Retrospective delirium ascertainment from case notes

Geriatric Medicine Research Collaborative

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ABSTRACT

Objectives This study sets out to ascertain if recognition of delirium impacts on patient outcomes.

Design Retrospective cohort study.

Setting Unscheduled admissions to acute care trust/secondary care UK hospitals.

Participants Six hundred and fifty-six older adults aged ≥65 years admitted on 14 September 2018.

Measurements Delirium was ascertained retrospectively from case notes using medical notes. Documented delirium was classified as recognised delirium and retrospectively ascertained delirium was classified as unrecognised delirium.

Primary and secondary outcome measures Primary outcome measure: inpatient mortality. Secondary outcome measures: length of stay, discharge destination.

Results Delirium was present in 21.1% (132/626) of patients at any point during admission. The presence of delirium was associated with increased mortality (HR 2.65, CI 1.40 to 5.01). Recognition of delirium did not significantly impact on outcomes.

Conclusions Delirium is associated with adverse outcomes in hospitalised older adults. However, there is insufficient evidence that recognition of delirium affects outcomes. However, delirium recognition presents an opportunity to discuss a person's overall prognosis and discuss this with the patient and their family. Further research is needed to assess the pathophysiology of delirium to enable development of targeted interventions towards improved outcomes in patients with delirium.

Strengths and limitations of this study

- ► Our unique retrospective approach has enabled true determination of the effect of delirium recognition on outcomes.
- ► Collaborative research has enabled collection of data from multiple sites across the UK.
- ► We adjusted for variables including age, gender, dementia status, frailty and specialty; we were unable to adjust for disease or delirium severity.

INTRODUCTION

Delirium is a common neuropsychiatric manifestation of physical precipitants (including acute illness, medications, trauma and surgery) and systemic inflammation.[1] The presence of delirium is known to be associated with increased risk of adverse outcomes (twofold increased mortality,[2–4] increased length of hospital stay[3–5] and increased risk of care home placement[2 3]). Outcomes have been shown to be worse with longer duration of delirium.[6] There is good quality evidence that multifactorial interventions can be used to prevent delirium in at-risk individuals,[7 8] but there is no known single intervention for the treatment of delirium, beyond treating recognised precipitants.[8 9]

Despite this, delirium is known to be frequently under-recognised[10]; only a third of cases were recognised in our previous prospective study of delirium point prevalence in unscheduled admissions of older adults.[4] International programmes strive to increase delirium recognition.[11] This is important to enable explanation of diagnosis and prognosis to patients, relatives and carers. However, the effect of recognition of delirium on clinical outcomes has been unknown. One previous single-site study demonstrated increased adverse outcomes for patients with delirium who were discharged early.[12] Prospective studies often lead to recognition of delirium by nature of their study design; thus, the effect of recognition cannot truly be evaluated.[4] This study aimed to evaluate the effect of recognition of delirium on adverse outcomes using a retrospective cohort design.

METHODS

Cohort identification

This was a multicentre retrospective cohort study within the UK using case notes review. Patients were identified through consult with site patient record and informatics teams. We included patients aged 65 years and older, who were admitted on 14 September 2018 across all sites as unscheduled admissions, with lengths of stay of 2 days or greater.

a	A disturbance in; i) Attention- reduced ability to direct, focus, sustain, and shift attention FROM: 20-1, MOYB (if done), comments including "distractible", "inattentive", or similar OR ii) Awareness (reduced orientation to the environment) FROM: comments including "drowsy", "agitated", or similar	**Yes**	No	?
b	The disturbance; i) Develops over a short period of time (usually hours to a few days) Ii) Represents a change from baseline attention & awareness iii) tends to fluctuate in severity during the course of the day FROM: documentation as new problem by medical staff, or relative concern	**Yes**	No	?
c	An additional disturbance in cognition (e.g. memory deficit, disorientation, language, visuospatial ability, or perception). FROM: AMTS, MOCA (if done), comments of "confusion", or similar	**Yes**	No	?
d	Exclusions- The disturbance in criteria A and C are; i) Better explained by another pre-existing, established, or evolving neurocognitive disorder, or ii) Occur in the context of a severely reduced level of arousal such as coma. FROM: History suggestive of progressive condition on admission OR severely obtunded patient e.g. in the context of Type 2 respiratory failure requiring ICU admission	Yes	**No**	?
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, or exposure to a toxin, or is due to multiple aetiologies. FROM: Acute illness/precipitant of any description (should be yes for all patients)	**Yes**	No	
	Probable Delirium Diagnosis – all items a,b,c and e 'yes', plus d 'no'	**Yes**	**No**	
	Possible delirium diagnosis – if any '?' or e 'no'	Yes	No	

Figure 1 Criteria used for retrospective delirium diagnosis as adapted from DSM-5. A diagnosis of probable delirium was made in retrospective case notes reviewed in patients who satisfied criteria of 'yes' to a, b, c and e, and 'no' to d. DSM-5,Diagnostic and Statistical Model of Diseases, fifth edition. AMTS = Abbreviated Mental Test Score; MOCA = Montreal Cognitive Assessment

This project was performed as a substudy within a larger quality improvement project; the date were chosen as it was 6 months before and after the dates of separate prospective data collection. We excluded patients who were admitted to critical care during their admission or who were admitted electively. Delirium is known to be common in patients admitted to critical care but requires a separate screening process,[13] and our retrospective ascertainment has not been validated in this group.

