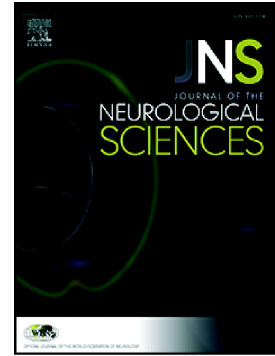


## Accepted Manuscript

Identification of delirium and dementia in older medical inpatients in Tanzania: A comparison of screening and diagnostic methods

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**Identification of delirium and dementia in older medical inpatients in Tanzania: A  
comparison of screening and diagnostic methods**

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**ABSTRACT**

**Background:** In sub-Saharan Africa, there are no validated screening tools for delirium in older adults. This study assesses clinical utility of two instruments, the IDEA cognitive screen and the Confusion Assessment Method (CAM) for identification of delirium in older adults admitted to medical wards of a tertiary referral hospital in Tanzania.

**Method:** The IDEA cognitive screen and CAM were administered to a consecutive cohort of older individuals on admission to Kilimanjaro Christian Medical Centre using a blinded protocol. Consensus diagnosis for delirium was established against DSM-V criteria and dementia by DSM-IV criteria

**Results:** Of 507 admission assessments, 95 (18.7%) had DSM-V delirium and 95 (18.7%) had DSM-IV dementia (33 (6.5%) delirium superimposed on dementia). The CAM and IDEA cognitive screen had very good diagnostic accuracy for delirium (AUROC curve 0.94 and 0.87 respectively). However, a number of participants (10.5% and 16.4% respectively) were unable to complete these screening assessments due to reduced consciousness, or other causes of reduced verbal response and were excluded from this analysis; many of whom met DSM-V criteria for delirium. Secondary analysis suggests that selected cognitive and observational items from the CAM and IDEA cognitive screen may be as effective as the full screening tools in identifying delirium even in unresponsive patients.

**Conclusion:** Both instruments appeared useful for delirium screening in this inpatient setting, but had significant limitations. The combination of assessment items identified may form the basis of a brief, simple delirium screening tool suitable for use by non-specialist clinicians. Further development work is needed.

(250 words)

## INTRODUCTION

Delirium is an acute onset syndrome of cognitive dysfunction presenting with deficits in attention, arousal and global cognition [1], highly prevalent in older hospitalised adults in high-income countries (HICs) [2]. Well-recognised adverse outcomes include cognitive decline [2-5], disability [6, 7] and increased mortality rates [3, 6].

Although prompt interventions can improve outcome [8], delirium remains under diagnosed, and may be missed in up to 50% of cases in HICs [9, 10]. Diagnosis is most challenging in some of those most at risk, such as older people and those with preexisting cognitive impairment. Use of validated screening tools improves detection rates [9, 11].and is recommended in guidelines for older hospitalised adults [12].

In sub-Saharan Africa (SSA), there are currently no validated screening tools for delirium in older people. Demographic transition has resulted in a rapidly growing older population, and recent epidemiological studies of dementia suggest a similar prevalence to that seen in HICs [13, 14]. Delirium is likely to be similarly prevalent in older adults but existing data are limited. Currently available data suggest a high rate of misdiagnosis of delirium as a psychiatric disorder and adverse outcomes [15]. A substantial diagnostic gap is suggested by the fact that the limited available studies report prevalence of 9.1-19.7% [16, 17] on clinical criteria whereas in contrast a large case-note based study of older people admitted to three large centers in SSA reported delirium prevalence of 0-2.6% [18].

This diagnostic gap may also be due to shortages of specialist clinicians with skills in cognitive assessment. Geriatricians, psychiatrists and neurologists are scarce across SSA outside large urban centers [19-21]. Cognitive assessment tools and other screening methods developed in HICs often perform poorly in SSA due to cultural differences and high levels of illiteracy amongst older adults, especially in rural areas [12]. Therefore, objective screening methods for the cognitive impairments typical of delirium, that can be used accurately by non-

specialists and are not literacy-dependent, are needed.

Our overall aim was to determine the most effective method of screening and identification of delirium in older hospitalised adults in SSA. Key objectives were: 1) Evaluate the performance of two screening instruments with potential utility for identification of delirium in this setting (the IDEA cognitive screen and Confusion Assessment Method (CAM)) against gold-standard DSM-V consensus diagnosis of delirium; and 2) Conduct a secondary analysis of all screening and assessment items to determine those most predictive of delirium and potentially useful in development of a screening method for use by non- specialists.

