NIHR | National Institute for Health Research

Journals Library

Check for updates

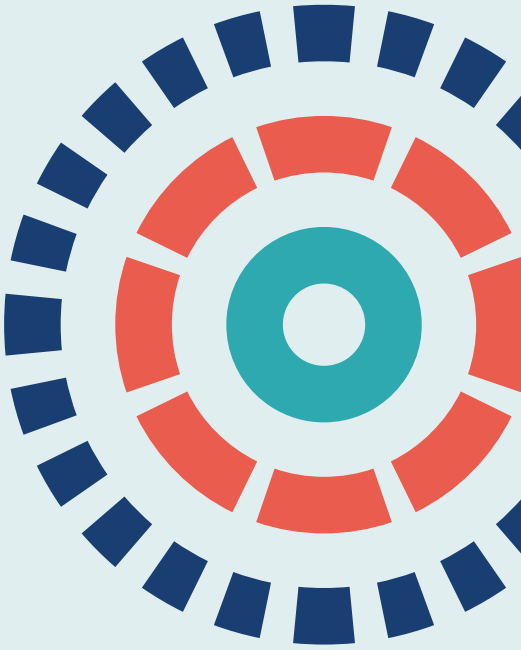
Health Services and Delivery Research

Volume 9 • Issue 8 • April 2021

ISSN 2050-4349

Understanding health-care outcomes of older people with cognitive impairment and/or dementia admitted to hospital: a mixed-methods study

Emma Reynish, Simona Hapca, Rebecca Walesby, Angela Pusram, Feifei Bu, Jennifer K Burton, Vera Cvoro, James Galloway, Henriette Ebbesen Laidlaw, Marion Latimer, Siobhan McDermott, Alasdair C Rutherford, Gordon Wilcock, Peter Donnan and Bruce Guthrie



DOI 10.3310/hsdr09080

Understanding health-care outcomes of older people with cognitive impairment and/or dementia admitted to hospital: a mixed-methods study

Emma Reynish,[1*] Simona Hapca,[2] Rebecca Walesby,[1] Angela Pusram,[1] Feifei Bu,[1] Jennifer K Burton,[3] Vera Cvoro,[3] James Galloway,[4] Henriette Ebbesen Laidlaw,[1] Marion Latimer,[1] Siobhan McDermott,[1] Alasdair C Rutherford,[1] Gordon Wilcock,[5] Peter Donnan[2] and Bruce Guthrie[2]

[1]Faculty of Social Sciences, University of Stirling, Stirling, UK
[2]School of Medicine, University of Dundee, Dundee, UK
[3]Deanery of Clinical Sciences, University of Edinburgh, Edinburgh, UK
[4]Health Informatics Centre, University of Dundee, Dundee, UK
[5]Oxford Institute of Population Ageing, University of Oxford, Oxford, UK

*Corresponding author

Declared competing interests of authors: Peter Donnan reports grants from Shire Pharmaceuticals Ltd (London, UK), Gilead Sciences, Inc. (Foster City, CA, USA) and Novo Nordisk (Bagsværd, Denmark) outside the submitted work, and that he is a member of the New Drugs Committee of the Scottish Medicines Consortium. Vera Cvoro reports receiving funded space from the European Stroke Organisation at the European Stroke Organisation Conference 2017, outside the submitted work.

Published April 2021
DOI: 10.3310/hsdr09080

This report should be referenced as follows:

Reynish E, Hapca S, Walesby R, Pusram A, Bu F, Burton JK, *et al*. Understanding health-care outcomes of older people with cognitive impairment and/or dementia admitted to hospital: a mixed-methods study. *Health Serv Deliv Res* 2021;**9**(8).

Health Services and Delivery Research

ISSN 2050-4349 (Print)

ISSN 2050-4357 (Online)

This journal is a member of and subscribes to the principles of the Committee on Publication Ethics (COPE) (www.publicationethics.org/).

Editorial contact: journals.library@nihr.ac.uk

The full HS&DR archive is freely available to view online at www.journalslibrary.nihr.ac.uk/hsdr. Print-on-demand copies can be purchased from the report pages of the NIHR Journals Library website: www.journalslibrary.nihr.ac.uk

Criteria for inclusion in the *Health Services and Delivery Research* journal

Reports are published in *Health Services and Delivery Research* (HS&DR) if (1) they have resulted from work for the HS&DR programme, and (2) they are of a sufficiently high scientific quality as assessed by the reviewers and editors.

HS&DR programme

The HS&DR programme funds research to produce evidence to impact on the quality, accessibility and organisation of health and social care services. This includes evaluations of how the NHS and social care might improve delivery of services.

For more information about the HS&DR programme please visit the website at https://www.nihr.ac.uk/explore-nihr/funding-programmes/health-services-and-delivery-research.htm

This report

The research reported in this issue of the journal was funded by the HS&DR programme or one of its preceding programmes as project number 13/54/55. The contractual start date was in June 2015. The final report began editorial review in June 2018 and was accepted for publication in April 2019. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The HS&DR editors and production house have tried to ensure the accuracy of the authors' report and would like to thank the reviewers for their constructive comments on the final report document. However, they do not accept liability for damages or losses arising from material published in this report.

This report presents independent research funded by the National Institute for Health Research (NIHR). The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, NETSCC, the HS&DR programme or the Department of Health and Social Care. If there are verbatim quotations included in this publication the views and opinions expressed by the interviewees are those of the interviewees and do not necessarily reflect those of the authors, those of the NHS, the NIHR, NETSCC, the HS&DR programme or the Department of Health and Social Care.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Published by the NIHR Journals Library (www.journalslibrary.nihr.ac.uk), produced by Prepress Projects Ltd, Perth, Scotland (www.prepress-projects.co.uk).

NIHR Journals Library Editor-in-Chief

Professor Ken Stein Professor of Public Health, University of Exeter Medical School, UK

NIHR Journals Library Editors

Professor John Powell Chair of HTA and EME Editorial Board and Editor-in-Chief of HTA and EME journals. Consultant Clinical Adviser, National Institute for Health and Care Excellence (NICE), UK, and Professor of Digital Health Care, Nuffield Department of Primary Care Health Sciences, University of Oxford, UK

Professor Andrée Le May Chair of NIHR Journals Library Editorial Group (HS&DR, PGfAR, PHR journals) and Editor-in-Chief of HS&DR, PGfAR, PHR journals

Professor Matthias Beck Professor of Management, Cork University Business School, Department of Management and Marketing, University College Cork, Ireland

Dr Tessa Crilly Director, Crystal Blue Consulting Ltd, UK

Dr Eugenia Cronin Senior Scientific Advisor, Wessex Institute, UK

Dr Peter Davidson Consultant Advisor, Wessex Institute, University of Southampton, UK

Ms Tara Lamont Senior Scientific Adviser (Evidence Use), Wessex Institute, University of Southampton, UK

Dr Catriona McDaid Senior Research Fellow, York Trials Unit, Department of Health Sciences, University of York, UK

Professor William McGuire Professor of Child Health, Hull York Medical School, University of York, UK

Professor Geoffrey Meads Emeritus Professor of Wellbeing Research, University of Winchester, UK

Professor James Raftery Professor of Health Technology Assessment, Wessex Institute, Faculty of Medicine, University of Southampton, UK

Dr Rob Riemsma Reviews Manager, Kleijnen Systematic Reviews Ltd, UK

Professor Helen Roberts Professor of Child Health Research, UCL Great Ormond Street Institute of Child Health, UK

Professor Jonathan Ross Professor of Sexual Health and HIV, University Hospital Birmingham, UK

Professor Helen Snooks Professor of Health Services Research, Institute of Life Science, College of Medicine, Swansea University, UK

Professor Ken Stein Professor of Public Health, University of Exeter Medical School, UK

Professor Jim Thornton Professor of Obstetrics and Gynaecology, Faculty of Medicine and Health Sciences, University of Nottingham, UK

Please visit the website for a list of editors: www.journalslibrary.nihr.ac.uk/about/editors

Editorial contact: journals.library@nihr.ac.uk

Abstract

Understanding health-care outcomes of older people with cognitive impairment and/or dementia admitted to hospital: a mixed-methods study

Emma Reynish,[1*] Simona Hapca,[2] Rebecca Walesby,[1] Angela Pusram,[1] Feifei Bu,[1] Jennifer K Burton,[3] Vera Cvoro,[3] James Galloway,[4] Henriette Ebbesen Laidlaw,[1] Marion Latimer,[1] Siobhan McDermott,[1] Alasdair C Rutherford,[1] Gordon Wilcock,[5] Peter Donnan[2] and Bruce Guthrie[2]

[1]Faculty of Social Sciences, University of Stirling, Stirling, UK
[2]School of Medicine, University of Dundee, Dundee, UK
[3]Deanery of Clinical Sciences, University of Edinburgh, Edinburgh, UK
[4]Health Informatics Centre, University of Dundee, Dundee, UK
[5]Oxford Institute of Population Ageing, University of Oxford, Oxford, UK

*Corresponding author Emma.Reynish@stir.ac.uk

Background: Cognitive impairment is common in older people admitted to hospital, but previous research has focused on single conditions.

Objective: This project sits in phase 0/1 of the Medical Research Council Framework for the Development and Evaluation of Complex Interventions. It aims to develop an understanding of current health-care outcomes. This will be used in the future development of a multidomain intervention for people with confusion (dementia and cognitive impairment) in general hospitals. The research was conducted from January 2015 to June 2018 and used data from people admitted between 2012 and 2013.

Design: For the review of outcomes, the systematic review identified peer-reviewed quantitative epidemiology measuring prevalence and associations with outcomes. Screening for duplication and relevance was followed by full-text review, quality assessment and a narrative review (141 papers). A survey sought opinion on the key outcomes for people with dementia and/or confusion and their carers in the acute hospital ($n = 78$). For the analysis of outcomes including cost, the prospective cohort study was in a medical admissions unit in an acute hospital in one Scottish health board covering 10% of the Scottish population. The participants ($n = 6724$) were older people (aged ≥ 65 years) with or without a cognitive spectrum disorder who were admitted as medical emergencies between January 2012 and December 2013 and who underwent a structured nurse assessment. 'Cognitive spectrum disorder' was defined as any combination of delirium, known dementia or an Abbreviated Mental Test score of < 8 out of 10 points. The main outcome measures were living at home 30 days after discharge, mortality within 2 years of admission, length of stay, re-admission within 2 years of admission and cost.

Data sources: Scottish Morbidity Records 01 was linked to the Older Persons Routine Acute Assessment data set.

Results: In the systematic review, methodological heterogeneity, especially concerning diagnostic criteria, means that there is significant overlap in conditions of patients presenting to general hospitals with confusion. Patients and their families expect that patients are discharged in the same or a better

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

condition than they were in on admission or, failing that, that they have a satisfactory experience of their admission. Cognitive spectrum disorders were present in more than one-third of patients aged ≥ 65 years, and in over half of those aged ≥ 85 years. Outcomes were worse in those patients with cognitive spectrum disorders than in those without: length of stay 25.0 vs. 11.8 days, 30-day mortality 13.6% vs. 9.0%, 1-year mortality 40.0% vs. 26.0%, 1-year mortality or re-admission 62.4% vs. 51.5%, respectively (all $p < 0.01$). There was relatively little difference by cognitive spectrum disorder type; for example, the presence of any cognitive spectrum disorder was associated with an increased mortality over the entire period of follow-up, but with different temporal patterns depending on the type of cognitive spectrum disorder. The cost of admission was higher for those with cognitive spectrum disorders, but the average daily cost was lower.

Limitations: A lack of diagnosis and/or standardisation of diagnosis for dementia and/or delirium was a limitation for the systematic review, the quantitative study and the economic study. The economic study was limited to in-hospital costs as data for social or informal care costs were unavailable. The survey was conducted online, limiting its reach to older carers and those people with cognitive spectrum disorders.

Conclusions: Cognitive spectrum disorders are common in older inpatients and are associated with considerably worse health-care outcomes, with significant overlap between individual cognitive spectrum disorders. This suggests the need for health-care systems to systematically identify and develop care pathways for older people with cognitive spectrum disorders, and avoid focusing on only condition-specific pathways.

Future work: Development and evaluation of a multidomain intervention for the management of patients with cognitive spectrum disorders in hospital.

Study registration: This study is registered as PROSPERO CRD42015024492.

Funding: This project was funded by the National Institute for Health Research (NIHR) Health Services and Delivery Research programme and will be published in full in *Health Services and Delivery Research*; Vol. 9, No. 8. See the NIHR Journals Library website for further project information.

