

***Implementing the 4 'A's Test:
Detecting delirium in acutely admitted older adults in a
London Teaching Hospital***

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Abstract

Delirium is prevalent amongst older patients admitted to hospital. It is not well recognised, contributing to poor patient outcomes. Quick and effective routine delirium screening is needed. The 4 A's Test (4AT) is a short tool that was recently developed to increase rates of detection of delirium and cognitive impairment in acute general hospitals. The aim of this study is to assess the effectiveness of this tool in older adults admitted to King's College Hospital (KCH) and to analyse patient factors associated with a higher 4AT score. The study sample (n=167) included acute admissions ≥ 75 y discharged from KCH in June 2013. The study found that 84% of eligible patients received 4AT screening. 29% of patients scored 4-12 (suspected delirium), 23% scored 1-3 (suspected cognitive impairment) and the remaining 48% scored 0 (no cognitive impairment) on admission. A strong correlation between the 4AT and the clinical picture ($p < 0.001$) was found, supporting the accuracy of the 4AT as a delirium screening tool. Findings suggest that being female ($p = 0.002$) and living in a care home ($p = 0.002$) were independently associated with higher rates of cognitive impairment on admission into hospital. It was not associated with a patient's age ($p = 0.673$).

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1. Introduction

1.1. Background

Delirium is a complex clinical syndrome characterised by disturbed consciousness, a change in cognition or in perception that develops over a short period of time and typically follows a fluctuant course (DSM-IV-TR, 2010). The most common complication in hospitalised older people, delirium is thought to occur in up to 50% of older patients postoperatively, more in patients admitted to intensive care, and between 11-42% of all hospital in-patients (Siddiqi *et al.*, 2006).

Multiple adverse outcomes of delirium have been identified, including an increased risk of cognitive decline and acceleration of dementia, and an increased risk of mortality, with a review by Khan *et al.* (2012) finding a mortality rate of 38% in delirious elderly patients (>65) compared to 27.5% in non-delirious controls, an association that persisted independent of pre-existing dementia. In addition, the aforementioned review authors also found that patients with delirium were at a higher risk of institutionalisation and dementia compared to controls, while patients with a diagnosis of delirium superimposed on dementia were worst off, with the incidence of 30-day rehospitalisation and admission to long term care higher than patients with either condition alone.

Despite the significant prevalence of delirium amongst patients in a variety of hospital units and the adverse potential outcomes of this condition, delirium detection rates remain low. For example, a study by Collins *et al.* (2012) of 720 acute elderly medical admissions found that the clinical teams did not pick up 72% of 110 delirium cases. While low detection rates may suggest inadequate training and expertise amongst clinical teams, they also reflect the absence of an appropriate system for detecting delirium in medical admissions, especially amongst geriatric populations.

Part of the problem lies in how best to screen for delirium. The wide spectrum of detection tools available, including the Confusion Assessment Method (CAM) (Inouye *et al.*, 1990), Nursing Delirium Screening Scale (Gaudreau *et al.*, 2005), Memorial Delirium Assessment Scale (Kazmierski *et al.*, 2008) and others, is thought to reflect the clinical heterogeneity of the condition coupled with the varied skills of those assessing patients for delirium. While some patients with delirium may be detected and subsequently diagnosed as having delirium through observed behaviours, others are detected only after a comprehensive cognitive assessment involving greater expertise (MacLulich *et al.*, 2013).

A good screening programme requires a suitable test or examination that is accurate, economically viable and acceptable to the population (Wilson and Jungner, 1968). A review of 11 delirium scales showed that the CAM had the most evidence supporting its use as a bedside tool with a sensitivity of at least 86% and a specificity of 93% (Wong *et al.*, 2010). However, rapid transfer of patients and busy clinical settings make proper delirium diagnosis and documentation challenging and the average 10 minutes required to administer CAM makes it an unlikely first-line detection tool.

In response to the need for a suitable delirium screening tool, the 4 A's Test (4AT, 2011) was developed to increase rates of detection of delirium and cognitive impairment in acute general hospital settings. The test is designed to be used by any health professional at first contact with the patient, and at other times when delirium is suspected. It is brief (<2 min), requires no special training, takes into account the assessment of severely agitated or drowsy patients and incorporates general cognitive screening. There are 4 categories: 1) Alertness 2) AMT4 3) Attention 4) Acute change or fluctuating course. Validation data of the 4AT is not currently available although a recent study by Lees *et al.* (2013) suggests its superior accuracy as a short screening tool for delirium and cognitive impairment.

Recognizing the unmet need of delirium in medical care, NICE published delirium guidelines in 2010 to offer best practice advice on the prevention of delirium in adults in hospital or long-term care who are at risk of delirium and subsequent management of patients who develop the condition. Highlighted risk factors for delirium include patients 65 years and older, severe illness, current hip fracture or patients with dementia and/or cognitive impairment (NICE, 2010).

Dementia is thought to be an underlying condition in up to 50% of delirium in elderly patients and is known to be a potent predisposing factor for the development of delirium (Hall *et al.*, 2012). Thus, improving delirium detection rates in older patients admitted to hospital and providing prompt treatment may have a positive impact on the deliverance of dementia services in view of their close association. The disease burden of dementia is a significant challenge for the NHS, with an estimated 25% of acute beds occupied by people with dementia, rising to 40% or even higher in elderly care wards. It is thought that only 42% of the estimated 670 000 people with dementia in England have a formal diagnosis, sacrificing the improvement in quality of life that a timely diagnosis can bring through preventing crises and offering support to carers (CQUIN for Dementia, 2012).