## **MATERIALS AND METHODS**

### **Ethical approval and consent**

Ethical approval was granted locally by the Kilimanjaro Christian Medical College Research and ethics committee (CRERC) and by the National Institute of Medical Research (NIMR) of Tanzania in Dar-es-Salaam. Patients were given written and verbal information about the study and its aims before gaining their informed consent. Where patients were unable to write, a thumbprint was used. If patients were admitted unconscious or lacking the capacity to consent, a close relative was asked to assent on the patient's behalf.

### **Setting and study participants**

This study took place in the internal medicine department of Kilimanjaro Christian Medical Centre (KCMC), an 800-bed tertiary referral hospital in Northern Tanzania serving a rural population of over eight million people. Consecutive samples of individuals aged 60 and over admitted to the department from 14<sup>th</sup> January to 3<sup>rd</sup> February 2015 (pilot phase) and from 6<sup>th</sup> March 2015 to 10<sup>th</sup> July 2015 were invited to participate on admission. No substantial changes were made to the study design or data collection methods following the pilot phase and so data were combined for analysis (**Figure 1**).

### **Assessments**

Initial clinical assessment took place wherever possible in the morning after admission, following initial review by the treating medical team. The following data were collected: background demographic data alongside physical observations; level of arousal using the Alert-Voice-Pain-Unresponsive (AVPU) scale [22] designed for use by non-specialists in routine practice and pain assessed on a visual analogue scale of 0-10 with 10 rated as most severe. Where necessary, non-literate or observational assessments (e.g. Wong-Baker Faces scale) were used and equivalent scores recorded. Data on medical diagnoses, comorbidities, risk factors and outcome were also collected and participants reassessed

every three days during admission to determine in-hospital incidence of delirium. This study relates to screening at admission only.

### **Clinical assessment for delirium and dementia**

All patients were assessed by a research doctor with an interest in geriatrics or psychiatry (S-MP, AD, EGL or LT) assisted by a trained study nurse or clinical officer with experience of cognitive assessment in older adults, and fluent in both English and Swahili. Clinical assessments were conducted independently of, and blinded to, IDEA cognitive screen scores. Full assessment for cognitive impairment included a neurological examination, detailed standardised bedside cognitive assessment and mental state examination recorded in free text (see **Figure 1**). Where significant low mood was observed, the brief Geriatric Depression Scale (GDS) was used to identify possible depression as a possible cause of poor cognitive performance but depression or other psychiatric disorders were not the main focus of the assessment and were not routinely screened for. Assessment of potential confounders of screening tool performance including educational level and sensory impairment was also carried out (see **Figure 1**).

Pre-existing dementia was assessed through a detailed semi-structured informant history for cognitive and functional impairment based on DSM-IV criteria previously used for dementia assessment in Tanzania and Nigeria [23]. Informants were usually close relatives and resident in the same household. All informants were asked 'is this a recent change?'. Use of a single question in identification of delirium has been validated in HICs [24].

In order to take into account possible fluctuations in presentation, a subset of participants were reviewed by a neurologist or physician to increase accuracy of diagnoses, where possible this assessment took place later the same day. This assessment took place blinded to the outcome of both screening tools to maintain objectivity. Where possible all those screen-positive on the CAM were assessed alongside 10% of screen-negative individuals, selected using a random number generator.

### **Consensus diagnoses of delirium and dementia**

All clinical assessment data, with the exception of the IDEA cognitive screen result and CAM algorithm, were reviewed by a consultant old age psychiatrist, nurse specialist in old age psychiatry and research doctor in psychiatry (EML, GC, S-MP) for blinded consensus diagnosis of delirium by DSM-V criteria. Cases of subsyndromal or resolving delirium not meeting DSM-V criteria were recorded, but classified as 'no delirium'.

We considered it important to accurately identify dementia in order to assess screening tool performance in delirium versus cognitive impairment in general. Consensus diagnoses of dementia followed DSM-IV criteria, taking into account all available clinical information, including previous admission records where available. In cases of possible dementia not meeting DSM-IV criteria a follow-up assessment was offered for diagnostic clarification after discharge. Where necessary, due to geographical constraints, this assessment took place by telephone interview with a close relative. Dementia subtype diagnoses were made by clinical criteria where possible, but limited, partly because neuroimaging was not available at the time of the study. Other psychiatric disorders were noted where a clear clinical description of symptoms made this possible.

