diagnosis **[136]**. Patient's admitted to the acute care hospital setting present an assessment opportunity for assessment of cognitive impairment during their hospital stay.

Delirium is also common within the acute care setting. A point-prevalence study of 280 patients in acute care found prevalence of delirium to be 20%; or when considering only patients age $\geq$ 80 years, prevalence was found to be 35% **[84]**. Half of patients with delirium in this study were found to have a pre-existing dementia. Furthermore, systematic review revealed a point prevalence of 15-30% among elderly patients at admission and an incidence rate of up to 56% during hospitalisation **[137]**.

There is currently no one agreed strategy when screening for cognitive impairment within the hospital setting perhaps with a lack of validation and training for delirium and dementia screening tools. Usually a direct patient testing method is used when screening for cognitive impairment using brief tests of components of cognition such as memory, attention and visuospatial abilities. Arguably, this form of screening may not capture all the information of interest, as it only looks at one moment in time rather than change from a potentially higher, baseline level of cognitive function **[138]**. Informant-based assessment may gain preference as it is less vulnerable to cultural and educational bias. To investigate if the patient presents with a neuropsychological change over time,

whether chronic or acute, screening tests have been developed which aim questions at an informant such as a relative or primary carer.

Informant-based screening tools exist for dementia with the most widely used and validated being the 26-item IQCODE **[139]**, which also exists as a revised, 16-item screening tool **[140]**. Very brief, SSQ's have been developed for both dementia **[119, 121-123]** and delirium **[106, 120]**, although lack validation and consensus.

A number of SSQ's for cognitive impairment currently exist although none that are validated within the elderly, acute care population and show inconsistency on a number of levels; question wording, respondent type (patient/carer/informant), response type (dichotomised/Likert scale) **[141]**.

3.2 Research Question

How do SSQ's for delirium and dementia perform within the acute care hospital setting?

3.3 Aim

I aimed to assess the performance of two SSQ's, one for delirium and one for dementia, in hospitalised, elderly individuals as part of a secondary analysis of a local, previously collected data set.

3.4 Methods

3.4.1 Participants

This was an observational pilot study of patients $\geq$ 65 years old of which my role in the investigation was solely the analysis of the available data. The original purpose of this data collection was to establish the proportion of older medical and geriatric in-patients with a diagnosis of dementia as well as to examine any documented contact with local psychiatric services. Patients were selected from either an acute medical unit (October-December 2004) or Geriatric Assessment Unit (GAU) (February-March 2005) of an urban

teaching hospital. The acute medical unit admits patients of all ages in need of emergency hospital admission. The GAU admits patients age ≥ 65 years old and preferentially selects those with complex co-morbidities; frailty; physical and/or cognitive decline. Patients were selected using random number tables which were linked to alphabetical order of patient name. A maximum of 7 patients were recruited per 24 hours.

Patient exclusions were; the verbal component of the Glasgow Coma Scale rated as none or sounds only, moderate-severe dysphasia (grossly impaired comprehension, unintelligible speech, or major difficulties in expression), non-English speaking, learning disability, major deafness or blind, or readmission of patient previously included in the study.

The patient's capacity to provide consent was indicated by an independent doctor. In cases where the Doctor concluded the patient did not have capacity to provide own consent for participation, written informed consent was provided by their next of kin. The informant was provided with an information sheet which provided information on study objectives and the nature of patient participation with the opportunity to ask questions, prior to providing consent.

Reference standards for dementia and delirium were performed within 36 hours of the patient's admission. These included the MMSE for dementia and the CAM for delirium. The assessments were performed by a single trained observer, a senior medical student, who received formal one-to-one training in bedside cognitive assessment from an experienced consultant geriatrician.

Information was also obtained from patient medical records following cognitive assessment. This included demographic details such as age, sex and date of birth, current living arrangements and next of kin information. I described functional ability using an IADL scale **[142]**.

Where possible, the next of kin was provided with a study pack which contained an introductory letter, information sheet, two consent forms, IQCODE, SSQ's for dementia and delirium as well as an envelope to return the consent form, IQCODE and two SSQ's.

The preferred method of study pack administration to next of kin was face-to-face with verbal instruction from the researcher. If this was not possible, the study pack was posted to the home address. In cases where the next of kin was not available to complete the study, any relative or carer who had known the patient for the last 5 years was eligible to take part in the study.

The study was approved by the Scotland A Multi-centre Research Ethics Committee.

3.4.2 Reference standards

The CAM **[93]** is a commonly used measure of delirium in hospitalised patients. The CAM consists of 9 operationalised criteria based on the DSM-IIIR. Observations made during direct cognitive testing as well as information obtained from nurse interview regarding fluctuating course and sleep-wake cycle are used to evaluate four components of patient cognition; acute onset and 1) fluctuating course, 2) inattention, 3) disorganised thinking and 4) altered level of consciousness. For delirium to be diagnosed by the CAM, criteria 1) and 2) must be present as well as either 3) or 4).

The 16 item IQCODE **[143]** is an informant-based questionnaire which asks relatives to consider changes in the patient's abilities at certain activities within the last 10 years. Such items include "remembering where things are usually kept" and "learning new things". Relative responses are given on a 5-point Likert scale ranging from "Much improved" to "Much worse. Average rating across all items is then calculated with a cut off of >3.38 accepted as indicative of possible dementia in this study.

The MMSE **[114]** is a multiple component screening tool which aims to measure 6 cognitive domains; orientation, registration, attention & calculation, recall, language and copying ability. The test is administered directly to the patient, usually by a member of the medical team. The test is scored out of a total of 30 with a score of <24 generally accepted as indication of possible cognitive impairment.

3.4.3 Index tests

Two single questions were developed to specifically screen for dementia and delirium separately. These were based on the question format of the IQCODE as an existing, validated informant-based cognitive assessment method.

The SSQ-dementia was;
"How has your relative/friend's memory changed over the past 5 years (up to just before their current illness)?"

The SSQ-delirium was;

"How has your relative/friend's memory changed with his/her current illness?"

Response format imitated that of the IQCODE using a 5-point Likert scale used for each question;

Much Improved/A Bit Improved/Hasn't Changed Much/A Bit Worse/Much Worse

3.4.4 Statistical analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) version 19. Clinical and demographic information was examined using descriptive statistics. I compared subjects with and without an informant response.

For analysis of SSQ data, I used three categories: "much worse"; "bit worse" and "no decline" (which was a combination of "much better", "bit better" and no change scores). To allow test accuracy analysis, SSQ responses were further dichotomised as suspected cognitive impairment ("bit worse" and "much worse" responses) and no cognitive impairment ("much better", "bit better" and "no change" responses).

I used ROC analyses to compare the index test of SSQ-delirium against the reference standard CAM and also the MMSE. I compared SSQ-dementia against the reference standard of IQCODE. I used usual diagnostic thresholds for IQCODE (mean score <3.38)

and for MMSE (total score <24).

I described diagnostic metrics of sensitivity; specificity; positive and negative predictive value and corresponding 95% confidence intervals (95%CI).

I described differences in scores on ordinal reference standard tests (IQCODE and MMSE) for the three SSQ categories across both SSQ's. Patient's scores on the MMSE and IQCODE were analysed for statistical significance between the three SSQ outcomes using Kruskal-Wallis H Test analyses. Between group analyses were then carried out to determine where the statistical difference existed using Mann Whitney U post hoc analysis with Bonferroni correction.

3.5 Results

A total of 161 patients were recruited; 80 from the acute care unit and 81 from the GAU across a 3 month period (October-December 2004). Patient's characteristics are summarised in **Table 11**, with separate analyses for those with and without SSQ responses from an informant. SSQ's were completed for 71/161 (44.1%) of patients. Characteristics of respondents only differed significantly in terms of age (p=0.049). There was no statistical difference in proportions living alone / with family between those with and without an informant response. IADL assessment revealed that the patient cohort was relatively independent.

Considering the 70 patients who had completed SSQ delirium and dementia data, 26 (37.1%) had a positive screen for both the dementia and delirium question, 25 (35.7%) had a negative screen on both questions, 10 (14.3%) had a positive screen for dementia only and 9 (12.9%) had a positive screen for delirium only

Kruskal-Wallis H Test analysis revealed a statistically significant difference in MMSE scores between the different SSQ-delirium outcomes ($H(2) = 21.4$, $p < 0.001$). MMSE scores between the different SSQ-dementia outcomes were found to be statistically significant ($H(2) = 16.8$, $p < 0.001$). See

Table 12 for further detail on average scores across response type.

Analyses also revealed a statistically significant difference in IQCODE scores between the three different SSQ-delirium outcomes; ($H(2) = 27.3$, $p < 0.001$), mean scores of 3.4 for those identified as “no change or better”, 3.9 for those identified as “a bit worse” and 4.6 for patients identified as “much worse”.

A statistically significant difference in IQCODE scores was also found between the different SSQ-dementia outcomes; ($H(2) = 41.2$, $p < 0.001$), mean scores of 3.2 for those identified as “no change or better”, 3.9 for patients identified as “a bit worse” and 4.7 for patients identified as “much worse”.

ROC analyses revealed the sensitivity and specificity values of the SSQ-dementia and SSQ-delirium, when comparing the SSQ’s to a routinely used screening test (IQCODE with a cut-score of <3.38 and CAM positive diagnosis respectively). The SSQ-dementia was found have an AUC of 0.882 and SSQ-delirium had an AUC of 0.665 (**Figure 4**). The SSQ-dementia had a sensitivity of 83.3% (35/42) and specificity of 93.1% (27/29). The sensitivity of the SSQ-delirium was 76.9% (10/13) and specificity was 56.1% (32/57) (**Figure 5**). Sensitivity, specificity, positive predictive values and negative predictive values are reported in **Table 13**.

3.6 Discussion

The most prominent finding from this analysis was the high sensitivity and specificity of the SSQ for dementia. This one-item screen performed at a similar level to the routinely used 16-item IQCODE. However, while the SSQ for delirium showed a similar sensitivity, it had low specificity. Almost half of individuals with normal cognitive functioning, as classified by CAM diagnosis, were identified by the SSQ having suspected delirium.

While the SSQ-delirium appeared not to perform well as a first step tool in delirium detection, this may be better explained by methodological issues with difficulties in screening for delirium, in general. A defining feature of delirium is fluctuation in presence of symptoms, and as such it is very difficult to have exact concurrence between a

screening tool for delirium and the reference standard; in this study the SSQ-delirium and CAM, respectively. Thus, it is possible that delirium can be present at one testing point but not the other. Interpretation of the performance of the SSQ-delirium in this study is limited as data on the time lag between the SSQ-delirium and CAM was not collected. It would also be of interest for future studies to test the SSQ-delirium blinded from CAM diagnosis.

Undiagnosed dementia may account for the high number of false positive results identified by the SSQ-delirium. The majority of patients identified as positive by the SSQ-delirium also had a positive result on the SSQ-dementia. It is possible that an informant based question is not suitable to accurately differentiate those at high risk of having delirium from those at high risk of having dementia.

Direct cognitive testing of patients is the most commonly used screening method for cognitive impairment **[144]**. However, informant testing shows promise in improving detection of at-risk individuals. It has been demonstrated that an informant questionnaire shows the same performance as direct cognitive testing, despite the fact that these different screening tools measure different patient attributes **[145]**. A major advantage of informant based assessments is that they do not suffer the same problems as cognitive testing and is not affected by education level or susceptible to ceiling effects **[124]**. Single question screening for cognitive impairment is a hot topic at the moment and there is a paid incentive being rolled out across hospitals in England in an attempt to improve diagnosis of patients with cognitive impairment known as the CQUIN framework **[111]**. Of particular interest to this study is the first stage, 'Find' whereby the patient or informant is asked the question, 'Has the patient been more forgetful in the last 12 months to the extent that it has significantly affected their daily life?' This suggests that single question methods of screening for cognitive impairment are beginning to be used on a large scale despite not being fully validated.

The advantage of using an informant-based screening tool for delirium is less clear than for dementia. Due to the fluctuating nature of delirium, it can easily be missed and the need for a relative to be present to provide information introduces further timing challenges as access to informants is only possible at discrete selected times. However,

evidence suggests that delirium is most prevalent in older patients when they are at their most sick, usually soon after admission or in those patients who have prolonged hospitalisation. Thus, those may be particularly important times to use the SSQ-delirium. It is clear from the literature that some form of delirium screening is needed rather than subjective clinical judgement which has been shown to perform poorly at detecting prevalent delirium **[74]**. This supports the need for a more structured approach to be implemented as a brief first step to identify those with suspected delirium who would then be assessed using diagnostic tools such as the CAM.

Routine screening for cognitive impairment is necessary in older hospitalised patients and effective screening is beneficial to clinical staff as well as the outcomes of the patients. This task is made more difficult by the lack of uniformity regarding the various screening tools available **[146]**.

Caution must be taken when interpreting these results as the reference standards were screening tests rather than a formal clinical diagnosis. The recruitment and consent strategy could have led to biases within this study; those at higher risk of cognitive impairment may have had more visits from family and hence more likely to return the informant questionnaire, especially in cases where the patient was unable to provide consent and hence a relative or carer had to provide consent. As this study obtained single question informant report in less than half of patients this raises issues of feasibility as there is strong potential for many individuals with suspected cognitive impairment not being assessed. From this data set, it is unclear whether such low response rates were due to patients not having a suitable relative or carer available to answer the SSQ's or whether it was due to a lack of appropriate measures taken by the researcher to insure return of informant responses.

Presenting informants with the IQCODE prior to answering the SSQ's may also have influenced the results, possibly enhancing how well the SSQ's appeared to perform.

However, within these limitations I believe these results still provide useful information on how simple responses from informants may perform. This pilot study was strengthened by broad inclusion criteria thus providing a sample relatively representative

of older adult acute care admissions. The SSQ's were based on the format of a validated informant questionnaire, the IQCODE.

These preliminary findings show promise for use of a single question screening tool as the first step in the detection of cognitive impairment and prompt more thorough investigation. As yet there is no one cognitive screening tool that has achieved widespread consensus, thus the comparisons made to the IQCODE and MMSE only provide evidence for the value of carrying out a more in-depth study. Future research should compare the single question screen to a gold standard clinical evaluation as well as against other, more detailed screening tools of dementia and delirium to determine more reliable diagnostic test accuracy figures. The use of an informant-based SSQ may be particularly useful in combination with a direct cognitive testing method in helping to distinguish patients who fall within the middle, grey area of scores on cognitive test based screening tools. Furthermore, it is apparent that there is need for investigation to determine how to get higher uptake of relatives/carers to provide informant report.

3.7 Conclusions

This analysis has provided evidence that a single-item informant based screen may perform in a comparable way to much longer screens for dementia by effectively differentiating those with suspected cognitive impairment from normally functioning patients. Further validation is warranted. However, if a screening tool as straightforward as asking a single question, which has low time cost and requires little to no training to administer, can perform as well as more complex screens such as the IQCODE, then it would seem intuitive that this is a preferable option. However, results showed that a single question screening tool may not have the same potential when identifying individuals with suspected delirium.

Table 11 Summary of characteristics of all patients with specification of respondents and non-respondents to the single screening questions.

	All patients	**Patients with informant**	**Patients with no informant**
	(n = 161)	**(n = 70)**	**(n = 91)**
Mean age (years)	79.6 (range = 65–97)	**80.9 *** (range = 67–97)	**78.6 *** (range = 65–94)
Male n (%)	62 (38.5%)	27 (38.5%)	35 (38.5%)
Living arrangements n (%):			
Alone	80 (49.7)	32 (45.7)	48 (52.7)
With spouse/other family	66 (41.0)	31 (41.2)	35 (38.5)
Sheltered accommodation	8 (5)	4 (4)	4 (4)
Nursing/residential care	4 (2.5)	1 (1.4)	3 (3.3)
Cognitive and functional assessments			
MMSE mean (SD)	18.9 (7.7)	18.5 (8.1)	19.2 (7.5)
MMSE <24 n (%)	107 (66.4%)	45 (64.3%)	62 (68.1%)
CAM positive n (%)	27 (16.8%)	13 (18.6%)	14 (15.4%)
IADL mean score (SD)	8.7 (4.3)	9.1 (4.2)	8.4 (4.4)

Table 12 IQCODE and MMSE scores (means and S.D.) across SSQ delirium and dementia responses.

SSQ response		No change or better	Bit worse	Much worse
IQCODE	**Delirium SSQ**	3.4	3.9**	4.6**
		(SD = 0.6, N = 35)	(SD = 0.6, N = 25)	(SD = 0.5, N = 10)
	Dementia SSQ	3.2	3.9**	4.7**
		(SD = 0.4 N = 34)	(SD = 0.6 N = 27)	(SD = 0.4, N = 10)
MMSE	**Delirium SSQ**	22.9	15.0**	12.0**
		(SD = 5.6, N = 35)	(SD = 8.6, N = 25)	(SD = 5.8, N = 10)
	Dementia SSQ	22.0	17.1*	10.1**
		(SD = 6.3, N = 34)	(SD = 7.9, N = 27)	(SD = 6.6, N = 10)

Notes: Mann Whitney U post hoc analysis with Bonferroni correction.

** = p < 0.01, ** = p < 0.001, compared to 'nochange or better'.*

Abbreviations: MMSE = Mini-mental state examination; IQCODE = Informant questionnaire on cognitive decline in the elderly; IADL = Instrumental activities of daily living.

Table 13 Analysis of diagnostic accuracy.

