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A prospective observational study to investigate utility of the Delirium Observational Screening Scale (DOSS) to detect delirium in care home residents

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Abstract

Background

Care home residents are particularly at risk of delirium due to high prevalence of dementia. The Delirium Observation Screening Scale (DOSS) identifies behavioural changes associated delirium onset that nursing staff are uniquely placed to recognise. We tested the psychometric properties of the DOSS in UK care homes compared with the Confusion Assessment Method (CAM).

Design

Prospective observational cohort study performed between 01/03/2015 and 30/06/2016.

Setting

9 UK residential and nursing care homes.

Subjects

Residents over 65 years except those approaching end of life or unable to complete delirium assessments.

Methods
The 25-item DOSS was completed daily by care home staff and compared with the temporally closest CAM performed twice per week by trained researchers. Sensitivity, specificity, positive and negative predictive values, diagnostic odds and likelihood ratios were calculated.

Results
216 residents participated; mean age 84.9 (SD 7.9); 50% had cognitive impairment (median AMTS 7 (IQR 3 to 9)). Half of all expected DOSS assessments occurred (30,201); of these, 11,659 (39%) were complete. 78 positive CAM measurements were made during 71 delirium episodes in 45 residents over 70 weeks. Sensitivity and specificity for delirium detection were optimised at a DOSS cut-point of >=5 (sensitivity 0.61 (95% CI: 0.39-0.80) and specificity (0.71 95% CI: 0.70-0.73)). Positive and negative predictive values were 1.6% and 99.5% respectively.

Conclusions
The low sensitivity of the DOSS limits clinical utility for detection of delirium as part of routine care for care home residents, although a negative DOSS affords confidence that delirium is not present.

Key words
Delirium, Screening, Diagnostic Test Accuracy, Care Home, Delirium Observation Screening Scale

Key points
- Routine administration of the DOSS for delirium screening by care home staff is feasible
- The 25-item DOSS has low sensitivity, but acceptable specificity for the detection of delirium in care homes
- Delirium is very unlikely if the total DOSS score is less than 5.

Introduction
Delirium is a common and serious clinical syndrome characterised by sudden onset of altered cognition and impairments of attention and awareness(1). Symptoms fluctuate over days or hours and often manifest as changes in behaviour. Delirium is associated with increased risk of new or accelerated cognitive problems (2), functional decline and death (3). The onset of delirium may be the first indicator of a change in health state, e.g. urinary tract infection.

Delirium is expected to be common in care homes due to the high prevalence of dementia: a key delirium risk factor(4). Based on expert consensus of reported estimates, the 2014 Dementia UK report cites dementia prevalence of 58% in residential and 73% in nursing care home residents (5). Care home staff are particularly well placed to detect changes in residents' behaviour that may indicate onset of delirium. However, many diagnostic tools for detection of delirium require time and expertise to administer and this limits their utility for use in routine care (6). Following a review of the literature, we identified the Delirium Observation Screening Scale (DOSS) (7), as a candidate instrument for delirium detection in care homes due to its ease and speed of use and its good psychometric properties when used by nurses in hospital wards (sensitivity 89%, sensitivity 88% (8)).

We conducted a study to test the feasibility, diagnostic test accuracy and test-retest reliability of the DOSS when used to detect delirium as part of routine care in care homes.

Methods

Study design

Prospective observational cohort study of the feasibility and test accuracy of the DOSS completed by care home staff compared with the Confusion Assessment Method (CAM) (9) completed by research staff.

Recruitment

Sites

Nursing and residential care homes in Bradford, Leeds, Harrogate and York were invited to participate. Sites were eligible providing there was agreement from the care home manager to release care home staff to attend training sessions, and to embed daily 25-item DOSS assessment into routine practices. Care homes participating in other research studies likely to impact on the incidence or prevalence of delirium were excluded.

Participants

Exclusion criteria were age under 65 years; approaching end of life or in receipt of palliative care (as advised by care home staff); and communication difficulties significant enough to preclude completion of the CAM for delirium assessment.

Participant consent

Following eligibility screening and an assessment of capacity to consent to participate in the study, written informed consent was sought. A combined capacity and consent process was used to maximise the likelihood of an informed decision (10). For residents lacking capacity to consent to participate, agreement to take part in the study from a personal or nominated consultee was sought, based on best interests of the potential participant (11).