### **Identification of delirium or major cognitive impairment by treating medical team**

A retrospective case note review compared consensus diagnoses of delirium with identification of delirium by the treating medical team during admission (see **Figure 1**)

### **Cognitive screening using the IDEA (Identification and Intervention for Dementia in Elderly Africans) cognitive screen**

All consented individuals underwent bedside cognitive screening using the IDEA cognitive screen. The IDEA was developed for use by non-specialist healthcare workers to identify dementia in low-literacy populations in SSA. It has been validated for major cognitive impairment in hospital inpatient settings in Tanzania and Nigeria and outpatient and community settings in Tanzania [23, 25, 26]. Assuming basic training in a healthcare profession, minimal additional training is required to allow it to be administered



successfully. The IDEA includes assessment of orientation, delayed recall, abstract thought, category (animal) fluency and visuo-construction. The IDEA cognitive screen was administered by a study nurse or clinical officer, blinded to outcome of all other clinical assessments. On completion, the IDEA screen was immediately filed separately from other clinical data to maintain blinding of personnel conducting the other clinical assessments. Where the IDEA screen was attempted, but abandoned because of confusion or inability to understand the task, total scores were recorded as zero as the individual was assumed to have severely impaired cognition preventing successful performance on the test. Where screening was not possible due to physical illness or lowered conscious level, outcome was recorded as 'unable to complete'.

### **Confusion Assessment Method (CAM) screening**

The CAM algorithm [27] includes the following; acute onset cognitive disturbance with fluctuation (CAM 1) *and* attention deficit (CAM 2) alongside *either* disorganised thinking (CAM 3) or abnormal arousal (CAM 4). Sensitivity and specificity for delirium by DSM-IV criteria are excellent in published meta-analyses [28] and in HIC settings the CAM is used for both delirium screening and diagnosis [29]. The CAM typically takes 10-15 minutes to complete [27] but requires a degree of training and clinical experience of cognitive assessment [30]. The CAM algorithm was completed by a junior research doctor (blinded to IDEA cognitive screen score and other clinical assessments) following detailed bedside clinical assessment (see below) and discussion with nursing staff and family members. The CAM was then filed separately to maintain blinding for clinicians completing additional assessments and consensus diagnoses (see **Figure 1**).

Where CAM assessment was considered impossible by the assessing doctor (e.g. due to limited verbal response) participants were classified 'CAM-unable' and CAM items assessable through observation scored alongside limited neurological and mental state examination and informant history.

**Statistical analysis**

Data were analysed using SPSS software (version 20 for windows, IBM Corp, Armonk, NY, USA). All data were non-normally distributed and therefore data were presented by median and inter-quartile range and non-parametric tests were used throughout. Diagnostic accuracy was assessed using the area under the receiver operating characteristic (AUROC) curve statistic as an overall assessment of screening performance.

Exploratory factor analysis of all screening and assessment items for delirium (IDEA six item screen and CAM items, beside cognitive tests and informant single question) was conducted to investigate latent traits within the screening items. An oblique rotation method was selected due to high correlation between variables. Factors to be extracted were determined using a scree plot. Items with the largest loadings on each factor were explored using logistic regression models with DSM-V delirium as the dependent variable. The significance level was set at 5% and two-tailed tests were used throughout.

## RESULTS

### Characteristics of the study cohort

During the study period there were 609 admissions (including 51 re-admissions) of individuals aged 60 and over to the internal medical department. Of these, 510 patients were recruited to the study. Reasons for exclusion were as follows: died or transferred before assessment ( $n = 56$ ) refused or were unable to consent ( $n = 26$ ) or could not be assessed for other reasons ( $n = 17$ ) (see **Figure 1**). Three further patients were excluded from analysis due to large amounts of missing data. Thus data were available for 507 people, see **Figure 1**. The 507 admissions fully assessed and the 102 exclusions not assessed for delirium did not significantly differ in sex ( $X^2 (1) = 0.921, p = 0.337$ ) or in median age ( $U = 24312.0, p = 0.340$ ).

Characteristics of the study cohort are described in **Table 1**. Ninety-five people (18.7%) had delirium and 95 (18.7%) had dementia (only one of whom had previously been given a diagnosis). Of the 95 with delirium, 33 (6.5%) had delirium superimposed on dementia. There was a high prevalence of reduced arousal (20.6%). Delirium was recorded in the hospital records of 8 individuals of whom 6 met DSM-V delirium criteria (see **Table 1**).