	Single Question for Delirium CAM + ve	Single Question for Dementia IQCODE <3.38
Area Under Curve (95%CI)	0.67 (0.51-0.82)	0.88 (0.80-0.97)
Sensitivity of Single Question % (95% CI)	10/13 76.9 (46.2-95.0)	35/42 83.3 (68.6-93.0)
Specificity of Single Question % (95% CI)	32/57 56.1 (42.4-69.3)	27/29 93.1 (77.2-99.2)
Positive Predictive Value of Single Question % (95% CI)	10/32 28.6 (14.6-46.3)	35/37 94.6 (81.8-99.3)
Negative Predictive Value of Single Question % (95% CI)	32/35 91.4 (76.9-98.2)	27/24 79.4 (62.1-91.3)

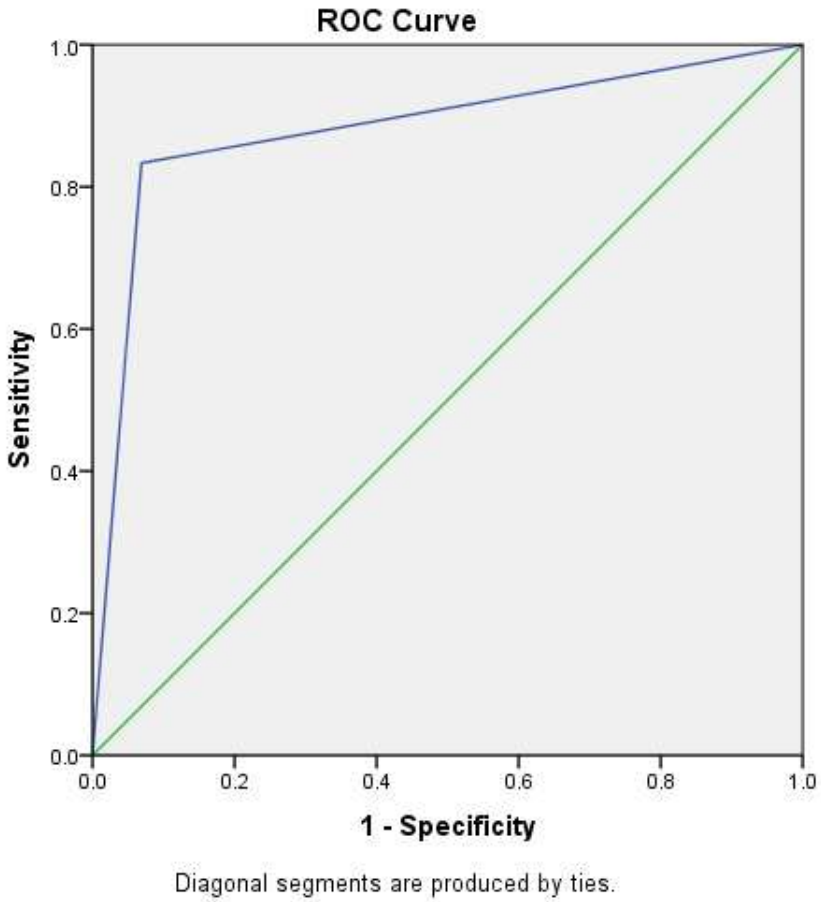


Figure 4 ROC curve showing performance of the single screening question for dementia compared to a score on the IQCODE of <3.38.

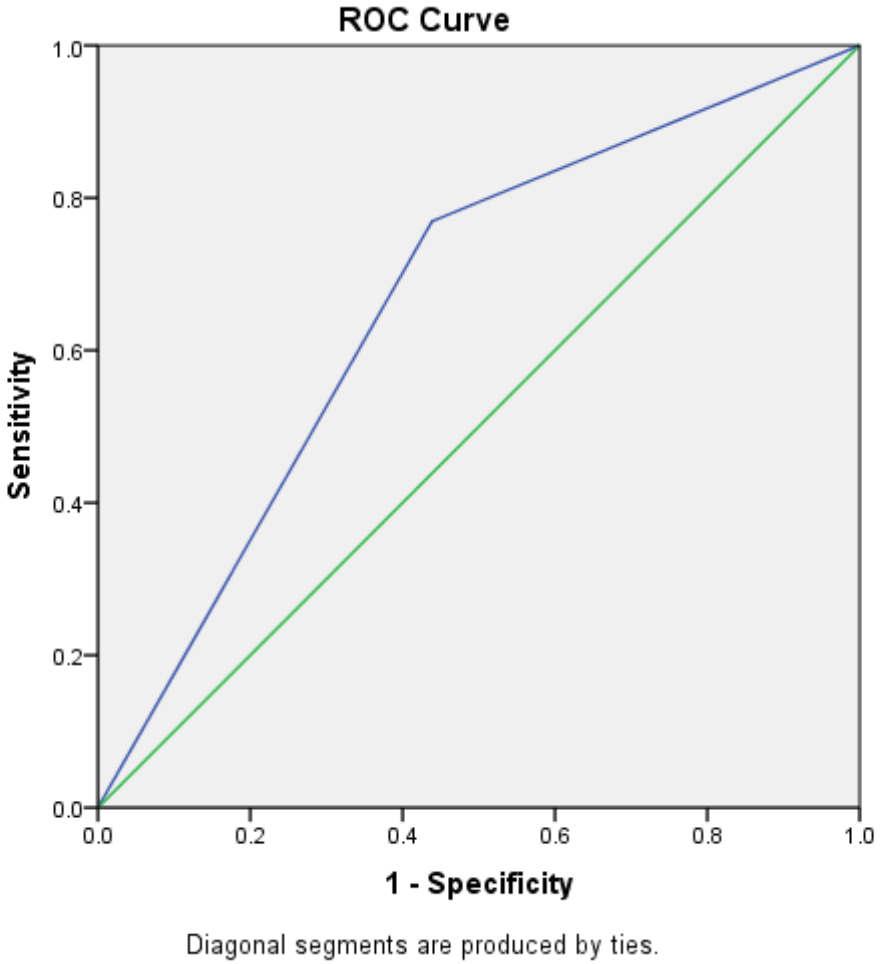


Figure 5 ROC curve showing performance of the single screening question for delirium compared to a CAM positive diagnosis.

Chapter 4: Service evaluation of usual cognitive impairment screening practice in acute care wards.

4.1 Introduction

Cognitive impairment is under-detected in older, hospitalised individuals **[147]**. However, patients with dementia or MCI are at greater risk of complications such as poor mobility, increased risk of falls, dehydration and incontinence, thus need specialised hospital care **[148]**. Chronic cognitive impairment is also an indicator of increased risk of delirium, occurring in up to 56% of these patients **[149]**. Delirium represents a particularly serious problem for hospitalised, older individual being associated with a mortality rate of up to 76% **[150]**.

Hospital admission can provide an opportunity for access to older individuals who may not usually be so readily accessible for screening of cognitive impairment. In England there has recently been political intervention in a controversial attempt to improve detection and diagnosis of cognitive impairment in older patients through paid incentive **[111]**.

Guidelines from a number of organisations exist to direct clinicians on the preferred screening test(s) to use to detect cognitive impairment in medical patients. For example, the British Geriatric Society (BGS) **[151]** suggests using the MMSE **[114]**, a clock drawing task **[152]** and the IQCODE **[153]**, alongside a screen for delirium. This is then recommended to be followed by a detailed assessment for patients identified by these tools as at risk of cognitive impairment.

Identification of older hospitalised patients with chronic cognitive impairment is important for informing decisions on capacity, to aid rehabilitation and to help detect or even prevent delirium and other associated complications **[154]**. Cognitive screening is the first step in this strategy. I am unaware of current local practice – ascertaining this will help to develop ways to improve detection if this is identified to be necessary.

Local guidance followed within acute care wards at Glasgow Royal Infirmary recommends the use of the TIME bundle **[88]** (Appendix D) which promotes delirium care in acute wards. The TIME bundle proposes a four stage care bundle and is part of an NHS initiative to improve care for older patients;

- **T**hink- Exclude and treat possible triggers.
- **I**nvestigate- Correct underlying causes.
- **M**anagement- Treat all underlying causes identified above.
- **E**ngage- Interact with family and carers to determine if this behaviour is different from the patient's baseline. Explain and document diagnosis of delirium as appropriate.

However, the TIME bundle does not recommend any specific delirium or cognitive impairment screening tools.

4.2 Research Question

What is currently done to screen for cognitive impairment locally in acute care wards?

4.3 Aim

I aimed to determine the use of cognitive impairment screening tools in inpatients in the Department of Medicine for the Elderly, Glasgow Royal Infirmary. Specifically, I wanted to determine what methods were used to assess for cognitive impairment and delirium and how often a diagnosis of delirium was documented. A secondary objective was to determine the proportion of patients with major barriers to completing assessments for cognitive impairment

4.4 Methods

4.4.1 Participants

I was interested in examining medical records of unscheduled, acute care and geriatric in-patients aged over 65 years at Glasgow Royal infirmary. I used a prospective sampling frame, retrospectively assessing medical records of patients discharged across a 2 week period. Medical records were examined across a total of 9 acute geriatric in-patient wards within Glasgow Royal Infirmary during this service evaluation. Medical records were examined on the basis of patients who had completed an episode of care and had been discharged, died or transferred for slow stream rehabilitation within the pre-specified two week period. Prior to the service evaluation, it was estimated that 120 patients would meet inclusion criteria for medical record examination based on average hospital patient turn over.

4.4.2 Target conditions

I examined medical records for evidence of assessment for delirium, dementia and cognitive impairment. Tools used for all cause cognitive impairment were recorded during hospitalisation. Screening tool(s) used as well as the period of time after admission assessments were carried out was recorded. Clinical diagnoses of dementia and delirium were also recorded.

Descriptive terms referring to the patients mental state, for example; “confused”, “cognitively impaired”, “cognitively intact” “alert and orientated” but where-by no cognitive assessment tool was indicated as well as terms which may be used as a proxy for delirium such as “acute confusional state” were recorded. No pre-specified list of accepted terms was specified prior to data collection.

4.4.3 Procedure

Medical records of patients who had completed a period of care within the pre-specified wards were examined daily Monday to Friday. Ward clerks were consulted to identify

relevant patient medical records. Where a ward clerk was not available, discussion with nurses took place.

Once medical records were obtained, I examined their content from point of admission to the applicable ward. One researcher carried out evaluation of all medical records. A standardised data collection sheet (Appendix E) was used to collect information from each patient's medical records. This information included; age, sex, date of admission/discharge/ death, cognitive assessments carried out, delirium noted, delirium diagnosis method, other suggestions of possible cognitive impairment, prior dementia diagnosis, usual place of residence, discharge destination, barriers to cognitive assessment. A numerically coded, pre-specified list of common responses was recorded as a key on the data collection sheet for usual place of residence, discharge destination and barriers to cognitive assessment.

Suggested responses for usual place of residence were;

1) Home
2) Sheltered/Supported Accommodation
3) Residential/Nursing Care Home
4) NHS Long-Term Care
5) Other (specify)

This list remained the same for discharge destination but with the addition of a sixth potential response; "death".

Suggested responses for barriers to cognitive assessment were;

1) Hearing Impairment
2) Visual Impairment
3) Dysphasia
4) Unwilling
5) Too Drowsy/Loss of Consciousness
6) Too Unwell/End of Life Care
7) Other (specify)

4.4.4 Analysis plan

Data were analysed using statistical package for the social sciences (SPSS) Version 19. Demographic and clinical information was examined using descriptive statistics. Proportions of patients with a noted delirium diagnosis and prior diagnosis of dementia were of interest, as well as proportions of patients screened with specific cognitive impairment/delirium screening tests.

Chi-squared test analysis was carried out to investigate if those with a diagnosis of dementia were more or less likely to receive cognitive assessment during hospital admission.

An independent samples t-test was also carried out to assess the association between cognitive assessment administration and patient age.

4.5 Results

A total of 106 consecutive patient records were examined during this 2 week evaluation period with no patients missed during this assessment period. Patients were mean age 81.3 years old (SD= 7.3) and 44.3% male. Average length of patient hospitalisation was 12.8 (SD=9.4) days.

Table 14 details proportions of the samples usual place of residence as well as discharge destination. The results in this table illustrate that 8/106 (7.6%) of patients did not return home when it was previously their usual place of residence. 4/106 (3.8%) patients died.

Service evaluation data revealed that 89/106 (84.0%) patients had at least one cognitive assessment documented in the medical records in the form of the AMT 4 with 17/106 (16.0%) patients having no cognitive assessment data recorded. The AMT 4 was the first documented cognitive assessment tool in all cases. 22/106 (20.8%) patients were screened using the MMSE and 1/106 (0.9%) patients were screened using the Addenbrooke's Cognitive Examination (ACE-R) as a second documented cognitive assessment screening tool.

Of the patient medical notes examined, 6/106 (5.7%) had a noted diagnosis of delirium with no noted method of diagnosis in any case. 33/106 (31.1%) patients had a prior diagnosis of dementia.

Documented barriers to cognitive assessment were; hearing impairment 3/106 (2.8%), visual impairment 4/106 (3.8%), dysphasia 2/106 (1.9%), too drowsy 2/106 (1.9%).

There was not found to be a statistically significant difference between cognitive assessment during admission and having a prior diagnosis of dementia ($x(1)=0.80$, $p=0.36$) indicating that having a prior diagnosis of dementia does not increase likelihood of receiving cognitive assessment during admission to the evaluated acute care wards.

Furthermore, no statistically significant association existed between cognitive assessment and patient age ($t(104)=1.86$, $p=0.66$), with older age not found to increase the likelihood of a patient being tested for cognitive impairment during admission to acute care wards.

4.6 Discussion

I found that most geriatric in-patients age 65 years and over in this service evaluation had at least one documented cognitive test. The prevalence of documented delirium was found to be low with no noted method of diagnosis in any of these cases.

One way of measuring patient outcomes is to compare the patient's usual place of residence with discharge destination with 8% of patients in this cohort not returning to the accommodation they came from prior to hospitalisation.

A minority of cases had documented barrier(s) to cognitive assessment within their medical records. These included sensory impairments, dysphasia and being too drowsy. These barriers to cognitive assessment highlight what may need to be looked out for in future research and in clinical practice. It is important to consider possible ways to adapt to these to enable as many patients as possible to complete simple cognitive assessments such as using a conversational aid device to overcome hearing impairment. It is likely that these figures for barriers to cognitive impairment are higher in actual clinical practice than those documented. For example, sensory impairment has been shown to be viewed as a 'normal' and common part of ageing and therefore receives less attention by clinical staff than other conditions associated with ageing which are viewed as more 'treatable' such as heart failure and diabetes **[155]**. Thus, it is logical that this lack of urgency towards these typical barriers would transfer to what is documented within patient case records.

This service evaluation revealed a low prevalence of documented delirium within older people in acute care. These results are not in line with local guidance which recommends the use of the TIME bundle **[88]** which promotes the documentation of delirium diagnosis. Delirium prevalence varies across studies investigating similar patient populations. A study based in Italy revealed a delirium prevalence of 12.3% using DSM-IV diagnostic criteria in 236 patients within an older inpatient cohort ($\geq$70 years old) **[108]**. Also using DSM-IV criteria, an Irish study revealed a prevalence of 19.6% in an acute hospital cohort **[84]**. Finally, a Thai older patient population ($\geq$70 years old) revealed a much larger delirium prevalence of 40.4% using DSM-IV criteria **[156]**. As the above studies all show uniformity in the diagnostic measure being used, is unclear whether this variation in

delirium prevalence across studies can be accounted for by cultural differences. However, these studies reveal that delirium is a common disorder; a conclusion which was not revealed by the results of this evaluation. This suggests that in usual clinical practice delirium diagnosis is being undocumented and perhaps under-diagnosed.

It is important to use standardised delirium diagnostic criteria and to make note of this when a diagnosis is recorded within patient notes. Research has revealed that in the intensive care unit, where the incidence of delirium is high, objective assessment based on the CAM criteria by medical students identified that 38.8% of patients had delirium at some point during hospitalisation. Subjective nurse assessment revealed 26.1% had delirium during hospitalisation **[157]**. Furthermore, 5% (n=8) of patients within this study were prescribed haloperidol and lorazepam despite not meeting CAM diagnostic criteria for delirium due to subjectively being labelled as having delirium. These results suggest that a standardised criterion is important to avoid missing patients with delirium as well as to correctly identify those who do have delirium.

Dementia was found to be a common and documented disorder with almost a third of patients noted as having a known dementia. This is in line with systematic review evidence **[158]** which revealed that published prevalence figures of dementia in older hospitalised patients ($\geq$55 years old) ranged from 12.9%-63.0%, taking in to account only studies which used robust methodologies. This evidences that dementia is a common disorder within older, hospitalised patients.

The results of this evaluation are strengthened by a prospective, consecutive sampling method which ensured that all patient case-notes were able to be accessed within a pre-specified time frame. This was carried out over a total of nine wards spanning all older acute care in-patient wards within the target hospital, thus reducing risk of any results being due to specific clinician practice.

I exclusively examined all patient case-records thoroughly, reducing likelihood of missing information if multiple individuals with less commitment to the project or less familiar with the topic were involved in this process.

It is important to note that results from this service evaluation are not generalisable to other hospital or patient settings but only represent current practice at the target hospital and during the specific time period it took place.

My results inform future research and highlight that delirium documentation and detection is an area within this particular hospital setting is an area which promptly requires further attention. This is required both in relation to the screening and diagnosis of delirium, with both going unrecognised within this evaluation.

While the results of this service evaluation reveal that dementia is a common disorder within older acute care patients, delirium is not found to be as well documented within patient case notes. The prevalent nature of dementia is important when considering the complex relationship between delirium and dementia. A longitudinal study **[159]** which tracked more than 500 individuals across a 10 year period found that those who previously had delirium, three quarters of these patients went on to develop dementia compared to a third of those who did not have a history of delirium. It was found that delirium in those with existing dementia accelerated the severity of dementia. It is important to note that these results were found in individuals age 85 and over. Building on this, further research should explore whether the prevention and/or swift management of delirium by identifying the underlying cause can lead to the reduction of patients developing dementia or reduction in the dementia progression for those who already have this disorder. However, this is not possible unless delirium is diagnosed and documented effectively.

4.7 Conclusion

It was found that while screening of cognitive impairment was completed in a vast majority of patients, there was no documented screening or diagnosis of delirium in the acute care wards within this service evaluation. While it is not optimal to diagnose a new dementia during hospital admission when a patient is likely not functioning at their cognitive baseline, delirium on the other hand is a disorder which is ideally diagnosed and resolved before discharge.

Results from this service evaluation show that clinicians give higher priority to the documentation of dementia but this also needs to be the case for delirium.

Table 14 Proportion of patients' usual place of residence and discharge destinations.

	Usual place of residence	**Discharge destination**
Home N (%)	82/106 (77.4%)	74/106 (69.8%)
Sheltered/supported accommodation N (%)	8/106 (7.5%)	7/106 (6.6%)
Residential/nursing care N (%)	15/106 (14.2%)	19/106 (17.9%)
NHS long term care N (%)	1/106 (0.9%)	2/106 (1.9%)

Died N (%)	n/a	4/106 (3.8%)

Chapter 5: National clinician survey of cognitive screening in the acute care hospital setting.

5.1 Introduction

Guidelines from a number of organisations exist to direct clinicians on the best screening tests to use to detect cognitive impairment in medical patients. The updated NICE dementia guidelines (April 2015) **[160]** suggest that the ACE-R appears to have better diagnostic test accuracy for the screening of dementia compared to the widely used the MMSE **[161-164]**, and that the ACE-III may also show promised but requires further validation **[164]**. It is recommended that dementia assessment should take place alongside a delirium screening tool, supplemented by relative/carer report.

This statement is aligned with local policy. The Scottish government has implemented a two year programme titled 'Improving the care for older patients in acute hospitals' **[88]**. In terms of cognitive impairment, this programme particular focuses on the detection of delirium, claiming the disorder to be a prevalent 'medical emergency'. The Scottish government provide a 'Delirium toolkit' aimed to improve delirium detection rates in acute care. The toolkit operates under the heading 'Think Delirium' and suggests that a local delirium screening tool should be used, a cognitive impairment screening tool as well as an informant based screening tool which gathers patient history from a relative, carer or close friend. Although suggestions are made of possible screening tools to be used, no one specific measure is suggested for each form of assessment, instead referencing the use of a 'local tool'.