Contents

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

List of tables

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

List of figures

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

List of boxes

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

List of abbreviations

AD	Alzheimer's disease
ADL	activities of daily living
AIC	Akaike information criterion
AMT	Abbreviated Mental Test
AMU	acute medical unit
APOE	apolipoprotein E
BI	Barthel Index
CAM	Confusion Assessment Method
CCI	Charlson Comorbidity Index
CHI	Community Health Index
CI	confidence interval
CIF	cumulative incidence function
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CSD	cognitive spectrum disorder
DSD	delirium superimposed on dementia
DSDC	Dementia Services Development Centre
DSM-III	*Diagnostic and Statistical Manual of Mental Disorders*, Third Edition
DSM-IV	*Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition
DSM-IV-TR	*Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, Text Revision
FC	family carer
HIC	Health Informatics Centre
HR	hazard ratio
IADL	independent activities of daily living
ICD-9	*International Classification of Diseases*, Ninth Edition
ICD-10	*International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision
ICU	intensive care unit
IL-1α	interleukin 1 alpha
IL-6	interleukin 6
IQCODE	Informant Questionnaire on Cognitive Decline in the Elderly
LIF	leukaemia inhibitory factor
LoS	length of stay
MCI	mild cognitive impairment
mDAS	Memorial Delirium Assessment Scale
MeSH	medical subject heading
MMSE	Mini Mental State Examination
MRC	Medical Research Council
MSSE	Mini Suffering State Examination
NIHR	National Institute for Health Research
OPRAA	Older Persons Routine Acute Assessment
OR	odds ratio
PC	professional carer
PDD	primary degenerative dementia
PwC	Person with Cognitive Spectrum Disorder
QoL	quality of life
RCD	recoverable cognitive dysfunction
RR	rate ratio
rSSD	residual subsyndromal delirium
SAP	statistical analysis plan
SIMD	Scottish Index of Multiple Deprivation
SMR	Scottish Morbidity Records
SOP	standard operating procedure
SSD	subsyndromal delirium
TNF-α	tumour necrosis factor alpha

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Plain English summary

People who are confused because of dementia or another reason and who are admitted to hospital often do badly. Improving this situation is complex. This project looked at what happened to patients with confusion who were admitted to a typical general hospital over a 2-year period (2012–13) and provides a baseline from which to measure improvement in a future evaluation.

The research was carried out in four ways. First, all available research publications were reviewed. Second, hospital records were analysed to calculate the health-care outcomes (e.g. mortality, length of stay and re-admission). Third, the hospital costs of patients with and of those without confusion were compared. Finally, we carried out a survey of people with confusion who had been patients in hospital and their families to see what was important to them.

From the research publications, we found that there is overlap between the conditions that cause confusion and there is no agreement on how to test for and define these conditions.

From the hospital records, we found that one-third of all patients aged $\geq$ 65 years have confusion, and that they had higher mortality and a longer hospital stay than those without confusion.

The analysis showed that patients with confusion had an overall higher cost for their hospital admission than patients without confusion; however, this was because they stayed in hospital longer. Their daily cost was lower.

When surveyed, patients and their families told us that they expect the patient to leave the hospital in the same or a better condition than they were in on admission. Failing that, they expect patients to have a satisfactory experience of their hospital stay.

These findings will be used to inform the development of a standardised management plan to improve the identified outcomes and, therefore, the quality of care. This will be evaluated in a future study.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Scientific summary

Background

People with dementia and other disorders resulting in confusion are an important subset of frail older people who present specific challenges, particularly when admitted to acute hospitals. The Department of Health and Social Care and the Royal College of Psychiatrists have estimated that two-thirds of hospital beds are occupied by patients aged ≥ 65 years, up to half of whom might have some kind of cognitive impairment, including dementia and delirium.

In the hospital setting, cognitive impairment may be due to a number of overlapping conditions. People may have pre-existing dementia before admission, may develop delirium (characterised by an acute onset of confusion, a fluctuating course and inattention) as part of the acute illness precipitating admission or may have delirium superimposed on dementia. Finally, unspecified cognitive impairment due to undiagnosed dementia or delirium, adverse effects of medication, poorly controlled physical morbidities (e.g. diabetes mellitus) or a combination of these is also common. The symptoms and presenting features of all of these conditions show considerable overlap, which can lead to misdiagnosis; for example, the onset of neuropsychiatric symptoms in a patient with dementia may be labelled as worsening of their dementia rather than be properly attributed to delirium. We therefore use the term 'cognitive spectrum disorders' to signify the presence of cognitive impairment, whether formally diagnosed or not.

Older people admitted to hospital with a cognitive spectrum disorder are a heterogeneous and highly vulnerable population who are typically poorly assessed and managed, and it is important to understand their needs better in order to focus care and treatment. However, most research in older people admitted to hospital has studied either dementia or delirium in isolation and has been most commonly undertaken in relatively small cohorts of selected volunteers in specialist geriatric settings, risking selection bias and poor generalisability. Relatively few studies have examined outcomes in this population, particularly outcomes after discharge. Systematic reviews that separately examined dementia, delirium and delirium superimposed on dementia in hospital inpatients have been published. In these, prevalence varies depending on the population studied (e.g. specialist settings vs. unselected medical admissions; early vs. later assessment after admission, age range considered) and the assessment methods used, with dementia assessment not normally including a delirium screen, thereby increasing the risk of misclassification.

Objectives

The study sits in phase 0/1 of the Medical Research Council Framework for the Development and Evaluation of Complex Interventions, and will provide the baseline for the development of an intervention for evaluation in the future. The increased understanding resulting from this study is a component that is necessary for the next step in improving the quality of care for people with cognitive impairment in general hospitals.

The study aimed to improve the understanding of the outcomes of emergency hospital admission in people with cognitive impairment and/or dementia to support the development of a multidomain intervention.

The objectives of the study were twofold:

1. review of outcomes – review of current literature and a patient opinion survey to obtain an understanding of the quality and type of evidence that exists about the prevalence of cognitive impairment in older people admitted to hospital as emergencies and associations with a spectrum of outcomes assessed or measured in this domain, and elucidate the outcomes that are important to people who have experienced an acute hospital admission

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

2. analysis of outcomes – data linkage and analysis of a unique routine population-based health-care data set to measure health-care and economic outcomes following hospital admission of older people with and older people without cognitive impairment and dementia.

The research was conducted from January 2015 to June 2018 and used data from people admitted between 2012 and 2013.

Methods

The project used a systematic review of the research literature, a patient opinion survey and analysis of a unique large admission data set to examine health-care outcomes and costs for older people with cognitive impairment and dementia admitted as an acute medical emergency.

Review of outcomes

Systematic review

This involved database searches identifying peer-reviewed quantitative epidemiology measuring prevalence and associations with outcomes. Screening for duplication and relevance was followed by full-text review and assessment of quality, followed by a narrative review of the data.

Patient opinion survey

A survey sought opinion on the key outcomes for people with dementia and/or confusion, and their carers, in the acute hospital.

Analysis of outcomes

A prospective cohort study of people who underwent an Older Persons Routine Acute Assessment was undertaken. The Older Persons Routine Acute Assessment is based on the principles of comprehensive geriatric assessment (Stuck AE, Siu AL, Wieland GD, Adams J, Rubenstein LZ. Comprehensive geriatric assessment: a meta-analysis of controlled trials. *Lancet* 1993;**342**:1032–6), with trained specialist nurses carrying out a structured assessment during the first 24 hours of admission, including an Abbreviated Mental Test (Hodkinson HM. Evaluation of a mental test score for assessment of mental impairment in the elderly. *Age Ageing* 1972;**1**:233–8); the Confusion Assessment Method for the presence of delirium (Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med* 1990;**113**:941–8); an assessment of the presence of delirium based on clinical history, examination and informant report; documentation of the presence of a pre-admission diagnosis of dementia from self-report/informant report and/or hospital and primary care records; and estimation of functional status in terms of activities of daily living both on admission and at 3 months prior to admission (Katz S, Ford A, Moskowitz R, Jackson B, Jaffe M. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. *J Am Med Assoc* 1963;**185**:914–9). An analysis of the Older Persons Routine Acute Assessment data set measured associations between different patterns of cognitive impairment and outcomes.

Setting

A medical admissions unit in an acute hospital in one Scottish health board.

Participants

Older people (aged $\geq$ 65 years), with or without a cognitive spectrum disorder, admitted as medical emergencies between January 2012 and December 2013 who underwent a structured nurse assessment (Older Persons Routine Acute Assessment). 'Cognitive spectrum disorder' was defined as any combination of delirium, known dementia and an Abbreviated Mental Test score of $<$ 8 out of 10 points.

Main outcome measures
Living at home 30 days after discharge, mortality within 2 years of admission, length of stay, re-admission within 2 years of admission and cost.

Data sources
Scottish Morbidity Records 01 data were linked to the Older Persons Routine Acute Assessment data set.

Older people admitted as medical emergencies in this Scottish health board have been routinely screened for cognitive impairment, delirium and dementia using structured instruments since 2011. This unique data set was linked to routine hospital and place of residence data by the University of Dundee Health Informatics Centre, and used to examine how a range of outcomes varied between those with and those without cognitive impairment, delirium on admission and/or dementia.

Results

The systematic review highlights the significant overlap in conditions of patients presenting to general hospitals with confusion (cognitive spectrum disorders). Methodological heterogeneity, especially concerning diagnostic criteria, results in some dementia cohorts including patients with concurrent delirium (delirium superimposed on dementia), some delirium cohorts differentiating between those with pre-existing cognitive impairment (delirium superimposed on dementia) and those with isolated delirium, and some cohorts screening using cognitive function alone.

Despite considerable methodological differences, cognitive spectrum disorders are common in the inpatient population over the age of 65 years, and are associated with significantly longer lengths of stay and worse survival in both the short and the longer term. Differences in outcomes between individual conditions are less clear and may benefit from some standardisation across conditions of diagnostic categorisation. This means that there is significant overlap in conditions of patients presenting to general hospitals with confusion.

The survey provides an insight into the challenges facing general hospitals in relation to an admission of a person with a cognitive spectrum disorder to ensure that the outcome is perceived as positive for the patient and their carers/family.

Although the overall expectation relating to health and well-being when discussing a positive outcome for this group of patients is no different to that for the general population, in that they wish to return home with the same functionality and cognitive ability as they had prior to the event that led to the admission, the focus for many, when asked about a positive outcome, is on the process of the actual hospital stay. The issues surrounding this highlight that there are some challenges here that the respondents felt were important to a positive outcome. So, failing being able to be discharged home in the same condition as at the time of admission, having a satisfactory experience of the admission was seen as a positive outcome.

From the analysis of the Older Persons Routine Acute Assessment data set, we found that 35% of people aged $\geq$ 65 years with an incident admission to the acute medical unit had a cognitive spectrum disorder. Delirium was present in 23.4% of admissions and dementia was present in 15.3% of admissions. Almost one-third of people with delirium and almost half with dementia had both delirium and dementia (7.6% had delirium superimposed on dementia). A further 4.2% of people who were admitted had unspecified cognitive impairment, defined as a low Abbreviated Mental Test score without known dementia or delirium. Cognitive spectrum disorders were strongly associated with low functional ability, with > 50% of patients with known dementia (either alone or superimposed on delirium) having a low activities of daily living score prior to admission (persistently low activities

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

of daily living scores) and almost 50% of patients admitted with delirium alone having a decline in activities of daily living scores from their functional status 3 months prior to admission (changed activities of daily living scores). Only 19% of people admitted with cognitive spectrum disorders had persistently high activities of daily living scores, compared with 58.2% of people admitted without cognitive spectrum disorders.

Outcomes in older people with cognitive spectrum disorders following hospital admission are significantly worse than in those without cognitive spectrum disorders. The proportion of people living at home 30 days post discharge was significantly lower among patients with cognitive spectrum disorders than among patients without cognitive spectrum disorders (81.7% vs. 93.4%). Delirium superimposed on dementia had the poorest outcome, with only 69.1% of people in this group living at home 30 days post discharge.

Mortality from the date of admission was high, with 52.6% of people with cognitive spectrum disorders dying within the 2-year follow-up period, compared with 33.5% of people without cognitive spectrum disorders. The presence of any cognitive spectrum disorders was associated with increased mortality over the entire follow-up period but with different temporal patterns depending on the type of cognitive spectrum disorder. Compared with people without cognitive spectrum disorders, delirium alone was associated with increased mortality risk in the 6 months after admission and 1 year from admission until the end of follow-up. Having dementia alone or delirium superimposed on dementia was not associated with mortality in the first 3 months, but was associated with higher mortality at 3 months to 2 years post admission. Having unspecified cognitive impairment was not associated with mortality in the first 6 months post admission, but was associated afterwards.

Re-admission at the 2-year follow-up was high, with 65.6% of people with cognitive spectrum disorders being re-admitted within 2 years, compared with 60.1% of people without cognitive spectrum disorders. At the end of the 2-year follow-up, 13.2% of patients with cognitive spectrum disorders died without being re-admitted, compared with 5.3% of patients without cognitive spectrum disorders. Compared with people without cognitive spectrum disorders, delirium alone or dementia alone was associated with increased re-admission risk during the whole follow-up period. Having delirium superimposed on dementia was not associated with an increased risk of re-admission in the first 3 months, but was associated with a higher risk of re-admission at 3 months to 2 years post admission. Having unspecified cognitive impairment was not associated with an increased risk of re-admission at any time after discharge.

Finally, older people with cognitive spectrum disorders have an average length of stay of almost 25 days, compared with 12 days in those without a cognitive spectrum disorder. Length of stay in people with cognitive spectrum disorders varied depending on the type of cognitive spectrum disorder, with hospital stays for people with delirium superimposed on dementia being more than three times longer than stays for people without cognitive spectrum disorders, and stays were almost twice as long for people with delirium alone, dementia alone or an unspecified form of cognitive impairment.