### Diagnostic accuracy of the CAM

Of the 507 people with a clinical diagnosis, 53 (10.5%) were classified as 'CAM unable'. Of the remaining 454, 89 (19.6%) were CAM positive for delirium. The overall diagnostic accuracy of the CAM was excellent (see **Table 2**). A total of 8/53 (15.1%) of 'CAM unable' participants met DSM-V delirium criteria and overall 22/53 (41.5%) met criteria for major cognitive impairment (dementia or delirium). CAM items 2 and 3, which are more reliant on verbal response, were poorly completed, whilst almost all participants could be assessed on observation and clinical history items CAM 1 and CAM 4 (see **Table 2**). Allowing for these limitations, CAM 2 (inattention) showed the highest diagnostic accuracy.

### Diagnostic accuracy of the IDEA six-item screen

The IDEA cognitive screen was attempted by 424 (83.7%) participants. Reasons for exclusions are detailed in **Figure 1**. Of those attempting the IDEA cognitive screen, 64 (15.1%) had DSM-V delirium, 73 (17.2%) had DSM-IV dementia (25 (5.9%) had delirium superimposed on dementia). A significant proportion of the 83 unable to attempt the IDEA screen met DSM-V delirium criteria ( $n = 31$ , 37.3%), DSM-IV dementia criteria ( $n = 22$ , 26.5%) or had delirium superimposed on dementia ( $n = 8$ , 9.6%). In those assessed, diagnostic accuracy of the IDEA screen for DSM-V delirium and major cognitive impairment was good, with an AUROC curve of 0.866 (0.826-0.907) for delirium and 0.874 (0.838-0.909) for major cognitive impairment. Sensitivity, specificity and predictive value are reported in **Table 2**.

### Differentiation of delirium and dementia

Within the group identified with major cognitive impairment (delirium or dementia) the CAM demonstrated excellent discriminatory ability in identifying delirium from dementia. Of 134 with major cognitive impairment who completed the CAM, 87 had delirium and 47 had dementia without delirium. The CAM correctly identified 79/87 (90.8%) of those with delirium and 45/47 (93.7%) of those without delirium. Of two incorrectly classified as having delirium, both had dementia. Within this group sensitivity was 91% and specificity was 96%. CAM 2 (inattention) was the most accurate individual test when used alone (sensitivity 94%, specificity 76%). In the 103 who had major cognitive impairment and completed the IDEA cognitive screen, differential accuracy was poor, with an AUROC curve of only 0.60 (95% confidence interval (CI) 0.49-0.71) for delirium. Similarly, of those with cognitive impairment on screening (IDEA cognitive screen of 7 or below) the CAM correctly identified delirium (sensitivity 0.93, specificity 0.96). Of those with major cognitive impairment, 23/157 (14.6%) and 45/157 (28.7%) were unable to complete the CAM or attempt the IDEA cognitive screen,

limiting clinical utility. The single question 'is this a sudden change?' was only moderately useful (sensitivity 92% specificity 60%).

### **The role of visual impairment**

We wished to investigate whether the relatively poor performance of the IDEA cognitive screen was due to uncorrected visual impairment. The IDEA screen was re-evaluated disregarding the only visually presented item (matchstick constructional praxis task). Removal of the praxis task made little difference to the overall accuracy of the IDEA for identification of delirium or major cognitive impairment [AUROC 0.871 (95% CI 0.833-0.912), 0.879 (95% CI 0.844-0.913)] respectively.

### **Investigation of combinations of individual CAM and IDEA cognitive screen items as predictors of delirium**

All six IDEA screen items, bedside cognitive tests of orientation, attention, registration and recall, CAM items 1 and 4 and the single informant question were investigated to identify those that may be of greatest clinical utility in this setting. CAM items 2 and 3 were not evaluated due to the observed difficulties in rating these items, suggesting that they would not be suitable for screening in this setting. Exploratory factor analysis identified three factors broadly interpreted as representing learning/recall, observation/behaviour and orientation, explaining 41.9%, 9.67% and 7.5% of the variability respectively. A logistic regression model was constructed to identify those items that were significant independent predictors of delirium. The final model is shown in **Table 3** and included word recall, CAM 1, CAM 4 and sex. Nagelkerke's  $R^2$  for the model was 0.676. Weightings were applied to the model based on the parameter estimates and these weights used to develop a crude screening tool. The tool had a higher AUROC than the IDEA cognitive screen (0.94 (95% CI 0.92 to 0.97)), and had the advantage of being much shorter. Accuracy was similar to that of the CAM, but assessment data were available for almost all participants including those rated unassessable on the full CAM. The scoring system ran from 0 to 8, with a score of  $\geq 6$  the optimal cut off for identifying those with delirium (sensitivity 0.94, specificity 0.90).