Retrospective delirium ascertainment

Data collectors were clinicians with expertise in delirium diagnosis. Data collectors reviewed case notes from the admission to assess for documentation of a delirium diagnosis by the clinical team. If a delirium diagnosis was made at any stage, this was classified as recognised delirium and assumed to be a true diagnosis. If there was no diagnosis of delirium, data collectors proceeded to retrospectively ascertain if there was evidence of delirium through the clinical notes. Probable delirium diagnosed from case notes vignettes has been shown to be sensitive to identification of prospectively diagnosed delirium.[14] Ascertainment of delirium status was based on the Diagnostic and Statistical Model of Diseases, fifth edition (DSM-5) (figure 1).[15] Change in awareness is not required as part of the relaxed DSM-5 definition.[16] As inattention is more difficult to identify retrospectively if screening has not been performed, we used a relaxed definition requiring the presence of disturbances in either attention or awareness. Our approach was previously piloted in a single site as part of another study, with excellent agreement between multiple data collectors.[17] If patients met some but not all criteria for DSM-5 delirium, then a diagnosis of possible delirium was recorded.[14] Data collectors recorded whether delirium was prevalent (present on admission) or incident (acquired during their hospital stay). The subtype and delirium duration were recorded from case notes review where possible. Delirium ascertained retrospectively was classified as unrecognised delirium. Data collectors also recorded if patients had been screened for delirium within 48 hours of admission (regardless of presence/ absence of delirium) and whom screening was performed by (training doctor below registrar level/geriatric medicine registrar or consultant/general medicine registrar or consultant/surgical registrar or consultant/nurse or allied health professional). We did not collect information on the screening tools used.

Other variables recorded

Age, gender, frailty, dementia and main specialty during admission were all recorded from inpatient notes or local hospital electronic data collection. Clinical Frailty Scale (CFS)[18] was retrospectively ascertained by data collectors from the inpatient clinical notes using

information available on social and functional history recorded by the clinical team (doctors, nurses or allied health professionals involved in their care). Dementia status was recorded based on documentation of known history or high clinical probability considered by data collectors. Data collectors made a clinical diagnosis of probable dementia if there was documentation of pre-existent cognitive decline affecting the patient's activities of daily living, but a formal diagnosis had not been made. Specialty was recorded as one of seven groups: acute medicine, geriatric medicine, stroke medicine, other medicine, orthopaedic surgery, general surgery or other surgery. Data on length of hospital stay, mortality and discharge location were collected up until 1 month after admission. Each site also provided data on if their site had a specialised delirium team, a geriatric medicine service embedded into the admissions unit, a delirium assessment tool in the clerking booklet, local delirium guidelines or a local delirium patient/carer leaflet at the time of the study.

Central data collation

Individual hospital sites were required to register to participate in this study via REDCap; REDCap is a secure browser-based web application that ensures enables protected collation of data. All data collected via REDCap were fully anonymised. Data upload forms were formatted, so that data could only be uploaded in the prespecified formats.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, V.22 (IBM, Armonk, New York, USA). Descriptive statistics were reported as mean, SD and frequencies. Probable dementia was considered as dementia for data analysis. Frailty was analysed as CFS 1–3 (robust), 4–6 (prefrailty/ frailty) and 7–9 (advanced frailty/end of life). We used logistic regression to determine factors that were predictive of screening and recognition. We used binary logistic regression and Cox regression to assess if the presence of delirium was predictive of inpatient death compared with no delirium. We then used binary logistic regression and Cox regression to assess whether unrecognised delirium was predictive of inpatient death as compared with recognised delirium. The same approach was used to assess if recognition of delirium was predictive of new institutionalisation (discharge to a new care home), by first assessing the effect of delirium overall and then recognition. Length of stay was $\log^{10}$ transformed to obtain a normal distribution, and linear regression was used to analyse the effect of delirium and the effect of delirium recognition. Delirium duration was also log transformed with linear regression used to assess the effect of delirium recognition on delirium duration. Variables included in multivariable analysis were age, gender, dementia status, frailty and specialty. Additional models were analysed with subtype and duration of delirium as additional variables.