Ethics approval

Ethical approval was granted from Leeds West Research Ethics Committee (14/YH/1174).

Study procedures

Assessments

Screening

All residents in participating care homes were screened for eligibility unless the care home manager identified that they met exclusion criteria. Screening data comprised: age; sex; established diagnosis of dementia, or positive response to the dementia screening question: "*Has the person been more forgetful in the last 12 months to the extent that it has significantly affected their daily life*" (12).

Baseline assessment

For residents recruited to the study, the Abbreviated Mental Test Score (AMTS) (13) and a baseline CAM (9) were also performed.

Study assessments

Delirium Observation Screening Scale (DOSS)

The DOSS was developed in the Netherlands for use in acute care settings to identify features of affect or behaviour that facilitate recognition of Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) defined criteria for delirium (7). Completion takes less than five minutes and is based on non-technical observations from nurses or carers as they provide regular care.

The 25-item DOSS has been shown to have content validity and internal consistency for the detection of delirium (Crohnbach's alpha 0.93 and 0.96 respectively) (7) . Concurrent validity against established delirium diagnostic instruments is good (7).

The original 25-item DOSS had been refined to a shorter 13-item scale (14) which has a predilection for items relating to hyper-active delirium. We used the longer form of the instrument in order to maximise the likelihood of detecting hypoactive delirium, and to facilitate future development of a shorter, care home specific version of the instrument.

Twelve questions of the DOSS were re-worded to simplify the language and for question 17, "pulls at intravenous tubes" was substituted for "pulls at catheter or oxygen tubing" as intravenous treatments would not be routine in a UK care home. The overall number of questions remained 25. Individual questions were scored 0 (behaviour never observed) or 1 (behaviour sometimes or always observed) in keeping with the scoring schedule for the 13-item DOSS. A higher score indicates features more indicative of delirium: questions 1, 5, 13 and 14 are reverse scored. We asked staff to complete the assessment instrument daily supplemented with information gathered from shift handovers to inform presence or absence of night-time behaviours.

Confusion Assessment Method (CAM)

The CAM is an operationalised approach to the application of the DSM-III delirium diagnostic criteria which is used extensively in research (15), and recommended by NICE to confirm the presence of delirium in routine clinical care (16). The CAM comprises four components, i) acute onset and fluctuating course, ii) disturbance of attention, iii) additional cognitive disturbance, iv) altered level of consciousness. A CAM assessment is positive when a participant has components (i) and (ii), and either (iii) or (iv). Administration takes between 5 and 10 minutes. It has high sensitivity and specificity for the detection of delirium (pooled estimates of 94% and 89% respectively) (15), although sensitivity may be lower (77%) in populations with high prevalence of dementia (17). A structured approach was adopted to complete the CAM that included information gathering from care home staff, assessing inattention using the Months of the Year Backwards (MOTYB) test, and testing abstract thought / reasoning by researchers judging the participants understanding of the meaning of well-known proverbs (18).

Training

Care Home staff

Interactive small group training sessions (2 hours) were provided for of the staff of the participating care homes. These sessions were based on contextualising the previous experience of the care home staff in the behavioural disturbances associated with delirium, and how to use this information to complete the DOSS instrument.

Research staff

Research staff were trained in the administration of the CAM instrument by a consultant geriatrician. in accordance with the CAM administration manual (9). Training included face-to-face learning, interactive learning and scenario based delirium detection sessions. Additionally, researchers were observed completing the CAM in the care home setting. Regular monthly checks of inter-rater reliability (five residents) were performed between the research assistants throughout the course of the study.

Data collection

Research assistants performed CAM assessments twice per week (excluding weekends) for all residents recruited into the study and scored according to the algorithm in the CAM administration handbook (9). DOSS assessments were performed daily by the care home staff using paper based forms. Assessments were repeated for each resident once per week by a different member of care home staff for assessment of inter-rater reliability.