## DISCUSSION

The brief delirium screen developed outperformed both the IDEA and CAM on internal validation. Our presented development and validation models demonstrated a high degree of accuracy in detection of delirium, which surpassed that of the IDEA and was similar to that of the CAM.

This increased accuracy may be due in part to its simplicity and lower reliance on clinical judgement. In our study, non-neurologists with cognitive assessment experience had difficulty in rating CAM items 2 and 3 in individuals with lowered arousal. This reduced the overall clinical utility of the CAM because a significant proportion of these 'CAM unable' individuals met DSM-V delirium criteria. Similar reductions in CAM sensitivity due to difficulties with CAM items 2 and 3 have been noted in other studies, especially where less experienced raters administered the CAM [30].

The novel delirium screening tool developed includes assessment of the following cognitive and observational elements; short term recall, altered consciousness and both acute onset and fluctuation. It does not specifically include inattention. Attentional deficits are well-recognised to differentiate delirium and dementia [31] because attention is typically affected globally and early in delirium, but only complex attention is impaired in mild to moderate Alzheimer's disease [32]. Although we identified inattention as the most accurate CAM item in terms of general diagnostic accuracy and discrimination of delirium and dementia, it was excluded from the model due to the identified difficulties with its completion. Although it could be argued that difficulty completing an item assessing attention is consistent with attentional difficulty, the fact that a large number of people who would fit into this description were recorded as unassessable suggests that inclusion of this item in a screen could lead to people being misclassified. The decision to exclude this item was, therefore, a pragmatic one, based on our desire to develop a simple and robust screening tool. Our modelled screening tool includes short term recall of a previously learned word list. This item might therefore be indirectly measuring attention (since attention is required in order to register

and retain the list) without the challenge of assessing inattention in more complex clinical assessment.

Many screening tools used for identification of delirium in HICs rely heavily on orientation, despite evidence that orientation may be unaffected in up to a quarter of older people with delirium [32]. Our tool includes items requiring registration and short-term recall rather than orientation, and may therefore have broader applicability.

Acute onset and fluctuation as reported by a carer was identified as a key element during modelling. In contrast, a positive answer to 'is this a sudden change' by an informant was only moderately useful in differentiating delirium and dementia. Previous work by our team has described a high prevalence of both vascular dementia and stroke in Tanzania [9, 10] It may be difficult for family members asked this question to separate delirium from stepwise deterioration in vascular cognitive impairment. The additional element of 'fluctuation' as well as acute change appeared to be more useful in identification of delirium in this setting.

Altered arousal is another key element of our delirium screening tool. Lowered arousal is independently associated with poor outcome and therefore these individuals are at particularly high risk, but likely to be missed by routine use of the CAM for screening by non-specialists (as lowered arousal might prevent assessment of inattention or disorganised speech).

### **Overall utility of the CAM**

Joint practice recommendations from the European and American Delirium Associations advise that inability to cooperate with cognitive assessment for attention be rated as severe inattention, in patients able to make at least some verbal response and not in coma [33].

This was the approach followed when making DSM-V consensus diagnoses [34] but differs from that of the DSM-IV on which the CAM is based. Accurate completion of the CAM in a setting with a high prevalence of severe physiological illness is challenging and requires experience and judgement. Although the overall diagnostic accuracy of the CAM compared favourably to that reported in HIC meta-analyses (sensitivity 91% vs 82-94% and specificity

96% vs 89-99% [29, 35]), in SSA where expertise in neurology or geriatrics might be limited outside urban centres, the CAM is unlikely to be useful in routine screening. In our cohort the CAM demonstrated excellent performance in differentiating delirium and dementia in those with major cognitive impairment (delirium or dementia) and those with cognitive impairment on screening (IDEA screen  $\leq 7$ ). It has been recommended that the CAM be used for confirmatory assessment in those found to have cognitive impairment on initial screening [29] due to the time taken to complete the assessment and level of skill required. In this hospital setting with trained personnel including physicians and neurologists, this approach should be feasible. In rural areas (where up to 63% of people in SSA live) and without specialist staff this approach may be problematic.

### **Screening using the IDEA cognitive screen**

Routine bedside structured cognitive assessment of older hospitalised adults at risk of delirium is recommended by existing good practice guidelines in HICs [12]. The diagnostic accuracy of the IDEA cognitive screen compared favourably to other previous validation studies [23, 26] and other commonly-used cognitive screening tests [36]. Diagnostic accuracy for major cognitive impairment (delirium and dementia) was lower than that previously reported in medical inpatients and outpatients in SSA (0.903 and 0.931 respectively) [23]. This may relate to the degree and severity of illness in this cohort.