Patient and public involvement

Prior to conduct of this study, the investigators held multiple discussion groups with both healthy older adults and older adults who had previously been hospitalised as well as their carers. Healthy older adults expressed that delirium would be a condition of particular concern and one of their greatest anxieties around being admitted to hospital. Relatives of patients who had been hospitalised with delirium reported that it was a frightening experience, with concerns about how long it would continue and whether their relative was likely to improve.[19] Data collection was performed from case notes, so there was no increased burden to patients in this study. Results were disseminated alongside increasing awareness of delirium to members of the general public on World Delirium Awareness Day using local stands at participating sites.

RESULTS

A total of 2147 patients were identified across 27 different UK hospitals. Reasons for exclusion were critical care admission (23), elective admission (388), admission less than 2 days (442), age (520), logistical reasons (100) and other nondeclared reasons (17). A further patient was excluded from analysis due to incomplete data upload and 30 patients due to admission less than 2 days. A total of 626 patients from 27 different hospitals were included. Figure 2 shows the flowchart of patient data inclusion within this study.

The mean age was 80.3 (SD 8.2) and 53.8% (337/626) was women. The majority (77.0%; 482/626) was admitted under medical specialties, the remainder being admitted under surgical specialties (30.0%; 144/626). Considering frailty, 29.6% (185/625) were classified as robust (CFS 1–3), 52.9% (331/625) were classified as prefrail/ frail (CFS 4–6) and 17.4% (109/625) were classified as advanced frail/end of life (CFS 7–9). Dementia was present in 17.3% (108/626) and a further 2.9% (18/626) had probable dementia. Demographics for all patients overall and separated by delirium status are shown in table 1.

Delirium prevalence and incidence

Delirium was present in 21.1% (132/626) at some point during their admission; 4.5% (28/626) incident cases and 16.6% (105/626) prevalent cases. Prevalence at individual sites is available online (online supplemental table S1). Delirium was documented in the notes of 56.8% (75/132) of cases, the remainder (43.2%; 57/132) being diagnosed retrospectively. A further 2.4% (15/626) had evidence of possible delirium on retrospective notes analysis. Considering subtype, 33.3% (44/132) were hypoactive, 31.1% (41/132) were hyperactive, 12.9% (17/132) were mixed and 22.7% (30/132) had no clear motor subtype. The median duration of delirium was 5 days (IQR 3–11). In adjusted models, the presence of dementia (OR 2.51, CI 1.53 to 4.13; p<0.001) and increasing frailty status (CFS 4–6: OR 2.61, CI 1.34 to 5.05; p=0.004; CFS 7–9: OR 4.04,

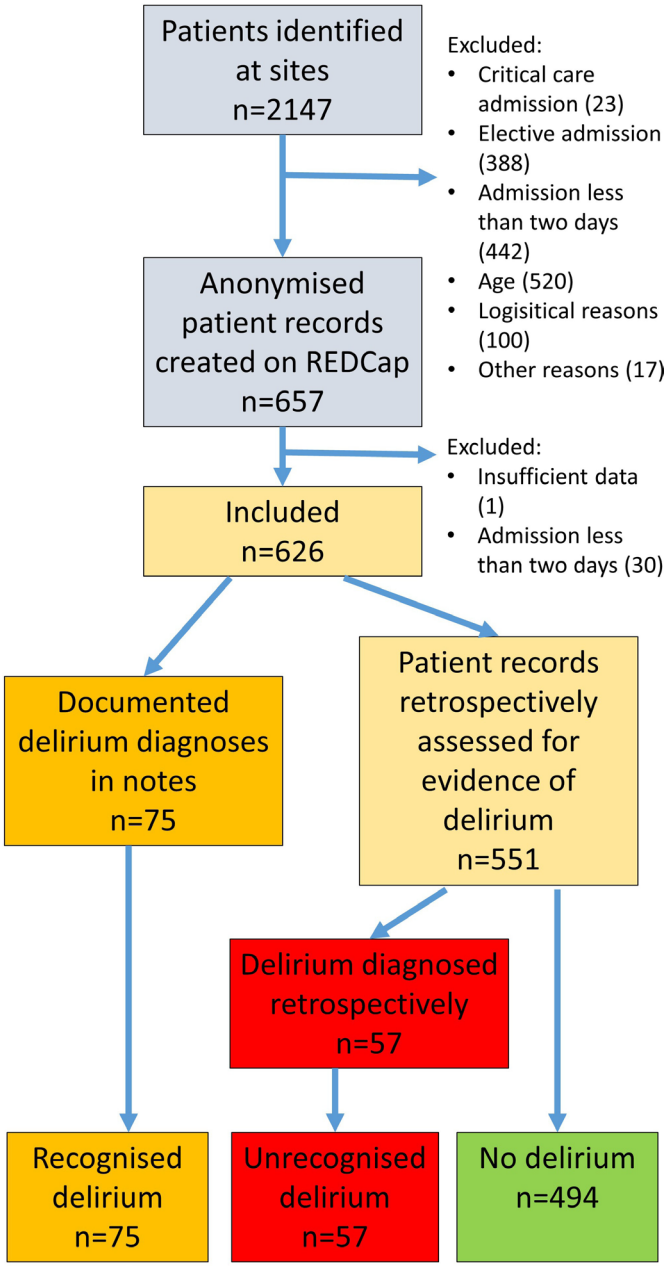

Figure 2 Flowchart of patient identification and delirium diagnosis. Case notes were reviewed in 656 patients, of whom 75 had a recognised diagnosis of delirium and a further 57 were considered to have unrecognised delirium.