When hospital costs were examined for patients with and patients without cognitive spectrum disorders, both cross-sectionally and longitudinally, we found that patients with cognitive spectrum disorders had significantly higher hospital costs at their incident admission than non-cognitive spectrum disorder patients did. However, if we looked at it from a longitudinal perspective, the cost of patients with cognitive spectrum disorders, particularly those with delirium superimposed on dementia or unspecified cognitive impairment, cumulate at a lower rate than patients with no cognitive spectrum disorders. The cost difference between cognitive spectrum disorder and non-cognitive spectrum disorder patients generally became negligible in the long run. Moreover, we demonstrated that the cognitive spectrum disorder group was not homogeneous. Patients with different cognitive spectrum disorders might differ in their one-off incident costs, as well as in the growth rate of their cumulative costs, if examined longitudinally.

Finally, the study highlighted the importance of accounting for mortality while making longitudinal predictions of costs for patients with different conditions. In our case, patients with cognitive spectrum disorder tended to have a higher hazard rate of death than non-cognitive spectrum disorder patients did. If we ignore this while fitting a longitudinal model, we risk overestimating the cost growth rate of cognitive spectrum disorder patients and, accordingly, the differences in their cumulated totals.

Limitations

A lack of diagnosis and/or standardisation of diagnosis for dementia and/or delirium was a limitation for the systematic review, the quantitative study and the economic study.

Additional limitations of the quantitative study arise from the use of routine health-care data and the cross-sectional nature of the Older Persons Routine Acute Assessment. The following five areas are discussed in further detail in the description of the work: (1) coverage, (2) accuracy of brief assessment tools, (3) cross-sectional nature of assessment, (4) lack of full dementia diagnostic workup and (5) differences between admission and incident cohorts. The economic study was limited to in-hospital costs as we had no data for social or informal care costs.

The survey was conducted online, limiting its reach to older carers and those people with cognitive spectrum disorders.

Conclusion

The three distinct research methodologies used in this project demonstrate the consistent finding that patients admitted to hospital with confusion (whether due to delirium, diagnosed or undiagnosed dementia or a combination of these) have poor outcomes. The overlapping clinical manifestations and non-standardised diagnostic criteria for each of the individual cognitive spectrum disorders hampers our ability to synthesise evidence on each condition's prevalence and associated outcome. When taking all cognitive spectrum disorders as a whole, over one-third of patients from the older population who are admitted to hospital have a cognitive spectrum disorder. When analysing the outcomes of the four mutually exclusive subgroups of the population with cognitive spectrum disorders (known dementia, delirium, delirium superimposed on dementia and unspecified cognitive impairment), outcomes remain poor and show no clear distinction between subgroups. Future research should include standardisation of case-finding and diagnostic criteria to aid stratification of cognitive spectrum disorders. Longitudinal research and analysis adjusting for physical comorbidity and function should examine whether cognitive impairment is an independent predictor of poor outcome or whether worse outcome is mediated by physical comorbidity, functional status or frailty. Finally, research designed to elucidate whether these poor outcomes are a result of the pathological processes themselves or the care delivered within the hospital setting will further our understanding of clinical management.

Study registration

This study is registered as PROSPERO CRD42015024492.

Funding

This project was funded by the National Institute for Health Research (NIHR) Health Services and Delivery Research programme and will be published in full in *Health Services and Delivery Research*; Vol. 9, No. 8. See the NIHR Journals Library website for further project information.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Chapter 1 Background

Dementia and cognitive impairment pose a major challenge to health services. Dementia prevalence is most strongly associated with age,[1] and has risen sharply with increasing population longevity resulting, in part, from the medical advances made in reducing vascular mortality in mid-later life and early later life.

Current policy

The framework of policy that currently exists for guiding and improving the care and treatment of people with dementia is extensive. The importance of improving general hospitals' response to dementia is frequently highlighted. In addition, the recognition that the measurement of outcomes, rather than only process measures, when aiming to improve quality of care is deeply rooted in governmental policy.

Dementia is on the policy radar at the global level. In December 2013, the UK hosted the G8 (Group of Eight) dementia summit. This concluded with the publication of a declaration setting out agreements that had been reached. Since this event, a World Dementia Council and World Dementia Envoy have been appointed to lead the global dementia action.

The UK Prime Minister's Dementia Challenge was launched in March 2012.[2] One of its three key domains was the 'health and care' of people with dementia.

The Dementia Challenge follows on from the individual nations' dementia strategies. In England, objective 8 of the National Dementia Strategy[3] prioritises the identification of leadership for dementia in general hospitals, defining the care pathway for dementia and the commissioning of specialist teams to work in general hospitals. In Scotland, improving care in hospitals was the second of two key improvement areas in the first Dementia Strategy.[4] The second Dementia Strategy states one of the key priorities to be that people with dementia in hospitals or other institutional settings are always treated with dignity and respect.

In 2006, the National Institute for Health and Care Excellence (NICE)/Social Care Institute for Excellence[5] recommended that hospitals review their facilities and service function so that they promote independence and maintain function in people who have a dementia.

In 2010, the government published the White Paper *Equity and Excellence: Liberating the NHS*.[6] This outlined the intention to move the NHS away from focusing on process targets to measuring health outcomes.

In 2013, the Department of Health and Social Care published *Dementia: A State of the Nation Report on Dementia Care and Support in England*.[7] Once again, general hospitals' response to people with dementia was highlighted as a priority.

The current *NHS Outcomes Framework 2013–14*[8] sets out the outcomes and corresponding indicators used to hold the NHS Commissioning Board to account for improvements in health outcomes. It states that:

> *Health outcomes matter to patients and the public. Measuring and publishing information on health outcomes are important for encouraging improvements in quality.*
>
> *Reproduced from the Department of Health and Social Care.*[8]
> *Contains public sector information licensed under the Open Government Licence v3.0*

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

This sits alongside the *Adult Social Care Outcomes Framework 2014 to 2015*,[9] which sets out the indicators for measuring adult social care outcomes, which have been recognised as being as important for people with dementia.

Current evidence

Dementia presents specific important challenges in acute hospitals. In 2001, the Department of Health and Social Care estimated that two-thirds of hospital beds were occupied by patients aged > 65 years,[10] up to half of whom might have some kind of cognitive impairment, including dementia and delirium.[11] Poor identification of cognitive impairment, frailty, comorbidity and polypharmacy complicate the picture and make this a highly vulnerable but heterogeneous population. The commonest symptom of dementia is cognitive impairment, but, in the hospital setting, individuals with cognitive impairment due to dementia are difficult to distinguish from those with delirium. In a study by Sampson *et al.*,[12] which included a specialist clinical assessment for delirium, the prevalence of dementia in general hospitals was found to be 42.4% in patients aged > 70 years, but half of these individuals did not have a formal diagnosis. In acute hospital admissions, dementia is a common comorbidity but it is poorly recognised and poorly managed. In a systematic review, Mukadam and Sampson[13] found that prevalence estimates for people with dementia in a general hospital setting varied from 12.9% to 63.0%, but it was not possible to estimate a pooled prevalence because of heterogeneity between studies in terms of the population studied (specialist geriatric medicine settings alongside unselected medical admissions), the assessment methods used and the majority of studies not screening for delirium or depression, meaning that the rish of misclassification was high.

Poor outcomes for people with dementia after hospital admission were highlighted by the 2016 Alzheimer's Society (London, UK) poll of > 570 carers, families and friends of people with dementia.[14] Ninety per cent said that they felt that the person with dementia became more confused while in hospital. This was a follow-up from their 2009 staff and carer survey, which found that the health of most people living with dementia is worse when they leave hospital than when they are admitted.[15]

The Alzheimer's Society also reported from a Freedom of Information request that the average length of stay (LoS) in hospital in 2015 for someone aged > 65 years was 5.5 days, whereas for people with dementia it was 11.8 days.[14]

Current knowledge concerning the outcomes of this hospital population with cognitive impairment can be divided into three distinct groups: reports look at the outcomes of (1) those with dementia, (2) those with delirium and (3) the broader population of those with cognitive impairment. Evidence-based documentation of outcomes for people with cognitive impairment in this setting is sparse. The 2011 systematic review by Mukadam and Sampson[13] identified seven studies reporting outcomes for people with dementia who were admitted to an acute hospital.[16–22] The included studies mostly did not screen for delirium or depression, and a significant proportion of the 'dementia' identified may be misclassified. Included studies were generally small, with six having sample sizes of 100–375; the other study[17] included 2000 patients. The review found that individuals with dementia have worse outcomes, including increased length of hospital stay, functional decline and likelihood of discharge to institutional care. It also found that the cost of treatment was higher for those with dementia.[13] The current understanding of the health economic impact of dementia is often defined by intervention rather than health-care setting, and estimates for cost of care for patients with dementia in general hospitals are sparse, despite some important existing work on dementia.[23]

When looking at the outcomes of patients with delirium in general hospitals, there is substantial evidence that shows that outcomes are poor.[24] Delirium is a common condition, known for its acute onset in confusion, fluctuating course and inattention. Delirium affects up to 30% of older hospital patients, and people who develop delirium have high mortality.[25] As well as an increase in overall

morbidity and mortality, delirium increases the lengths of hospital stays.[26,27] Delirium can also lead to significant functional decline; following an episode of delirium, patients are more likely to require social support, which can range from new or increasing home care input to an increase in the likelihood of admission to a nursing home.[24] There is also evidence that shows that cognitive function in elderly patients can be significantly worsened following a period of delirium, and may never return to its premorbid baseline.[28] People with a dementia have a fivefold risk of developing delirium.[11] There are estimates from over a decade ago that delirium cost the US health system > US$4B in inpatient costs alone.[29] In a study of delirium in elderly patients on general medical units during their initial hospitalisation and 1 year following their discharge, Leslie *et al.*[30] showed that delirium during a hospital stay was associated with higher mean total costs (at least US$69,498 vs. US$47,958), as well as 2.5 times higher costs per day (US$461 vs. US$166). This study concluded that delirium was responsible for between US$60,516 and US$64,421 additional health costs per year per delirious patient, which translates to a US$38B per year financial burden of delirium, with significantly higher figures (US$143B–152B per year) when the figure was processed using models that accounted for the fact that the data were right-censored. In 1986, Levkoff *et al.*[31] estimated that if the LoS of each delirious patient could be reduced by just 1 day, the savings to Medicare would amount to US$1B–2B annually.

In a randomised controlled trial of a specialist medical and mental health unit versus standard care for those admitted to hospital with 'confusion', the primary outcome measure used was the number of days at home beyond 90 days after randomisation.[32] Results showed no difference in this outcome between the two groups, although the intervention significantly improved patient experience and the satisfaction of family carers. Bradshaw *et al.*[33] examined outcomes for people with comorbid mental health problems (dementia, delirium and depression). This study showed a high mortality, high re-admission rate and high discharge to care home rate within the study population, but there was no comparison with a similar population without mental health disease and no subgroup analysis of different mental health conditions.

Why this study?

There is little doubt that outcomes for people with cognitive spectrum disorders (CSDs) admitted to hospital are worse than those for people without CSDs, and it is likely that these could be improved. Plausible interventions to improve the outcomes are necessarily complex because they have to address the multiple clinical and social scenarios encountered, but their development requires a good understanding of the population with CSDs in the acute general hospital, and their outcomes. Lack of or incorrect CSD diagnosis, frailty, comorbidity and polypharmacy complicate the picture and make for a heterogeneous population. There is initial evidence from the USA that holistic management of older adults can improve outcomes.[34] The Medical Research Council (MRC) Framework[35] for the Development and Evaluation of Complex Interventions recommends pre-intervention development work to understand the population receiving the intervention, and to inform the choice of appropriate outcomes. Current knowledge of how common CSDs are among older people admitted to hospital and their post-hospital outcomes is sparse owing to the difficulties (especially consent and external validity) of recruiting a large and representative patient cohort, but such epidemiology is a central first step (theoretical phase) in the development of interventions.

Reporting of health-care outcomes, such as LoS, mortality and re-admission, is difficult to capture in this population owing to underdiagnosis. This is compounded by the fact that 'dementia' per se is rarely recorded as the primary reason for admission and is unreliably recorded as a secondary reason.

The need for this research is all too apparent when reviewing the catastrophic impact that poor outcomes from a hospital admission may have on the lives of individuals with a CSD, their families and the health and social care systems. Decline in physical and mental well-being in the older population can happen at any time and an admission to general hospital is often the trigger for an irreversible

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

acceleration in this decline. What happens in general hospitals can have a profound and permanent effect on individuals with CSDs and their families, not only in terms of their inpatient experience, but also in terms of their ongoing functioning, relationships, well-being, quality of life (QoL) and the fundamental decisions that are made about their future.[36]

This research enables accurate documentation of these outcomes and provides a baseline from which to measure improvement. This documentation adds evidence to be used in future policy development to drive these changes.

The increased understanding resulting from this study is a component that is necessary for the next step in improving the quality of care for people with CSDs in general hospitals.

Chapter 2 Systematic reviews

Background

Older people admitted to the acute hospital present with CSDs including dementia, cognitive impairment, delirium and delirium superimposed on dementia (DSD). This study systematically reviewed the prevalence and outcomes of such disorders and highlights the varied range of prevalence estimates for each condition and the variation in methodology contributing to these findings.

Introduction

The literature review examined evidence that currently exists in the field of cognitive impairment in general hospitals. It covered the domains of cognitive impairment, dementia and delirium both separately and in a combined fashion, thereby summarising the majority of this subject area for the first time, and, in the case of dementia, updating the review compiled in 2008.[13] The primary aim of this current review was to systematically report the prevalence and outcomes of cognitive impairment in older people admitted to general hospitals across the spectrum of all cognitive disorders.