Previous validation work took place in a small, government hospital where those who were seriously unwell were routinely transferred to tertiary services for further management.

Although the IDEA cognitive screen appeared clinically useful, a significant proportion of participants were unable to complete it. Over a third of the 83 individuals unable to attempt the IDEA screen due to lowered arousal or illness severity had DSM-V delirium and routine cognitive assessment with the IDEA screen might lead to these individuals being missed. A major finding of this study was that the IDEA cognitive screen alone did not differentiate delirium and dementia. Since only one participant had a previous dementia diagnosis, and



both delirium and dementia were highly prevalent, use of the IDEA alone would not differentiate individuals with delirium and needing urgent medical attention from those with long standing cognitive impairment. Nevertheless, it is unrealistic to expect any brief cognitive screen, including those commonly used in high-income settings, to be able to identify underlying reasons for poor screening performance.

### **Association with confounders**

The effect of visual impairment has not previously been evaluated in performance of the IDEA screen. In this study we found that significant and uncorrected visual impairment was highly prevalent, and that significant measured visual impairment correlated with a score  $\leq 7$  on the IDEA screen (the previously validated cut-off for major cognitive impairment), independent of age, education and the presence of delirium. This is likely to be due to difficulties in completing the matchstick praxis task and indicates that this needs to be taken into account when interpreting the IDEA score. Nevertheless, disregarding the matchstick item made little difference to test accuracy despite the high prevalence of visual impairment and since visuospatial impairments are commonly found in delirium, this test appears to be clinically useful. As in previous validation studies for dementia, the IDEA did not appear educationally biased in this setting despite the literacy rate being substantially higher than in previous validation studies.

### **Overall utility of screening tools**

Both CAM and IDEA greatly outperformed routine detection of delirium by nursing and medical staff as evidenced by mention of delirium or confusion in the medical notes. Improvement of detection rates through use of a structured screening method is well evidenced in HIC settings [11] and our findings indicate that routine delirium screening using an appropriate method is highly recommended.

### **Limitations**

A number of limitations are acknowledged. KCMC is a tertiary referral hospital and therefore those admitted would be expected to be more seriously unwell than in other hospital

settings. Educational level was higher than that recorded in previous validation studies of the IDEA cognitive screen in the same geographical region, indicating possible differences in socio-economic status. Our cohort might therefore not be typical of other settings in Tanzania. All cognitive tests were conducted in a very busy ward environment, which could at times be noisy, and this could have impacted on performance on cognitive tests, particularly for those with sensory impairment. Nevertheless no private or quiet environment for testing was available, and this therefore represented the 'real life' conditions in which cognitive assessment would normally take place. Similarly, we deliberately included all possible patients in this study, including those who may have been dysphasic or aphasic or with lowered level of consciousness. Although this may have affected screening tool performance, this reflects the situation in which these tools would be used.

Although a subset of individuals received a second review by a specialist (neurologist or physician) on the same day, it was not possible to provide a second independent clinical review for all patients due to resource implications in this busy hospital environment. Some individuals with cognitive fluctuations may therefore have been missed.

This was not a study of dementia or depression, and therefore milder cases may have been missed, particularly in those with delirium at assessment. Only 12 GDS assessments for depression were completed, suggesting that only those with the most severe symptoms were identified during neurocognitive assessment. The effect of depression on cognitive assessment with the IDEA screen cannot therefore be commented on. Nevertheless, we were able to obtain an informant history for almost all participants, and the vast majority of participants lived with family members. As a result, cognitive impairments were likely to have been observed and commented on by family members in the history. A strength of the study was the follow-up assessments for diagnostic clarification in cases of possible dementia, reducing the possibility that cases of dementia were missed. Finally, identification of delirium by treating medical staff was assessed only through retrospective case note review and it is possible that a greater number of cases were recognised, but not identified through this process.

## Conclusions

This study has evaluated the performance of a brief cognitive screening tool designed for identification of dementia (the IDEA cognitive screen) and the CAM in identification of delirium in a large tertiary referral hospital in Tanzania, with a similar presence of delirium on admission to that seen in HICs. Both tools performed well in identification of delirium, but sensitivity was reduced due to difficulty in completion of assessments by those individuals who were most severely unwell, and therefore likely to be at the greatest risk. The IDEA screen did not differentiate delirium and dementia. The CAM showed excellent diagnostic accuracy for delirium in individuals identified with cognitive impairment, but requires specialist knowledge for accurate completion. Using all relevant cognitive and behavioural assessment data collected during the study we have suggested a brief assessment for delirium designed for use by non-specialists which appears to identify delirium with a high degree of accuracy. Further development work and testing in other centres in SSA will confirm the utility of these screening items for delirium. Our findings indicate that use of a structured screening tool outperformed routine clinical assessment in identification of delirium as in previous HIC studies and routine use of a delirium screening tool in older hospitalised adults is therefore highly recommended.