CI 1.88 to 8.71; p<0.001) were associated with increased odds of delirium (online supplemental table S2). There were reduced odds of delirium in patients admitted to other surgery specialties (not general or orthopaedic) (OR 0.10, CI 0.01 to 0.75; p=0.026) and stroke specialties (OR 0.12, CI 0.02 to 0.92; p=0.042).

Screening and recognition

Overall, 30.4% (190/626) were screened for delirium within 48 hours of admission. Where screening was performed, 46.2% (85/184) were performed by a doctor less senior to registrar level (foundation year 1 through to core medical training year 2), 33.2% (61/184) were performed by a nurse or allied health professional, 9.8% (18/184) were performed by a geriatric medicine registrar or consultant, 8.7% (16/184) were performed by a registrar or consultant in another medical specialty and 2.2% (4/184) were performed by a surgery registrar or consultant. The presence of dementia (OR 1.63, CI 1.01 to 2.61; p=0.044) and increased age (OR 1.03 per year of life, CI 1.00 to 1.05; p=0.031) were associated with increased odds of delirium screening. Admission under general surgery (OR 0.41, CI 0.18 to 0.98; p=0.045) and other medicine specialties (OR 0.56, CI 0.33 to 0.97; p=0.039) were associated with reduced odds of screening (online supplemental table S3).

Of those patients who were considered to have delirium through either documentation in the notes or retrospective identification, delirium was considered to be recognised in 56.8% (75/132). Recognition rates at individual sites are available online (online supplemental table S1). Screening for delirium was associated with increased odds of recognition (OR 5.05, CI 2.19 to 11.65; p<0.001) and this was not affected by grade or profession of screener. Recognition was not affected by age, gender, dementia status, frailty or specialty (table 2).

Effect of delirium on outcomes

Delirium was associated with increased odds of inpatient mortality in both univariable (OR 4.74, CI 2.56 to 8.76; p<0.001) and multivariable (OR 3.27, CI 1.65 to 6.48; p<0.001) analysis (online supplemental table S4). These results were duplicated in time to event analysis in multivariable analysis (HR 2.65, CI 1.40 to 5.01; p<0.001) (table 3). The presence of delirium was associated with increased odds of new discharge to a care home in univariable (OR 2.57, CI 1.08 to 6.14; p=0.033) but not multivariable (OR 1.26, CI 0.48 to 3.36; p=0.639) analysis (online supplemental table S5). Length of stay did not significantly differ in patients with delirium compared with those without (online supplemental tables S6, S7).

Effect of delirium recognition on outcomes

Recognition of delirium did not impact on the risk of inpatient mortality in univariable or multivariable analysis in either logistic regression or time to event analysis in a statistically significant manner (HR 0.72, CI 0.24 to 2.12; p=0.547) (table 3 and online supplemental table S8). Similarly, recognition did not statistically significantly impact on the odds of new discharge to a care home (OR 2.59, CI 0.16 to 41.43; p=0.501) (online supplemental table S9) or length of hospital stay in univariable or multivariable analyses (online supplemental tables S10 and S11). However, recognition of delirium was associated with an increased duration of delirium compared with unrecognised delirium (+1.55 days, CI 1.10 to 2.19; p=0.012) (online supplemental tables S12 and S13). Inclusion of delirium duration and subtype in multivariable analysis did not affect the impact of recognition on mortality, length of stay or new discharge to a care home.

Table 1 Demographics of patients included in study

	All	No delirium	Delirium	P value
Age (mean, SD)	80.3 (8.2)	79.6 (8.2)	82.9 (8.1)	<0.001
Gender (% female)	53.8% (337)	54.9% (271)	50.0% (66)	0.320
Dementia (known/probable %)	20.2% (126)	14.4% (71)	41.7% (55)	<0.001
Clinical frailty scale				
1–3	29.6% (185)	34.9% (172)	9.8% (13)	<0.001
4–6	53.0% (331)	52.1% (257)	56.1% (74)	
7–9	17.4% (109)	13.0% (64)	34.1% (45)	
Specialty				
Acute medicine	19.5% (122)	19.0% (94)	21.2% (28)	<0.001
Geriatric medicine	25.7% (161)	20.4% (101)	45.5% (60)	
Stroke	4.3% (27)	5.3% (26)	0.8% (1)	
Other medicine	27.5% (172)	29.1% (144)	21.2% (28)	
Other surgery	6.7% (42)	8.3% (41)	0.8% (1)	
General surgery	7.7% (48)	8.5% (42)	4.5% (6)	
Orthopaedic surgery	8.6% (54)	9.3% (46)	6.1% (8)	

Patients with delirium were older, more likely to have dementia, and more likely to be frail compared with those without delirium. The prevalence of delirium in patients admitted other surgical specialties other than general or orthopaedic was lower than across other specialties.