A variety of other guidelines exist for the screening of cognitive impairment which contains their own specific suggests of which screening tools should be used. The BGS guidance for the prevention, detection and management of delirium **[151]** suggests that all patients over the age of 65 should be screened for cognitive impairment on admission using the AMT or MMSE. The BGS then goes on to suggest that all patients identified by these tools as having cognitive impairment as well as other at risk groups including the severely ill, those with sensory impairment and those with dementia should be assessed

for delirium using the CAM. These guidelines were first published in 2006, thus the suggested screening and diagnostic tools may be outdated.

The Alzheimer's Society provides a 'cognitive assessment toolkit' **[165]** to help aid clinical assessment of cognitive impairment. This tool kit provides specific guidance for use in the acute care setting suggests an initial, brief assessment using the CQUIN SSQ 'insert question', followed by the AMT 10 and/or the General Practitioner Assessment of Cognition (GPCOG) and/or Six-item Cognitive Impairment Test (6CIT). It is suggested this should be supplemented with the CAM for the diagnosis of delirium.

The range of guidelines available and conflicting suggestions of which screening tool should be used for the detection of possible cognitive impairment may cause confusion among clinicians of the best way to go about this. It is of interest to determine which of these guidelines are followed nationally, if any.

5.2 Research Question

Which tools are used to screen for cognitive impairment in Scottish acute care wards?

5.3 Aim

To identify what clinicians report is being used to screen for cognitive impairment across Scotland to determine if there is consensus between Scottish hospitals. Current tools used as well as how well clinicians believe these tools are used in practice are of interest.

5.4 Methods

5.4.1 Target population

In the first instance, every hospital within Scotland with a geriatric in-patient department was identified. Following this, the lead clinician was identified within each unit. This was done using knowledge of on-site clinicians at Glasgow Royal Infirmary and supplemented by internet searches where necessary. Email addresses for each lead clinician were identified in the same way. In cases where email addresses were not listed on the hospital website, telephone calls were made to the request email address information. The questionnaires were sent by email to all clinicians on the same day with one further email reminder sent two weeks if no response had been received.

5.4.2 Measures

A short questionnaire (Appendix F) was sent to the lead clinician within each hospital. This questionnaire was first piloted with local geriatric clinicians at Glasgow Royal Infirmary who were requested to give qualitative input regarding how the length, response format and items of the questionnaire. Questions focused on; what tools are being used, whether guidelines are followed and how well cognitive impairment is screened for in older patients. The questionnaire consisted of five separate items with a combination of open and closed response options. The questions were designed to fit on one A4 sheet to encourage a good response rate. Respondents had the option to return the questionnaire by email or post.

5.5 Results

I received 18 responses of a possible 23 (78%). Of the respondents, all but one stated that guidelines exist within their unit for screening of cognitive impairment for older patients (>65 years). A variety of tools were identified as being used for the screening of cognitive impairment with most respondents (83%) stating that more than one tool is used within their unit. The most commonly used tool was the MMSE (56%), followed by the AMT 4 (50%) and the 4AT (39%). The ACE-III & ACE-R, the MoCA and the Mental Status Questionnaire (MSQ) were also highlighted as being used for cognitive impairment screening in selected older, hospitalised patients (**Table 15**). This figure provides a colour coded map of responses given for cognitive impairment screening tool used. This figure illustrates that there is an even spread of the tools used, with no tools appearing to be area specific.

Clinicians were also asked what diagnostic tool(s) they used for the detection of delirium, if any (

Table 16). Four tools were identified; 4AT (56%), the CAM (28%), SQiD (11%) and the DSM-IV criteria (6%). However, 33% of respondents stated they used clinical judgement alone or had no criteria for the detection of delirium. **Figure 6** provides a colour coded map of responses given for delirium screening tool used. This figure illustrates that there is a strong presence of the use of the 4AT within the south east of Scotland as well as the

CAM exclusively being used in this area for the screening of delirium. Furthermore, there is a lack of specific screening tool being used within the West of Scotland, highlighted as the only area which relied on clinical judgement/no criteria.

Finally, clinicians were asked to rate how well they thought screening for cognitive impairment was carried out within their unit on a Likert scale ranging from 1 ('poor') to 5 ('excellent'). Results showed an average rating of 3.9 with no respondent rating below a 3 ('average').

5.6 Discussion

I received a reasonably good response rate from lead clinicians in geriatric units across Scotland, receiving over three quarters of clinician surveys back by email. This was particularly the case within the East and West of Scotland, with less clinician representation in the North of Scotland.

While almost all respondents stated their unit had formal guidelines, there is notable heterogeneity in tools being used to screen for cognitive impairment in Geriatric Units in Scotland. It appeared that there may be some confusion over which is the best cognitive impairment screening tool to use, with the vast majority of respondents citing more than one tool. However, it may be the case that it is more suitable to employ a multi-tool approach to assessment of cognitive impairment with a very brief screening tool used first such as the AMT 4 followed by a more detailed tool such as the MMSE or MoCA if the initial screen prompts further assessment. However, there were a variety of tools used and it appears that these were evenly spread through-out Scotland for the screening of cognitive impairment, with no tools appearing to be specific to be region specific. It is unclear whether this heterogeneity is due to a range of effective tools being available for cognitive screening or due to confusion over which tool should be used within acute care.

These results are supported by heterogeneity in approach to cognitive assessment also found in a larger scale survey of 174 clinical staff across Scotland within the stroke hospital setting **[166]**. This study revealed that a total of 45 different cognitive

assessment tools were stated as being used across Scottish stroke wards, suggesting lack of uniform assessment is not just apparent within the acute care setting.

An important finding was the lack of formal screening for delirium. It was found that a third of respondents did not have a delirium screening criteria or used clinical judgment alone. This was only found to be the case within the West of Scotland suggesting there may be a lack of local guidance for the assessment of delirium within this region. There appears to be a need for an evaluation of delirium screening in acute care in-patients in this region to determine which assessment tool clinicians should use.

Furthermore, there was clear preference for use of the 4AT within the East of Scotland. The 4AT is a local tool which was developed in Edinburgh, which may explain it is predominantly used within this region. However, at the time this clinician survey was carried out, there were no published validation studies of the 4AT (January 2014). Also, the only clinicians who claimed to use the CAM were in the East of Scotland. This may be regarded as an outdated delirium assessment tool as it is based on DSM-IV published in 2008 **[112]**. There has since been a further publication of diagnostic criteria (DSM 5) **[14]**. It could be argued that using the 4AT and CAM is better than carrying out no formal assessment of delirium, as clinicians claim to be the case in the West of Scotland.

Another Scotland-wide survey carried out in 2013 across acute stroke units revealed 43% of clinicians stated they used clinical judgement when identifying delirium **[167]**. This is despite evidence that clinicians are not good at picking up cognitive impairment, including delirium, when based on non-structured assessment alone **[168]**.

However, in general clinicians' feel cognitive screening is being carried out to an adequate standard. This does not agree with a Scottish government audit of cognitive impairment assessment in hip-fracture patients carried out during the same period of time as this clinician survey (December 2012-March 2013) **[169]**. This audit revealed that in NHS Fife, less than half of patients had any cognitive assessment documented at all and that only 30% of patients had cognitive assessment carried out within the first 24 hours.

It is important to note a potential weakness to the methodology of this sampling when deciding to only approach lead clinicians from each acute care unit in Scotland rather

than a variety of clinicians working within each unit. Only approaching one member of each acute care unit means that it is not possible to compare responses from others within each area and may provide a skewed impression of what one individual thinks is being done within their unit as well as only providing one opinion of how well clinicians feel cognitive screening is being carried out at that hospital. Furthermore, if multiple individuals were sent a questionnaire within each hospital this may have lead to a higher percentage of responses from all areas, rather than relying on one single clinician to reply.

I suggest that further research is required to inform development of a standardised assessment protocol of cognitive impairment including delirium in older hospitalised patients across Scotland.

Table 15 Screening tool frequency with percentage of hospitals citing this tool for the detection of possible cognitive impairment.

MMSE	AMT4	4AT	AMT10	ACE-III/ACE-R	MoCA	MSQ
10 (58%)	9 (53%)	7 (41%)	6 (35%)	5 (29%)	5 (29%)	1 (6%)

MMSE=Mini-Mental State Examination, AMT= Abbreviated Mental Test, 4AT=4 A's Test, ACE=Addenbrooke's Cognitive Examination, MoCA=Montreal Cognitive Assessment, MSQ=Mental Status Questionnaire.

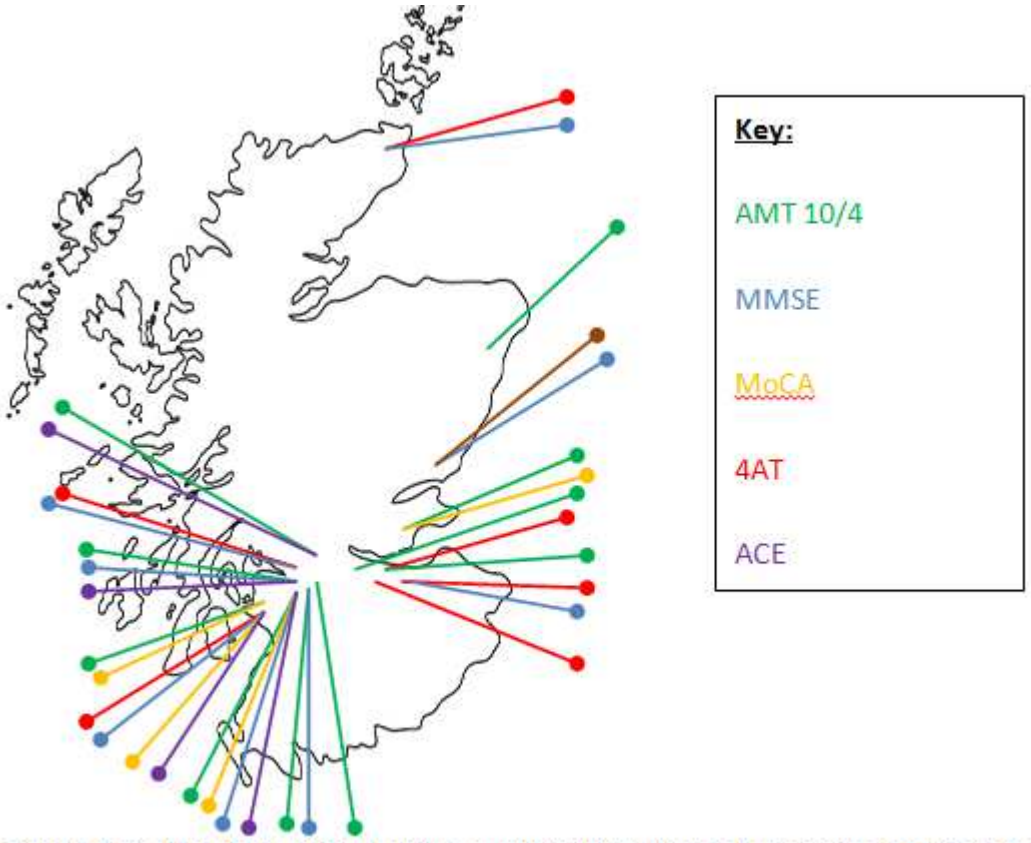


Figure 6 Scotland map illustrating cognitive impairment screening tool use by region.

Table 16 Screening tool frequency with percentage of hospitals citing this tool for the detection of possible delirium.

4AT	No criteria/ clinical judgement	CAM	SQiD	DSM-IV
10 (59%)	6 (35%)	5 (29%)	2 (12%)	1 (6%)

4AT=4 A's Test, CAM=Confusion Assessment Method, SQiD=Single Question in Delirium, DSM-IV=Diagnostic and Statistical Manual 4th edition.

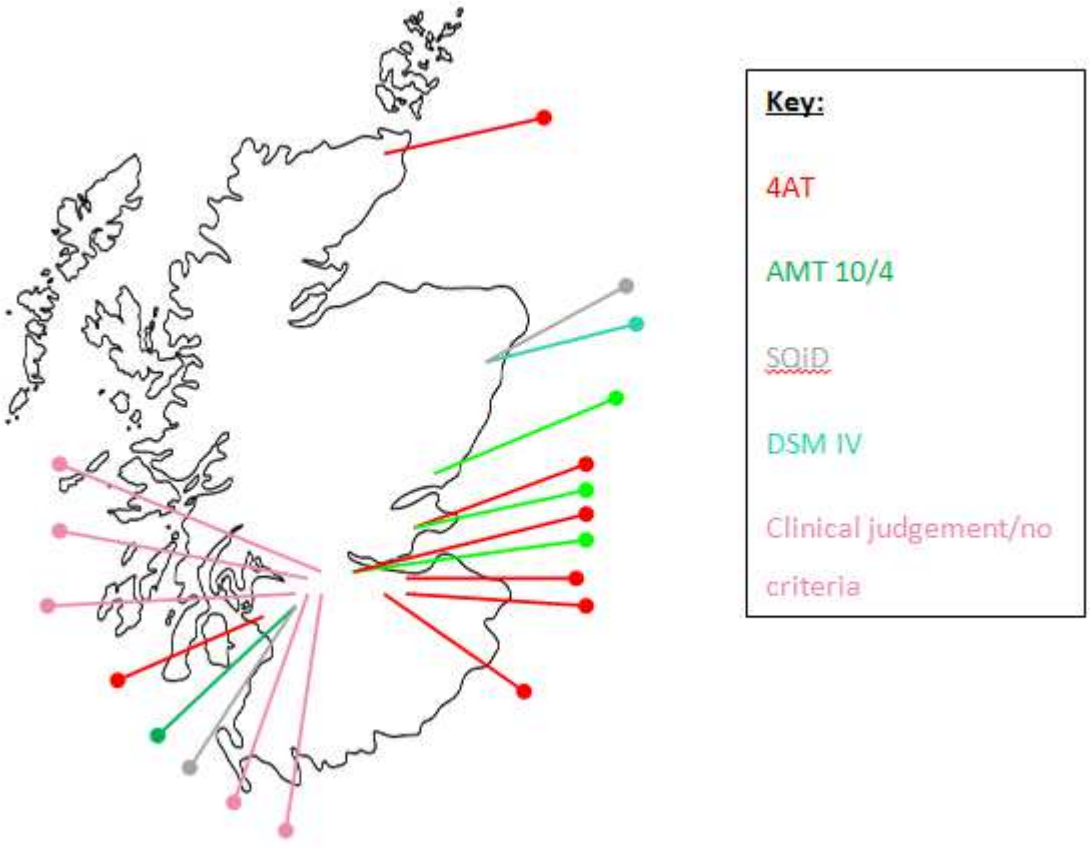


Figure 6 Scotland map illustrating delirium screening tool use by region.

Chapter 6: Evaluation of delirium screening tools in geriatric medical in-patients.

6.1 Overview

There are a variety of methods available to clinicians to aid the diagnosis of delirium which have shown excellent performance in the research setting **[170-171].** The CAM is the most widely used instrument for the detection of delirium both clinically and within research **[16,18].** The CAM is a brief tool designed to take 5-10 minutes to complete, has been translated in to 10 languages and has been found to have excellent sensitivity (93%-100% and specificity (98%-100%) **[172].** However, these high sensitivities do not seem to transfer to the routine clinical setting when administered by nurses at the bedside (19-47%) **[173-175].**

The fifth revision of the DSM 5 **[14]** provides an updated definition of criteria individuals should fulfil for a diagnosis of delirium. DSM 5 criteria defines the core features of delirium to be impaired awareness, inattention, acute onset, fluctuating course as well as an additional cognitive impairment such as memory or language. These impairments should be evidenced by a physically evident cause and not better explained by an existing disorder. The European Delirium Association and American Delirium Society made a joint proposal for an amendment of DSM 5 delirium criteria **[176]**. They suggested that in order to make this diagnostic criteria more inclusive, patients who are unable to complete direct cognitive testing due to reduced level of arousal should be classified as having inattention and evidence suggest that this patient group are likely to have a delirium **[177]**.

While the DSM 5 delirium diagnostic criteria go some way towards standardising and aiding the delirium diagnosis process. Published guidance recommends that all older adults admitted as an emergency to hospital should be assessed for possible delirium **[160]**. It is not feasible or appropriate for all adults to undergo a very detailed assessment of cognition. Brief screening tools that can be carried out by nursing staff throughout the

day are therefore important in the detection of possible delirium. However, there is no consensus on how this assessment should be performed.

6.2 Research Question

Which cognitive/delirium screening tools recommended for routine use with older inpatients in Greater Glasgow & Clyde are effective for the screening of delirium?

6.3 Aim

This project aimed to evaluate the test accuracy of routinely used brief cognitive assessment tools for detection of a clinical diagnosis of delirium. The feasibility and diagnostic test accuracy of delirium screening tools will be assessed.

6.4 Methods

6.4.1 Participants

I recruited a consecutive cohort of non-elective patients in an urban teaching hospital. Patients were ≥65 years old and being cared for in GAU's. The GAU offers comprehensive assessment to older adults following triage in an acute medical unit. All patients under the care of 6 senior elderly-care physicians were eligible for evaluation.

I used routine health-care data collected as part of a departmental service evaluation and service improvement initiative looking at delirium assessment. Approval to access, collect and analyse NHS data for this study was obtained from the Caldicott Guardian (Appendix G & H). The components of the cognitive tests which I used were all recommended for routine clinical use in the assessment of older people in the Rehabilitation and Assessment Directorate of Glasgow and Greater Clyde. In reporting our project, I followed best practice guidance as described in the dementia specific extension to STAndards for the Reporting of Diagnostic accuracy studies **[178]**. A service evaluation approach was used in this study rather than a research project as, given the inconclusive

nature of existing empirical evidence; it was not deemed that any screening tools not recommended for routine clinical use were required to be evaluated at this point. While this prevented the expansion of the project beyond these recommended screening tools, it allowed for an efficient evaluation of these in a large number of patients who should have been receiving cognitive and delirium screening during this time period regardless.

6.4.2 Index tests

Index tests for cognitive impairment recommended for routine use in this population were of interest to this study. These encompassed the AMT **[129]**, 4AT **[108],** bCAM **[91]** and the SQiD **[106]**. MOTYB is a component of the 4AT and bCAM and was also considered separately as a standalone index test. These screening tests included routine information from direct patient testing (18 items) as well as informant report from relatives and on-duty nurses.