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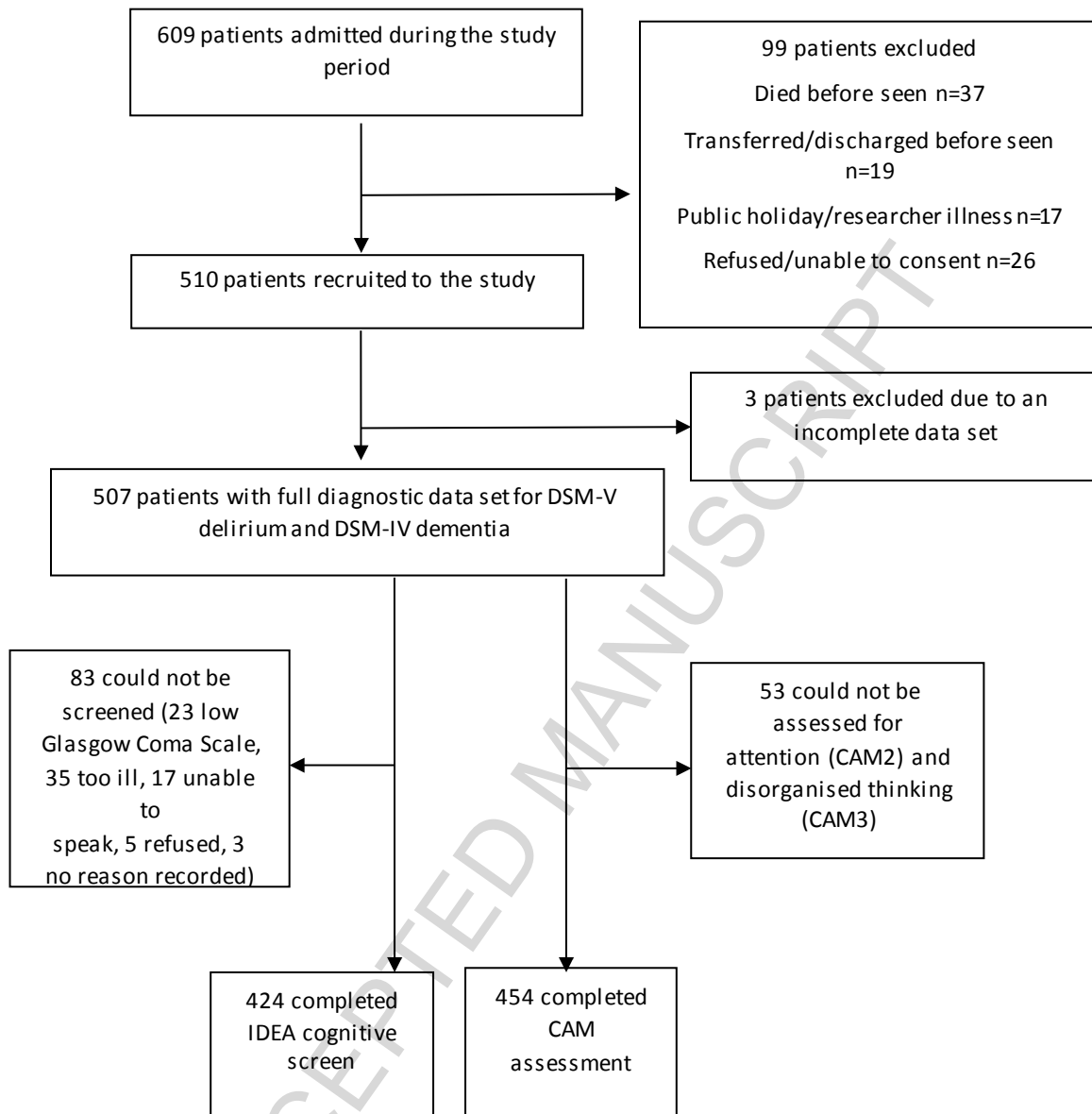
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**Figure 1:** Study recruitment and assessment flow chart