Sample size

Sample size was calculated to give 95% confidence that the true sensitivity and specificity of the DOSS were within 5% of the observed value using the normal approximation to the binomial proportion distribution, and published estimates of pooled sensitivity (92%) and specificity (82%) (19). To achieve this, 113 episodes of delirium were required during the study. An inflation factor of 1.5 was applied to allow for the repeated measurements (170 episodes of delirium). Previous studies in long term care settings allowed calculation of a period prevalence of delirium of 21.8% in 24 weeks (20); and an average duration of delirium of 11 days (21). Based on these figures, we estimated that the requisite number of assessments would be made in 258 residents during 36 weeks.

Analysis

We considered consecutively positive CAM assessments obtained within three days of each other to represent the same episode of delirium. Delirium incidence was calculated as the number of CAM positive episodes of delirium during the study period divided by cumulative time at risk for all participants (from recruitment to death or end of the study), presented per 100 person-weeks.

The feasibility of administration of the DOSS by care home staff was examined through exploring the rates of missing data for each item. Inter-rater reliability was assessed through calculation of intra-class correlation coefficients between staff-administered DOSS assessments with a two way random effects model. Diagnostic test accuracy (DTA) of the DOSS was measured against the reference test (CAM). We compared the researcher administered CAM result to the temporally closest (date and timed) DOSS measurement. Only paired assessments made within 24 hours, and where both DOSS and CAM had no missing data were used. A binary logistic regression model with clustered robust standard errors was used to account for clustering within individuals. Sensitivity, specificity, positive and negative predictive values, likelihood ratios positive and negative and a diagnostic odds ratio were calculated. Cut-points for the 25-item DOSS for those with, and without pre-existing cognitive impairment were determined at the values which maximised the area under the receiver operating curves (ROC), corresponding with optimal trade-off between sensitivity and specificity. Analyses were performed in STATA version 13 (22).

Research protocol

The protocol for this work was published prior to the end of recruitment (23). Trial registry number: ISRCTN 14608554.

Results

Demographics

509 care home residents were screened in nine care homes between 01/03/2015 and 30/06/2016; 390 residents were eligible and 216 were recruited (see figure 1).

Baseline demographics of the recruited and not recruited residents were comparable (Table 1). Fifty percent of participants had either a previous diagnosis of dementia, or a positive response to the cognitive impairment screening question. The median AMT score for residents recruited to the study was 7 (IQR 3 to 9); 34 residents died during the study (18%). The distribution of total DOSS scores was right skewed with a median 1 (IQR 0-3) for those without cognitive impairment, and median 4 (IQR 2-8) for those with cognitive impairment.

Delirium occurrence

A CAM was recorded for 197 participants at baseline, 2 of these were positive. We recorded 78 positive CAM measurements during 71 episodes of delirium in 45 residents over the course of the study. Overall incidence of CAM positive delirium was 0.85 episodes per 100 person-weeks; period prevalence was 33% (71 episodes in 216 residents).

Feasibility of DOSS use

Of 58, 920 DOSS assessments expected during the 16 months of the study, 30,201 (51%) were performed and 10,945 of these (36 %) had no missing items; a further 38% had only one missing item. Patterns of missing items revealed that questions 17 (pulls at catheter or oxygen tubing), 20 (has vivid and frightening dreams during the night) and 21 (was awake/woke up often during the night) were poorly completed with 51%, 18% and 20% missing respectively. With these items removed, 89% (12,238) of all DOSS assessments were complete over the course of the study.

Inter-rater reliability

Inter-rater reliability of the DOSS was based on 141 participants for whom observations had been repeated concurrently by independent observers. Inter-rater reliability of the DOSS was good (ICC=0.71, 95% CI: 0.61-0.78).

Inter-rater reliability for the CAM was conducted with 108 residents. Overall the total CAM severity score had an excellent kappa co-efficient of 0.8 (SE 0.20). The proportion of exact agreement was 99%.

Diagnostic test accuracy

11, 697 CAM assessments were performed by the research staff. In 7,999 instances, CAM and DOSS assessments were performed within 24 hours of each other and diagnostic test accuracy analysis has been performed on these paired assessments.

A cut point of 5 or more on the 25-item DOSS maximised sensitivity (0.61 95% CI: 0.39-0.80) and specificity (0.71 95% CI: 0.70-0.73); area under the receiver operating curve was 0.66 (95% confidence interval 0.58-0.80). Diagnostic odds ratio was 3.9, positive predictive value 1.3%, negative predictive value 99.5%. Likelihood ratios were 2.1 positive, and 0.55 negative. Removal of poorly completed items (questions 17, 20, 21) did not improve the overall diagnostic test accuracy of the DOSS to detect delirium.