The research questions answered by this review are as follows:

- What is the prevalence of CSDs (including cognitive impairment, dementia, delirium and DSD) in older people admitted to hospital acutely?
- What outcomes have been reported/observed/studied and how have they been measured in this population?
- What are the differences in the outcomes experienced by those with and those without CSDs following an acute hospital admission?

Methods

Protocol and registration

A protocol for the review was developed and registered with PROSPERO in 2015 (PROSPERO CRD42015024492) before work was started on defining search terms.[37]

Eligibility criteria

An inclusive approach was adopted in the original search. *Table 1* contains the full list of inclusion and exclusion criteria. The exposure of interest was CSD and how it was measured or diagnosed.

TABLE 1 Inclusion and exclusion criteria for the systematic review

Inclusion criteria	Exclusion criteria
• Observational studies, including cohort studies, case–control studies and cross-sectional studies • Systematic reviews • Conference abstracts • Study included adult hospital inpatients with an unscheduled acute hospital admission • Included prevalence and/or outcome data about CSDs • Article available in English	• Randomised controlled trials, intervention studies, quality improvement initiatives, before-and-after designs • Narrative reviews • Elective admissions • Non-general hospital settings • Inpatients who had been discharged home before data collection • Did not report prevalence data or outcome data on any of the outcomes of interest

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Randomised controlled trials, intervention studies, quality improvement initiatives, before-and-after designs and narrative reviews were excluded as they do not provide general population (unselected) prevalence or outcome data. Systematic reviews were retained for review of their reference lists.

Other exclusions were made to remove non-general hospital settings, such as community hospitals, intensive and post-acute care units, rehabilitation hospitals, outpatient clinics, primary care, mixed settings (i.e. outpatients and inpatients) and inpatients who had been discharged home before data collection.

Outcomes of interest included mortality (in-hospital and at follow-up), length of hospital stay, hospital re-admission, admission to long-term care (nursing homes, etc.), health or social care costs, physical function [activities of daily living (ADL)], QoL and change in cognitive function. Any articles that did not report prevalence data or outcome data on any of the outcomes of interest were excluded.

No restrictions were made for date of publication in the search. Conference abstracts were included in the screening and a search was carried out based on title and first and last author to identify any subsequent full-text publication for inclusion in the review. Systematic reviews were not included in the full-text review. The results were restricted to publications available in the English language.

Information sources

The following databases were searched between 29 January and 1 February 2016:

- Ovid MEDLINE In-Process & Other Non-Indexed Citations and Ovid MEDLINE (date range searched: 1946 to present)
- Ovid EMBASE (date range searched: 1980 to 2016 week 4)
- EBSCO*host* Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus
- Ovid PsycINFO (date range searched: 1806 to January week 4 2016)
- Cochrane Database of Systematic Reviews.

See *Appendix 2*, *Table 25*.

Search

Initial scoping searches were undertaken in MEDLINE using keywords and medical subject heading (MeSH) terms both separately and combined in order to comprehend their coverage. The search was formed using three distinct concepts: (1) CSD (made up of searches for dementia, delirium and cognitive impairment), (2) hospital inpatient and (3) prevalence and/or outcomes. Search terms were combined within the concepts using OR and the three concepts were combined using AND.

Search strategy development drew on a range of existing published sources. The reviews conducted by Mukadam and Sampson[13] and Siddiqi *et al.*[38] were consulted and search strategies were shared with the review team. The Cochrane Dementia and Cognitive Improvement Group search strategies for delirium and dementia were used to inform search strategy development.[39] Terms for cognitive impairment were expanded. Additional assistance and advice was given by an information specialist from the University of Stirling.

Multiple iterations of the search were tested to ensure that it identified all papers on a list of target publications constructed by the research team. The search strategy was circulated to the External Advisory Board for comment and then finalised. A copy of the complete search strategy is available in *Appendix 2*.

Study selection

All articles were uploaded into the online systematic review tool for screening and review (Covidence, VIC, Australia). Direct deduplication was carried out by the software. Titles and abstracts were screened independently by pairs of reviewers, one of whom was a senior reviewer, and all conflicts were resolved through discussion between two of the senior reviewers.

Prior to full-text screening, two senior reviewers reassessed all titles and abstracts and removed those that were not in the general or geriatric medical setting in order to limit the heterogeneity of study methods resulting from disease-specific hospital settings. A spreadsheet was developed to classify these so-called specialist populations for future use by one reviewer, and each entry was checked by a second reviewer to ensure consistency in classification. Any studies that did not meet the review exclusion criteria were removed at this stage with the agreement of the two reviewers.

Full-text screening of 422 articles was undertaken independently by pairs of experienced reviewers. Of these articles, 73 were reviewed twice independently by pairs of reviewers and consensus was reached over any conflicts. Full-text screening for the remaining 349 articles was completed by at least one independent senior reviewer. Eighty per cent of the 349 articles reviewed were cross-checked by two senior reviewers to ensure consistency and evaluation of judgements about relevance. There was strong consistency in judgements between both reviewers, and any conflicts between the reviewers were resolved. The final number of included articles was 146. Sixty-four foreign-language papers were not considered for review.

An exclusion hierarchy was developed for full-text screening, recognising that there may be multiple reasons to exclude a single study:

1. non-human study
2. paediatric population (aged < 18 years)
3. duplicate record
4. specialist population
5. wrong study design
6. wrong setting
7. wrong population
8. conference abstract (with no subsequent full text)
9. no prevalence/outcome data reported
10. foreign-language publication
11. insufficient information to evaluate.

Data collection

A data extraction form was developed using Google Docs (Google Inc., Mountain View, CA, USA). This was piloted with the data extraction team to improve consistency of approach. It was developed in line with Stirling University Literature Review and Evaluation Methodology. Data extraction was carried out by two independent reviewers. To ensure consistency of data extraction, all articles were cross-checked by each reviewer. Particular attention was given to articles for which a second opinion was sought. All conflicts were resolved by consensus between the two reviewers and did not require the opinion of a third reviewer.

Data items

Data were extracted on the following items: emerging issues, population, setting, type of study, age range, sample size, sex of participants, coverage, the country that the study was conducted in, inclusion and exclusion criteria, start date of the study and study duration. For each CSD covered in the article, data items included the definition of CSD used in the paper, assessment tools or diagnostic criteria, number of cases, size of underlying population, quoted prevalence and quoted incidence. For associated outcomes, the following data items were extracted: LoS; QoL; mortality; nursing/care home admission; functional status/ADL; change in cognitive status; health-care costs; hospital re-admission; other outcomes; and covariates. All outcomes were reported on.

Quality assessment of studies

Quality assessment was conducted based on the tool developed by Boyle[40] and adapted by Mukadam and Sampson.[13] This was integrated into the data extraction form.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

A maximum quality score of 18 could be assigned in the context of each diagnosed condition. When evaluation questions were not applicable to the study (e.g. when studies did not address all conditions), the maximum score was adjusted to reflect this and to ensure that quality was measured equitably for all studies.

Risk of bias across studies

To ensure consistency of judgements about the quality of evidence, the second independent reviewer assessed 20% of the included studies; this has been found in previous work to be sufficient to ensure consistency. These studies were identified randomly and any identified disagreements were resolved.

Summary measures

Studies were included if they reported quantitative data on the prevalence of any of the CSDs in an unselected hospital population and/or if they reported quantitative data on the outcomes of interest, based on CSD category or comparing a CSD with no CSD.

Results of the systematic review

Study selection

The initial search identified 23,000 records after initial deduplication. Following title and abstract screening, 2646 records remained. Specialist population removal removed a further 1553 articles (*Table 2*). In addition, 671 identified articles did not comply with the original study eligibility criteria and so were removed, resulting in 422 for full-text review. A total of 277 records were excluded from the review on full-text screening (see the exclusion hierarchy in *Study selection*). The search was re-run to identify any conference abstracts available as full-text articles, which yielded one additional full text for inclusion. A total of 141 articles were included in the review (*Figure 1*).

TABLE 2 Articles removed from specialist populations and other exclusions

Category	Number of articles removed
Emergency department	133
Haematology and oncology	81
Orthopaedics and trauma	290
Cardiovascular and cardiac surgery	262
Postoperative	134
Stroke and brain injury	148
Palliative care	32
Disease or condition specific	320
Nutrition and electrolytes	48
Percutaneous endoscopic gastrostomy	22
Care home	21
Psychological liaison	33
Unclassified	29
Total number of specialist populations removed	1553
Total number of other exclusions[a]	671
Total number of exclusions	2224

a These articles did not comply with the original study eligibility criteria.

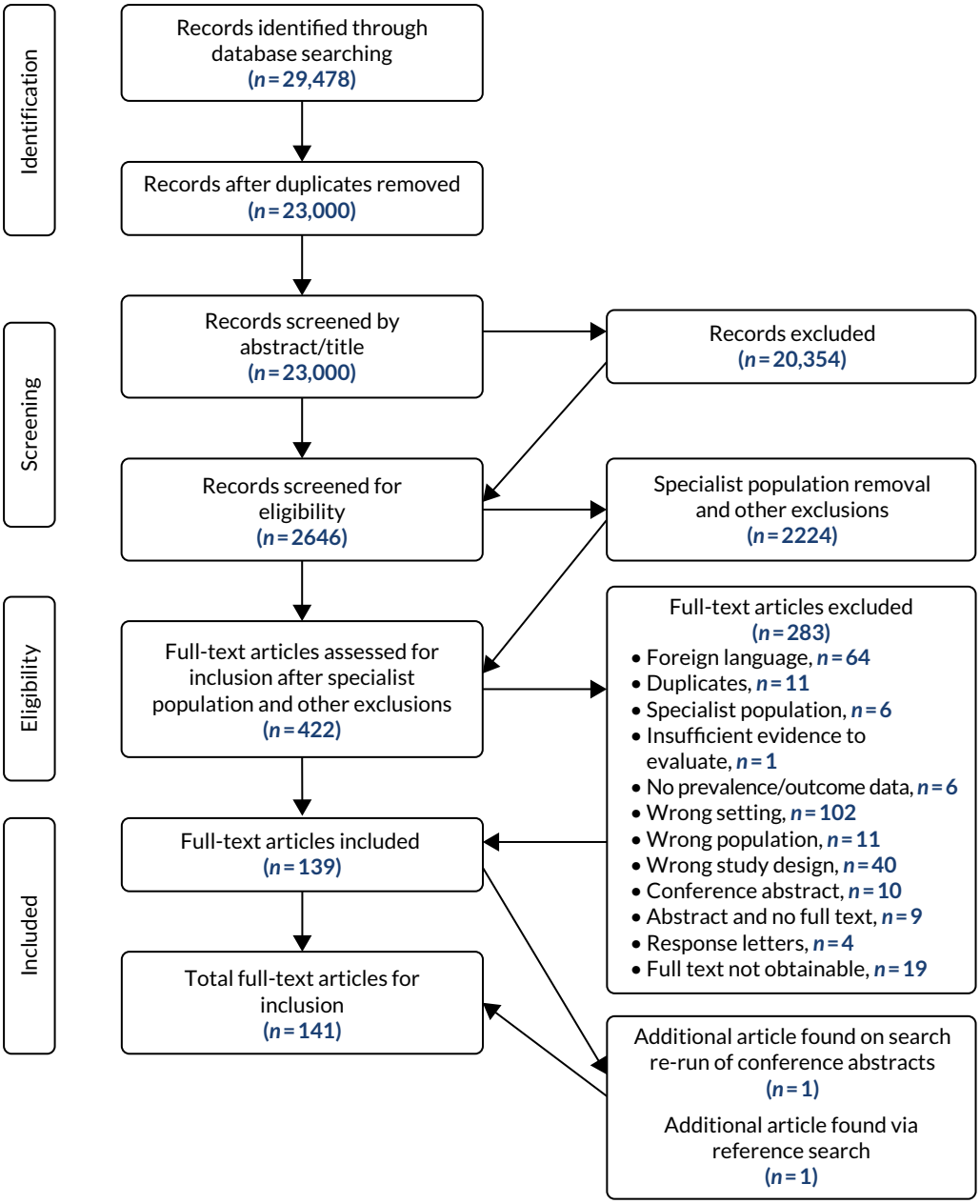


FIGURE 1 The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

Studies excluded from the review

A total of 283 studies were excluded. Studies were excluded for the following reasons: foreign language ($n = 64$), duplicates ($n = 11$), specialist population ($n = 6$), insufficient evidence to evaluate ($n = 1$), no prevalence or outcome data ($n = 6$), wrong setting ($n = 102$), wrong population ($n = 11$), wrong study design ($n = 40$), conference abstract ($n = 10$), abstract identified and no full text available ($n = 9$), response letters ($n = 4$) and full text not obtainable ($n = 19$).

Included study characteristics

A total of 141 studies were included in the review. A summary of the characteristics of the included studies is provided in *Appendix 3*, *Table 26*.