AMT 10/4 [129, 179]

This is a ten item tool developed for the assessment of cognitive impairment. Patients gain a point for every correct answer, with a total score calculated out of ten. A shorter version of this tool can also be administered asking only four of the ten AMT 10 questions, namely the AMT 4 (Appendix I)**.** The shorter, four item version may be as effective as the full AMT 10 at detecting possible cognitive impairment (MMSE≤24) **[180].** This tool was not developed specifically for the screening of delirium, thus no validated cut-point has been established. A score of ≤7/10 has been found to have good diagnostic test accuracy when screening for a significant cognitive impairment **[168].**

4AT [108]

A brief screening tool designed for the detection of possible delirium as well as cognitive impairment. This tool has 4 separate domains which measure alertness, AMT 4, attention and acute change/fluctuating course. The tool has a maximum score of twelve with a higher score indicating increased impairment (Appendix J)**.** The 4AT has been validated in

two studies; in a sample of 234 older in-patients and in a separate study of 111 stroke patients **[108, 120]**.

bCAM [91]

This is a two stage screening method for delirium (Appendix K). In the first stage the patients' level of consciousness (direct observation) and inattention (Spelling 'lunch' backwards) are assessed. Patients with disturbed consciousness or more than one spelling error proceed to a second stage including assessment of inattention (MOTYB) and disorganised thinking assessed through direct patient testing (6 short questions). This tool is intended to be a short and pragmatic operationalisation of the CAM, a method of delirium diagnosis which uses DSM IV criteria.

SQiD [106]

An SSQ for delirium to be directed at a relative, carer or close friend of the patient. The question asks; "Has your friend/relative been more confused lately?" with a dichotomised response method, yes or no.

6.4.3 Reference standard

Elderly care physicians used a standardised checklist when diagnosing delirium and dementia. This checklist was based on the fifth edition of the DSM 5 criteria for delirium **[14]** (Appendix L) and the fourth edition of the DSM-IV criteria for dementia **[113]** (Appendix M).

Clinicians had 3 choices when considering the diagnosis of delirium;

i) Delirium (meeting all DSM-V criteria)
ii) Possible delirium ('don't know' clinician response for one or more DSM-V criteria, with all other criteria met)
iii) No delirium (any DSM-V criteria not met).

For dementia diagnosis, if the patient had a prior diagnosis of dementia then the checklist was not required and the clinicians marked this on the sheet. If the patient did not have a prior diagnosis of dementia then the clinician assessed the patient as either;

i) New dementia (meeting all DSM-IV criteria)
ii) Possible dementia ('don't know' clinician response for one or more DSM-IV criteria, with all other criteria met)
iii) No dementia (any DSM-IV criteria not met).

For the purposes of this evaluation, it was decided that DSM-IV criteria for dementia would be used as there was some uncertainty among involved clinicians over the relatively new DSM 5 dementia criteria; the disorder itself being renamed as major neurocognitive disorder. DSM-IV criteria was still current clinical practice for the diagnosis of dementia at the time of this evaluation.

Clinical assessment was performed as part of routine clinical care. This initial clinician assessment was blinded from index test results.

6.4.4 Procedure

The routine data required to populate the index test assessments were administered and collated by a single observer blinded from elderly care clinician assessments until all index test scoring was completed. Index test assessment was aimed to be completed within two hours of clinician assessment.

Direct patient assessments consisted of 18 items. Items which overlapped between index tests such as MOTYB and the AMT 4 were only administered once per patient. There were also three questions to be asked of a nurse familiar with the patient and two questions to be answered by a relative or carer. The order of testing was fixed for all patients (Appendix N).

Direct patient testing duration was timed to the nearest second using a stop-watch. Following patient assessment, any barriers to the patient's ability to complete any part or all of the cognitive assessment procedure was recorded such as hearing impairment,

dysphasia, and medical instability. A headset with amplifier was also made available to patients with hearing impairments. Patient test duration was timed using a stop-watch.

Informant data from nurses was collected as soon as possible after direct patient testing. Following this, an A4 sheet of paper detailing the nature of the investigation and two SSQ's (Appendix O) for delirium (SQiD) and cognitive impairment (SSQ used within the CQUIN framework) was left with the nurse to be passed on to a relative, friend or carer to be completed the same day, where possible.

I obtained clinical and demographic information from patient case-notes following assessment. This included age, sex, date of admission, main symptom(s) at presentation, and barriers to communication (including deafness, visual impairment, and dysphasia).

Information obtained from direct patient testing was fed back to the relevant clinician on the next ward round to inform the patient care process.

Direct patient screening and clinician assessment of delirium was performed once per patient.

6.4.5 Analyses

Subjects were categorised according to delirium diagnosis (definite, possible, no delirium). Differences in clinical and demographic features between the three groups of patients were described using Kruskal-Wallis H test analyses. Where data suggested a between group difference, I used Mann Whitney U analysis to confirm differences between two groups.

I described test accuracy statistics of sensitivity, specificity, positive and negative predictive values and corresponding 95% confidence intervals; comparing the routine cognitive index tests (AMT-10, AMT-4, 4AT, bCAM, MOTYB and SQiD) against the reference standard of consultant elderly care physician diagnosis of delirium (DSM V). For the 4AT, a pre-determined threshold of $\leq$4/12 was used. The bCAM and SQiD were both dichotomised as positive or negative outcomes. Sensitivities and specificities were also calculated for each individual score on MOTYB ranging from 0 to 12.

ROC analyses were carried out separately on all index tests, comparing to reference standard DSM-V delirium diagnosis. ROC analyses were used to select optimal cut-point for screening tests which did not have an agreed cut-point specifically for delirium based on existing literature (AMT-10/-4, MOTYB). Data were analysed separately for delirium only diagnosis (table 2) and a composite of delirium and possible delirium diagnosis (table 3).

ROC analyses were carried out separately for each for the 4 components of the 4AT; altered alertness, AMT 4, MOTYB and acute change/fluctuating course. Analyses were carried out in accordance with the 4AT scoring system.

All analyses were performed using SPSS for Windows (version 22.0; SPSS, Armonk NY, IBM Corp.)

6.5 Results

6.5.1 Main analyses

I assessed 500 patients over an 8 month period. Clinicians completed assessment of delirium in 94.8% of patients (474/500) with 1.6% (8/500) not assessable and 3.6% (18/500) patients not seen by study clinician during the assessment period. Patients were 87% female (433/500); mean age 83.1 years (SD= 6.7) (

Table 17)**.** Patients were tested a median of 2 days after admission (IQR=1-3).

Reference standard: Using DSM-V delirium criteria, 18.6% (93/500) patients had definite delirium, 20.8% (104/500) possible delirium and 55.4% (277/500) no delirium (Figure 7).

30% (150/500) of patients had a prior diagnosis of dementia and 4% (22/500) received a new diagnosis of dementia (DSM-IV criteria).

Index tests: Index test assessment took place in a mean time of 50 minutes (range=0-105 minutes) from clinician delirium assessment. Direct patient assessment took a mean total time of 4.8 minutes (range= 4-7 minutes).

Barriers to direct cognitive testing were noted in 17.8% (89/500) of patients. Within this group of patients, 4.8% (24/500) had a level of dementia which prevented understanding of instruction, 3.8% (19/500) were too drowsy to be assessed at all, 2.8% (14/500) had a hearing impairment which could not be overcome by a hearing amplifier, 2.4% (12/500) were deemed by the elderly care physician as too unwell or inappropriate for direct cognitive assessment (e.g. terminal care), 1.8% (9/500) were dysphasic, 1.6% (8/500) were unwilling to answer assessment questions and 0.6% (3/500) were blind.

I was able to obtain a total score on the 4AT in 86.8% (434/500) of patients; on MOTYB in 84.2% (421/500); on the AMT 10/AMT 4 in 81.6% (408/500); and on the bCAM in 77.4% (387/500). Data was obtained from relatives or carers for 28.2% (141/500) of patients using the SQiD.

Figure 7 provides a flowchart detailing complete and incomplete delirium diagnoses as well as total numbers of patients who were able to complete each index test.

Mean scores on the AMT 10, AMT 4, 4AT and MOTYB were presented by delirium diagnosis in **Table 18** and **Figure 8** as well as dementia diagnosis **Table 19** and **Figure 9.**

ROC analyses were carried out to assess diagnostic accuracy of the index tests when comparing to a definite diagnosis of delirium. The AMT 10 was found to have a sensitivity of 86.6 and specificity of 63.5 at a cut-point of $\leq$4/10. The AMT 4 was found to have a sensitivity of 92.7 and specificity of 53.7 at a cut-point of $\leq$3/4. The 4AT was found to have a sensitivity of 86.7 and specificity of 69.5 at a cut-point of $\geq$4/12. The bCAM was found to have a sensitivity of 70.3 and specificity of 91.4. MOTYB was found to have a sensitivity of 91.3 and specificity of 49.7 at a cut-point of $\leq$5/12. The SQiD was found to have a sensitivity of 91.4 and specificity of 61.3. See **Table 20** for further detail. ROC curves for patients with definite delirium are displayed in **Figure 10**.

ROC analyses were carried out to assess diagnostic accuracy of the index tests when comparing to a definite diagnosis of delirium or possible delirium (combined as 'delirium' group). The AMT 10 was found to have a sensitivity of 76.4 and specificity of 72.9 at a cut-point of $\leq$4/10. The AMT 4 was found to have a sensitivity of 85.1 and specificity of 63.6 at a cut-point of $\leq$3/4. The 4AT was found to have a sensitivity of 69.8 and specificity of

76.7 at a cut-point of ≥4/12. The bCAM was found to have a sensitivity of 45.6 and specificity of 95.0. MOTYB was found to have a sensitivity of 82.4 and specificity of 61.5 at a cut-point of ≤5/12. The SQiD was found to have a sensitivity of 71.0 and specificity of 66.7. See **Table 21** for further detail.

For the MOTYB cognitive assessment, it was found that 23.3% were able to complete all 12 months in the correct order. A score of 0/12, where the patient did not get any of the MOTYB in the correct order, had a larger number of patients than any other single score with 25.2% (126/500). A cut-point of ≤5 (i.e. this is the number of consecutive months correctly recited in backwards order starting at December) provided a sensitivity of 91.3% with a specificity of 49.7.

6.5.2 Further analyses I

Further analyses were carried out to determine the diagnostic test accuracy of each of the 4 components of the 4AT separately.

ROC analyses revealed that of the 4 components of the 4AT, acute change/fluctuating course had the greatest diagnostic test accuracy (AUC=0.80) and altered alertness the lowest (AUC=0.55). Sensitivities ranged from 94.4% for MOTYB to 14.4% for altered alertness. Specificities ranged from 95.3% for altered alertness to 39.6% for MOTYB (**Table 22).**

6.5.3 Further analyses II

I evaluated the reasons for diagnostic uncertainty in attending clinicians by looking at the frequency of 'don't know' responses to DSM 5 criteria for patients with 'possible delirium' (n=104) (**Table 23**).

Clinicians were most unsure about whether a patient has shown a change from baseline (n=65), if there has been fluctuation in severity (n=57), acute onset of delirious symptoms (n=56) and whether the symptoms could be better explained by another pre-existing, established or evolving neurocognitive disorder (n=51). There were few patients where clinicians were unsure of whether they had altered attention (n=5), altered awareness

(n=11), additional disturbance in cognition (n=13) or whether the symptoms occurred in the context of a severely reduced level of arousal such as coma (n=3).There were no cases where clinicians were unsure that there was evidence that the disturbance had a direct physiological cause.

98/104 of patients identified as 'possible delirium' had a possible or existing dementia, with 6/104 patients having no dementia. Specifically, 57 (54.8%) patients had a prior or new dementia, 41 (39.4%) had a possible dementia and 6 (5.8%) of patients had no dementia. All patients had a mean of 2.5 items on the DSM-V criteria checklist marked as "don't know", those with a new or prior dementia had a mean of 2.5 items marked as "don't know", a mean of 2.8 items for those with possible dementia and a mean of 1.3 items for those with no dementia.

6.6 Discussion

I found that brief cognitive screening tests, including AMT10, AMT4, MOTYB and 4AT, had good sensitivity for detecting definite delirium, above 86%. However the specificity of these assessments for definite delirium was lower, ranging from 53 to 70%. These figures are reflected in the negative and positive predictive values, with good negative predictive value (over 95%) but poor positive predictive value (40% or less). Amongst these assessments using the full AMT-10 seemed to carry no advantage over the subset of questions in the AMT-4, with very similar diagnostic performance characteristics. The bCAM appeared to demonstrate notably lower sensitivity. Thus, bCAM appeared to be less appropriate as a screening tool for delirium as a test with high sensitivity is essential when screening.

The above brief cognitive assessments appeared to be feasible in this cohort, although common barriers to assessment (severe illness, depressed conscious level, inability to respond to instruction) prevented direct assessment of cognition in around 1/5 cases. The informant-based SQiD showed promise as a screening assessment, with high sensitivity and good negative predictive value, however it proved difficult to obtain these data with informant responses obtained in less than 30%.

While the AMT 10 and AMT 4 were not originally designed for the screening of delirium, both were feasible screening tools within this population. The AMT 10 did not appear to perform better than the AMT 4 for the screening of delirium. Further validation is needed to establish optimal cut points.

MOTYB appeared to be a difficult task for patients in this population with less than quarter receiving full marks and a quarter unable to recite any of the months in the correct order. This may be due to the high proportion of patients with dementia in this study. A recent study in which MOTYB was assessed in a population of elderly patients without dementia found that 87% were able to recite all 12 months **[181]**.

Using MOTYB as a screening tool for delirium in a population where dementia is prevalent showed high sensitivity but low specificity. It is unclear from existing literature what the optimal cut point for this tool should be. This investigation revealed low cut points of 3 or 4 out of 12 appeared to have best diagnostic test accuracy.

MOTYB did appear to be a sensitive and very brief tool when screening for delirium in this sample of older, acute care patients. Further research is necessary to examine the best way to score this test. It may be appropriate to use this test alongside another brief screening test for delirium to improve specificity. A recent systematic review examined existing evidence for use of MOTYB across clinical and research settings and found it to be sensitive to significant cognitive impairment as a whole. However, it was concluded that there was a lack of consistency when rating and administering this test across studies **[182]**. A clear assessment procedure is necessary for use with MOTYB, for example to clarify if patients should or should not have the opportunity to self-correct.

Separate analysis of the 4 components which make up the 4AT revealed that alertness, AMT 4 and MOTYB were highly feasible using the 4AT scoring system. The scoring for the 4AT allowed for a larger proportion of patients to be scored compared the standard scoring of the AMT 4 and MOTYB in this evaluation. This is due to the 4AT giving patients a score even if they are unable to attempt these direct cognitive testing components. Simplifying the MOTYB scoring system to indicate patients with a score of less than 7 out of 12 or unable to attempt as showing impairment on this task may be more feasible but loses a lot of valuable information than when scoring individually. However, this

simplified scoring may be more suitable for a rapid screening tool of delirium. The alertness component of the 4AT showed very poor sensitivity but boosts the overall specificity of the tool, with a high individual specificity. The AMT 4 and acute change/fluctuating course components had good diagnostic test accuracy.

The performance of the bCAM as a screening test for delirium appeared to be less good, with poor sensitivity, missing around 3 in 10 patients with delirium. However it had good specificity at over 90%. Therefore the bCAM might have a role as an assessment to detect patients with definite delirium for research studies (few false positives), but it appears not to be appropriate as a clinical screening test for the acute medical condition of delirium (too many false negatives).

While the SQiD showed promise as a very brief screening tool with high sensitivity which required no direct patient contact, it did not appear to be feasible within this cohort. It is likely the number of responses would have been higher if testing had been carried out over a number of days rather than at one point in time whereby an informant response was necessary within that same day. However, due to the fluctuating nature of delirium it is necessary to screen regularly, yet evident from this evaluation that it is not always possible to get quick and easy access to a relative or close friend within the acute care environment. The SQiD may be more appropriate as a supplementary delirium screening tool along-side brief direct cognitive testing, in patients where this is possible to be obtained.

This study was conducted following results obtained from service evaluation of what was currently being done to screen for delirium at Glasgow Royal Infirmary (chapter 4) as well as Scotland-wide clinician survey of cognitive screening, including delirium (chapter 5). Both revealed a local problem of a lack of both delirium diagnosis being carried out and delirium screening tools being used. I presented the results of this evaluation orally to the Delirium Short Life Working Group with the aim of feeding in to local delirium screening policy by providing evidence from a large, representative cohort of older in-patients within Glasgow Royal Infirmary.

This study showed that there was often uncertainty in the diagnosis of delirium, even by experienced clinicians with an interest in cognitive impairment. A comparable proportion

of patients were diagnosed with possible delirium as were identified as having definite delirium. This diagnostic uncertainty may have been more apparent as elderly care physicians were asked to make a diagnosis of delirium at a single point in time early in the patient's admission. Diagnostic uncertainty is likely to be less if patients are followed over time, gathering more information and with a more prolonged period of observation of symptoms as well as behaviours. However even allowing for this it is clear that diagnostic uncertainty is a major issue which is generally under-recognised within the current literature, where there is often a focus on making a definite yes or no delirium diagnosis. The use of a "possible delirium" label may be useful for elderly care physicians within the hospital setting.

It was found that almost half of those marked as possible dementia were diagnosed with delirium. This highlights the difficulties of diagnosing a chronic cognitive impairment such as dementia in the acute care environment in which patients are more likely to have complications such as delirium and other illnesses which would either not be present or less severe when returned to the community setting. As would be expected, a low proportion of those with no dementia had delirium.

Our findings are generally consistent with the published literature. A delirium prevalence as found in this cohort of 19% is in line with other recent reports of older hospital inpatients. A meta-analysis of 42 studies reported delirium prevalence in medical in-patients to be 10-31% **[183]**.

The 4AT was investigated as a delirium assessment tool in a consecutive sample within acute care in Italy (n=236) **[108]**. In this study, the 4AT was found to have a sensitivity of 90% and specificity of 84%. I found a similar sensitivity although specificity in our study was not as good. This study did not compare the 4AT with other brief cognitive assessments so may present more accurate diagnostic test accuracy of the tool as a stand-alone screening test for delirium. Other investigators have reported better performance of the 4AT; this assessment has been reported to have very high sensitivity (100%) and good specificity (82%) within the acute stroke unit setting **[120]**. This enhanced 4AT performance was found in a different clinical population to the one evaluated here, specifically patients recovering from stroke. Furthermore, this was in a

smaller patient sample (n=108) than our study and carried out within a much smaller time frame (10 weeks vs. 8 months), with multiple researchers carrying out index tests.

There is limited validation data published on the bCAM. It has been tested in an emergency department sample of 406 patients. Despite this tool being used within a different clinical context, researchers found similar test accuracy to our data with poor sensitivity and a missed delirium diagnosis in around 1 in 5 patients, but claimed excellent specificity of 97% **[91]**.

The results of this study are strengthened by a relatively large sample of consecutive patients across multiple acute care wards. Also, results are made more reliable by a blinded methodology with completely separate assessors carrying out index tests from reference standard diagnosis. Experienced elderly care physicians carried out the most up to date delirium diagnostic criteria (DSM 5) using a standardised assessment method, recorded for each individual patient. This reference standard mirrors recommended clinical practice.