In residents with cognitive impairment, a DOSS cut point of 7 maximised the sensitivity and specificity of the DOSS to detect CAM positive delirium (sensitivity 0.60 (95%CI: 0.30-0.90), specificity 0.72 (95%CI: 0.70-0.74), diagnostic odds ratio 3.9).

Diagnostic test accuracy for residents without cognitive impairment was better and optimised at a DOSS cut point of 3 or more (sensitivity 67% (95%CI: 0.36-0.98), specificity 71% (95%CI: 0.68-0.74), diagnostic odds ratio 5.0).

Discussion

The National Institute for Health and Care Excellence (NICE) has recommended that all residents in care homes are observed daily for changes in behaviour that might indicate delirium (16). Use of the DOSS instrument is a possible mechanism to achieve this, but there are resource implications. Across a 40-bedded care home unit, once daily administration of the DOSS would require up to 3 hours of staff time. Our prospective study has demonstrated that incorporating routine administration of the DOSS into care homes is feasible following a single two hour interactive small group staff training session. Training focused on the behavourial features of delirium contextualised with previous experience of the staff, and could be incorporated into a more general delirium awareness package. Inter-rater reliability of the DOSS is good when administered by different members of the care home team. Routine DOSS administration was sustained throughout the study and three quarters of assessments were either complete or had one missing item. Three DOSS questions (17, 20, 21) were responsible for almost two-thirds of non-completed items. These related to night-time observations of residents or were relevant only to a limited number of care home residents (catheters / oxygen tubing). With these items removed, 89% of the DOSS assessments were fully completed, and removal of these items did not affect the sensitivity or specificity of the instrument.

A key finding from our study was the high negative predictive value of the DOSS indicating that a diagnosis of delirium is very unlikely (5 in 1000) in the context of a DOSS score of four or less. One possible use of the DOSS, therefore, might be as a way to increase confidence that a resident does not have delirium. Using an alternative cut-point of >=3 for those without prior cognitive impairment improved sensitivity without loss of specificity.

We found the incidence of delirium in care homes was about half of that previously reported in both Canadian (2.2 per 100 person weeks) (20), and UK long term care facilities (1.8 per 100 patient weeks) (24) (PiTSTOP). This could indicate that we studied a population less at risk from delirium than the previous studies (which could result in less precision around diagnostic test accuracy estimates), or that our application of the CAM resulted in systematic underdetection of delirium (which could affect detection of true positive cases and therefore the sensitivity estimate of the DOSS).

We plan further examination of the DOSS. Firstly we will assess the scalability of the 25-item scale. Second, we will explore whether the magnitude of deviation from an individual's usual baseline DOSS score (indicating new behavioural disturbance) can indicate onset of delirium. Finally, we will determine whether the DOSS may be helpful in describing delirium phenomenology.

Conclusion

Although feasible to complete, the low sensitivity of the DOSS limits its clinical utility to identify delirium in care home residents. The high negative predictive value means that residents with a negative DOSS assessment are extremely unlikely to have delirium, and the instrument may be useful to exclude delirium in this context.

Duplicate Publishing

The preliminary results from this study were presented in poster and abstract format at the European Delirium Association meeting in Villamoura, Portugal in November 2016.

Conflicts of interest

ET, TM, NS and JY all declare no conflicts of interest.

Sources of funding

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Table 1 Baseline characteristics of eligible residents

Eligible residents N = 390	**Not recruited** **N= 174**	**Recruited** **N=216**
Age (SD)	85.9 (7.5)	84.9 (7.9)
Sex N (%) Female	115 (66)	131 (61)
Previous dementia (%)	59/174 (34)	87/216 (40)
Positive answer to dementia screening question (%)	28/174 (16)	28/216 (13)
Any cognitive impairment	87/174 (50)	115/216 (53)