**Table 1:** Characteristics of the 507 patients included in the study

<b>Full days from hospital admission to assessment</b>	
1	415/497 (83.5%)
2	51/497 (10.3%)
3	27/497 (5.4%)
3-7	4/497 (0.8%)
<b>Median age (IQR)</b>	
	75 (67-81)
<b>Sex</b>	
	225 Females (44.4%)
<b>Highest educational level</b>	
Less than one year or none	96/500 (19.2%)
Some primary school	163/500 (32.6%)
Completed primary school	111/500 (22.2%)
Some secondary school	58/500 (11.6%)
Completed secondary school	34/500 (6.8%)
Tertiary education	38/500 (7.6%)
<b>AVPU arousal</b>	
A-Alert	400/501 (79.4%)
V-Voice	71/501 (14.1%)
P-Pain	12/501 (2.4%)
U-Unresponsive	21/501 (4.2%)
<b>Prevalence of dementia</b>	
Overall	95/507 (18.7%)
Males	47/282 (16.6%)
Females	48/225 (21.3%)
60-69 years	12/175 (6.86%)
70-79 years	26/173 (15.0%)
80 years and over	57/159 (35.8%)
<b>Prevalence of delirium</b>	
Overall	95/507 (18.7%)
Males	68/282 (24.1%)
Females	27/225 (12.0%)
60-69 years	25/175 (14.3%)
70-79 years	27/173 (15.6%)
80 years and over	43/159 (27.0%)
<b>Prevalence of major cognitive impairment</b>	
Overall	157/507 (30.9%)
Males	94/282 (33.3%)
Females	63/225 (28.0%)
60-69 years	31/175 (17.7%)
70-79 years	44/173 (25.4%)
80 years and over	82/159 (51.6%)
<b>Other psychiatric diagnoses</b>	
Depression	8 cases
Learning disability	1 case
Depression with psychosis	1 case
<b>Cognitive impairment identified by the medical team</b>	
Delirium	8 (6 DSM-V delirium 2 DSM-IV dementia)
Dementia	2 (1 DSM-V delirium 1 DSM-IV dementia)
Cognitive/behavioural problem 'disoriented', 'aggressive'	6 (5 DSM-V delirium, 1 DSM-IV dementia)



**Table 2:** Diagnostic accuracy of screening tools

<b>IDEA cognitive screen (n = 424)</b>	<b>Cut-off <math>\leq 7</math></b>	<b>Cut-off <math>\leq 8</math></b>
DSM-V delirium	sensitivity = 0.89, specificity = 0.70, ppv = 0.35, npv = 0.97	sensitivity = 0.92, specificity = 0.64, ppv = 0.31, npv = 0.98
Major cognitive impairment	sensitivity = 0.82, specificity = 0.77, ppv = 0.56, npv = 0.92	sensitivity = 0.88, specificity = 0.71, ppv = 0.52, npv = 0.94
<b>CAM (n = 454)</b>		
Delirium	sensitivity = 0.91 specificity = 0.97, ppv = 0.880, npv = 0.978	
Major cognitive impairment	sensitivity = 0.53 specificity = 0.90, ppv = 0.61, npv = 0.87	
<b>Individual CAM items</b>		
CAM 1 (n=499)	sensitivity = 0.95, specificity = 0.85, ppv = 0.60, npv = 0.97	
Delirium		
CAM 2 (n=454)	sensitivity = 0.94 specificity = 0.90, ppv = 0.69, npv = 0.99	
Delirium		
CAM 3 (n=448)	sensitivity = 0.72 specificity = 0.96, ppv = 0.80, npv = 0.94	
Delirium		
CAM 4 (n=496)	sensitivity = 0.86 specificity = 0.85, ppv = 0.56, npv = 0.96	
Delirium		

ppv – positive predictive value,

npv – negative predictive value

**Table 3:** Independent predictors of DSM V delirium form screening and assessment items

	<b>Parameter estimate</b>	<b>Odds ratio (95% CI)</b>	<b>Weight</b>
<b>Unable to recall any words on 10 word list</b>	1.169	3.217 (1.291 to 8.016)	1
<b>Positive CAM1</b>	3.468	32.074 (11.333 to 90.776)	4
<b>Positive CAM4</b>	1.454	4.280 (1.869 to 9.802)	2
<b>Male</b>	0.957	2.604 (1.268 to 5.349)	1

**Highlights**

- Identification of delirium is challenging in Africa and screening tools are lacking
- The CAM and IDEA screen had clinical utility, but limitations in this setting
- A novel brief delirium screen for older inpatients is proposed for further validation

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