I acknowledge the limitations of this study. The index tests were combined to form a short program of questions performed in a fixed order of testing. Individual screening assessments may perform differently if used in isolation and there is the risk of potential contamination of results between different screening questions. Our project was designed to describe clinical practice in a single site, an urban teaching hospital in an area of high socio-economic deprivation, with a high proportion of patients with underlying dementia. Results may not be generalisable to other health care contexts. Due to the allocation of single sex wards within the GAU, our evaluation included a low proportion of male participants.

Our data were gathered at a single point in time soon after admission and this may have artificially increased the diagnostic uncertainty of clinicians. In clinical practice patients are usually observed over a period, and this cumulative information ‘feeds in’ to determining whether or not delirium is present. Furthermore, while a small proportion of patients were identified as ‘too drowsy’ to be assessed for delirium, it may have been the case that these patients were ‘unassessable’ due to delirium. A revision to the DSM 5 delirium diagnostic criteria states that reduced level of consciousness is fundamental and

patients must not be excluded due to not being able to complete direct cognitive testing **[176]**.

I used ROC analyses to determine the optimal cut-points for the AMT-10 and AMT-4, due to the lack of existing research into optimal cut-points on these tests as screening tools for delirium. The approach may have exaggerated test performance compared to screening tests where a cut-point is already established (4AT, MOTYB).

There is a need for further validation of the briefest screening tools in this evaluation, the AMT 4 and MOTYB, in the context of delirium screening to ensure they are able to identify individuals with delirium in a high number of cases. Future research would be valuable in validating and refining the scoring system of the 4AT as well as optimal cut-points. Further validation of the evaluated index tests is essential across different clinical and geographical contexts is essential where-by differences in patient demographics may lead to different diagnostic test accuracy of the screening tools.

Future research may also wish to explore the issue of clinician uncertainty in diagnosing delirium. While it is not the norm, it may be more appropriate for clinicians to have the option to provide a “possible delirium” diagnosis, rather than being forced to assign a definite yes or no delirium label.

6.7 Conclusions

The most brief, simple assessments in this study, the AMT-4 and MOTYB, were found to have good sensitivity for underlying delirium in a population with a high prevalence of underlying dementia. The 4AT was found to have a slightly lower sensitivity, but higher specificity than these more simplified screening tools. The bCAM had poor sensitivity for definite delirium within this study, although it was highly specific; it seems less suited as a screening tool than the other assessments. Finally, systematic gathering of informant information such as using the SQiD was shown to have potential as a screening test, however further work is required on ways to more to effectively capture this information. Overall, the 4AT would be recommended for use within this particular setting showing to be the most feasible tool for the screening of delirium with good sensitivity and specificity.

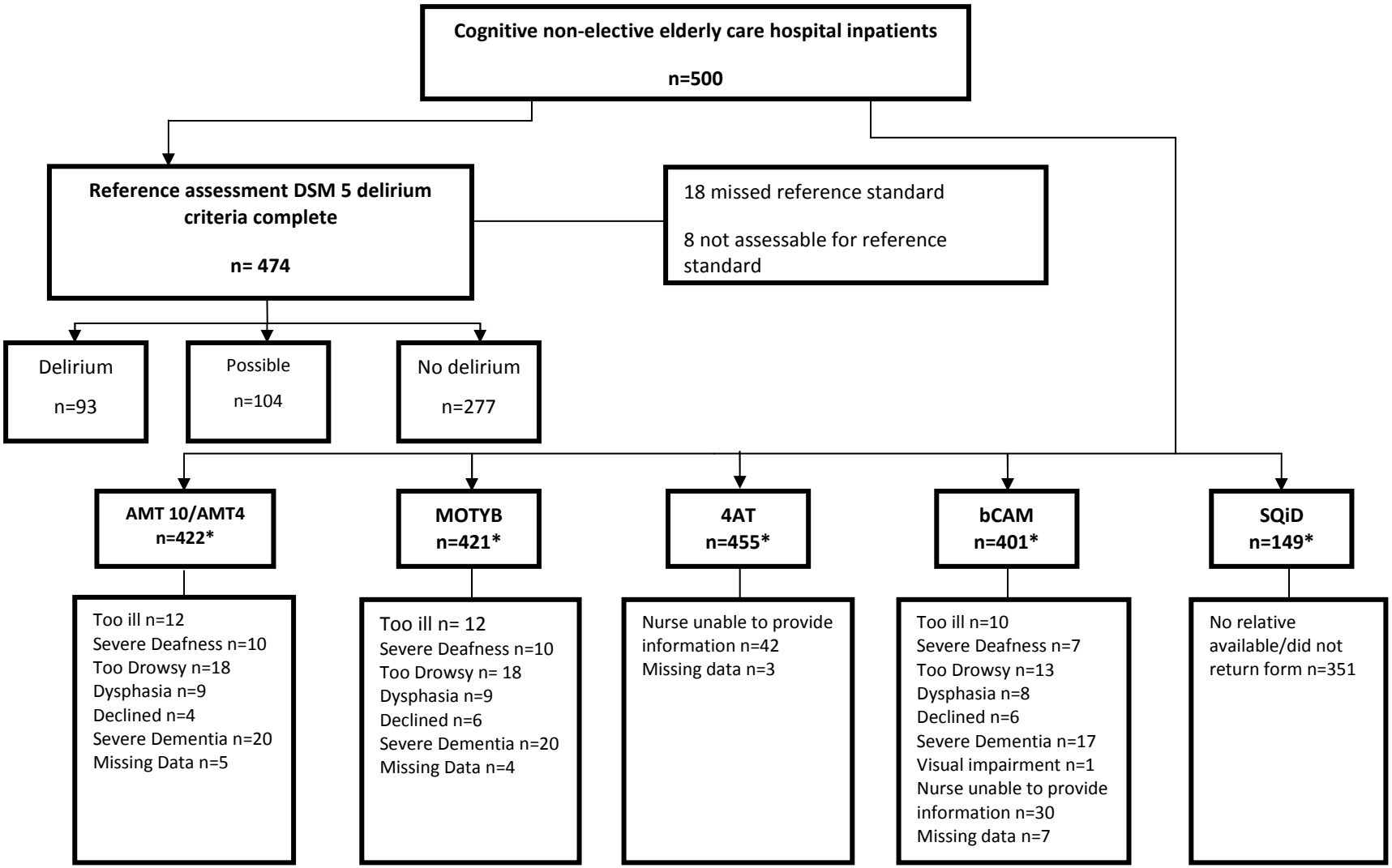

Cognitive non-elective elderly care hospital inpatients
n=500
Reference assessment DSM 5 delirium criteria complete
n= 474
18 missed reference standard
8 not assessable for reference standard
Delirium
n=93
Possible
n=104
No delirium
n=277
AMT 10/AMT4
n=422*
MOTYB
n=421*
4AT
n=455*
bCAM
n=401*
SQiD
n=149*
Too ill n=12
Severe Deafness n=10
Too Drowsy n=18
Dysphasia n=9
Declined n=4
Severe Dementia n=20
Missing Data n=5
Too ill n= 12
Severe Deafness n=10
Too Drowsy n= 18
Dysphasia n=9
Declined n=6
Severe Dementia n=20
Missing Data n=4
Nurse unable to provide information n=42
Missing data n=3
Too ill n=10
Severe Deafness n=7
Too Drowsy n=13
Dysphasia n=8
Declined n=6
Severe Dementia n=17
Visual impairment n=1
Nurse unable to provide information n=30
Missing data n=7
No relative available/did not return form n=351

Figure 7 Flowchart illustrating the number of patients who received the DSM 5 delirium reference standard as well as numbers who completed each index test and reasons for those who did not.

* The total number of patients who received each index test AND had a completed reference standard-

AMT 10/AMT 4= 408; MOTYB= 406; 4AT= 434; bCAM= 387; SQiD=141

Table 17 Summary of characteristics of patients by dementia diagnosis (DSM IV criteria).

	All patients (n= 500)†	**Patients with prior dementia (n= 150)**	**Patients with new dementia (n= 22)**	**Patients with possible dementia (n= 94)**	**Patients with no dementia (n= 208)**
Mean age (years)	83.1 (SD=6.7)	83.9 (SD=6.4)	84.8 (SD=6.5)	83.1 (SD=6.2)	82.6 (SD=7.1)
Male n (%)	67 (13)	19 (12.7)	2 (9.1)	15 (16.0)	27 (13.0)
Hearing impairment (%)	93 (18.6)	32 (21.3)	3 (13.6)	19 (20.2)	33 (15.9)
Sight impairment (%)	139 (27.8)	36 (24.0)	3 (13.6)	28 (29.8)	63 (30.3)
Alcohol dependence (%)	14 (2.8)	1 (0.7)	0 (0.0)	6 (6.4)	7 (3.4)
Main symptom at presentation;					
Confusion only (%)	102 (20.4)	39 (26.0)	4 (18.2)	24 (25.5)	30 (14.4)
Immobility only (%)	46 (9.2)	16 (10.7)	2 (9.1)	5 (5.3)	20 (9.6)
Falls only (%)	104 (20.8)	26 (17.3)	4 (18.2)	18 (19.1)	53 (25.5)
Combined confusion, mobility &/or immobility (%)	99 (19.8)	27 (18.0)	11(7.3)	22 (23.4)	31 (14.9)
Other (%)	149 (29.8)	42 (28.0)	1 (0.7)	25 (26.6)	74 (35.6)

Delirium diagnosis n (%)	93 (18.6)	30 (20.0)	5 (22.7)	41 (43.6)	17 (8.2)

Table 18 Mean scores split by delirium diagnosis with standard deviation in parenthesis (AMT 10, AMT 4, 4AT).

	Delirium (n=93)	Possible delirium (n=104)	No delirium (n=277)	No diagnosis (n=18)
AMT 10	3.4 (1.9)	4.7 (2.3)	6.5 (2.4)	5.4 (1.8)
AMT 4	1.8 (1.1)	2.6 (1.1)	3.3 (1.1)	3.0 (1.2)
MOTYB	1.5 (2.8)	3.3 (3.9)	6.7 (4.8)	4.7 (4.5)
4AT	6.5 (2.4)	4.6 (3.0)	2.0 (2.5)	4.5 (4.0)

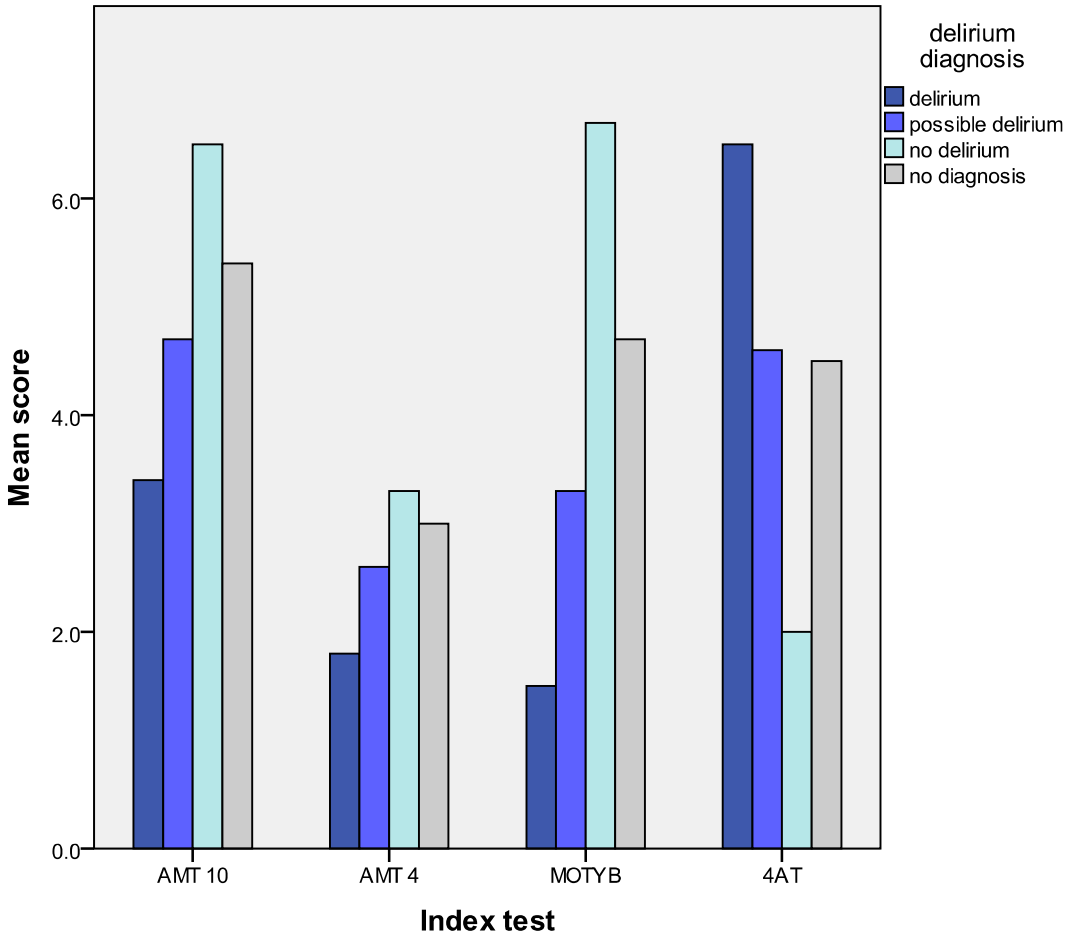


Figure 8 Mean scores (AMT 10, AMT 4, MOTYB, 4AT) split by delirium diagnosis.

Scoring: AMT 10, AMT 4 and MOTYB lower score equals greater impairment; 4AT higher score equals greater impairment.

Table 19 Mean scores split by dementia diagnosis with standard deviation in parenthesis (AMT 10, AMT 4, 4AT).

	New/Prior Dementia (n=172)	Possible dementia (n=94)	No dementia (n=208)	No diagnosis (n=18)
AMT 10	3.5 (2.2)	4.6 (2.0)	7.1 (2.0)	5.6 (1.9)
AMT 4	1.9 (1.2)	2.5 (1.1)	3.6 (0.8)	3.1 (1.2)
MOTYB	2.8 (3.7)	3.0 (3.9)	7.3 (4.7)	4.8 (4.5)
4AT	5.0 (2.9)	5.1 (3.0)	1.4 (2.2)	4.3 (4.1)

8 patients indicated as not to be assessed by senior clinician

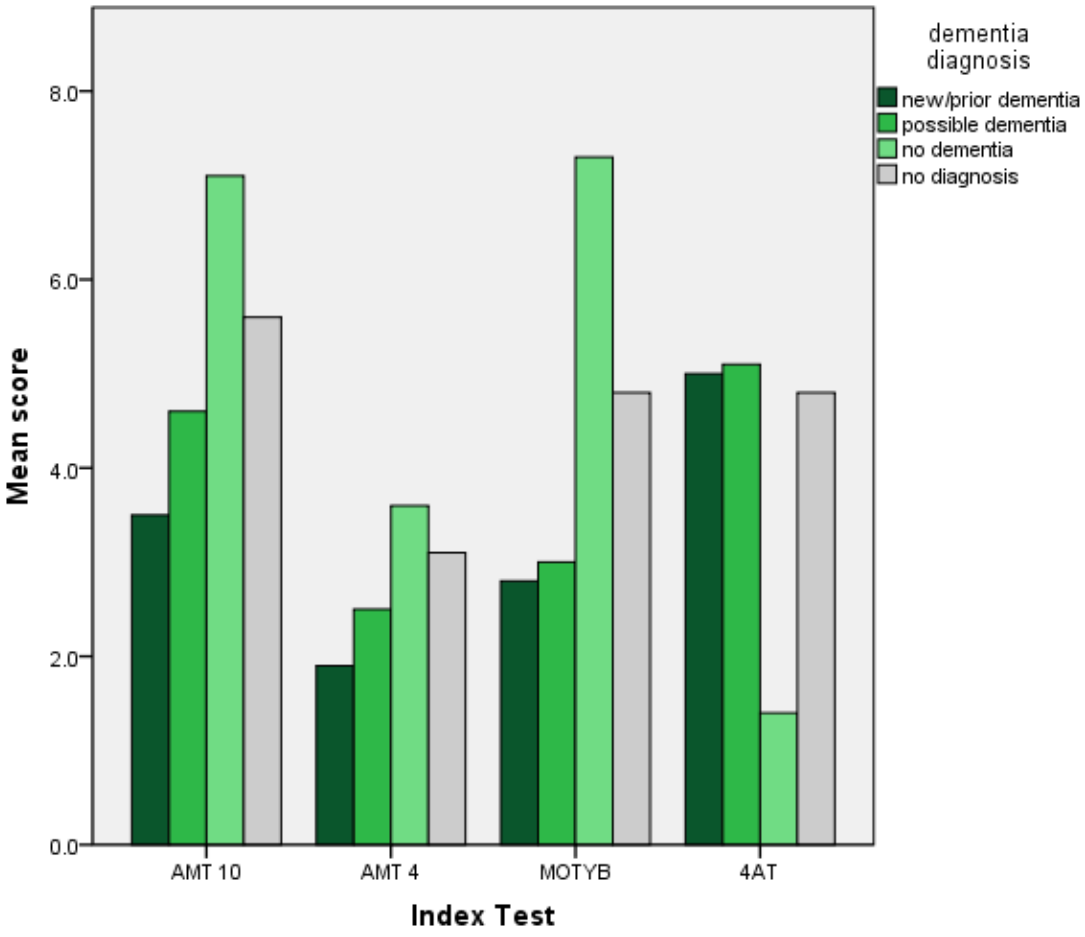


Figure 9 Mean scores (AMT 10, AMT 4, MOTYB, 4AT) split by dementia diagnosis.

Scoring: AMT 10, AMT 4 and MOTYB lower score equals greater impairment; 4AT higher score equals greater impairment.

Table 20 Diagnostic test accuracy for delirium of the AMT-10, AMT-4, 4AT, bCAM, MOTYB and SQiD in study cohort of 500 patients.

95% confidence intervals are presented in *italics*. Patients with **a definite delirium** diagnosis (n=93) classified as positive for delirium.