DISCUSSION

This study has confirmed previous findings that the prevalence of delirium was associated with increased risk of adverse outcomes[2–4] and increased risk of inpatient mortality. This effect is demonstrated even when accounting for other variables, suggesting that all things being equal, a patient with delirium is more likely to suffer from adverse outcomes just through way of having delirium. Previous research has also shown that delirium is associated with increased risk of a later life diagnosis of dementia,[20] and importantly it can be highly distressing for the patient and their relative.[19 21] Delirium can be a devastating condition and prevention should be of the utmost importance, particularly in frail vulnerable older adults. Our results differed from our previous study of delirium prevalence in not showing a significant increased length of stay[4]; this likely relates to the exclusion of patients with lengths of stay less than 2 days.

Despite this, the results of our study did not show any significant impact of recognition of delirium on outcomes. However, in patients where confusion and disorientation were named and recognised, but not specifically diagnosed as delirium, healthcare professionals may have been able to implement similar treatment strategies as they would had the term delirium been used. Patients in whom a new change in cognition, alertness or attentiveness was not recognised to any extent to have been documented represent a particular subset of under-recognition that may be at heightened risk. It is also important to note that we did not measure illness

Table 2 Logistic regression of variables predictive of delirium being recognised

	Beta	SE	Wald	Freedom	OR	CI		P value
						Lower	Upper	
Screening	1.62	0.43	14.43	1	5.05	2.19	11.65	<0.001*
Grade of screener			1.60	3				0.659
Age	−0.03	0.03	1.03	1	0.97	0.92	1.03	0.309
Gender	0.53	0.41	1.65	1	1.70	0.76	3.80	0.199
Dementia	0.19	0.48	0.15	1	1.20	0.47	3.09	0.700
Frailty			1.348	2				0.510
Specialty			7.00	6				0.324

Screening for delirium was associated with nearly five-fold increased likelihood of delirium recognition. The grade or profession of the screener did not impact on the chances of delirium being recognised. Recognition was not affected by age, gender, dementia, frailty or specialty.

Table 3 Cox regression for the association of delirium and delirium recognition with inpatient mortality

	Beta	SE	Wald	Freedom	HR	CI Lower	CI Upper	P value
Delirium unadjusted	1.14	0.30	14.43	1	3.13	1.74	5.65	<0.001*
Delirium adjusted*	0.98	0.33	9.02	1	2.65	1.40	5.01	0.003*
Recognition unadjusted	−0.61	0.41	2.17	1	0.55	0.24	1.22	0.141
Recognition adjusted†	−0.38	0.47	0.68	1	0.68	0.27	1.70	0.411
Recognition adjusted‡	−0.33	0.55	0.36	1	0.72	0.24	2.12	0.547

The presence of delirium was associated with increased risk of inpatient death in both univariable and multivariable analyses. Recognition of delirium did not statistically significantly impact on risk of inpatient mortality. The ORs represent the likelihood of death with recognised delirium compared with unrecognised delirium.
*Delirium adjusted for age, gender, dementia status, frailty and specialty.
†Recognition adjusted for age, gender, dementia status, frailty and specialty.
‡Recognition adjusted for variables above, duration, and subtype.

severity or delirium severity in this study. It is possible that more severe cases of delirium may have been more likely to be recognised, and previous research suggests that increasing severity of delirium may be associated with increased risk of adverse outcomes.[22] Thus, if recognised cases of delirium presented more severe cases, any positive effect of recognition may have been ameliorated by higher risk related to severity.

In addition, it was found that recognition was associated with increased delirium duration. It is probable that, rather than recognition causing delirium to last longer, longer lasting cases of delirium were more likely to be recognised. As longer delirium duration has been shown to be associated with worse outcomes,[6] this may have tempered our results, although inclusion of delirium duration in multivariable analysis did not affect the overall impact of recognition on outcomes. There is currently no known treatment for delirium in itself and the mainstay of treatment focuses on treatment of the underlying precipitant(s). There is currently insufficient evidence that multicomponent interventions, which have been shown to prevent delirium, are effective for treatment of delirium.[8] At present, the focus of quality improvement strategies should be on prevention of incident delirium; further research to determine the pathophysiology of delirium may enable targeted treatment in the future.[23]

We acknowledge that our study may have been underpowered to detect a statistically significant difference in mortality between recognised and unrecognised delirium. In a post hoc power calculation, a sample size of 75 would detect a 10% difference in mortality between groups with power of 0.67% and 10% alpha. We encourage the development of further studies to assess whether these results are duplicated in larger powered studies, in other settings, and in the incorporation of our results into future systematic reviews on this subject.