Reflecting the need to tackle this shortfall in dementia diagnosis, the CQUIN for Dementia was introduced for use in 2012 to “incentivise the identification of patients with dementia and other causes of cognitive impairment... and to prompt appropriate referral and follow up”. Under the Dementia CQUIN payment framework, hospital trusts can receive up to three stages of payment. The first payment is made if at least 90% of all acute admissions aged 75 and over are asked a dementia case finding question¹ and screened for dementia and delirium. The next payment is made if 90% of the patients who have been assessed as ‘at-risk’ of dementia from the case finding question and delirium screen undergo diagnostic assessment and investigation and the final payment is made if 90% of patients who have a positive diagnosis are referred for specialist assessment and follow-up.

¹ Have you/ has the patient been more forgetful in the past 12 months to the extent that it has significantly affected you/their daily life?

1.2. Study Aims and Objectives

In line with the Dementia CQUIN framework, King's Health Partners introduced the 4AT in 2013 as a screening tool for delirium and cognitive impairment. This study is an analysis of the implementation of this test at King's College Hospital and consequently aims to answer the following questions:

1. Are 90% of acute older admissions at KCH getting cognitive screening to meet the CQUIN targets?
2. Do the 4AT scores for delirium correspond to the clinical picture?
3. Are there patient characteristics (length of stay, age, gender, residential status, package of care, dementia diagnosis) that correlate with the 4AT score?

The objectives of the study are as follows:

1. To ensure that the 4AT is being administered to all eligible patients and appropriate documentation is made
2. To ensure that the 4AT scores is appropriately administered and corresponds well to the clinical picture described in the clinical records
3. To assess and identify trends in the social and medical demographics of patients screened with the 4AT

2. Method

2.1. Study Sample

All emergency admission patients aged over 75 who were discharged from King's College Hospital in June 2013, including those with a diagnosis of dementia, were included in this study. Patients with a length of stay less than 72 hours, transfers and patients receiving palliative care were excluded. A total of 167 patients were eligible for screening under these criteria. The list of in-patients who were eligible for cognitive screening each day by a member of the King's Older People's Assessment and Liaison (KOPAL) service was generated electronically.

2.2. Data Collection

The compiled list of eligible older acute admissions discharged in June 2013 was obtained from the King's Business Intelligence Unit. This contained a hospital number, date of birth, 4AT score, and dates of admission and discharge. Electronic case-notes were reviewed to obtain clinical details and demographic, health and social data (Table 1). Patient data was anonymised for confidentiality.

Table 1: Categories for collection of demographic, health and social patient characteristics

No.	Patient Characteristic	Categories
1.	Age	<i>Continuous data</i>
2.	Gender	<ul style="list-style-type: none"> • Male • Female
3.	Length of Stay	<i>Continuous data</i>
4.	Established Dementia Diagnosis	<ul style="list-style-type: none"> • Dementia • No Dementia
5.	Residential Status	<ul style="list-style-type: none"> • Own Home • Sheltered Accommodation • Care Home
6.	Package of Care	<ul style="list-style-type: none"> • No formal package of care (POC) or <1x/day POC • 1x /Day POC (ODS) • 2x /Day POC (BDS) • 3x /Day POC (TDS) • 4x /Day POC (QDS) • Care Home

2.3. Data Analysis

The data was analysed with SPSS v.21 using relevant means and correlation analyses.

2.3.1. Grouping of 4AT Scores

Patients' 4AT scores were divided into 3 groups:

Raw Score	Indicates
0	No Cognitive Impairment
1-3	Suspected Cognitive Impairment
4-12	Suspected Delirium

Table 2: Grouping of 4AT scores

According to guidance notes in the 4AT, a score of 4 or more “*suggests delirium but is not diagnostic: more detailed assessment of mental status may be required to reach a diagnosis*”. A score of 1-3 “*suggests cognitive impairment and more detailed cognitive testing and informant history-taking are required*”.

2.3.2. Clinical Picture Analysis

The patients' clinical picture was assessed through a retrospective analysis of electronic case-notes by one investigator, who scored patients against each of the four DSM-IV delirium criteria:

- Disturbance of consciousness
- Change in cognition that cannot be better accounted for by dementia
- Disturbance develops over a short period of time, usually hours to days and tends to fluctuate during the course of the day
- Evidence from the history, physical examination, or laboratory tests that the delirium is a direct physiological consequence of a general medical condition, Substance Intoxication or Withdrawal, use of a medication, or toxin exposure, or a combination of these factors.

A score of 0 was given for an unlikely symptom, 1 for a possible symptom and 2 for probable symptom, with a maximum score of 8. This approach has limitations in its sensitivity: in cases where there was an absence of information regarding the criteria, the default score was 0.

3. Results

3.1. Screening of Patients with 4AT

Cognitive screening was performed on 89% (n=149) of patients, with 84% of all patients receiving the 4AT test (Figure 1). The 4AT was not administered to 8 patients who were screened, with reasons listed in Table 3. 11% of patients did not receive screening. The reasons for patients not being screened are currently not well understood, although it is known that one patient was discharged before screening took place.