The sample size varied significantly, from 18[41] to 1,135,423[42] participants. Fifty-five per cent of the studies were conducted in Europe. A total of 127 (89%) of the included studies were reported as cohort designs, 12 of which were retrospective and 113 of which were prospective. There was one descriptive cohort study.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Five retrospective studies were reported as secondary analyses and two were reported as case–control studies. There were seven cross-sectional studies.[19,43–48]

Participants in one study had a mean age of < 65 years; 13 studies did not report the average age of participants.[49–52]

Study duration varied, with data ranging from 1 month to 17 years. Seventy-three studies represented the acute general setting, with 65 in the acute/geriatric setting, and three studies encompassed both acute general and geriatric settings.[53–55]

Twelve studies evaluated participants for both cognitive impairment and dementia. Sixteen studies evaluated dementia alone and 21 studies evaluated only cognitive impairment. Delirium was evaluated in 89 studies, DSD was evaluated in 18 studies, 46 studies screened for both delirium and dementia, and delirium, dementia and cognitive impairment were screened for in 11 studies.

There was heterogeneity in terminology used to describe the acute hospital setting, which encompassed terminology including 'teaching hospital', 'university hospital' and 'internal medicine'.

Screening and prevalence of delirium

A total of 89 included studies reported delirium prevalence. Delirium prevalence ranged from 5% to 85.5% (see *Appendix 3*, *Table 27*), reflecting the range of diagnostic tools and methodological approaches used.[56,57] Demographic characteristics of the cohort and differences in study design may also have influenced prevalence estimates; for example, Jitapunkul and Hanvivadhanakul[49] included an all-female sample. Goldberg *et al.*[58] used a sample that disproportionately included patients who had carers living locally and who had longer hospital stays.

Adamis *et al.*[59] included those with less severe delirium – in parallel with other studies demonstrating selection biases – and required participant consent, thus potentially underestimating delirium prevalence.

There were eight retrospective studies and three secondary analyses. These designs can lead to underestimates of prevalence figures and depend on quality and availability of medical data. Prevalence figures may also have been influenced by not routinely diagnosing delirium but using only a single assessment in which it is difficult to differentiate between new and existing cases of delirium (e.g. Edlund *et al.*[60]). Four studies included only incident cases; thus, prevalence could not be reported.[61–64]

The term 'acute confusion' was used to describe delirium in five studies.[49,50,65–67] Five studies reported prevalence of subsyndromal delirium (SSD): Bourdel-Marchasson *et al.*[68] (20.6% SSD), Cole *et al.*[69] (65% SSD), Lam *et al.*[70] [66.2% residual subsyndromal delirium (rSSD)], Martínez-Velilla *et al.*[71] (22.3% SSD) and Zuliani *et al.*[48] (37.9% SSD). Six studies reported prevalence figures for subtypes of delirium: mixed, hypoactive and hyperactive delirium.[19,57,60,70,72,73]

The most common tools adopted to diagnose delirium (see *Appendix 3*, *Table 27*) were the Confusion Assessment Method (CAM)/Confusion Assessment Method for the intensive care unit (CAM-ICU) (41 studies) and the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition (DSM-IV) (21 studies). There was considerable heterogeneity across studies in the diagnostic tools used. Basic and Khoo[74] and Basic and Hartwell[75] did not specify how diagnosis was made. Díez-Manglano *et al.*[76] defined delirium presence from any cause during the previous hospitalisation, and relied on medical notes to diagnose delirium.

Screening and prevalence of dementia

The *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, Text Revision (DSM-IV-TR), (21 studies) and the Mini Mental State Examination (MMSE) (21 studies) were the most commonly used tools to diagnose dementia (see *Appendix 3*, *Table 28*). There were five case-only studies.[12,77–80] Prevalence in the remainder of studies varied greatly: from 1.33%[81] to 74.4%,[70] probably owing to

sample selection biases and heterogeneity in screening tools and methodological approaches used to diagnose dementia. Five studies did not specify the criteria used to diagnose dementia.[41,72,75,82,83] Variations in demographic characteristics of the studied population also may have affected prevalence figures; for example, Di Iorio *et al.*[84] conducted a study in multiple hospital sites.

Six studies appeared to use the terms 'cognitive impairment' and 'dementia' interchangeably.[59,62,68,85–87]

Several studies were selective in the approach used. For example, Sampson *et al.*[12] excluded people with persistent delirium, so may have underestimated the prevalence of dementia, and Aminoff[77] used a case-only study to include only patients with severe dementia.

Five studies reported the prevalence of subtypes of dementia. Erkinjuntti *et al.*[17] found vascular dementia to be the most common (72.4%), then primary degenerative dementia (PDD) (23%) and then other causes (4.6%). Erkinjuntti *et al.*[18] reported prevalence of PDD as 16.1% and prevalence of vascular dementia as 69.4%, and 14.5% of patients had specific causes of dementia. Jackson *et al.*[88] reported Alzheimer's disease (AD) prevalence to be 66%, vascular dementia prevalence to be 26% and mixed dementia prevalence to be 6%, followed by dementia with Lewy bodies at 21%. Lorén Guerrero and Gascón Catalán[44] reported AD prevalence to be 40.74%. Wancata *et al.*[21] reported AD prevalence to be 61.8%, multi-infarct dementia prevalence to be 21.6%, pre-senile dementia prevalence to be 2.5% and unidentified dementia prevalence to be 14.1%.

There were 11 retrospective studies, including five secondary analyses. These study designs are likely to produce an underestimate of prevalence of dementia, as estimates were derived from medical notes or discharge codes, rather than from assessment actively undertaken by a researcher. In retrospective studies, validity depends on the quality of the discharge reports used as well as access to other data, including re-admissions. Furthermore, five prospective studies relied only on medical records to diagnose dementia.[49,67,79,89,90] Six prospective studies and one retrospective study did not specify how dementia was diagnosed.[41,54,63,72,75,82,91] Hsieh *et al.*[92] prospectively assessed dementia using a researcher-led approach but did not specify the diagnostic tool used.

Screening and prevalence of delirium superimposed on dementia

Typically, the term 'delirium superimposed on dementia' is used when an acute change in mental status (e.g. fluctuating course, inattention, altered level of consciousness and disorganised thinking) occurs alongside pre-existing dementia.[93] Across all papers, there was considerable heterogeneity in the operationalisation and measurement of DSD and the diagnostic criteria applied (see *Appendix 3*, *Table 29*). Five studies did not explicitly reference the term 'delirium superimposed on dementia', but included patients who presented with both conditions concurrently. Faezah *et al.*[72] did not clearly assign prevalence estimates to differentiate the subjects in the cohort under study.

Prevalence varied widely, from 0.5% to 76%, which probably reflects the range of diagnostic approaches and the variation in the populations assessed. McCusker *et al.*[94] reported the highest prevalence of DSD across all prospective studies, at 76% (based on 164/217 patients).

The DSM-IV was used in nine studies in conjunction with other tools to diagnose DSD, but there was no consensus approach to measure DSD. *International Classification of Diseases*, Ninth Edition (ICD-9), coding was used in two studies: Bellelli *et al.*,[55] who reported the lowest prevalence of DSD, and Gallerani *et al.*[95] Bellelli *et al.*[55] did not document pre-existing dementia using a separate, validated tool, which limited the ability to differentiate deficits associated with delirium from those in dementia. Rockwood[83] did not specify how dementia assessment took place. Several papers did not distinguish prevalent and incident cases of delirium as delirium assessment was undertaken on the day of admission only.[60,79,96,97] Single assessments also make it difficult to differentiate delirium from dementia as they share many symptoms. McCusker *et al.*[26] assessed prevalent and incident delirium separately but did not report the relative number of cases.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Screening and prevalence of cognitive impairment

A total of 21 studies screened for cognitive impairment but did not report prevalence estimates.

The range of prevalence was 8.9%[59] to 80%.[62] The majority of studies defined cognitive impairment as distinct from 'dementia', and, in 45 studies, the MMSE was used to diagnose cognitive impairment (see *Appendix 3*, *Table 30*). There was heterogeneity in the assessment tools used across studies, potentially biasing prevalence estimates.

Five studies focused on 'mild cognitive impairment (MCI)'. Bickel *et al.*[98] reported 'mild cognitive impairment' as patients diagnosed using International Working Group on MCI criteria and fulfilling criteria for cognitive impairment but not dementia; Orsitto *et al.*[46,99,100] used the Petersen criteria[101] to diagnose 'mild cognitive impairment'. Jackson *et al.*[88] defined MCI as when the person is neither normal nor demented with some evidence of cognitive decline, and ADL largely intact.

Two studies did not describe the diagnostic approach used to screen cognitive impairment.[102,103] There was some heterogeneity in the terminology used to define cognitive impairment, with six studies appearing to use the terms 'cognitive impairment' and 'dementia' interchangeably.[59,62,68,85–87]

Freedberg *et al.*[104] used ICD-9 coding to diagnose delirium and/or dementia under the umbrella term 'cognitive impairment', and did not report separate prevalence figures for delirium or dementia.

Esmayel *et al.*[43] evaluated a cohort with a high level of illiteracy and did not adequately distinguish between educational attainment levels that would potentially affect MMSE scores.

Dementia outcomes

Mortality

Outcomes in respect of dementia are summarised in *Appendix 3*, *Table 31*. Mortality was reported as an outcome in respect of dementia in 16 studies.[12,42,55,56,77,90,97,105–113]

Nine studies reported in-hospital mortality.[42,55,77,90,97,105,106,110,111] Seven studies reported post-discharge mortality.[56,105,107–109,112,113]

One study reported a statistical difference in in-hospital mortality rates between patients with dementia and delirium, with a higher mortality rate among delirious patients.[97] Four studies found that in-hospital mortality was independently predicted by dementia.[12,42,77,110] Aminoff[77] examined the role of suffering in patients, as measured by the Mini Suffering State Examination (MSSE), with advanced dementia in relation to mortality. Significantly higher MSSE scores were reported in the non-surviving patients than in the surviving patients. A higher MSSE score was a significant risk factor for mortality in multivariate analysis.

Forasassi *et al.*[111] found no statistically significant association between dementia and in-hospital mortality in univariate analysis. Dementia did not predict in-hospital mortality using multivariate analysis in four studies.[55,90,105,106]

Three studies did not find a significant association between dementia and discharge mortality after adjusting for confounders.[105,112,113] Zekry *et al.*[105] noted vascular or severe dementia to be associated with short- and long-term mortality. However, when vascular dementia was adjusted for in multivariate analysis, the effect of dementia (regardless of its aetiology) was not associated with in-hospital, 1-year post-discharge or 5-year post-discharge mortality.

Two studies found a significant relationship between dementia and post-discharge mortality.[107,108] Sampson *et al.*[107] found an association for dementia and post-discharge mortality and an association for patients with moderately severe and severe dementia after multiple adjustment. However, after adjusting

for Waterlow (pressure sore risk) score, this association was no longer significant. Ponzetto *et al.*[108] reported a significant difference in mortality up to 5 years post discharge stratified by dementia status.

Length of hospital stay

Nine studies reported length of hospitalisation as an outcome in respect of dementia.[17,18,20,21,74,81,97,109,114] All but one study established an association between LoS and dementia.[109] Two studies did not report associations.[74,81]

Wancata *et al.*[21] found that LoS was predicted by dementia in patients grouped into two subtypes of dementia displaying either cognitive or non-cognitive symptoms. Saravay *et al.*[114] reported each of eight behavioural and mental manifestations and complications associated with delirium, dementia and cognitive impairment to be significantly associated with increased LoS. McCusker *et al.*[109] did not find a significant association between presence of dementia and LoS in a cohort of delirious patients.

Nursing/care home admission and hospital re-admission

Five studies reported admission to care/a nursing home as an outcome for dementia.[21,45,78,94,115] All studies, with one exception,[94] found a significant association between dementia and nursing/care home admission. McCusker *et al.*[94] specifically found increased odds of long-term institutional transfer for at least 12 months after admission when patients presented with both delirium and dementia compared with dementia alone. Marengoni *et al.*[45] reported that admission to a nursing home or rehabilitation were each independently predicted by dementia after adjustment for confounders. Di Iorio *et al.*[85] reported that hospital re-admission within 3 months of discharge was associated with dementia, after adjustment.

Functional status

Five studies examined the relationship between dementia and functional status.[71,94,99,109,116] McCusker *et al.*[94,109] reported poorer functional status among demented patients than among non-demented patients at the 12-month follow-up with both the independent activities of daily living (IADL) and the Barthel Index (BI). Orsitto *et al.*[99] reported functional status to be worse in those with dementia than in those with MCI or no dementia. Dementia was associated with poorer functional status in all studies except McCusker *et al.*,[109] which did not examine any associations.

Cognitive status

McCusker *et al.*[94] reported that patients with dementia had worse MMSE scores over time than those without the condition. The effect of delirium on MMSE scores at follow-up was significant among patients with and patients without dementia. At enrolment, patients with only delirium had worse MMSE scores than those with only dementia, but patients with only delirium showed more improvement at follow-up than those with only dementia. McCusker *et al.*[109] found that MMSE scores were significantly lower at the 12-month follow-up in the dementia group.

Other

Two studies reported health-care costs as an outcome for dementia.[20,81] Torian *et al.*[20] reported no significant difference in net hospital profits and losses between patients with and patients without dementia. Briggs *et al.*[81] reported average hospital care costs as being three times higher per patient with dementia than per patient without dementia.