The overall prevalence of delirium was higher than our previous UK multicentre study of delirium[4] and is more closely concordant with prevalence studies performed elsewhere.[10] This may be related to the inclusion of incident as well as prevalent cases of delirium; our previous UK study included only prevalent cases, whereas point prevalence studies elsewhere have included both incident and prevalent cases. The incidence of delirium in this study was actually lower than has been shown in previous studies.[7 24] This may relate to implementation of multicomponent interventions to prevent delirium at individual sites or may relate to differences in population. Many incidence studies have previously been conducted on elective patients,[25] where all cases of delirium are considered incident. Screening rates were similar to that which has been shown previously although recognition rates were higher.[4]

We recognise that there are limitations to the use of retrospective methodology to diagnose delirium, although this approach has been previously validated against expert diagnosis.[14] Overall, this approach is more likely to miss cases rather than lead to false diagnoses; the true delirium prevalence may be even greater. In addition, where delirium was documented in the notes, we assumed this to be a true diagnosis. However, it is possible that some of these may not have met full criteria for delirium through prospective expert review. It would be unethical to conduct a prospective study to evaluate the effects of delirium recognition. However, our previous prospective study did not show any impact of recognition by the usual care team prior to screening by study staff.[4]

As described, the diagnosis of delirium is based on psychiatric criteria, although delirium itself is caused by physical precipitants. The psychiatric presentation of delirium may not correlate with the underlying biological processes. Thus, identification of the underlying biological processes may be more beneficial in enabling targeting of interventions. Further research evaluating the use of techniques such as electroencephalogram studies is needed.[26] Nevertheless, we consider that our methodology demonstrates feasibility in diagnosing delirium retrospectively from medical notes, which would not be possible using a biological definition. This enables the determination of the effect of delirium on outcomes in studies where this was not measured prospectively.[17]

CONCLUSION

This study has demonstrated novel and important results. Our finding that recognition of delirium did not impact on outcomes demonstrates why prevention of delirium is vitally important,[8] as the negative effects of delirium are not easily ameliorated once it occurs. Although we have not shown any effect of recognition on the outcomes measured, we emphasise that recognition remains important to offer an opportunity to explain the nature of the diagnosis to the patient and their relatives[19 21] and assist with prognostication.[20] We recommend that clinicians should use the word delirium rather than words such as confusion or agitation in order to ensure consistency in language and to enable clinical coding of diagnosis. Further research is needed to assess the pathophysiology of delirium to enable development of targeted interventions towards improved outcomes in patients with delirium.

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Table S1 – Delirium prevalence and recognition at participating sites

	Delirium prevalence - % (N)	Delirium recognition - % (N)
Hospital 1	22.6 (7/31)	57.1 (4/7)
Hospital 2	16.7 (2/12)	0.0 (0/2)
Hospital 3	9.1 (3/33)	33.3 (1/3)
Hospital 4	26.7 (4/15)	25.0 (1/4)
Hospital 5	19.2 (5/26)	40.0 (2/5)
Hospital 6	31.4 (11/35)	72.7 (8/11)
Hospital 7	14.7 (5/34)	40.0 (2/5)
Hospital 8	27.8 (5/18)	20.0 (1/5)
Hospital 9	23.8 (5/21)	40.0 (2/5)
Hospital 10	25.9 (7/27)	85.7 (6/7)
Hospital 11	23.1 (3/13)	66.7 (2/3)
Hospital 12	14.0 (6/43)	66.7 (4/6)
Hospital 13	19.0 (4/21)	75.0 (3/4)
Hospital 14	13.8 (4/29)	50.0 (2/4)
Hospital 15	3.8 (1/26)	100.0 (1/1)
Hospital 16	27.6 (8/29)	37.5 (3/8)
Hospital 17	38.5 (10/26)	60.0 (6/10)
Hospital 18	14.3 (2/14)	50.0 (1/2)
Hospital 19	29.6 (8/27)	75.0 (6/8)
Hospital 20	14.3 (3/21)	66.7 (2/3)
Hospital 21	16.7 (1/6)	0.0 (0/1)
Hospital 22	14.3 (3/21)	66.7 (2/3)
Hospital 23	33.3 (5/15)	80.0 (4/5)
Hospital 24	37.5 (6/16)	83.3 (5/6)
Hospital 25	28.0 (7/25)	28.6 (2/7)
Hospital 26	8.7 (2/23)	0.0 (0/2)
Hospital 27	26.3 (5/19)	100.0 (5/5)

Table S2 – Logistic regression of variables predictive of delirium presence

The presence of dementia and increasing frailty were associated with increased likelihood of delirium. Admission under other surgery specialties was associated with reduced likelihood of delirium as compared to acute medicine.