	Area under the curve (AUC)	**Sensitivity % (n)**	**Specificity % (n)**	**Positive Predictive Value % (n)**	**Negative Predictive Value % (n)**
AMT-10 (score ≤4/10) **n = 408**	0.80	86.6 (71/82) *77.3-93.1*	63.5 (207/326) *58.0-68.7*	37.4 (71/190) *30.5-44.7*	95.0 (207/218) *91.2-97.5*
AMT-4 (score ≤3/4) **n = 408**	0.80	92.7 (76/82) *84.8-97.3*	53.7 (175/326) *48.1-59.2*	33.5 (76/227) *27.4-40.0*	96.7 (175/181) *92.9-98.8*
4AT (score ≥4/12) **n = 434**	0.84	86.7 (72/83) *77.5-93.2*	69.5 (244/351) *64.4-74.3*	40.2 (72/179) *33.0-47.8*	95.7 (244/255) *92.4-97.8*
bCAM n = 387	0.81	70.3 (52/74) *58.5-80.3*	91.4 (287/314) *87.7-94.3*	65.8 (52/79) *54.3-76.1*	92.9 (287/309) *89.4-95.5*
MOTYB (score ≤5/12) **n = 406**	0.76	91.3 (73/80) *82.8-96.4*	49.7 (162/326) *44.1-55.3*	30.8 (73/237) *25.0-37.1*	95.9 (162/169) *91.7-98.3*
SQiD n = 141	0.77	91.4 (32/35) *76.9-98.2*	61.3 (65/106) *51.4-70.6*	43.8 (32/73) *32.2-56.0*	95.6 (65/68) *87.6-99.1*

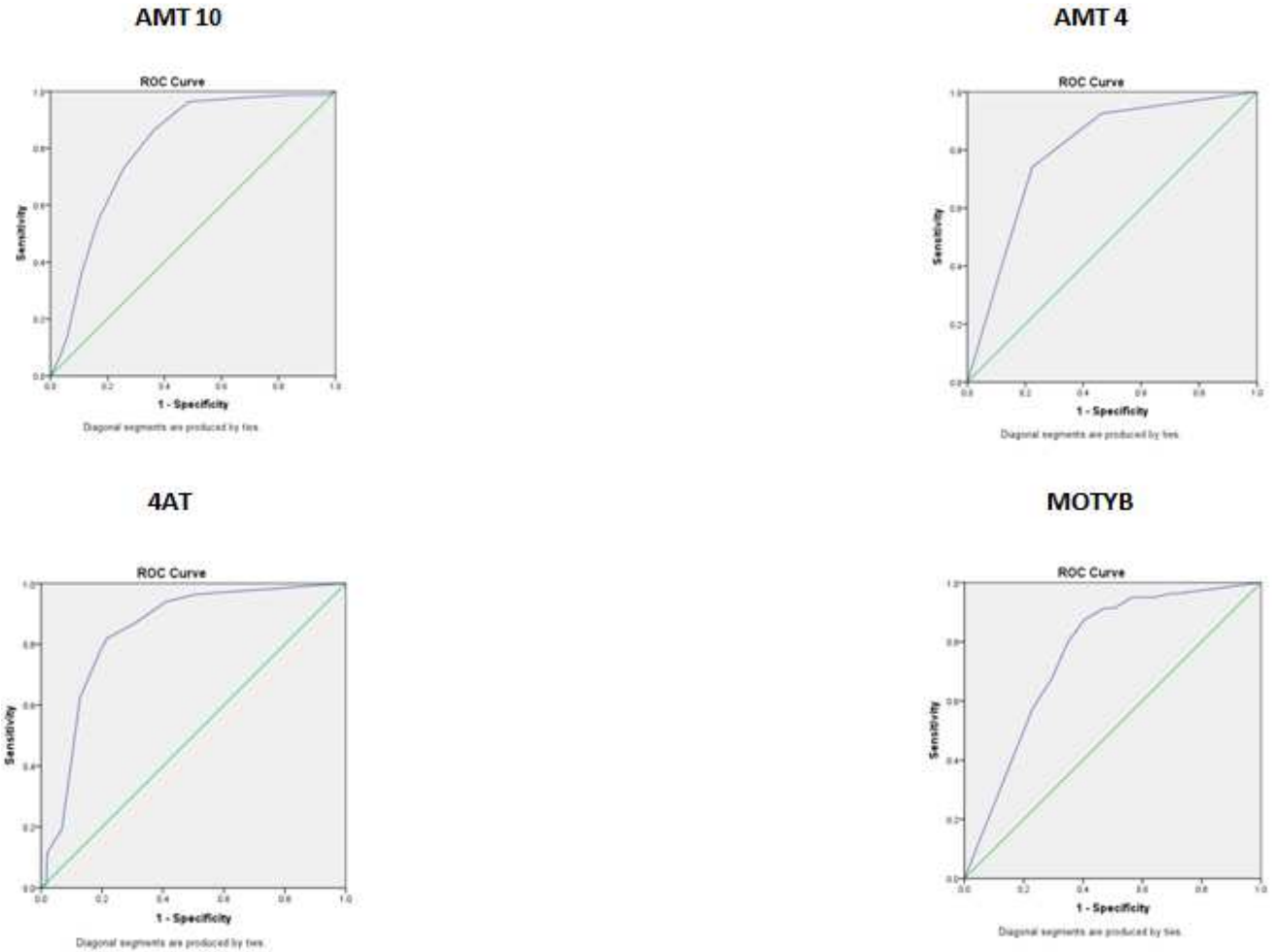


Figure 10 ROC curves showing index test performance for patients with definite delirium compared to all other patients.

Index tests illustrated are those which use a continuous scale- AMT 10, AMT 4, MOTYB and 4AT.

Table 21 Diagnostic test accuracy for delirium of the AMT-10, AMT-4, MOTYB, 4AT, bCAM, and SQiD in study cohort of 500 patients.

95% confidence intervals are presented in *italics*. Patients with a definite or possible delirium diagnosis (n=197) classified as positive for delirium.

	Area under the curve (AUC)	**Sensitivity % (n)**	**Specificity % (n)**	**Positive Predictive Value % (n)**	**Negative Predictive Value % (n)**
AMT-10 (score ≤4/10) **n = 408**	0.78	76.4 (123/161) *69.1-82.7*	72.9 (180/247) *66.9-78.3*	64.7 (123/190) *57.5-71.5*	82.6 (180/218) *76.9-87.4*
AMT-4 (score ≤3/4) **n = 408**	0.77	85.1 (137/161) 78.6-90.2	63.6 (157/247) *57.2-69.6*	60.4 (137/227) *53.7-66.8*	86.7 (157/181) *80.9-91.3*
4AT (score ≥4/12) **n = 439**	0.83	69.8 (118/169) *63.6-77.9*	76.7 (207/270) *71.8-82.1*	69.8 (118/169) *62.3-76.6*	81.2 (207/255) *75.8-85.8*
bCAM n = 387	0.70	45.6 (67/147) *37.4-54.0*	95.0 (228/240) *91.4-97.4*	84.8 (67/79) *75.0-92.0*	74.0 (228/308) *68.8-78.8*
MOTYB (score ≤5/12) **n = 406**	0.75	82.4 (131/159) *75.6-88.0*	61.5 (152/247) *55.2-67.6*	58.0 (131/226) *51.2-64.5*	84.4 (152/180) *78.3-89.4*
SQiD n=141	0.68	71.0 (49/69) *58.8-81.3*	66.7 (48/72) *54.6-77.3*	67.1 (49/73) *51.2-64.5*	70.6 (48/68) *78.3-89.4*

Table 22 4AT diagnostic test accuracy of individual items.

		N*	AUC	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Altered alertness		476	0.55	14.4 (13/90) 95% CI= 7.9-23.4	95.3 (368/386) 95% CI= 92.7-97.2	41.9 (13/31) 95% CI= 24.6-60.9	82.7 (368/445) 95% CI= 78.9-86.1
AMT 4	**1 incorrect**	477	0.74	93.4 (85/91) 95% CI= 86.2-97.5	45.1 (174/386) 95% CI= 40.0-50.2	28.6 (85/297) 95% CI= 23.6-34.1	96.7 (174/180) 95% CI= 92.9-98.8
	2 or more incorrect			78.0 (71/91) 95% CI=68.1-86.0	65.0 (251/386) 95% CI= 60.0-69.8	34.5 (71/206) 95% CI=28.0-41.4	92.62 (251/271) 95% CI= 88.8-95.4
MOTYB (<7)		476	0.63	94.4 (85/90) 95% CI= 87.5-98.2	39.6 (153/386) 95% CI= 34.7-44.7	26.7 (85/318) 95% CI= 22.0-32.0	96.8 (153/158) 95% CI= 92.8-99.0
Acute change/fluctuating course		436	0.80	82.9 (68/82) 95% CI= 73.0-90.3	77.1 (273/354) 95% CI= 72.4-8.4	45.6 (68/149) 95% CI= 37.5-54.0	95.1 (273/287) 95% CI= 92.0-97.3

*N represents number of patients this item of the 4AT was able to be completed in.

Table 23 Frequencies of 'don't know' responses for patients with 'possible delirium' (n=104). As assessed by clinicians on separate components of the DSM-V delirium criteria.

DSM V item	Altered attention	Altered awareness	Acute onset	Change from baseline	Fluctuation	Addition disturbance in cognition	Better explained by pre-existing disorder	Occurs during coma	Evidence of physiological cause
All patients	5/104 (4.8%)	11/104 (10.6%)	56/104 (53.8%)	65/104 (62.5%)	57/104 (54.8%)	13/104 (12.5%)	51/104 (49.0%)	3/104 (2.9%)	0/10 (0%)
Dementia new/prior	3/57 (5.3%)	4/57 (7.0%)	32/57 (56.1%)	38/57 (66.7%)	32/57 (56.1%)	2/52 (3.8%)	29/52 (55.8%)	1/52 (1.9%)	0/52 (0%)
Possible Dementia	1/41 (2.4%)	7/41 (17.1%)	22/41 (53.7%)	25/41 (61.0%)	24/41 (58.5%)	10/41 (24.4%)	22/41 (53.7%)	2/41 (4.9%)	0/41 (0%)
No Dementia	1/6 (16.7%)	0/6 (0%)	2/6 (33.3%)	2/6 (33.3%)	1/6 (16.7%)	1/6 (16.7%)	1/6 (16.7%)	0/6 (0%)	0/6 (0%)

Chapter 7: Discussion

7.1 General discussion

7.1.1 Current practice of assessment of cognitive impairment and delirium

Delirium can easily go undetected, especially in elderly individuals with a variety of physical and psychological issues. It is also a prevalent problem with a range of associated negative outcomes for the patient. In this thesis I have evaluated the current evidence base as well as clinical practice of screening for possible cognitive impairment and delirium, with a focus on older hospitalised patients in the acute care setting. Informed by these findings, an evaluation of delirium screening tools in acute care was carried out. I was particularly interested in determining how these screening tools would perform against a gold standard clinician diagnosis in a representative, consecutive patient cohort. This chapter will discuss the principle findings presented in this thesis in the context of existing clinical guidelines and literature as well how this body of work adds to our understanding of delirium assessment within acute care. Strengths and limitations of methodology will also be discussed as well as how implications of these findings can be expanded in future research.

The aims of this PhD thesis were;

i) To examine the performance of very brief screening tools in previously examined cohorts within acute care as well as other healthcare settings.
ii) To determine current practice of delirium and cognitive impairment screening locally and Scotland-wide within acute care.
iii) To examine the diagnostic test accuracy of delirium screening tools recommended for routine use within the acute care setting.
iv) To evaluate the feasibility of these delirium screening tools within the acute care setting.

The overall aim was to provide evidence that could inform current clinical practice of cognitive impairment screening. A summary of the projects explored in this thesis is presented in **Table 24**.

In chapters 2 and 3, I aimed to establish if very brief, single questions can reliably identify possible cognitive impairment across all healthcare settings. I did this by carrying out a systematic review of all single screening questions for cognitive impairment as well as secondary data analysis on a data set which employed 2 single screening questions in the acute care setting. I was also interested in establishing if there was further scope for research of single screening questions for cognitive impairment.

Chapter 2 adds to the existing literature a timely review in to single question screening for cognitive impairment including delirium. The systematic review revealed heterogeneity in the single questions used aimed at the screening of delirium, dementia and/or MCI, with a lack of validation for any specific question. Despite the lack of evidence, this systematic review was carried out at a time when a single screening question approach was being rolled out across England and Wales as part of a paid government initiative **[111]**. Furthermore, there is no evidence in the literature to suggest that the question used in this initiative is effective. Thus, a non-evidence-based approach to clinical practice is being used with no validation data to support it. It has been demonstrated that evidence-based practice is associated with higher quality of care and better outcomes for patients across healthcare settings, compared to methods based on tradition **[184]**.

In chapter 4 and 5, the focus was on current practice in Scotland in relation to screening for cognitive impairment. A service evaluation in a large general hospital as well as survey of lead clinicians within acute care wards across Scotland was undertaken. The nationwide survey revealed that a variety of tools for examining for cognitive impairment were used across the country, with evidence that locally developed tools for delirium were preferred in the East of Scotland and little was done to screen for delirium in the West. This lack of general consensus for screening of cognitive impairment across Scotland suggests a lack of evidence-based practice. Guidelines published by HIS **[88]** suggest that a 'local tool' should be used for the screening of delirium within the delirium

management pathway, with no further elaboration on the meaning of 'local tool'. This is recommended rather than suggesting tools which have a well-established base of evidence for the detection of possible delirium. These guidelines also recommend routine cognitive assessment although do not recommend one tool to do this but rather give examples of a range of possible tools.

The lack of uniform screening for cognitive impairment and delirium also limits future research abilities to compare and contrast across different acute care cohorts, with different scoring systems on different tests being difficult to compare. Thus, limiting our ability to fully evaluate screening test performance and how improvements to care of patients with delirium and dementia can be implemented.

It is important to carry out screening of delirium and not doing this or using clinician judgement alone may have severe consequences for patients. Results from the clinician survey suggesting that little was done to screen for delirium in the West of Scotland were further enforced by service evaluation results which showed that while initial, brief assessment of cognitive assessment was carried out relatively well using the AMT 4 **[180]**, there was no record of screening tools for delirium. This may suggest that there is a lack of awareness of the importance of delirium detection in this region.

In chapter 6 I wanted to further explore the outcomes of previous chapters which revealed that locally there was a problem in that not much was being done to screen for delirium. This is in spite of existing UK guidelines which recommend that all patients age 65 and over should be screened for delirium **[160]**. Due to the large number of delirium and cognitive impairment screening tools available, I decided to evaluate only those which were currently recommended for routine clinical use. The data I collected from 500 consecutive acute care in-patients revealed that the AMT 4 and 4AT are sensitive tools for the detection of possible delirium and are feasible for use within the acute care setting. MOTYB, executed as a component of two of the recommended tools, also stood out as showing promise for use as a standalone screen for delirium screening. Further investigation is needed to establish how best to capture informant response in a more feasible way, as the limited responses I was able to capture showed high sensitivity.

7.1.2 Clinical implications for delirium screening

Scottish and UK guidelines are in agreement that delirium is an important priority which should be routinely assessed in clinical practice. However, guidelines in the UK such as those published by HIS, the Scottish Delirium Association and NICE **[160]** appear vague or lack an evidence-based approach in their recommendations of delirium screening tools. This thesis provides an overview of clinical practice across Scotland and also provides clinical evaluation of screening tools for delirium which may better inform guidelines of which tools are feasible and sensitive in the screening of delirium.

The systematic review carried out in chapter 2 was motivated by a routine single screening question for cognitive impairment being rolled out nationally across England and Wales. I hypothesised that there would be a lack of strong, comparable evidence to support the use of a single screening question for acute and/or chronic cognitive impairment across healthcare settings. This hypothesis was supported by the review which found that there were few studies of single screening questions available with considerable heterogeneity. This review calls for validation of the CQUIN single question to assess if it is a suitable way to screen for cognitive impairment on a national basis, due to the lack of existing evidence to support this approach.

While it is not clear if the use of a single screening question for the first step in detection of possible cognitive impairment is ideal, the use of a uniform assessment method nationally has potential benefits. Chapter 4 revealed that there was no clear consensus on which tests to use to screen for cognitive impairment and delirium across Scottish acute care settings. Wide variation in cognitive assessment method use poses difficulties for description and comparison of these across diverse older patient cohorts. This lack of ability to compare patient assessments across different hospitals limits the ability of research to establish the true impact of delirium on long-term outcomes such as functional impairment, chronic cognitive impairment and mortality. The implementation of a Scotland or UK wide delirium and cognitive assessment pathway may offer benefits to both patients and clinicians. In chapter 6 I established that there are effective screening tools for delirium available which are brief, feasible and have high sensitivity in the acute care setting with patients over 65.

Results from the evaluation detailed in chapter 6 fed in to local West of Scotland guidelines for screening of delirium in acute care by providing recommendation accurate and feasible screening methods directly to a local clinical governance group, the Delirium Short Life Working group. However, a limitation of this investigation is that no follow-up was carried out to assess the outcome of these findings. The desired outcome would be that common assessment tool(s) were adopted across the West of Scotland and used routinely for the detection of possible delirium in acute care wards with all patients. Future evaluation of this may be of interest to establish if an evidence-based clinical practice approach was adopted.

The study described in chapter 6 reports the feasibility and test accuracy of a range of tools designed for the assessment of cognitive impairment and/or delirium. This was an evaluation of tools recommended for routine clinical use in Scotland. However, as already established, existing guidelines do not necessarily base recommendations on the best tools to use according to existing research. Thus, there may be more suitable validated screening tools available than those evaluated in chapter 6. A recent systematic review of delirium assessment in hospitalised patients revealed a range of screening tools which were not evaluated in this study **[185]** including the Nursing Delirium Screening Scale **[186]** and the Delirium Rating Scale **[187]** which both showed good sensitivity and specificity.

7.1.3 Suggestions for future research

The data presented in this thesis provide logical basis for further investigations within this research area including the utility of single question screening for both acute and chronic cognitive impairment. While it was revealed in chapter 2 that research in the area of single question cognitive screening is lacking, this does not discount the potential use of this very brief method of assessment and further research in representative patient cohorts would be highly beneficial.

In chapter 6 I provided diagnostic test accuracy data for the AMT and MOTYB which are tools not originally designed for the screening of delirium. Future research may be useful

to validate a cut-off point for the use of the AMT. Further validation of MOTYB in the acute care setting is also necessary.

For the patient assessment component of this thesis, I did attempt to be as inclusive as possible by selecting a consecutive cohort of older, acute in-patient. This cohort is suited to an evaluation of recommended routine delirium assessments. However, this sample may not be representative of all patients in acute hospital environments. Patients were recruited from a central Glasgow hospital; an area of lower socio-economic status compared to the rest of Scotland with half of Glaswegians living in 20% of Scotland's most deprived areas **[188]**. Lower socio-economic status has been found to be associated with higher incidence of dementia **[189]**. While the relationship between socio-economic status and delirium is unclear, dementia is a known risk factor of delirium. Audit data from an Australian hospital failed to reveal an association between delirium and socio-economic status **[190]**. However, it may be especially important to assess for cognitive impairment in areas with greater deprivation. Future research could further explore this relationship between socio-economic status and delirium, specifically in the UK.

It is essential that screening tools for delirium are also suitable for use with patients with dementia. In our cohort, a third of patients had dementia and over half of patients with dementia were diagnosed as having either definite or possible delirium. This highlights that dementia is very common in this population and increases the risk of a possible delirium. While I felt that it was out with the scope of this data, test accuracy of delirium assessment tools as a function of underlying dementia would be an area of interest for further exploration.