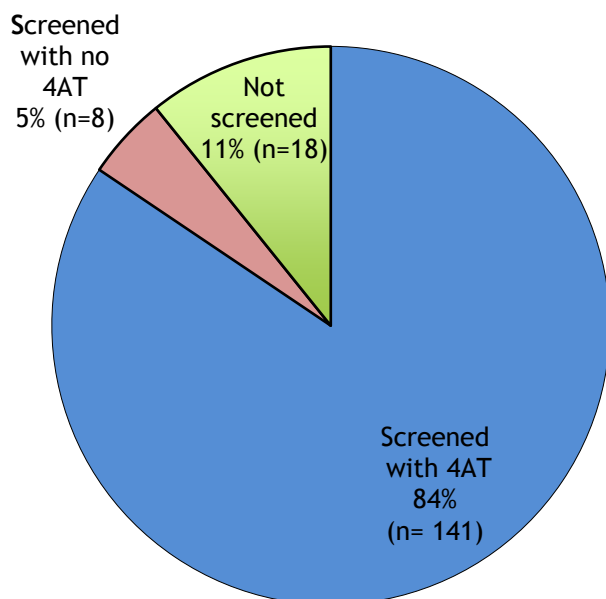


Fig 1: No. of Eligible Patients (n=167) screened with 4AT

Table 3: Reasons for Screened Patients with no 4AT (n=8)

Reason for patient not being screened with the 4AT	No of patients
Language Barrier	2
Dysphasia	2
High Dependency Unit	2
Mental Health	1
Patient Declined 4AT	1

3.2. Correlation of 4AT with Clinical Picture

3.2.1. Patients' 4AT scores

Of the 141 patients with a 4AT score, 48.23% (n=68) scored 0, indicating that just under half of patients show no cognitive impairment. The baseline clustering results in a heavily skewed data set as seen in Figure 2. Figure 3 shows the spread of data after grouping of 4AT scores. 32 (22.70%) patients scored 1-3 (suspected cognitive impairment) and 41 (29.08%) patients scored 4-12 (suspected delirium) on the 4AT.

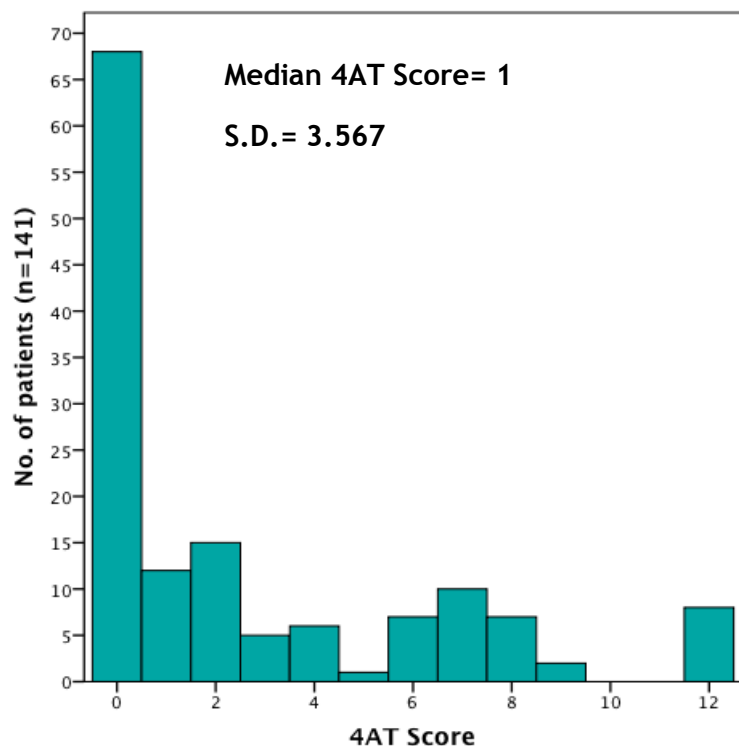


Fig 2: Histogram of patients' 4AT scores (n=141)