		Beta	S.E.	Wald	Freedom	OR	Confidence Interval		p value
							Lower	Upper	
Age		0.02	0.01	1.61	1	1.02	0.99	1.05	0.205
Gender		-0.43	0.22	3.77	1	0.66	0.43	1.00	0.052
Dementia		0.92	0.25	13.19	1	2.51	1.53	4.13	<0.001*
Frailty c.f. 1-3				12.77	2				0.002*
	4-6	0.96	0.34	8.07	1	2.61	1.35	5.05	0.004*
	7-9	1.40	0.39	12.72	1	4.04	1.88	8.71	<0.001*
				12.76	6				0.047

Specialty c.f. Acute medicine	Geriatric medicine	0.12	0.30	0.16	1	1.13	0.63	2.01	0.691
	Stroke	-2.15	1.06	4.14	1	0.12	0.02	0.92	0.042
	Other medicine	-0.25	0.32	0.61	1	0.78	0.42	1.45	0.433
	Other surgery	-2.34	1.05	4.98	1	0.10	0.01	0.75	0.026
	General surgery	-0.55	0.51	1.15	1	0.58	0.21	1.58	0.284
	Orthopaedic surgery	-0.56	0.47	1.40	1	0.57	0.23	1.44	0.237

Table S3 – Logistic regression of variables predictive of screening for delirium being performed

		Beta	S.E.	Wald	Freedom	OR	Confidence Interval		p value
							Lower	Upper	
Age		0.03	0.01	4.67	1	1.03	1.00	1.05	0.031*
Gender		<0.01	0.19	<0.01	1	1.00	0.70	1.45	0.982
Dementia		0.49	0.24	4.06	1	1.63	1.01	2.61	0.044*
Frailty c.f. 1-3				7.10	2				0.029*
	4-6	0.20	0.23	0.74	1	1.22	0.77	1.94	0.389
	7-9	-0.51	0.33	2.32	1	0.60	0.31	1.16	0.128
Specialty c.f. Acute medicine				20.59	6				0.002*
	Geriatric medicine	0.44	0.27	2.76	1	1.55	0.92	2.61	0.097*
	Stroke	-0.49	0.49	1.00	1	0.61	0.24	1.59	0.315
	Other medicine	-0.58	0.28	4.26	1	0.56	0.33	0.97	0.039*
	Other surgery	-0.35	0.42	0.67	1	0.71	0.31	1.62	0.412
	General surgery	-0.88	0.44	4.00	1	0.41	0.18	0.98	0.045*
	Orthopaedic surgery	-0.55	0.38	2.04	1	0.58	0.27	1.23	0.153

Increasing age and admission under geriatric medicine as compared to acute medicine were associated with increased likelihood of screening for delirium being performed.

Table S4 – Logistic regression of the association of delirium with inpatient mortality

	Beta	S.E.	Wald	Freedom	OR	Confidence Interval		p value
						Lower	Upper	
Delirium unadjusted	1.56	0.31	24.56	1	4.74	2.56	8.76	<0.001
Delirium adjusted¥	1.19	0.35	11.53	1	3.27	1.65	6.48	<0.001

The presence of delirium was associated with an increased likelihood of death within 30 days of admission in both univariable and multivariable analysis.

¥ Delirium adjusted for age, gender, dementia status, frailty, and specialty

Table S5 – Logistic regression for the association of delirium with discharge to a new care home

The presence of delirium was associated with increased chance of discharge to a new care home in univariable by not multivariable analysis (including frailty and dementia status).

	Beta	S.E.	Wald	Freedom	OR	Confidence Interval		p value
						Lower	Upper	
Delirium unadjusted	0.95	0.44	4.55	1	2.57	1.08	6.14	0.033
Delirium adjusted¥	0.23	0.50	0.22	1	1.26	0.48	3.36	0.639

¥ Delirium adjusted for age, gender, dementia status, frailty, and specialty

Table S6 – General linear model for the impact of delirium on $\log^{10}$ length of stay in multivariable analysis

Only frailty independently impacted upon length of stay.