Delirium outcomes

Mortality

Outcomes in respect of delirium are summarised in *Appendix 3*, *Table 32*. A total of 38 studies reported mortality, which was expressed differently depending on the study: chiefly in-hospital and/or post-discharge mortality.[49,55–57,59,60,63,66,69,70,73,90,92,94–97,109,112,113,116–131] It was also reported as a composite outcome and, less frequently, as survival rates/mean number of days survived.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Sixteen papers examined the unadjusted association between delirium and in-hospital or post-discharge mortality. Of these, 12 studies reported higher in-hospital death rates in presence of delirium, all of which reached statistical significance.[49,59,60,92,95–97,123–125,127,130] The remaining four studies examined delirium and post-discharge mortality rates, all of which reported a significant association.[60,63,92,130] McAvay *et al.*[63] revealed statistically significant higher death rates for patients whose delirium was not resolved at discharge than for patients with resolved delirium on 1-year discharge, and a significantly higher mean number of days of survival in resolved cases.

Kolbeinsson and Jónsson[97] found a higher in-hospital mortality rate among patients with delirium than among those with dementia. Reports of mortality were not unanimously higher in patients with delirium. Boustani *et al.*[129] reported no significant difference in survival rates between those with and those without delirium at 30 days post discharge. O'Keeffe and Lavan[122] found no statistically significant difference in in-hospital mortality rates between subtypes of delirium. Adamis *et al.*[130] found no significant difference in in-hospital mortality rates delirious patients and non-delirious patients (incident or prevalent). This was the same at 6 months post discharge, at which point delirium severity also failed to show an association with mortality. Two studies reported relative death rates in delirious patients and non-delirious patients, but did not examine an association between delirium and in-hospital mortality.[66,94]

Delirium independently predicted post-discharge mortality in eight studies after adjustment for confounders.[26,63,69,113,119,124,126,128] In five studies, delirium did not independently predict post-discharge mortality after adjustment for confounders.[112,116,120,121,123]

Delirium was a predictor of in-hospital mortality after multiple adjustments in five studies.[90,118–120,126] Eeles *et al.*[126] reported in-hospital and post-discharge mortality, and established an association between index admission, 1-year and 2- to 5-year post-discharge mortality and delirium. Jitapunkul and Hanvivadhanakul[49] observed 'history of acute confusion' as a significant predictor for mortality after controlling for multiple confounders. Delirium did not independently predict in-hospital mortality in three studies.[55,73,121]

White *et al.*[117] found that low levels of plasma esterase activity in delirious patients – regardless of whether delirium was acquired in hospital or present on admission – were significantly associated with increased in-hospital mortality. Two studies used a predictive model to predict mortality in delirious patients.[56,130] Adamis *et al.*[130] found no relationship between in-hospital and post-discharge mortality and delirium.

Seven studies examined mortality as a composite outcome.[63,69,70,92,122,127,128] Cole *et al.*[69] used a composite outcome (death and institutionalisation post discharge) to examine its association with non-recovery from SSD. Non-recovered SSD predicted death and institutionalisation at 6 and 12 months post discharge. Lam *et al.*[70] reported that rSSD on discharge was predictive of inpatient mortality or incident institutionalisation on discharge. O'Keeffe and Lavan[122] examined the percentage of deaths among subtypes of delirium (hypoactive, agitated, mixed or no delirium) and found no significant difference in mortality between these groups. Buurman *et al.*[128] found the composite outcome (mortality or functional decline) to be independently predicted by delirium. Dasgupta and Brymer[127] reported that delirium severity as measured by the Memorial Delirium Assessment Scale (mDAS) was independently predictive of poor recovery (functional decline, institutionalisation or death). Hsieh *et al.*[92] established one episode of delirium as independently associated with increased odds of unanticipated intensive care unit (ICU) admission or in-hospital mortality. In addition, delirium persisting for all 3 days of admission was independently associated with decline in discharge status (defined as discharge to care or in-hospital mortality). Using a composite outcome of nursing home placement and mortality, McAvay *et al.*[63] reported a greater risk for delirious patients at discharge of dying or being institutionalised than for those who were never delirious and those whose delirium resolved.

Length of hospitalisation

Twenty-eight studies[55,59,60,63,66,70,73,74,79,83,92,96,97,109,119–122,124–127,129,131–135] examined LoS as an outcome. Twenty studies established a statistically significant association between delirium and length of hospitalisation. Five studies[79,120,121,132,133] that adjusted for confounders reported delirium as independently predictive of

duration of hospitalisation. One study[134] found incident delirium and non-prevalent delirium to be predictive of LoS after adjustment. Basic and Khoo[74] reported that absence of delirium predicted a short LoS.

Functional status

Thirteen studies[66,70,71,83,94,109,112,116,121,124,125,131,136] reported functional status as an outcome for delirium, expressed as ADL scores. An additional three studies[69,127,128] reported on functional status as a composite outcome. One further study[120] reported care needs after discharge.

Two studies[83,125] reported no significant difference in functional dependency scores between delirious patients and non-delirious patients. González *et al.*[124] found a significant association between functional status (ADL) and delirium. Lam *et al.*[70] observed that patients without rSSD had significantly higher functional independence at admission and discharge and showed a faster rate of improvement in functional status than those with rSSD. However, the magnitude of change in functional recovery observed at discharge was not statistically different between those with and those without rSSD. McCusker *et al.*[109] reported that patients with transient delirium had significantly worse BI/IADL scores at follow-up than those with recovered delirium, and those with persistent delirium had worse functional outcomes than recovered patients. Wakefield[66] showed a decline in discharge functional status in patients who developed acute confusion during hospitalisation, although this did not reach significance.

Seven studies[94,109,112,116,120,121,136] used multivariate analysis to examine the relationship between delirium and functional status. All but two studies[94,136] reported delirium as independently predictive of functional dependency.

Cognitive impairment

Seven studies[69,70,94,109,112,125,137] that examined cognitive impairment (measured with the MMSE) as an outcome for delirium reported a significant difference in those whose MMSE scores improved compared with those who showed no improvement, according to delirium severity rather than delirium status. Feldman *et al.*[125] found a significant difference in MMSE score stratified by delirium status on discharge, compared with premorbid scores, and Lam *et al.*[70] found that cognition improved more slowly in those with rSSD. Cole *et al.*[69] established that MMSE score – a constituent item of a hierarchical composite outcome – was independently predicted by non-recovery from rSSD. Francis and Kapoor[112] found that cognitive status declined more significantly in delirious patients than in non-delirious patients in adjusted multivariate logistic regression. McCusker *et al.*[94] found that, over time, patients with both delirium and dementia had the worst MMSE scores and those who had neither condition had the best MMSE scores. On enrolment, patients with delirium only had worse MMSE scores than those with dementia only, but patients with delirium only showed greater improvement at follow-up than those with dementia only. After adjusting for covariates, all four groups showed small but statistically significant declines in MMSE scores from 2 to 12 months. McCusker *et al.*[109] found that those with persistent delirium had significantly worse MMSE scores at follow-up than those with recovered delirium. In terms of the clinical course of delirium, McCusker *et al.*[109] differentiated between transient, recovered and persistent symptoms of delirium present at discharge. Lam *et al.*[70] reported that rSSD patients improved more slowly in delirium severity than non-rSSD patients. Martínez-Velilla *et al.*[116] reported persistent delirium at follow-up as being significantly associated with previous episodes of delirium.

Nursing/care home admission and discharge status

Eleven studies[59,68,92,94,96,97,115,120,121,126,129] examined nursing/care home admission post discharge. Four papers[63,69,70,127] included nursing/care home admission as a composite outcome. Hsieh *et al.*[92] examined the rate of nursing home discharge in both delirious patients and non-delirious patients in addition to multivariate analysis examining the decline in discharge to a higher level of care, in discharge to a hospice or in-hospital deaths. Two papers[66,83] examined the outcome of discharge status. Two papers[60,73] examined home discharge as an outcome. Pendlebury *et al.*[120] examined hospital re-admission within 30 days as an outcome.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Three studies[60,96,129] reported higher rates of discharge to home among non-delirious patients than among delirious patients. Eeles *et al.*[126] reported higher rates of care home placement post discharge among delirious patients, which were statistically significant for up to 2 years from admission. One study[97] did not find differing institutionalisation rates between patients with dementia and delirium.

In nine studies, delirium predicted institutionalisation after adjustment for confounders. Discharge status decline was independently predicted by persistence of delirium for 3 days after adjustment for age and premorbid cognitive impairment in Hsieh *et al.*[92] However, after multiple adjustment, this association failed to reach significance. Bourdel-Marchasson *et al.*[68] established prevalent, incident and subsyndromal delirium as independent predictors of institutionalisation. Lam *et al.*[70] found rSSD to independently predict nursing home admission or mortality. Four studies[59,73,120,121] reported delirium as independently predictive of care home placement. Cole *et al.*[69] reported death or institutionalisation at 6 months post discharge as independently predicted by non-recovery from SSD. McAvay *et al.*[63] and Lam *et al.*[70] reported delirium as independently predictive of nursing home admission or mortality. Dasgupta and Brymer[127] reported that delirium severity predicted institutionalisation as part of a composite outcome, and reported a significant difference in care home admission rates between delirious patients and non-delirious patients. Two studies[94,115] did not identify delirium as independently predictive of nursing home admission after adjustment.

Other outcomes

No papers examined health-care costs in respect of delirium. O'Keeffe and Lavan[121] found that in-hospital delirium was the strongest predictor of developing a hospital-acquired complication. Hsieh *et al.*[92] reported a number of outcomes in respect of delirium (see *Appendix 3*, *Table 32*).

Cognitive impairment outcomes

Mortality

Outcomes associated with cognitive impairment are shown in *Appendix 3*, *Table 33*.

A total of 13 studies reported mortality as an outcome for cognitive impairment, six of which examined in-hospital mortality and six of which examined post-discharge mortality.[12,105,108,138–142] One study[104] examined death rates per person per year in respect of in-hospital, post-discharge and cumulative mortality. One study[143] reported probability of survival for up to 5 years after discharge. The MMSE was the most frequently used diagnostic tool for cognitive impairment, with lower scores representing greater impairment.

Three studies[12,138,140] reported an association between cognitive impairment and in-hospital mortality even after multiple adjustment for confounders. In addition, Freedberg *et al.*[104] reported in-hospital death rates per person per year, establishing a significant association with cognitive impairment after adjustment for confounders. Two unadjusted analyses[108,139] revealed an association between mortality and cognitive impairment. Zekry *et al.*[105] reported only death rates among cognitively impaired patients.

Of six studies investigating post-discharge mortality and cognitive impairment, one[140] found no association. Torisson *et al.*[142] found that cognitive impairment independently predicted post-discharge mortality. Espallargues *et al.*[138] reported an unadjusted association between cognitive impairment and the composite outcome of in-hospital mortality and mortality 1 month after discharge. Fields *et al.*[139] did not examine an association but reported mortality rates among cognitively impaired patients. Freedberg *et al.*[104] reported a significant association between post-discharge and cumulative death rates per person per year and cognitive impairment, after adjustment. Conde-Martel *et al.*[143] reported that post-discharge survival for up to 5 years was independently predicted by normal cognitive status.

Length of hospital stay

Eight papers[44,84,86,114,138,139,144,145] reported LoS as an outcome. All papers except Forti *et al.*[145] found a significant association between cognitive impairment and length of hospitalisation.

Composite outcomes

Two papers[138,145] used composite outcomes that included mortality. Espallargues *et al.*[138] used a composite of in-hospital mortality and mortality 1 month post discharge and Forti *et al.*[145] used unfavourable discharge (death plus any other ward discharge disposition other than return home). In both studies, cognitive impairment was significantly associated with a worse outcome.

Functional status

Three papers[54,99,146] examined the association between cognitive impairment and functional status. Two papers[54,146] established an association between cognitive impairment and poor functional status. Marengoni *et al.*[146] examined this association between two age groups and found that low MMSE scores, high depression rates and high disease severity rates predicted functional status in the oldest old age group. Low MMSE scores and depression rates showed an additive association with functional disability, particularly in younger patients. Orsitto *et al.*[99] examined functional status (ADL and IADL) in those with dementia and those with MCI, reporting functional status as significantly poorer in those with dementia than in those with no dementia or MCI.

Discharge destination, nursing home admission and hospital re-admission

Marengoni *et al.*[45] examined discharge destination to nursing home, rehabilitation unit or home, and three papers[139,147,148] examined admission to a nursing/care home post discharge. Two papers[85,138] reported hospital re-admission.

Helvik *et al.*[147] recorded an association between low MMSE score and care home admission. Joray *et al.*[148] found an adjusted association between institutionalisation and cognitive impairment in detected cases of cognitive impairment, and not when cognitive impairment was present but previously undetected, which represented the less severe cases of impairment. Fields *et al.*[139] did not examine associations and reported only rates of nursing home admission stratified by cognitive status. For hospital re-admission post discharge, Espallargues *et al.*[138] found no association for post discharge (collective follow-up period: 4 months). Di Iorio *et al.*[85] reported an adjusted association between early re-admission (within 3 months) and cognitive impairment. Marengoni *et al.*[45] reported that cognitive impairment determined admission to a rehabilitation unit but only in functionally impaired patients.

Cognitive decline

Two studies[98,141] examined the course of cognitive impairment. Inouye *et al.*[141] reported that higher educational level, pre-admission functional impairment and higher illness severity were predictive of recoverable cognitive dysfunction (RCD) after adjusting for MMSE score. Bickel *et al.*[98] noted the positive predictive value of MCI in determining cognitive impairment at discharge, particularly for those with multiple-domain MCI.