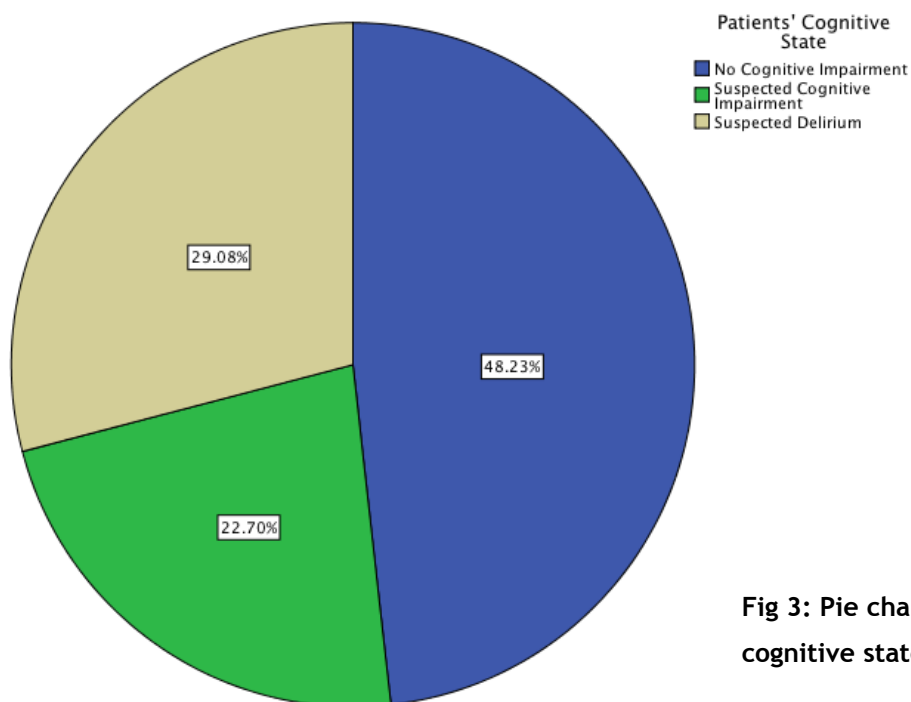


Fig 3: Pie chart of patients' cognitive state

3.2.2. Patients' Clinical Picture scores

Figure 4 shows the spread of clinical picture scores, with 76 (53.9%) patients scoring 0 on the DSM-IV Delirium Criteria scale.

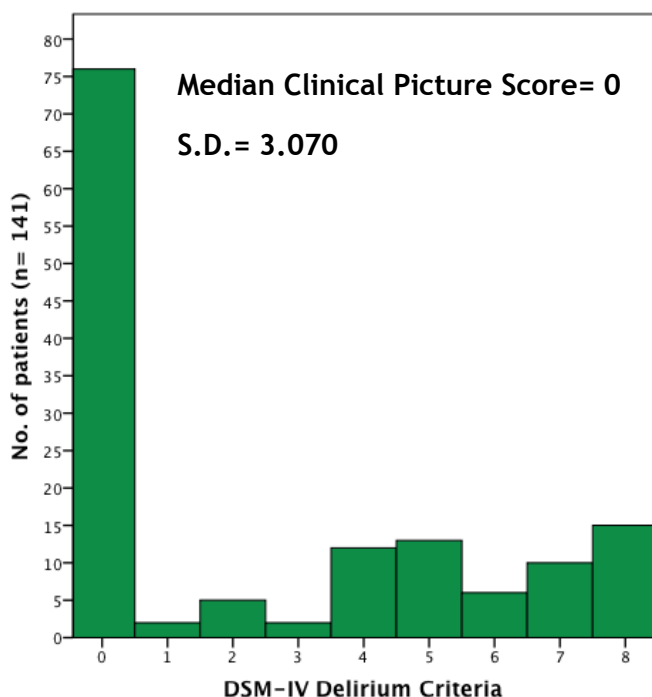


Fig 4: Histogram of patients' clinical picture scores (n=141)

3.2.3. Correlation of 4AT with Clinical Picture

There is a significant correlation between the 4AT and the clinical picture (Spearman's correlation analysis: $\rho = 0.804$, $p < 0.001$). In particular, of the patients that scored 0 on the DSM-IV Criteria scale, 63 scored 0 on the 4AT, 7 patients scored 1, 3 patients scored 2 and 1 patient each scored 4, 6 and 9 respectively on the 4AT.

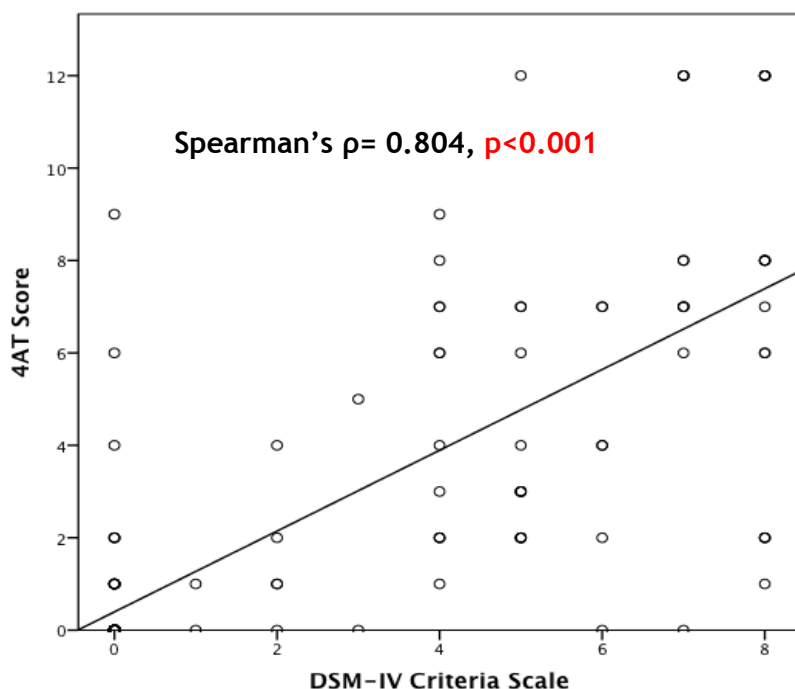


Fig 5: Correlation analysis between 4AT and DSM-IV Scale (n=141)

3.3. Specific Patient Characteristics

There is a significant difference in mean 4AT score according to a patient's gender (females have significantly higher 4AT scores than males), dementia diagnosis (patients with established dementia have a significantly higher 4AT score), residential status (patients in a nursing home have significantly higher 4AT scores) and package of care (Table 4).