Source	Type III Sum of squares	Freedom	Mean square	F	p value
Corrected model	5.58	12	0.47	4.29	<0.001
Intercept	3.23	1	3.23	29.78	<0.001
Delirium	0.37	1	0.37	3.37	0.067
Gender	0.03	1	0.03	0.28	0.600
Specialty	1.35	6	0.23	2.08	0.054
Dementia	0.06	1	0.06	0.59	0.444
Frailty	1.05	2	0.53	4.84	0.008
Age	0.06	1	0.06	0.57	0.450
Error	61.19	564	0.11		
Total	520.55	577			

Corrected total	66.77	576			

Table S7 – Comparison of main effects for delirium status and log^{10} length of stay

The presence of delirium did not significantly impact upon length of stay

Delirium status (a)	Delirium status (b)	Mean difference (b-a)	S.E.	p value	Confidence interval	
					Lower	Upper
No delirium	Delirium	0.07	0.04	0.067	-0.01	0.14

Table S8 – Logistic regression for the impact of recognition of delirium upon inpatient mortality

Recognition of delirium did not impact upon likelihood of inpatient mortality.

	Beta	S.E.	Wald	Freedom	OR	Confidence Interval		p value
						Lower	Upper	
Recognition unadjusted	-0.53	0.45	1.34	1	0.59	0.24	1.44	0.247
Recognition adjusted¥	-0.50	0.51	0.97	1	0.61	0.22	1.64	0.324
Recognition adjusted‡	-0.56	0.55	1.05	1	0.57	0.20	1.67	0.305

¥ Recognition adjusted for age, gender, dementia status, frailty, and specialty

‡ Recognition adjusted for variables above, duration, and subtype

Table S9 – Logistic regression for the impact of recognition of delirium upon likelihood of discharge to a new care home

Recognition of delirium did not impact upon the likelihood of discharge to a new care home. The odds ratios represent the likelihood of discharge to a new care home compared to previous residence in home own home in recognised delirium compared to unrecognised delirium.

	Beta	S.E.	Wald	Freedom	OR	Confidence Interval		p value
						Lower	Upper	
Recognition unadjusted	1.55	1.10	2.00	1	4.73	0.55	40.84	0.158
Recognition adjusted¥	1.50	1.25	1.43	1	4.47	0.38	52.07	0.232
Recognition adjusted‡	0.95	1.41	0.45	1	2.59	0.16	41.43	0.501

¥ Recognition adjusted for age, gender, dementia status, frailty, and specialty

‡ Recognition adjusted for variables above, duration, and subtype

Table S10 – General linear model for the impact of recognition of delirium upon log^{10} length of stay

Recognition of delirium was not associated with length of stay. Delirium duration was associated with length of stay.

Source	Type III Sum of squares	Freedom	Mean square	F	p value	Partial Eta squared
Corrected model	4.49	16	0.28	4.38	<0.001	0.44
Intercept	0.44	1	0.44	6.86	0.010	0.07
Recognition	<0.01	1	<0.01	0.03	0.860	<0.01
Gender	0.12	1	0.12	1.79	0.184	0.02
Specialty	0.53	6	0.09	1.39	0.23	0.09
Dementia	<0.01	1	<0.01	0.22	0.639	<0.01
Subtype	0.09	3	0.03	0.47	0.703	0.01
Age	<0.01	1	<0.01	0.03	0.860	<0.01
Duration	2.94	1	2.94	45.81	<0.001	0.337
Error	5.77	90	0.06			
Total	115.32	107				
Corrected total	10.26	106				

Table S11 – Comparison of main effects for recognition of delirium and log^{10} length of stay

There was no significant difference in length of stay between those with recognised and unrecognised delirium.

Recognition status (a)	Recognition status (b)	Mean difference (b-a)	S.E.	p value	Confidence interval	
					Lower	Upper
Recognised	Unrecognised	0.01	0.06	0.860	-0.10	0.12

Table S12 – General linear model for the impact of delirium recognition upon log^{10} delirium duration

Recognition was associated with log^{10} delirium duration in multivariable analysis. No other variables impacted upon delirium duration.

Source	Type III Sum of squares	Freedom	Mean square	F	p value	Partial Eta squared
Corrected model	3.74	15	0.25	1.68	0.065	0.18
Intercept	0.28	1	0.28	1.91	0.170	0.02
Recognition	0.97	1	0.97	6.51	0.013	0.05
Gender	0.11	1	0.11	0.77	0.383	0.01
Specialty	1.13	6	0.19	1.27	0.28	0.06

Dementia	0.08	1	0.08	0.55	0.459	0.01
Subtype	0.54	3	0.19	1.26	0.288	0.02
Age	0.01	1	0.01	0.09	0.764	<0.01
Error	16.92	114	0.15			
Total	90.61	130				
Corrected total	20.66	129				

Table S13 – Comparison of main effects for impact of recognition upon log^{10} delirium duration

Unrecognised delirium was associated with a reduced mean log^{10} delirium duration compared to recognised delirium.

Recognition status (a)	Recognition status (b)	Mean difference (b-a)	S.E.	p value	Confidence interval	
					Lower	Upper
Recognised	Unrecognised	-0.19	0.07	0.013	-0.34	-0.04