Delirium superimposed on dementia outcomes

Appendix 3, *Table 34*, outlines outcomes for DSD. Two studies examined outcomes for DSD.[79,94] McCusker *et al.*[94] showed that those presenting with both delirium and dementia had a poorer cognitive status and were more likely to be admitted to long-term care than those with neither condition. Lang *et al.*[79] identified DSD as a marker for prolonged hospital stay.

Methodological limitations

Quality of studies

Variation in the quality of studies in a systematic review is a limitation. From the assessment of the quality of the 141 selected studies, we would recommend that future studies in related areas ensure that, from the outset, they give a clear description of the population, the method of sampling and the condition(s) studied, with adjustments for any confounding factors; that a standardised tool for diagnosis of dementia and other risk factors is used; and, finally, that the study clearly explains statistical methods and clinically significant associations.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

We defined a high-quality study as one that dropped no more than 1 point in our assessment. From the 141 studies, 63 studies[12,21,45–48,53,56,61,64,65,69,70,74,84,98,103–105,107,110,112–115,118,120,121,123,124,128–132,134,136–162] scored high in our quality assessment. A further 22 studies[57,58,62,67,68,73,78,88,94,100,109,111,119,126,133,163–169] were classified as good, which we defined as dropping 2 or 3 points. The remaining 56 studies[17–20,26,41–44,49–52,54,55,59,60,63,66,71,72,75–77,79–83,85–87,89–92,95–97,99,102,108,116,117,122,125,127,135,170–177] dropped ≥ 4 points, scoring low in our quality assessment. A review of these studies showed that the most common study deficiency is a lack of or insufficient description of presence of condition and/or adjustment for confounding factors. Twenty-four studies did not contain this description and 16 studies gave only partial information about this. Apart from this, the study factors most commonly in need of improvement were clear explanation of statistical methods and clinically significant associations (10 did not and 22 only partially); use of a structured/standardised tool for definition of dementia and other risk factors (11 did not and eight only partially); clear description of the process of sampling and selecting patients (five did not and 26 only partially); and clear and detailed description of the characteristics of the population (five did not and 23 only partially).

Prevalence of delirium and delirium superimposed on dementia

There was considerable heterogeneity in the diagnostic tools used to assess delirium. In addition, some studies did not distinguish between prevalent and incident cases as assessment of delirium was conducted in one session rather than routinely.[60] This variation in approaches and tools used can affect the reliability of prevalence estimates.

Delirium has previously been reported to be under-recognised in older hospitalised patients.[93] The reliance on discharge codes in retrospective studies also typically leads to a higher underestimation risk. Underdiagnosis of delirium may also arise from lack of awareness of the fluctuative course of delirium and its potential overlap with dementia; thus, comprehensive cognitive assessment is necessary for distinguishing disorders with overlapping symptoms. Forty-nine studies that screened for dementia also screened for delirium, increasing the overall reliability of prevalence estimates, but when studies did not separately screen for each condition, an underestimate of delirium may have arisen in favour of dementia diagnosis.

Delirium superimposed on dementia is typically characterised by premorbid dementia followed by an acute mental change in which delirium is suspected. Previously, studies reported that delirium is underdetected in older hospitalised patients.[93] The potential risk factors for under-recognition of delirium by nursing staff are dementia and the hypoactive form of delirium, the onset of which does not necessarily elicit a distinctly recognisable change in mental status.[178]

The variation in assessment tools used to detect delirium and dementia also influences the wide range of prevalence estimates for DSD reflected in the included studies. For example, Bellelli *et al.*[55] reported that the ICD-9 has poor diagnostic accuracy for delirium, and Johnson *et al.*[179] found the *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition (DSM-III), to have greater diagnostic accuracy than the ICD-9. Of the included papers reviewed in which DSD was formally documented, one study did not assess the premorbid existence of dementia using a validated tool, such as the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), which meant that neurocognitive deficits attributed to delirium could not be reliably differentiated from those in dementia.[55]

Although the majority of studies used validated tools to assess delirium, there was no comment specifically on the diagnostic accuracy of those tools in the context of patients with dementia. In addition, when studies did not continually assess delirium to record incident cases, it was difficult to assess the epidemiological impact of delirium on those with dementia had there been serial cognitive testing.

In summary, to recognise cases of DSD it is important to conduct a baseline assessment of dementia, whereby medical staff have full clarity and recognition of the symptoms pertinent to dementia. This must be supplemented with the ability to differentiate between this baseline status and symptoms characteristic of an acute mental change attributed to delirium. Dementia is a risk factor for delirium and the co-existence of these conditions leads to poor prognostic outcomes. It is thus imperative that consensual, comprehensive

assessment approaches are undertaken using validated tools in the context of DSD in order to improve diagnostic accuracy in these groups.

Prevalence of dementia

Of 80 studies that screened for dementia, 49 also screened for delirium. The prevalence of dementia may be overestimated in studies not also screening for delirium.

Studies not including patients who were too ill to give informed consent or without proxies may exclude those at most risk of having pre-existing dementia, leading to selection bias, which affects prevalence estimates.

The high prevalence of mixed and vascular dementia reported in studies can be attributed to hospital setting; for example, more stroke patients are likely to be admitted to acute hospital settings or exhibit higher cardiovascular comorbidity.[13]

Prevalence of cognitive impairment

Seven papers used inconsistent terminology to distinguish 'cognitive impairment' and 'dementia', used the terms interchangeably or did not make separate diagnoses for each condition. According to the majority of studies screening for cognitive impairment, there is a consensus that cognitive impairment is diagnostically exclusive of dementia or delirium, despite the fact that the three conditions share common characteristics and thus present with overlapping symptoms. Inconsistencies in the terminology adopted across studies can thus give rise to unreliable estimates of prevalence for cognitive impairment.

There is overlap in the assessment of cognitive impairment and dementia given their shared characteristics and, when studies explicitly excluded subjects with dementia from their analyses, a more reliable prevalence estimate for cognitive impairment could be achieved. When studies did not explicitly report cut-off scores in the MMSE, prevalence estimates for cognitive impairment could be biased as criteria by which cognitive impairment is diagnosed are not reported.[62] Other factors that can lead to overestimates of prevalence are the potentially inadequate conditions to appropriate detection inside a hospital setting, presence of other clinical conditions or performance difficulties not related to cognitive impairment, which can yield unreliable cognitive evaluations, for example patients failing to use glasses/hearing aids while being assessed with the MMSE.[156]

Discussion

Clinical implications

Dementia and cognitive impairment

From this review, CSDs appear to result in unfavourable outcomes for patients acutely admitted to general hospitals, including in-hospital and post-discharge mortality, increased LoS and functional impairment. The variation in diagnostic methodology used can influence the strength of the observed association between dementia and mortality. Sampson *et al.*[12] excluded delirious patients to focus on the relationship between mortality and dementia, potentially underestimating the prevalence of those with pre-existing dementia who later presented with delirium, an established risk factor.[93] Thus, mortality may be underestimated in studies adopting similar approaches. Equally, the association may be overestimated in studies using single sites for their analyses.

One study[105] did not establish dementia (of any aetiology) as a predictor of mortality after controlling for vascular dementia. It is thought that vascular dementia is associated with cardiovascular comorbidity, which could explain mortality in these populations.[105] The complexity of the relationship between dementia and poor outcomes thus requires further scrutiny.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

In this review, cognitive impairment was associated with poor outcomes of increased risk of mortality, LoS, functional impairment and nursing home admission at discharge. It was also revealed that cognitive impairment is an important risk factor for the development of delirium. The routine diagnosis of cognitive status in hospital assessments would thus help identify acutely administered patients at risk of delirium.

Delirium

This review presents compelling evidence that delirium in acutely admitted older inpatients generally confers negative outcomes, such as increased risk of mortality, reduced functional status, increased LoS and referrals to care home at discharge. However, not all studies found an association between delirium and mortality. This may be attributed to the methodological heterogeneity between studies, including issues of generalisability, attrition rates, study duration, diagnostic heterogeneity (different use of tools and approaches used, including retrospective analyses), sample size variation and ensuring adequate controlling of potential confounders.

The association between rSSD/SSD and unfavourable clinical outcomes suggests that diagnostic screening should be encompassed by a multifactorial approach in consideration of its prognosis and management. In addition, our review showed that delirium was predicted by demographic factors, infections, nutritional status, illness and cognitive impairment. A standardised clinical diagnostic method would thus help identify the broad range of factors that place hospitalised patients at risk of delirium.

In addition, it is clear in this review that patients with delirium frequently present with low cognitive function and, over the clinical course, cognitive status improves. However, clarification is required on the complex relationship between the clinical features associated with delirium and changing cognitive function. Cognitive recovery is not simply explained by an improvement in delirium status but by a combination of factors, including demographic factors (sex), delirium severity, illness severity or change in presence of circulating biological markers.[137] The relationship between delirium and mortality may also be complex; for example, Martínez-Velilla *et al.*[71] reported that delirium was not independently associated with post-discharge mortality after controlling for illness severity, a significant risk factor for delirium. This suggests that delirium is a good indicator of comorbidity and that interventions require a multidisciplinary and broad factorial approach to elucidate the range of prognostic factors and aetiologies associated with delirium.

Functional decline was frequently independently associated with delirium; however, variations in the length of follow-up across studies could influence these associations as unpredicted, uncontrolled events unfold. Furthermore, when studies could not establish delirium as independently predictive of functional decline, it is possible that biological factors associated with delirium may mediate this relationship. For example, Adamis *et al.*[136] established that functional status was significantly affected by the biological markers apolipoprotein E (APOE), interleukin 1 alpha (IL-1α), interleukin 6 (IL-6), leukaemia inhibitory factor (LIF) and tumour necrosis factor alpha (TNF-α), and not by delirium itself. Thus, the pathophysiology of delirium may be complex and requires consideration.[165] Accordingly, clinical interventions for delirium management necessitate a broad multifactorial approach to address the range of co-existing factors accompanying delirium.

Delirium superimposed on dementia

Few studies examined the association between DSD and outcome; thus, it was difficult to draw meaningful conclusions. Previous studies have highlighted that delirium is poorly recognised in patients with dementia.[93] DSD can be defined as pre-existing dementia accompanied by an acute mental change typical of delirium, and it can be difficult to recognise hypoactive forms of delirium, which typically manifest more 'quiet' symptoms of delirium and share many overlapping symptoms with dementia.[93] Early recognition and prevention of delirious symptoms in people with dementia is imperative.

Conclusion

This study systematically reviewed the prevalence and outcomes of a range of CSDs, including dementia, cognitive impairment, delirium and DSD.

There was considerable methodological heterogeneity across studies reviewed, with relatively few reporting high-quality investigations. The narrative review revealed that delirium, dementia and cognitive impairment present significant problems for acutely admitted older hospital patients. Their admissions to hospital are associated with increased mortality, low functional independence, longer hospitalisation periods and higher risk of re-admission or nursing home admission. However, it is clear that, to improve the prognosis of acutely admitted patients diagnosed with CSDs, a broad, multifactorial approach to case finding, diagnosis and subsequent management is required.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Chapter 3 Quantitative study: the Older Persons Routine Acute Assessment data set

Context

Cognitive impairment of various kinds is common in older people admitted to hospital, but previous research has usually focused on single conditions in highly selected groups and has rarely examined associations with clinical outcomes. This study examined prevalence and outcomes of cognitive impairment in a large, unselected cohort of people aged ≥ 65 years who underwent an emergency medical admission.

Research objectives

As stated in the protocol, the aim of this element of the work was to 'analyse routine population-based health-care data to examine health-care and economic outcomes following hospital admission of older people with and without cognitive impairment and dementia'. This chapter reports health-care outcomes and *Chapter 4* reports economic outcomes.

Data and data methods

The population studied and the Older Persons Routine Acute Assessment data set

NHS Fife provides medical care to a varied urban and rural population of ≈ 360,000 people. From January 2011, all emergency medical admissions within the health board from any source were via a single acute medical unit (AMU) at the research hospital (the only exceptions are acute stroke and acute ST segment myocardial infarction, for which admission is via specialist services). The research hospital is a district general hospital with 640 beds and a full range of health-care specialties. After AMU admission, patients are usually discharged or stepped down to appropriate medical wards after 12–24 hours. Orthopaedic trauma patients requiring surgery are admitted via the surgical admissions unit and non-operative trauma patients are admitted via the AMU.

Starting in 2009 and funded by the Scottish Government Joint Improvement Team, this health board's Dementia Co-ordinating Group designed and implemented the Older Persons Routine Acute Assessment (OPRAA). From 2011, OPRAA was offered routinely to all people aged ≥ 65 years admitted as an emergency to a NHS hospital in this health board. By design, individuals with a predicted LoS of < 24 hours, for whom death was expected or with an acute illness requiring critical care intervention did not undergo an OPRAA.

The cohort

The design is a cohort study of all people aged ≥ 65 years with an acute medical admission to one district general hospital in Scotland, prospectively recruited to undergo an OPRAA. Inclusion and exclusion criteria are detailed in *Table 3*.