Table 4: Non-Parametric Means Analyses of Specific Patient Characteristics

Patient Characteristic	Non-Parametric Means Analyses (Mann-Whitney- Wilcoxon/ Kruskal-Wallis)
Length of Stay	H(35)= 37, p=0.371
Age	H(22)= 17.306, p= 0.746
Gender	U= 1782, p= 0.003
Dementia Diagnosis	U=165, p<0.001
Residential Status	H(2)= 10.466, p= 0.005
Package of Care	H(5)= 18.171, p= 0.003

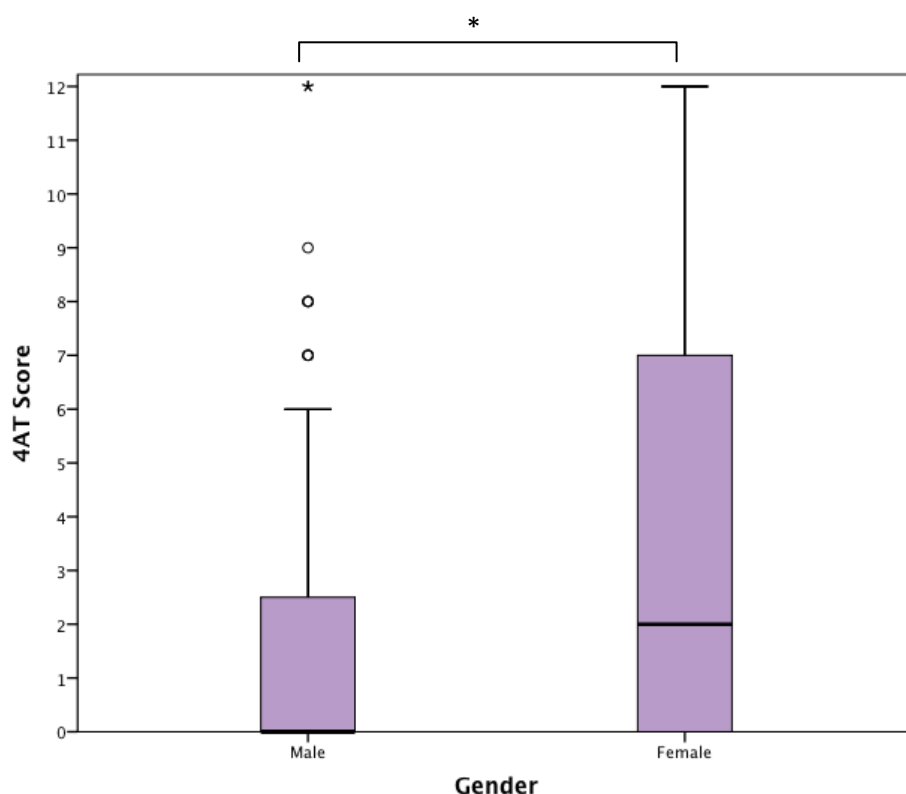


Fig 6a: Box-plot of Gender and 4AT (n=141)

*U= 1782, p=0.003

	N	Median 4AT Score
Male	65	0
Female	76	2

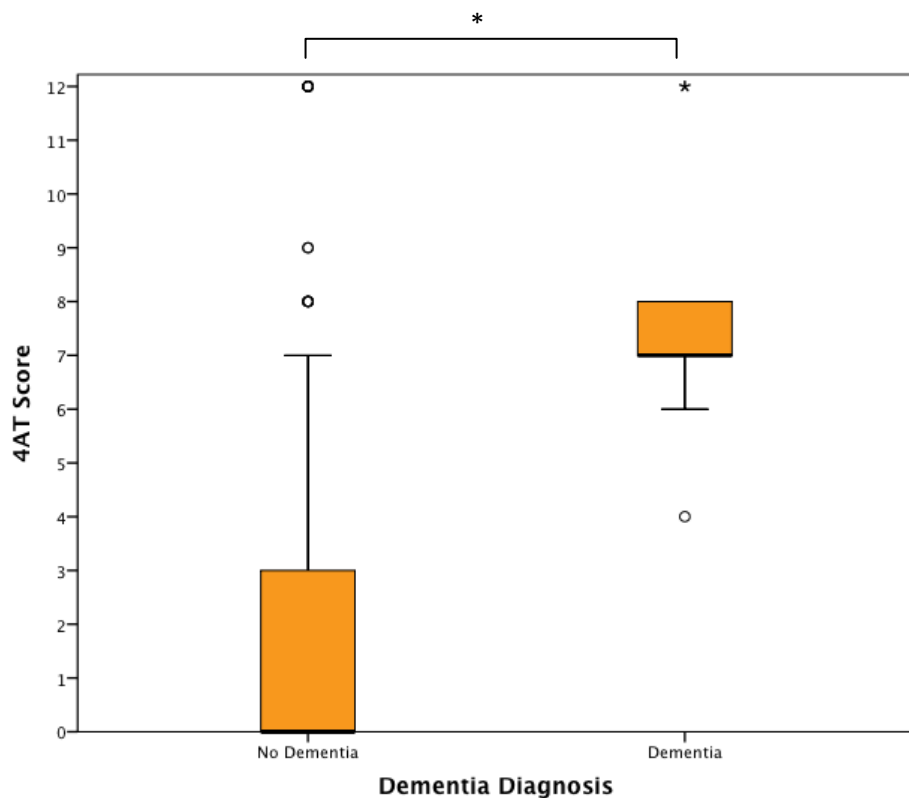


Fig 6b: Box-plot of Dementia Diagnosis and 4AT (n=141)