It is important to note that identification and implementation of effective delirium screening tools are different matters. Delirium education aimed at all clinicians responsible for older patients may be as essential as validation of the screening tools to be used. Research examining the use of educational interventions in relation to delirium has shown promising results. To investigate this, researchers carried out an audit before and after intervention implementing two 30 minute delirium ward-based education classes per month as well as one hour long departmental lessons. These educational sessions were based on information from the NICE delirium workshop session guide **[180]**.

Following intervention, 35% of patients received a delirium diagnosis using the Confusion Assessment Method (CAM) **[16]**. Prior to educational intervention to increase awareness of delirium, only 5.7% of patients received a delirium diagnosis. This has clinical implications for geographical areas identified as under-recognising delirium. National policy could allow for a standardised form of educational intervention to create a better awareness of the importance of delirium among clinicians. However, further research is needed to establish whether educational intervention provides a lasting or temporary effect on delirium detection.

Future research should focus on the evaluation of a full delirium assessment and treatment pathway, based on existing research, and evaluation this alongside usual practice. Validation of a standardised procedure for the screening and treatment of delirium in a large, representative older in-patient cohort would allow for implementation in to clinical practice. This would also require the use of a comprehensive training and education program for clinical staff.

7.2 Conclusions

The chapters in this thesis have investigated the use of delirium and cognitive impairment assessment tools, with particular interest in older acute hospital in-patients. It was highlighted that there was a lack of consensus in the screening tools being used, with a poor research base for ultra-brief cognitive screening tools and lack of evidence-based clinical practice being implemented in Scotland. I found a particular problem with little being done to formally screen for delirium within the West of Scotland.

While NICE acknowledge that clinical practice for the assessment of delirium and dementia should be informed by a combination of clinician expertise and research, currently this balance does not seem to have been achieved. Clinical practice should always reflect existing research evidence to improve patient care and outcomes by executing ‘tried and tested’ methods in high quality research. The study described in chapter 6 empirically evaluated cognitive assessments for the detection of possible delirium which could contribute to inform current guidelines.

Screening for delirium in older, unscheduled hospital admissions is a highly important area of research which may hold particular benefits for the long-term outcomes of these patients. Furthermore, screening may be considered the first step in any intervention of a given disorder. However, for screening to have any utility, a documented pathway is essential to illustrate the assessment, diagnosis and treatment of delirium based on existing evidence.

Table 24 Summary of the main findings presented in this thesis and how thesis aims were executed across the chapters.

Thesis aim	Studies (chapters)	Hypothesis	Outcomes
To examine the performance of very brief screening tools in previously examined cohorts within acute care as well as other healthcare settings.	Systematic review & secondary data analysis (2 & 3)	• The existing evidence base for very brief cognitive screening tools (single screening questions) would be limited. • Very brief cognitive screening tools (single screening questions) would show promise in the acute care setting.	• Only 5 studies utilising single screening questions for dementia/MCI/delirium identified by systematic review. • Secondary data analysis in acute care showed good sensitivity and specificity of a single screening question for dementia but lower sensitivity and specificity for a separate single screening question for delirium.
To determine current practice of delirium and cognitive impairment screening locally and Scotland-wide within acute care.	Service evaluation & clinician survey (4 & 5)	• Screening for cognitive impairment would be carried out routinely and the tools used would show variation through-out Scotland. • Screening tools specifically for delirium would be executed less well than screening for general cognitive impairment.	• Local service revealed screening for cognitive impairment was carried out relatively well using a recommended brief screening tool (AMT 4). • Local service evaluation and national survey revealed delirium screening was carried out less well, particularly in the West of Scotland. • There was heterogeneity in screening tools used for cognitive impairment and delirium across Scotland.

To examine the diagnostic test accuracy of delirium screening tools recommended for routine use within the acute care setting.	Delirium screening tool evaluation (6)	• Screening tools recommended for routine clinical use would show good diagnostic test accuracy for delirium within the acute care setting.	• Most of the screening tools evaluated showed good sensitivity. • The AMT 4, MOTYB and SQiD showed excellent sensitivity at the expense of specificity. • The bCAM did not appear to be suitable for use within the acute care setting, showing excellent specificity at the cost of sensitivity.
To evaluate the feasibility of these delirium screening tools within the acute care setting.	Delirium screening tool evaluation (6)	• The screening tools evaluated would be feasible for the screening of delirium within the acute care setting.	• The 4AT showed the best feasibility in this evaluation. • The AMT 4/10 and MOTYB also showed good feasibility with patients in acute care. • The SQiD was not found to be feasible in this evaluation, being returned by relatives in less than a third of patients.

MCI = Mild cognitive impairment, AMT=Abbreviated Mental Test, MOTYB=Months of the year backwards, SQiD=Single question in delirium, 4AT=4 A's Test

Appendices.

Appendix A. Search strategies

Cochrane DTA search terms
• (“informant* questionnaire*” adj3 (dement* or screening)).ti,ab • “informant questionnaire on cognitive decline in the elderly ”.ti,ab • (“screening test*” adj2 (dement* or alzheimer*)).ti,ab. • “inform* interview”.ti,ab. • “brief alzheimer* screen”.ti,ab. • “brief cognitive scale”.ti,ab. • “community screening interview for dementia”.ti,ab. • “cognitive abilities screening instrument”.ti,ab. • “cognitive assessment screening test”.ti,ab. • “cognitive capacity screening examination”.ti,ab. • “deterioration cognitive observee”.ti,ab. • “memory impairment screen”.ti,ab. • “quick cognitive screening test”.ti,ab. • “rapid dementia screening test”.ti,ab. • “short cognitive performance test”.ti,ab. • “short test of mental status”.ti,ab. • “dementia questionnaire”.ti,ab. • exp Dementia/ • Delirium, Dementia, Amnestic, Cognitive Disorders/ • dement*.ti,ab. • alzheimer*.ti,ab. • AD.ti,ab. • “cognit* impair*”.ti,ab. • (cognit* adj4 (disorder* or declin* or fail* or function*)).ti,ab • (memory adj3 (complain* or declin* or function*)).ti,ab. • Memory Disorders/di • exp “sensitivity and specificity”/ • sensitivit*.ab. • specificit*.ab. • (ROC or “receiver operat*”).ab. • Area under curve/ • (“Area under curve” or AUC).ab.
Web of Knowledge (edited compatible search strategy)
• (“ informant* questionnaire” (dement* or screening)) • ((“screening test*” (dement* or alzheimer*))) • “inform* interview” • “brief alzheimer* screen” • “brief cognitive scale” • “community screening interview for dementia” • “cognitive abilities screening instrument”

- "cognitive assessment screening test"
- "cognitive capacity screening examination"
- "deterioration cognitive observee"
- "memory impairment screen"
- "quick cognitive screening test"
- "rapid dementia screening test"
- "short cognitive performance test"
- "short test of mental status"
- "dementia questionnaire"

- exp Dementia/
- Delirium, Dementia, Amnestic, Cognitive Disorders/
- dement*
- alzheimer*
- AD
- "cognit* impair*"
- (cognit* (disorder* or declin* or fail* or function*))
- (memory (complain* or declin* or function*))
- Memory Disorders/

- exp "sensitivity and specificity"/
- sensitivit*
- specificit*
- (ROC or "receiver operat*")
- Area under curve/
- ("Area under curve" or AUC)

EBSCO search strategy (PsychInfo & CINAHL)

(("informant* questionnaire" (dement* screening)) ***use SmartText Searching***
(("screening test*" (dement* alzheimer*))) ***use SmartText Searching***
"inform* interview"
"brief alzheimer* screen"
"brief cognitive scale"
"community screening interview for dementia"
"cognitive abilities screening instrument"
"cognitive assessment screening test"
"cognitive capacity screening examination"
"deterioration cognitive observee" ***use Smart Text Searching***
"memory impairment screen"
"quick cognitive screening test"
"rapid dementia screening test"
"short cognitive performance test"
"short test of mental status"
"dementia questionnaire"

-AND-

DEMENTIA

exp Dementia/
Delirium, Dementia, Amnestic, Cognitive Disorders/

dement*
alzheimer*
AD
"cognit* impair*"
(cognit* (disorder* declin* fail* function*)) ***use SmartText Searching***
(memory (complain* declin* function*)) ***use SmartText Searching***
Memory Disorders/

DELIRIUM

Delirium
Acute Confusion*

MCI
MCI
"Mild cognitive impairment"
CIND
"Cognitive impairment no dementia"

-AND-

exp "sensitivity specificity"/ ***use Smart Text Searching***
sensitivit*
specificit*
(ROC "receiver operat*")
Area under curve/
("Area under curve" AUC)

-AND-

1 item
1 item screen
Single question screen
Single screening qu*
Single qu* detection
Single item screen
SQiD
Single qu* in delirium
Single item
Item analysis
Qu* analysis

Appendix B. Target journal articles.

Ayalon, L. (2011). The IQCODE versus a single-item informant measure to discriminate between cognitively intact individuals and individuals with dementia or cognitive impairment. *Journal of Geriatric Psychiatry & Neurology, 24*(3), 168-173.

Chong, M.S., Chin, J.J., Saw, S.M., Chan, S.P., Venketsasubramanian, N., Tan, L.C.S., et al. (2006). Screening for dementia in the older Chinese with a single question test on progressive forgetfulness. *International Journal of Geriatric Psychiatry, 21*, 442-448.

Ekerstrom, M., Skoogh, J., Rolstadh, S., et al. (2013). Sahlgrenska academy self-reported cognitive impairment questionnaire (SASCI-Q) – a research tool discriminating between subjectively cognitively impaired patients and healthy controls. *International Psychogeriatrics, 25*, 420-430.

Li, M., Ng, T.P., Kua, E.H., & Ko, S.M. (2006). Brief informant screening test for mild cognitive impairment and early Alzheimer's disease. *Dementia and Geriatric Cognitive Disorders, 25*, 392-402.

Sands, M.B., Dantoc, B.P., Hartshorn, A., Ryan, C.J., & Lujic, S. (2010). Single question in delirium (SQiD): testing its efficacy against psychiatrist interview, the Confusion Assessment Method and the Memorial Delirium Assessment Scale. *Palliative Medicine, 24*(6), 561-565.

Appendix C. Information for extraction to pro-forma.

A. Bibliographic information from paper
   - Author, paper title, journal title, year of publication, issue and page number(s).

B. Index test information
   - Index test question.
   - Who administered.
   - Respondent.
   - Response method e.g. dichotomised, likert scale.
   - Type of cognitive impairment assessed e.g. delirium, dementia, MCI.
   - Proportion screened positive and negative for cognitive impairment.

C. Reference standard
   - Reference standard used.
   - Who administered.
   - Type of cognitive impairment assessed e.g. delirium, dementia, MCI.
   - Proportion positive and negative for cognitive impairment.

D. Study population
   - Number of participants.
   - Age.
   - Gender.
   - Country study conducted in.
   - Setting e.g. primary care, secondary care, community.
   - Sampling type.
   - Time between index test and reference standard.

Appendix D. TIME delirium acute care bundle.

Initiate T,I & M within 2 hours *(include initials & time when complete)*		**Assessed/Seen**	**Results Seen**	**Abnormality found**
T	**Think, exclude and treat possible triggers**			
	NEWS (think Sepsis Six)			
	Blood Glucose			
	Medication History (new/changes/recently stopped)			
	Pain Review (Abbey Pain Scale)			
	Assess for urinary retention			
	Assess for Constipation			
I	**Investigate and intervene to correct underlying causes**			
	Assess hydration and start fluid balance chart			
	Bloods			
	Look for symptoms/signs of infection & perform appropriate cultures/imaging depending on clinical assessment			
	ECG			
M	**Management plan**			**Completed**
	Initiate treatment of all underlying causes found above			
E	**Engage & explore (within 2 hours or within 24 if family not present)**			
	Engage with family/carer- establish if this is normal behaviour. Ask; “how would you like to be involved?”			
	Explain diagnosis of delirium to patient/family or carers			
	Document diagnosis of delirium			

Appendix E. Data collection sheet used during service evaluation of older patient wards at Glasgow Royal Infirmary.

Age (yrs)	Sex (m/f)	Usual place of residence	Discharge destination	Date of admission	Date of discharge /death	Cognitive assessments (date)	Delirium (y/n/not stated)	Method of diagnosis (if recorded)	Other suggestion of poss. CI	Known dementia diagnosis (y/n)	Barriers to cognitive assessment

Key:

Usual place of residence

1) home 2)sheltered/supp accom 3) residential/nursing care 4) NHS LTC 5) other (specify)

Discharge destination

1) home 2)sheltered/supp accom 3) residential/nursing care 4) NHS LTC 5) death 6) other (specify)

Barriers to cognitive assessment

1) hearing imp. 2) sight imp. 3) dysphasia 4) unwilling 5) too drowsy/LOC 7) too unwell/dying 6) other (specify)

Appendix F. Clinician survey of usual clinical practice.

Survey of usual clinical practice

1. Please give the name and location of the hospital you are based in

2. Does your unit have set guidelines for the practice of screening for cognitive impairment in older hospital inpatients (≥ 65 years)? (please highlight)

Yes No

3. What tool(s) is/are primarily used for the screening of mild cognitive impairment and dementia in older hospital inpatients?

4. What tool(s) is/are primarily used for the assessment of delirium in older hospital inpatients? (if any)

5. How well do you think screening for cognitive impairment is carried out within your unit? (please highlight)

1 _____ 2 _____ 3 _____ 4_____ 5

Not at all well Extremely well

Thank you very much for your help. Please return to kirsty.hendry0@gmail.com

Appendix G. Caldicott Guardian Approval Form

Application for Caldicott Guardian Approval

NHS
Greater Glasgow and Clyde

NOTE: You must address the 6 Caldicott principles (Appendix A) when submitting this application.

1. Study / Project Title

The diagnostic accuracy of recommended delirium screening tools within geriatric medical in-patients

2. Please tick the type of study/project you are undertaking

Audit ☐ Research √☐ Service Improvement √☐ Other ☐
If other, please provide further details:

3. Who is providing clinical support for the study / project

Name: Prof David J Stott
Designation: Professor of Geriatric Medicine and Honorary NHS Consultant, Glasgow

Royal Infirmary

Email Address or Telephone Number: david.j.stott@glasgow.ac.uk;

4. Details of individual / organisation requesting data

Name: Prof David J Stott

Designation: Professor of Geriatric Medicine and Honorary NHS Consultant

Work/University Address:

Room 2.04, Floor 2, New Lister Building, Glasgow Royal Infirmary G31 2ER

Contact Number: tel 0141 201 8510

5. **Purpose for which data are to be used** (Principle 1)

Accurate recognition of delirium in older people in hospital is a current NHS priority.

Departments of Medicine for Older People in NHS GG&C aim to assess all patients for delirium, indeed cognitive assessment is an audit standard for external assessors such as OPAC.

We propose an evaluation of standard screening tests for cognitive impairment;

however given that there is variation in current practice the project will involve a clinical researcher (KH) applying these tests in a consistent and systematic manner.

The clinical diagnosis "gold standard" is recorded as part of routine clinical care and does not require additional testing.

It is currently unclear what clinicians should do as a first step in identification of delirium. This project will evaluate brief cognitive assessments (patient questionnaire comprising a total of 17 short items) that have been recommended for routine clinical practice; these items are included in the brief Confusion Assessment Method (bCAM), the 10-point Abbreviated Mental Test (AMT-10), 4'A'sTest (4AT) and the single question recommended in England and Wales as part of the Commissioning for Quality and Innovation (CQUIN) program (Have you been more forgetful in the last 12 months to the extent that it has significantly affected your daily life?). This information takes between 5 and 10 minutes to gather.

The following data will be recorded from the patient case record or informant interview (carer, relative or friend; or nurse) -

a) Has the patient's mental status changed from baseline?

b) Has the patient's mental status fluctuated since admission?

c) What is the patient's current mental status? (coded as per the Richmond Agitation Sedation Scale - RASS) (informant - nurse).

d) CQUIN question (informant – carer, relative or friend).

The feasibility within a non-elective elderly-care hospital in-patient cohort of gathering the component information for these assessment tools will be determined, and diagnostic accuracy of these tools (sensitivity, specificity, positive predictive values and negative predictive values) will be compared against a reference standard of experienced clinician (geriatrician and / or psychogeriatrician) evaluation based on the DSM 5 diagnostic criteria for delirium. The information gathered by KH for the index test scores will be shared with the clinician who carried out the reference standard clinical assessment of delirium once all assessments are complete. Therefore all information gathered will be used as part of the clinical process.

6. Which identifiable data items are required? Please detail why these are required. (Principles 2 and 3)

PID Required	√	**Justification**
CHI Number	No	
Forename	No	
Surname	No	

DOB	No	
Age	√	To allow basic description of population studied
Gender	√	To allow basic description of population studied
Address	No	
Post code (full)	No	
Post code (partial)	No	
Clinical data	√	1) Clinical records: Case notes documentation of acute confusion, fluctuation, prior dementia (also portal). Also may be obtained by nurse / carer

		or relative interview. 2) single question to relative / carer of forgetfulness as recommended for routine use in CQUIN England. 2) Patient assessment - recommended routine assessments to be performed by researcher (KH): AMT10, spell lunch backwards, give months of year backwards, 4 questions for disorganised thinking, single question to patient on cognitive decline in last 12 months (from CQUIN as above). 3) Expert clinician (geriatrician and / or psychogeriatrician) diagnosis of delirium and or dementia.
Other (please specify)	No	

7. Who will have access to this information? (Principle 4)

Internal: Kirsty Hendry, Prof D J Stott

External: No

8. Storage and use of personal data during the audit/project (Principle 5)

Will you be undertaking any of the following activities at any stage (including the identification of potential participants)? Please tick as appropriate.

√□ Access to Health Record (paper)

√□ Access to Health Record (electronic)

□ Sharing of identifiable data with other organisations (provide further detail below)

√□ Publication of data (if this could identify individuals provide further detail below)

□ Use of audio/visual recording devices

□ Storage of personal identifiable data on any of the following:

□ Manual files, including x-rays

□ NHS Computers

☐ Home or other personal computers

☐ University computer

☐ Private company computer

☐ Laptop computer (or any other mobile device)

☐ USB Flash Drive

Additional Information:

Non-identifiable information (age, gender, cognitive assessments, diagnoses of delirium and dementia) will be stored in a password protected file on a password protected university desktop computer, in a locked room (2.03 New Lister Building), backed up on the University secure server.

Paper record forms will be used to collate data prior to entry on the computer file. These will be kept in a locked cabinet in room 2.03 New Lister Building and destroyed (confidential waste) after data entry.

9. Destruction of Data

How long will the data be held? 10 years

How will the data be destroyed? Deletion from desktop computer and from University server.

10. Please provide your organisation's Data Protection Registration Number (if external to NHSGGC)

Not applicable

Note:

- Copies of any other relevant supporting documentation (e.g. ethics approval, patient information leaflet etc.) should be attached to this application
- Appendix A details the Caldicott Principles

Person responsible for the requested data

Name ……David J Stott……

Designation ……Professor of Geriatric Medicine and Honorary NHS Consultant, GRI…

Signature: …… ……..