Figure 1 CONSORT diagram

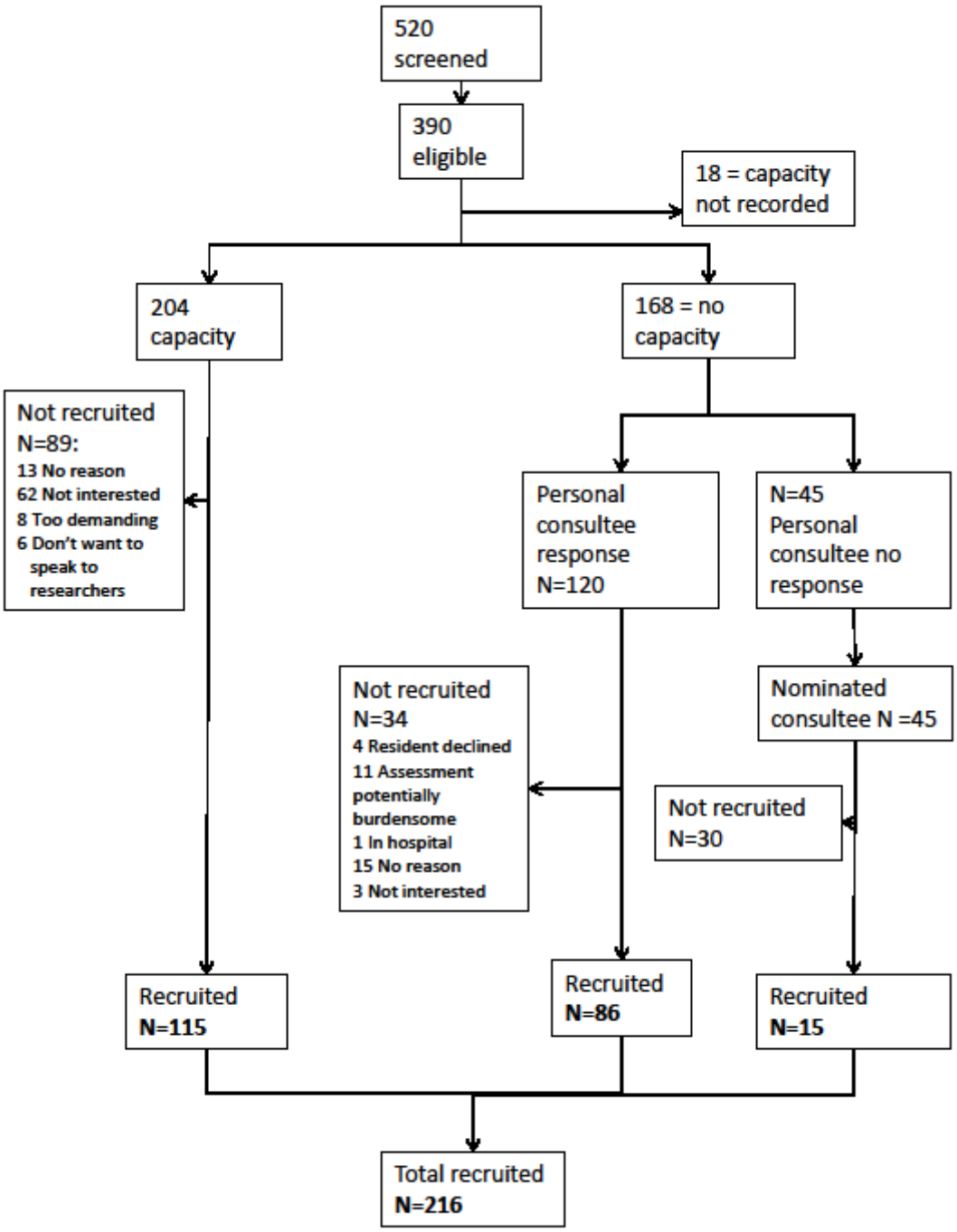

Table 2 2x2 contingency tables stratified by cognitive impairment

		CAM positive	CAM negative	
Cut point = 5 all participants	DOSS positive	14	809	823
	DOSS negative	9	2022	2031
		23	2831	2854
		CAM positive	CAM negative	
Cut point 3 participants without cognitive impairment	DOSS positive	784	3	787
	DOSS negative	327	6	333
		1111	9	1120
		CAM positive	CAM negative	
Cut point 5 participants with cognitive impairment	DOSS positive	908	4	912
	DOSS negative	353	6	359
		1261	10	1271

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