*U=165, $p < 0.001$

	N	Median 4AT Score
No Dementia	130	0
Dementia	11	7

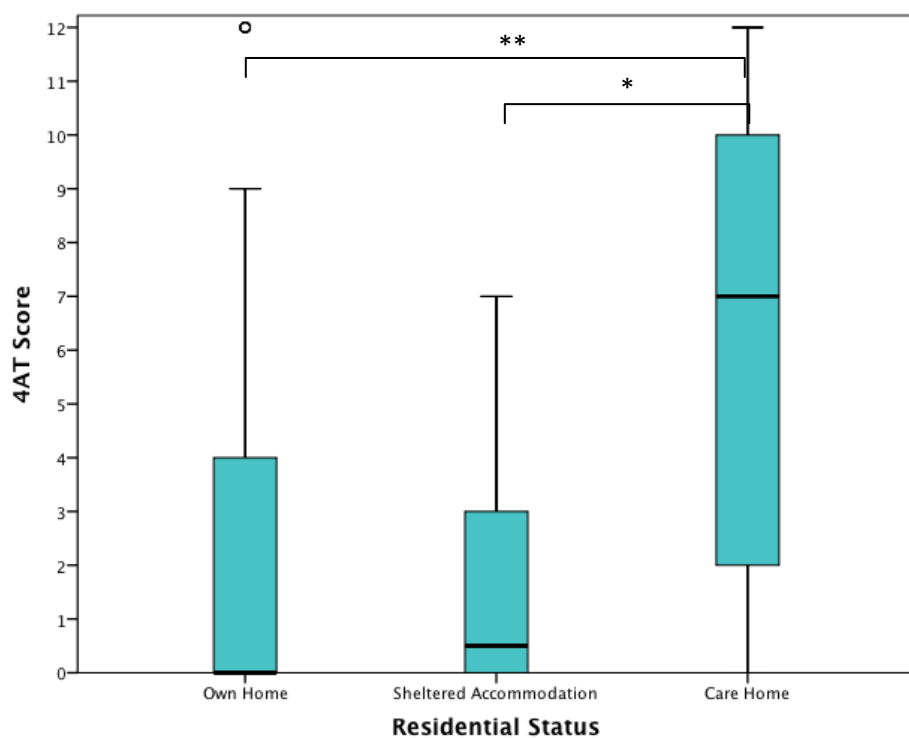


Fig 6c: Box-plot of Residential Status and 4AT (n=141)

Post-hoc tests:

* $t = -4.405$, $p = 0.004$

** $t = 4.029$, $p < 0.001$

	n	Median 4AT Score
Own Home	115	0
Sheltered Accommodation	14	0.5
Care Home	12	7

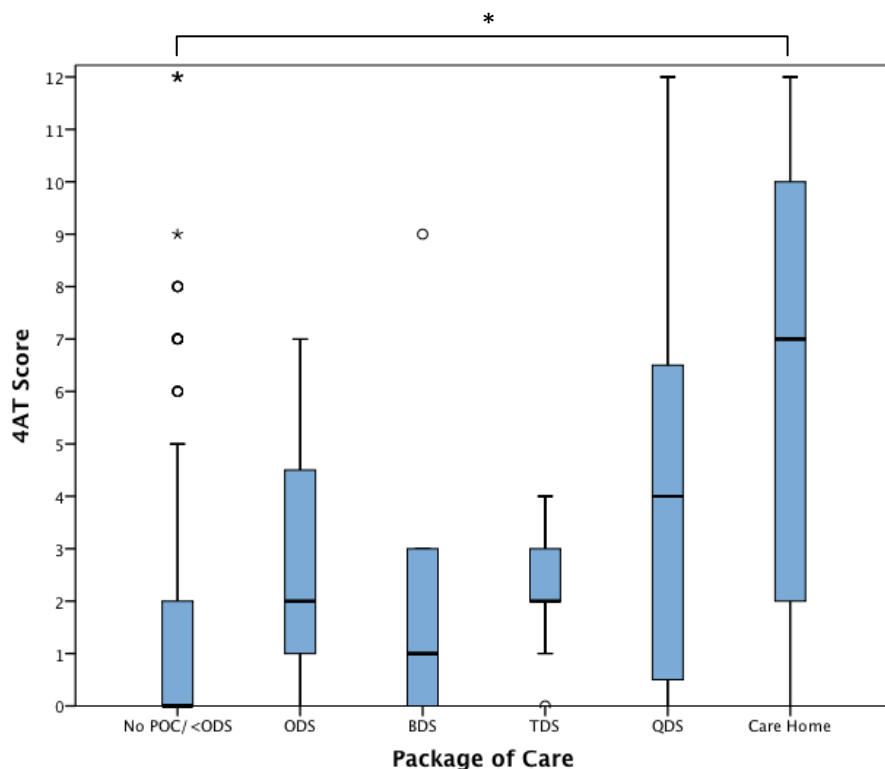


Fig 6d: Box-plot of Package of Care and 4AT (n=141)