Date:……13th March 2014……..

The release of data as described above is: **approved / not approved**

Caldicott Guardian ……..

Date ……

Caldicott principles

Principle 1 - **Justify the purpose(s)**
Every proposed use or transfer of patient-identifiable information within or from an organisation should be clearly defined and scrutinised, with continuing uses regularly reviewed, by an appropriate guardian.

Principle 2 - **Don't use patient-identifiable information unless it is absolutely necessary**
Patient-identifiable information items should not be used unless there is no alternative.

Principle 3 - **Use the minimum necessary patient-identifiable information**
Where use of patient-identifiable information is considered to be essential, each individual item of information should be justified with the aim of reducing identifiability.

Principle 4 - Access to patient-identifiable information should be on a strict need-to-know basis
Only those individuals who need access to patient-identifiable information should have access to it, and they should only have access to the information items that they need to see.

Principle 5 - **Everyone should be aware of their responsibilities**
Action should be taken to ensure that those handling patient-identifiable information - both clinical and non-clinical staff - are made fully aware of their responsibilities and obligations to respect patient confidentiality.

Principle 6 - **Understand and comply with the law**

Every use of patient-identifiable information must be lawful. Someone in each organisation should be responsible for ensuring that the organisation complies with legal requirements.

Caldicott Guardian for NHS Greater Glasgow & Clyde

Robin Wright

Director of Health, Information & Technology

Greater Glasgow & Clyde NHS Board

J B Russell House

Gartnavel Royal Hospital

Gt. Western Road

Glasgow

All queries in the first instance should be made to:

Isobel Brown, Information Governance Manager Tel 0141 211 1790 or Email: Isobel.brown@ggc.scot.nhs.uk

OR

Ann McClumpha on Tel: 0141 201 4611 or E-Mail: ann.mcclumpha@ggc.scot.nhs.uk

Appendix H. Caldicott Guardian Approval Email Correspondence

From: **Kirsty Hendry** [mailto:kirsty.hendry0@gmail.com]
Sent: 13 March 2014 12:41
To: Brown, Isobel
Subject: Caldicott Guardian Approval application

Dear Ms. Brown;

Please find attached our application for Caldicott Guardian Approval.

We are very grateful for your time and consideration.

Regards,

Kirsty

Brown, Isobel <Isobel.Brown@ggc.scot.nhs.uk> Thu, Mar 20, 2014 at 11:36 AM

To: Kirsty Hendry <kirsty.hendry0@gmail.com>
Cc: david.j.stott@glasgow.ac.uk, "McClumpha, Ann" <Ann.McClumpha@ggc.scot.nhs.uk>

Hi Kirsty

I have authorised this project on behalf of the Caldicott Guardian. If you require a signed copy of the form returned to you, please let me know.

Regards

Isobel

_____
_____

Isobel Brown |Information Governance Manager | NHS Greater Glasgow & Clyde |

Western Infirmary| Management Building | Dumbarton Road | Glasgow | G11 6NT |

T: 0141 211 1790 | E: isobel.brown@ggc.scot.nhs.uk | W: www.nhsggc.org.uk

O'Neill, Elaine <Elaine.O'Neill2@ggc.scot.nhs.uk> Mon, Mar 24, 2014 at 2:52 PM

To: Kirsty Hendry <kirsty.hendry0@gmail.com>

Hi Kirsty,

In regards to this newer study - Are you treating it as a 'service evaluation'? or is it 'research'?

Having Caldicott Guardian approval doesn't mean that you don't require Ethics and R&D approval, this is decided upon whether the study is 'research' or not.

Kind Regards

Elaine O'Neill

Research Co-ordinator's Asst

NHS Greater Glasgow & Clyde

Research & Development

Western Infirmary

1st Floor, Tennent Building

38 Church Street

Glasgow

G11 6NT

tel: 0141 232 9448

int: 59448

Web: www.nhsggc.org.uk/r&d

David Stott <David.J.Stott@glasgow.ac.uk> Mon, Mar 31, 2014 at 1:49 PM

To: "Elaine.O'Neill2@ggc.scot.nhs.uk" <Elaine.O'Neill2@ggc.scot.nhs.uk>
Cc: "kirsty.hendry0@gmail.com" <kirsty.hendry0@gmail.com>

Hi Elaine,

The primary purpose of Kirsty's study is service evaluation, examining a package of current cognitive assessments recommended for routine use in older people in acute care with the aim of refining our process of assessment in NHS GG&C. However there is a research element to this work, as such a service evaluation is novel and the results will be of relevance not just within our organisation but also out-with GG&C.

The general view of all the NHS clinicians included in this service evaluation is that this project comprises of systematic gathering and appraisal of routine health data and that Caldicott approval would be sufficient (and that ethics approval would not be required), however we would be grateful of you could provide a view from R&D on whether any further approvals will be required before we start. Given that there is a research element to this project we anticipate that Kirsty's research passport will need to be updated to include this project.

I have attached the approved Caldicott application.

I look forwards to hearing your views.

Many thanks

Yours sincerely

David

O'Neill, Elaine <Elaine.O'Neill2@ggc.scot.nhs.uk> Mon, Mar 31, 2014 at 2:43 PM

To: Kirsty Hendry <kirsty.hendry0@gmail.com>

Hi Kirsty,

Erica Packard has followed up with Prof Stott this afternoon and they have agreed that it won't be considered "Research" but will be processed as "Service Evaluation" which means you don't require R&D approval, this also means it shouldn't be added to your Research Passport.

Kind Regards

Elaine O'Neill

Research Co-ordinator's Asst

NHS Greater Glasgow & Clyde

Research & Development

Western Infirmary

1st Floor, Tennent Building

38 Church Street

Glasgow

G11 6NT

tel: 0141 232 9448

int: 59448

Web: www.nhsggc.org.uk/r&d

Appendix I. The Abbreviated Mental Test

Questions	**Score** (0 or 1)
1. What is your age?	
2. What is the time to the nearest hour?	
3. Give the patient an address and ask him/her to repeat at end of test. E.g. 42 West Street	
4. What is the year	
5. What is the name of the hospital?	
6. Can the patient recognise two people? e.g. nurse/doctor	
7. What is your date of birth?	
8. In what year did WWI begin?	
9. Who is the present prime minister?	
10. Count backwards from 20 to 1 (no errors)	

* AMT 4 uses only items 1, 4, 5 & 7

Appendix J. The 4 A's Test

[1] ALERTNESS

This includes patients who may be markedly drowsy (eg. difficult to rouse and/or obviously sleepy during assessment) or agitated/hyperactive. Observe the patient. If asleep, attempt to wake with speech or gentle touch on shoulder. Ask the patient to state their name and address to assist rating.

	Normal (fully alert, but not agitated, throughout assessment)	**0**
	Mild sleepiness for <10 seconds after waking, then normal	**0**
	Clearly abnormal	**4**

[2] AMT4

Age, date of birth, place (name of the hospital or building), current year.

	No mistakes	**0**
	1 mistake	**1**
	2 or more mistakes/untestable	**2**

[3] ATTENTION

Ask the patient: "Please tell me the months of the year in backwards order, starting at December."
To assist initial understanding one prompt of "what is the month before December?" is permitted.

Months of the year backwards	Achieves 7 months or more correctly	**0**
	Starts but scores <7 months / refuses to start	**1**
	Untestable (cannot start because unwell, drowsy, inattentive)	**2**

[4] ACUTE CHANGE OR FLUCTUATING COURSE

Evidence of significant change or fluctuation in: alertness, cognition, other mental function (eg. paranoia, hallucinations) arising over the last 2 weeks and still evident in last 24hrs

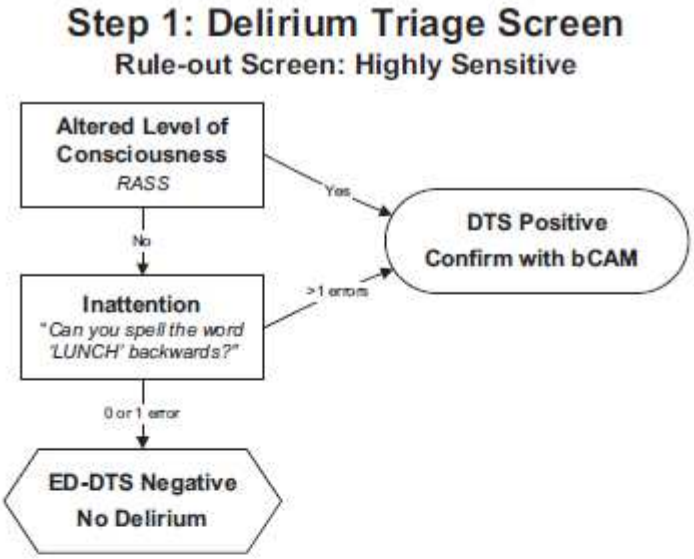
	No	**0**
	Yes	**4**

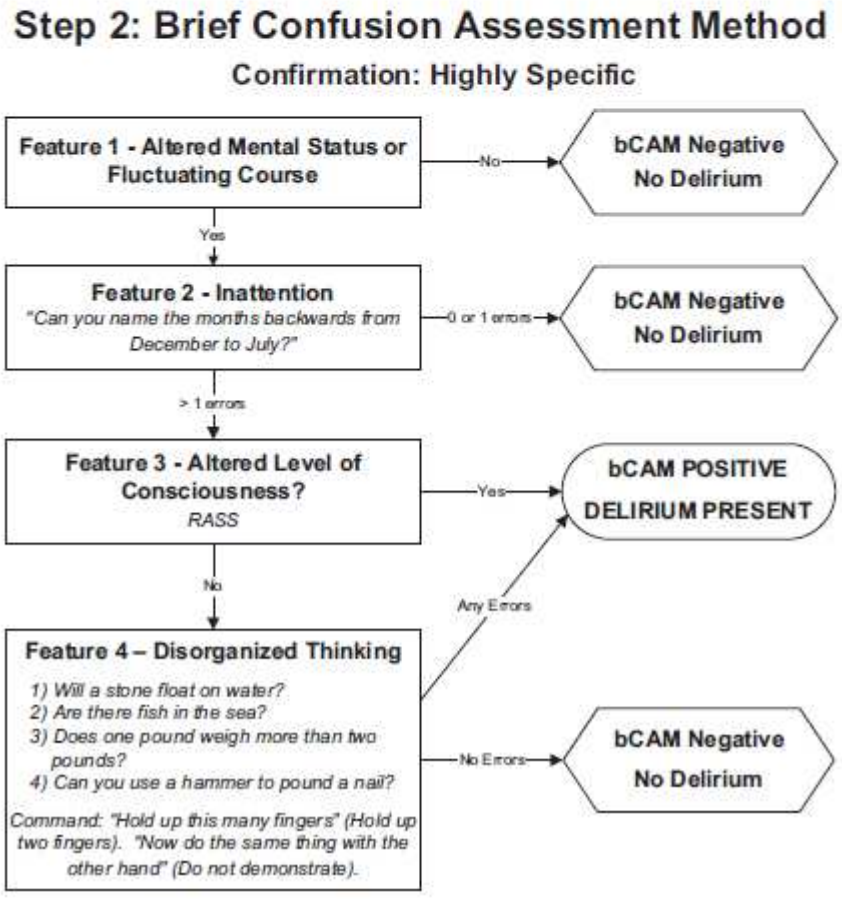
---

4 or above: possible delirium +/- cognitive impairment
1-3: possible cognitive impairment
0: delirium or severe cognitive impairment unlikely (but delirium still possible if [4] information incomplete)

4AT SCORE ☐

Appendix K. The brief Confusion Assessment Method





Appendix L. Operationalised DSM 5 delirium diagnostic criteria used in this evaluation.

DSM-V Delirium criteria / exclusions

a) *A disturbance in;*

i) Attention- reduced ability to direct, focus, sustain, and shift attention **yes / no / don't know**

ii) Awareness (reduced orientation to the environment) **yes / no / don't know**

b) *The disturbance;*

i) Develops over a short period of time (usually hours to a few days) **yes / no / don't know**

ii) Represents a change from baseline attention & awareness **yes / no / don't know**

iii) Tends to fluctuate in severity during the course of the day **yes / no / don't know**

c) An additional disturbance in cognition (e.g. memory deficit, disorientation, language, visuospatial ability, or perception). **yes / no / don't know**

d) *Exclusions- The disturbance in criteria A and C are;*

i) Better explained by another pre-existing, established, or evolving neurocognitive disorder **yes / no / don't know**

ii) Occur in the context of a severely reduced level of arousal such as coma. **yes / no / don't know**

e) There is evidence from the history, physical examination or laboratory findings that the disturbance is a direct physiological consequence of another medical condition, substance intoxication or withdrawal (i.e. due to a drug of abuse or to a medication), or exposure to a toxin, or is due to multiple etiologies. **yes / no**

INITIAL DIAGNOSIS: Delirium - all items a, b, c and e 'yes', plus d 'no' ☐

No delirium - if any 'no' in a,b,c,or e or yes in d ☐

Possible delirium - if any 'don't know' in a-d or 'no' in e. ☐

Appendix M. Operationalised DSM IV dementia diagnostic criteria used in this evaluation.

DSM-IV Dementia criteria / exclusions

If prior diagnosis of dementia, please go to the diagnosis section below.

a) Memory impairment **yes / no / don't know**

b) At least one of the following; **yes / no / don't know**

Aphasia ☐ Apraxia ☐ Agnosia ☐
Disturbances in executive functioning ☐

c) The cognitive impairments must be severe enough to cause impairment in social and occupational functioning. **yes / no / don't know**

d) The decline must represent a decline from a previously higher level of functioning. **yes / no / don't know**

e) Exclusion - The cognitive deficits occur exclusively during the course of a delirium.

yes / no / don't know

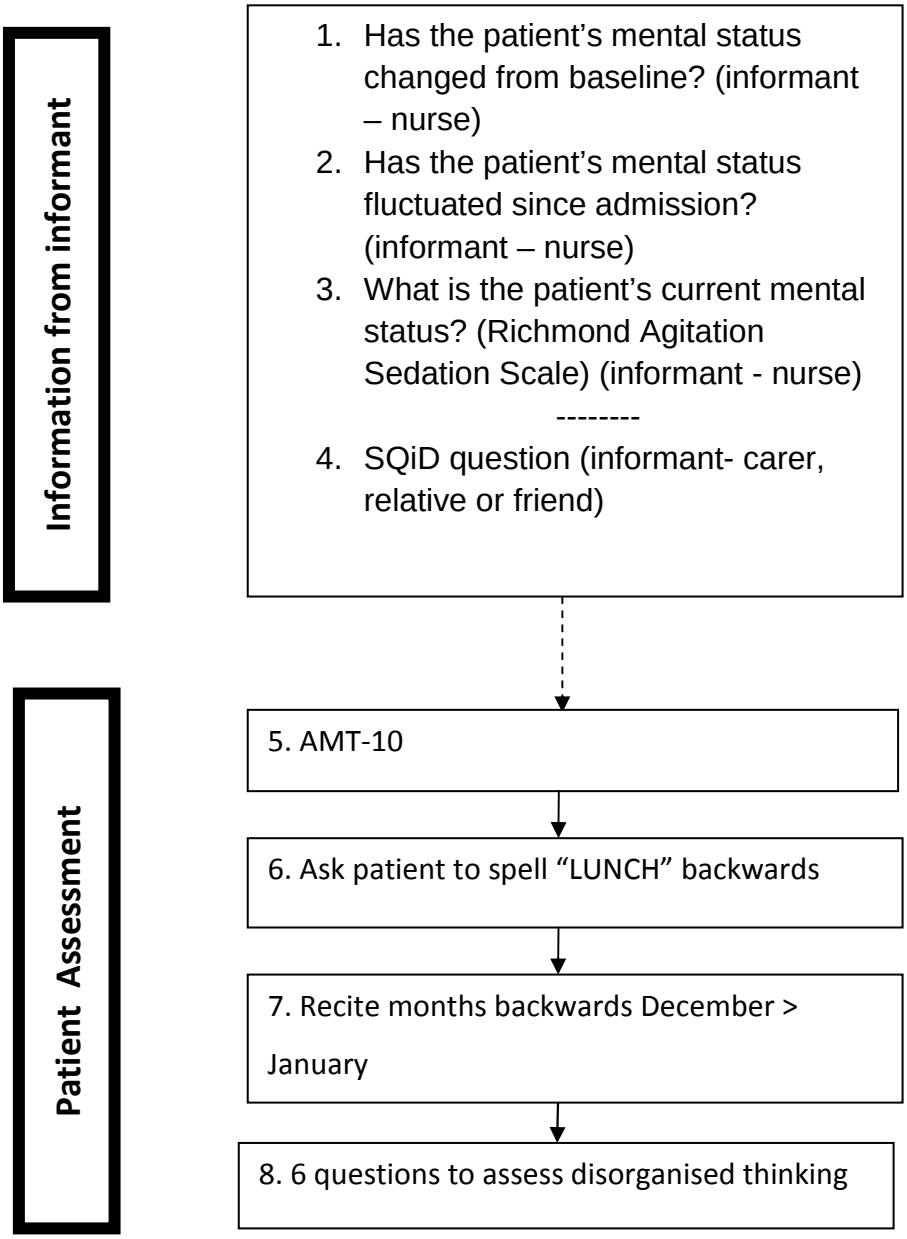
INITIAL DIAGNOSIS:

Dementia- prior diagnosis ☐ Dementia- a-d all 'yes' plus e 'no' ☐

Possible Dementia- if any 'don't know' plus other responses all consistent with dementia as above ☐

No Dementia- if any a-d 'no' or e 'yes' ☐

Appendix N. Screening test procedure split by informant and patient-based information.



Appendix O. Relative/Carer single delirium screening data collection sheet.

Relative/Friend/Carer Questionnaire
Memory or confusion problems in older in-patients.

- Problems with memory/confusion are very common in older people. Information from relative/friends or carers plays an important role in identifying such cognitive problems. We are evaluating ways of systematically gathering this information.

- It would be very helpful if you could answer the following 2 questions. If you feel a different individual is better placed to answer these questions, please inform the ward nursing staff.

Patient ID: **Ward:** **Date:**

Relationship to patient:_____

1. Has your relative/friend been more forgetful in the past 12 months, to the extent that it has significantly affected their daily life? *(please circle your response)*

   YES **NO** **DON'T KNOW**

2. Do you think your relative/friend has been more confused lately? *(please circle your response)*

   YES **NO** **DON'T KNOW**

Please leave the completed questionnaire with the ward nursing staff
-Thank you very much for your time-

Prof. David J Stott, Dr. Pam Fraser, Dr. Anne-Louise Cunnington, Dr. Jennifer Burns, Dr. Terry Quinn, Dr. Hazel Miller, Dr. Craig Harrow

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