Post-hoc tests:
* $t = 4.420$, $p = 0.001$

	N	Median 4AT Score
No POC/ <ODS	99	0
ODS	3	2
BDS	6	1
TDS	9	2
QDS	11	4
Care Home	12	7

4. Discussion

4.1. Screening of Patients with 4AT

In June 2013, KCH screened 89% of eligible patients for delirium and cognitive impairment. Within patients who were screened, dysphagia, language barriers and mental health were cited as reasons for patients not having been administered the 4AT. However, one of the advantages of the 4AT over other cognitive tests is the possibility for testers to take communication difficulties (dysphasia, language barriers) into account (4AT, 2011). In this context, additional training to familiarise health care professionals with the use of the 4AT in patients with communication difficulties might be of use in ensuring that these patients receive adequate cognitive screening in spite of such difficulties.

Reasons for the remaining 11% of patients who were not screened are not well documented and generally unclear. In one case, the patient was discharged before screening could be administered. In order to achieve and maintain the Dementia CQUIN target of 90% for 3 consecutive months, a review of the administrative systems that lead to the generation of the list of patients eligible for screening each day could help to elucidate the reasons for these patients not having been screened.

4.2. Correlation of 4AT with Clinical Picture

The strong correlation (Spearman's $\rho = 0.804$, $p < 0.001$) of the 4AT scores with the DSM-IV delirium criteria scale supports other studies (e.g. Lee *et al.*, 2013) that have found the 4AT to be an accurate tool for screening of delirium and cognitive impairment. In this study, the spread of 4AT scores indicates that about 30% of patients have suspected delirium (Fig 3). This is unsurprising. Evidence cited in the NICE delirium guidelines suggests that the prevalence of delirium in people on medical wards is about 20% to 30%, while 10% to 50% of patients who have undergone surgery develop delirium (NICE, 2010). These high rates of delirium prevalence reinforce the need for robust detection and subsequent management of delirium amongst acute older hospital admissions. With findings from this study supporting the accuracy of the 4AT, and demonstrating the feasibility of its administration, the 4AT appears well placed as a screening tool to fulfil this need.

It is worth noting that there were patients who scored positively on the 4AT score but 0 on the clinical picture assessment. The latter was derived from documentation of clinical observation, which suggests that clinical teams are not picking up a number of patients with cognitive impairment \pm delirium. The under-diagnosis of delirium is well documented, especially if the patient presents with the more common hypoactive type (MacLulich *et al.*, 2013). While identification of the agitated patient is easy, identifying abnormally drowsy and quiet patients is more challenging. As such, implementing routine mental state assessment is an important step forward, especially if accompanied by greater staff awareness and improved clinical skills in delirium detection and prevention.

Although more than half of patients (51.77%) screened in this sample scored positively (>1) on the 4AT, a quick review of the clinical notes suggests that measures to prevent and manage delirium,

outside of follow-up assessment recommended under the CQUIN pathway, were not discussed in most cases. In light of this, and in the spirit of obtaining maximal benefit from conducting 4AT screening, it is worth considering whether immediate delirium prevention measures (MacLulich *et al.*, 2013), such as urging staff to provide hearing aids and glasses, involving family members in care, providing frequent orientation and reinforcing measures to prevent dehydration, infection and hypoxia, can be effective and cost-efficient ways of supplementing the follow-up care that patients receive under the CQUIN pathway.

4.3. Specific Patient Characteristics

Understanding the factors associated with the development of delirium enables the identification of high-risk patients and thus delirium prevention measures can be put in place even before cognitive screening is carried out. This study looked at six patient characteristics, with plans in the next phase to investigate at least three other factors (pre-admission psychotropic medication, medication on admission and co-morbidities).

4.3.1. Length of Stay

The finding in this study that 4AT score does not correlate significantly with a patient's length of stay is somewhat surprising. Amongst the multiple adverse outcomes associated with delirium, an increased length of stay is often cited, along with new institutionalisation and new-onset dementia. One possible explanation for this finding lies in the time of onset of delirium. A study by McCusker *et al.* (2003) suggests a disparity between the effects of prevalent (delirium present at time of admission) and incident delirium (delirium after admission) on length of stay; while prevalent delirium was not associated with a significantly longer hospital stay, incident delirium was associated with an excess stay after diagnosis. The time frame in which cognitive screening was carried out in this study implies that largely prevalent delirium would have been picked up, and hence not be associated with an increased length of stay. Additionally, there is a small group of patients who have a delayed discharge for social reasons, which can lead to increased lengths of stay not associated with the patient's clinical condition.

4.3.2. Age, Gender and Dementia Diagnosis

It is well documented that advanced age is significantly associated with the development of delirium (Elie *et al.*, 1998) and is the basis for focusing delirium detection efforts on older hospital admissions. However, this study found that variance in age does not result in a significantly different mean 4AT score. A reason for this potentially surprising finding is that it is within the cohort of patients above 75 years old. Other studies that have looked at the effect of age on prevalence of delirium amongst in-patients have analysed broader patient cohorts and age distinctions (<80y and >80 y, Levkoff *et al.*, 1992).

This has implications for the finding that females have a significantly higher 4AT score than males. In the UK, average life expectancy for females is 3-4 years more than that of males. However, that there are more elderly females does not explain the significantly higher 4AT score for females since age itself does not affect 4AT scores in this study. It is possible that more older females could imply

more females with dementia since the prevalence of dementia rises dramatically from 1 in 25 in 70-79 year olds to 1 in 6 in patients >80 years old. However, preliminary covariate analysis suggests that the effect of age remains when dementia diagnosis is accounted for. It is worth noting that the 4AT test has not been shown to demonstrate a bias towards either gender and should not be a reason for this effect of gender. A repeat of this study with a greater sample population will be of use in investigating this effect.

Within the patients who were screened with the 4AT, 8% (n=11) of patients had an established dementia diagnosis. That having an established dementia diagnosis results in a significantly higher mean 4AT is not surprising and coherent with the knowledge that the rate of delirium is higher in patients with pre-existing cognitive impairment. However, there have been questions surrounding delirium assessment in patients with dementia, given the practical difficulty in differentiating between signs of delirium and fluctuating cognitive function or psychological symptoms in patients with dementia (Davis *et al.*, 2013). Morandi *et al.* (2012) conducted a review looking at the validity of tools in diagnosing delirium superimposed on dementia (DSD) and found a high specificity but only moderate sensitivity (60-70%) in non-intensive care settings, highlighting the difficulty of differentiating between DSD and dementia.

4.3.3. Residential Status and Package of Care

Findings in this study that patients in a care home have significantly higher levels of suspected cognitive impairment and delirium than patients who live at home or in sheltered accommodation are supported by similar findings in other studies (Sandberg *et al.*, 1998). Analysis of social support factors suggests that mean 4AT scores increase with an increased package of care: a patient receiving no package of care has a median score of 0 compared to a median score of 7 amongst patients who live in a care home. Presumably, patients enter a care home when their disability has reached a certain level of impairment and it is unsurprising that patients from care homes have higher levels of cognitive impairment than patients living in sheltered accommodation or their own homes. Moreover, it is known the prevalence of dementia amongst residents of a care home is significantly higher than that amongst other older people (Magaziner *et al.*, 2000). However, while dementia, delirium and cognitive impairment are present in a substantial part of the care home population, it is thought that, "staff do not often realise that the people they care for have dementia, and often deny this is the case" (Matthews and Denning, 2002). Given the increased risk of delirium superimposed on patients with pre-existing dementia, and the subsequent effects of this delirium on accelerating the progress of dementia, patients from care homes should be promptly recognised as patients at high risk for delirium and adequate preventative measures put in place.

4.3.4. Limitations of Study

There were several limitations in this study. First, clinical details were obtained from a retrospective review of the electronic case-notes. Clinical observations from the Emergency Department were not reviewed unless they were documented electronically, which might have

resulted in the omission of some clinical details not noted upon admission to the ward. Second, the clinical picture assessment was conducted by one assessor, which ensured uniformity across the sample but might affect reliability. There are plans for a second assessor to review the assessment, increasing reliability of results. Moreover, only DSM-IV delirium diagnostic criteria were used in this study. The DSM-IV and ICD-10 criteria (research and clinical versions) have characteristics in common but also major differences. Importantly, a study by Laurila *et al.* (2012) showed that prevalence rates of dementia in their study sample were higher when DSM-IV criteria (24%) were used as compared to ICD-10 criteria (10%). This might result in a difference in correlation between 4AT and the clinical picture if ICD-10 criteria is used as the basis for clinical picture assessment. Finally, the study involved a local audit and small cohort sample (n=167). If the results are to be representative of the greater UK population, the study must be expanded in size and also include other hospital populations around the UK. Research on validating the 4AT is currently being undertaken and an increase in evidence base is important in informing the administration and interpretation of the test.

4.3.5. Future Plans

This study looked at 6 pre-determined patient characteristics, which were primarily demographic in nature. In the next phase of this study, important clinical factors in the development of delirium such as pre-admission medications, existing co-morbidities and reasons for admission will be analysed. Additionally, subsequent phases will look at the clinical outcomes of patients who screened positive for cognitive impairment in order to assess the clinical impact of introducing the 4AT and complete subsequent stages of the Dementia CQUIN framework. Importantly, the impact on caregivers will also be investigated, in line with the notion of the benefit that a timely diagnosis of dementia can bring through preventing crises and offering support to carers.

5. Conclusion

There is a strong evidence base for the widespread prevalence of delirium and dementia amongst older patients. Yet, detection rates remain poor. The recent introduction of a national guideline and framework for delirium and dementia respectively highlight the efforts made to tackle these unmet needs of medical care. The development of the 4AT is timely and evidence from this study suggests that it is an accurate tool in screening for delirium and cognitive impairment. Its implementation at King's College Hospital appears to be achieving set targets, underlining the feasibility of using the 4AT as a first-line screening tool. Specific patient characteristics, including being female, living in a care home and having an established dementia diagnosis appear to have a significant correlation with the prevalence of cognitive impairment and delirium, although further studies might be needed to confirm these findings. By identifying patients at a high risk for cognitive impairment, and in conjunction with heightened screening, efforts to prevent and manage delirium can be more effectively instituted and sustained, leading ultimately to better clinical outcomes for patients.

6. Acknowledgements

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