Data for all emergency medical admissions of people aged ≥ 65 years were identified from Scottish Morbidity Records (SMR) 01 data, which is a validated NHS Scotland routine data set providing information on the date of admission and discharge, type of admission, admission and discharge destination and the patient's main and other conditions [in the form of *International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision (ICD-10) codes]. An emergency medical admission was defined as an admission via the study hospital AMU under an acute medicine, general medicine or

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 3 Cohort inclusion and exclusion criteria

Inclusion criteria (patients meeting all of the criteria below)	Exclusion criteria
Aged ≥ 65 years	
An emergency medical admission via the study hospital AMU under an acute medicine, general medicine and geriatric medicine specialty	Had a medical admission in the 6 months prior to the start of the study
Received an OPRAA	Did not receive an OPRAA (individuals with a predicted LoS of < 24 hours, for whom death was expected or with an acute illness requiring critical care intervention)

geriatric medicine specialty. Admission and final discharge date and the Community Health Index (CHI) number (the NHS Scotland unique patient identifier) were then used to link all eligible admissions in SMR01 to the OPRAA data set and to determine eligible admissions whereby patients underwent an OPRAA.

An incident cohort was further defined, comprising people aged ≥ 65 years who had received an OPRAA during their first acute medical admission within the study period, providing that they had not had an acute medical admission in the 6 months prior to the start of the study.

The study period was chosen to reflect a period when OPRAA was routine. Between 1 January 2012 and 30 June 2013, > 80% of all acute medical admissions for those aged ≥ 65 years underwent an OPRAA.

Data extracted

For eligible patients, discharge diagnosis (excluding dementia) from all previous admissions recorded in SMR01 were used to calculate each participant's Charlson Comorbidity Index (CCI) at each eligible admission.[180] The CHI data set was used to define participant age, sex and postcode-defined socioeconomic status [measured using quintiles of the Scottish Index of Multiple Deprivation (SIMD)] on admission.[181] Data on all community-dispensed prescriptions were used to create an additional multimorbidity score for case-mix adjustment, calculated as the number of drugs (defined as the number of distinct *British National Formulary*[182] subsections) prescribed to the patient in the 84 days prior to admission.[183]

A number of ways of identifying whether or not patients were care home residents were examined, including SMR01 admission and discharge coding, and the CHI Institution Flag. However, none was considered reliable, so manual classification of recorded address in the CHI register was used to identify patients as care home residents by comparison with the published list of Care Inspectorate-registered residential services.

The OPRAA data set was used to identify patients with CSDs, defined as one or more of known dementia alone, delirium alone, delirium superimposed on known dementia and unspecified cognitive impairment, and functional status based on assessment of ADL.[184] Full definitions of these variables are shown in *Appendix 1*.

The CHI number was used to deterministically link all data sets. The SMR01 data set was linked to the CHI, OPRAA, SMR04 and community-dispensed prescribing data sets to ascertain demography on admission and mortality, the presence of CSDs on admission and functional status before and on admission.

Definitions of primary and secondary outcomes

The primary outcome was whether or not an individual was living at home 30 days after discharge (binary outcome). The primary outcome was measured only in patients who were admitted from their private home (i.e. not care home residents) and were discharged alive from hospital. A negative outcome was defined as patients living in a care home, being back in the hospital or being dead at 30 days after discharge.

Master CHI, together with SMR01, was used to determine whether the person was admitted or discharged to a care home, a process that involved a thorough validation of care home addresses. SMR01 was also used to determine whether or not the person had survived the incident admission or was re-admitted within 30 days after discharge and CHI was used to ascertain mortality within the 30 days from discharge.

Secondary outcomes:

- Mortality. The CHI data set was used to ascertain mortality, defined as time to death from admission with a 2-year follow-up period.
- Re-admission. This was defined as the time to the first emergency re-admission from discharge for the patients who survived the incident admission; this was calculated from SMR01 with 2-year follow-up from discharge. Mortality following discharge was another possible outcome acting as competing risk for re-admission, and master CHI was used to calculate the time to death from discharge within the 2-year follow-up time.
- Length of stay. This was defined as the full length of incident admission (in days) and was calculated from SMR01 based on the difference between discharge and admission dates. For patients who were admitted and discharged on the same day, the LoS was corrected to 1 day rather than 0 days.

Missing data

Data on delirium diagnosis (either CAM positive or clinical delirium) were missing in 3.7% of cases within the incident cohort. Based on the OPRAA alone, 9.8% of participants in the incident cohort were recorded as having a known dementia and 20.3% of cases had missing data for known dementia. After adding information on dementia from SMR01, SMR04 and prescribing data sets, the percentage of people with known dementia increased to 15.3%, with the remainder of cases being treated as absent of dementia. A total of 20.9% of cases had a missing Abbreviated Mental Test (AMT) score within the OPRAA, of which 15.5% had neither delirium nor dementia; these were classified as not having any CSD.

Twenty-seven per cent of ADL scores within the OPRAA had missing values. Multiple imputation was used to impute the missing values in terms of presence and absence of a persistently low ADL score or changed ADL score and a sensitivity analysis was conducted to assess the effect of missing ADL scores on the survival analysis results.

Ethics considerations

Data provision and initial management including linkage was carried out by the University of Dundee Health Informatics Centre (HIC), with analysis of anonymised data carried out in an ISO27001 and Scottish Government-accredited secure safe haven. The University of Dundee HIC standard operating procedures (SOPs) have been reviewed and approved by the regional NHS Research Ethics Service and consent for this study was obtained from the health board's Caldicott Guardian.[185]

Modes of analysis/interpretation

Statistical analysis

Summary statistics based on proportions and their confidence intervals (CIs) were initially used to describe prevalence of CSDs (known dementia alone, delirium alone, DSD, unspecified cognitive impairment and no CSD) in older people admitted to an AMU and how this varied with sex, age, socioeconomic deprivation (SIMD quintiles) and whether or not they were admitted from a care home. The characteristics of older people in the different CSD groups were examined in terms of CCI (with four groups: 0, 1, 2–5 and ≥ 6), the number of drugs prescribed in the 84 days prior to admission (with four groups: 0, 1–5, 6–10 and ≥ 11 drugs) and ADL function (persistently low ADL score, changed ADL score or persistently high ADL score; see *Appendix 1*).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Descriptive statistics of the primary and secondary outcomes based on proportion and their CIs were generated prior to any modelling exercise. As described above, the exact cohort of patients included in analysis depended on the outcome. For example, for the primary outcome of whether or not a patient was living at home 30 days after discharge, the cohort comprised people admitted to hospital from their own home (because patients living in care homes very rarely move out of the care home so have a fixed negative outcome) and who survived to discharge.

Statistical analysis of the primary outcome

Associations between presence of different types of CSD and the primary outcome (whether or not the person is living at home at 30 days from discharge) were analysed, with logistic regression unadjusted and adjusted for baseline variables at admission, such as sex, age, deprivation status, comorbidity and number of drugs. A logistic regression model adjusted for functional status was used to explain how much of the poor outcome in patients with CSDs was explained by their functional ability. The results of the logistic regression were reported in terms of odds ratios (ORs) and their CIs. The *c*-statistic was estimated as a measure of predictive ability.

Statistical analysis of time to death from admission

Analysis of time to death from admission was initially assessed with Kaplan–Meier survival plots and log-rank tests for association considering the explanatory variables listed above. A 2-year follow-up time from admission was considered in the survival analysis and Cox proportional hazards models were first implemented to investigate the effect of CSDs on survival. Assessment of the proportional hazards assumption showed that some of the Cox model covariates did not meet this assumption, so a non-proportional Cox model with time-varying coefficients was implemented.[186,187] Time-varying coefficients were modelled based on a piecewise constant model function, where the 2-year follow-up time was split into five clinically meaningful time intervals: up to 1 month (implemented as up to 30 days), 1–3 months (31–90 days), 3–6 months (91–180 days), 6 months to 1 year (181–365 days) and 1–2 years (366–730 days). Akaike information criterion (AIC)-based model selection was then implemented to optimally choose the time points (within the 2-year follow-up period) when a change in hazard ratio (HR) was supported by the data. The effect of CSDs on survival was estimated in terms of unadjusted HRs and HRs adjusted for demographics and comorbidity variables, as well as HRs additionally adjusted for ADL functional status to specifically determine how much of the increase in HR in people with CSDs can be explained by their functional status. Variable selection in the adjusted models was conducted based on best fit evaluated using the AIC.

Finally, the log-likelihood ratio test statistic together with AIC scores were used to test whether or not different types of CSD were associated with mortality risk. Specifically, we tested for a difference in mortality risks between DSD and delirium alone or dementia alone, and unspecified cognitive impairment and dementia alone. This was done by comparing model performance between the model based on four CSD categories and a reduced model in which two types of CSD were grouped together depending on the hypothesis we wanted to test.

Statistical analysis of time to re-admission from discharge

Time to re-admission from discharge under the competing risk of death was initially assessed with cumulative incidence function (CIF) plots, and Gray's[188] test for subdistribution hazard was used to compare CIFs of time to re-admission among the groups of patients depending on their CSD type or demographics, comorbidity and functional status. Fine and Gray's[189] regression model was used to analyse the effect of CSD type on time to re-admission under the competing risk of death with a 2-year follow-up time. Assessment of the proportional subdistribution hazards assumption indicated that some of the Fine and Gray[189] model covariates did not meet this assumption, so a model with time-varying coefficients was fitted to the data using piecewise constant coefficients, where the 2-year follow-up time was split into four clinically meaningful time intervals: up to 30 days, 30–90 days, 90 days to 1 year and 1–2 years. AIC-based model selection was then implemented to determine the time points (either 30 days, 90 days or 1 year, or all of them) when a change in subdistribution HR was supported by the data. The effect of

CSDs on re-admission was estimated in terms of both unadjusted HRs and HRs adjusted for demographics and comorbidity variables, with variable selection based on best fit evaluated using the AIC.

Finally, a non-proportional Fine and Gray[189] subdistribution hazard model for CSDs adjusted for ADL functional status (in addition to the other covariates) was fitted to the data to help determine how much of the increase in subdistribution HR in people with CSDs can be explained by their functional status.

Statistical analysis of length of stay

Patients admitted to the AMU would generally experience a short to moderate length of hospital stay, with only a small number having long hospital admissions, resulting in a positively skewed distribution of the LoS data. Therefore, a generalised linear model assuming a Gamma distribution with log-link function was used to analyse the LoS data.[190] Again, three models were fitted to the LoS data: the unadjusted model (with different types of CSD vs. no CSD in the model), the model adjusted for baseline variables at admission (sex, age, deprivation status, comorbidity and number of drugs) and the final model that was further adjusted for functional status. The variables CCI and number of drugs prescribed in the 84 days prior to admission appeared to be linearly related to LoS and, therefore, were introduced in the gamma model as numerical covariates. The results of the generalised gamma linear model were reported in terms of LoS rate ratios (RRs) between the category of interest and the reference category.

Changes to the National Institute for Health Research protocol

The statistical analysis plan (SAP) followed the protocol developed as part of this National Institute for Health Research (NIHR) project (Health Services and Delivery Research 13/54/55). As part of the modelling framework, Cox proportional hazards models and Fine and Gray[189] competing risk models were proposed in the original application to analyse mortality and re-admission data. Non-proportional hazard models were developed to address violations of the Cox proportional hazards model assumption and Fine and Gray[189] subdistribution proportional hazard assumptions.

The original SAP also proposed the use of propensity scores in the regression models to reduce the potential bias introduced by the fact that not all of the acute admissions will have an OPRAA completed. However, calculation of the propensity scores would have relied on the assumption that those with no OPRAA also had no CSDs. Examination of ICD-10 codes from the SMR01 data and examination of the prescribing data revealed that, among people with no OPRAA, some had dementia, and it is also possible that some of those who were terminally ill might have had delirium. As a result, it was agreed that assuming that people with no OPRAA also had no CSDs was not appropriate and so propensity score methods based on this assumption would have been an invalid approach to reduce bias.

All data analysis was carried out using SAS® 9.4 software (SAS Institute Inc., Cary, NC, USA). (SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration.)

Results of the quantitative study

The cohort

A 2-year study period between 1 January 2012 and 31 December 2013 was defined. During this time, there were a total of 17,151 acute medical emergency admissions to the study hospital, of which 12,378 had an OPRAA, giving a coverage of 72.2%. A total of 9331 were incident admissions, of which 6724 had an OPRAA, representing 72.1% of all incident admissions during this time. The 6724 people with an incident OPRAA admission between 1 January 2012 and 31 December 2013 are the core cohort under investigation in this study.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Patients with an incident OPRAA admission were, on average, aged 79.2 (95% CI 79.0 to 79.4) years, 56.3% (95% CI 55.1% to 57.5%) were women and 7.4% (95% CI 6.8% to 8.1%) were admitted from a care home. A total of 20.5% (95% CI 19.6% to 21.5%) of patients lived in the most deprived fifth of areas and 14.6% (95% CI 13.8% to 15.5%) lived in the most affluent fifth.

One or more CSDs were present in 35.4% (95% CI 34.3% to 36.6%) of the incident OPRAA admissions. Delirium alone was present in 15.8% (95% CI 14.9% to 16.7%) of admissions, known dementia alone was present in 7.8% (95% CI 7.2% to 8.5%) of admissions, DSD was present in 7.6% (95% CI 7.0% to 8.3%) of admissions and unspecified cognitive impairment was present in 4.2% (95% CI 3.7% to 4.2%) of admissions.

Table 4 compares people with and without CSDs in terms of their demographics, comorbidities and functional status. People with CSDs were significantly older than those without CSDs (mean age 82.1 years vs. 77.6 years, difference 4.4 years, 95% CI 4.1 to 4.7 years), with 41.5% of people with CSDs aged $\geq$ 85 years versus 21.1% of those without (difference 20.4%, 95% CI 18.1% to 22.7%). A total of 59.2% of patients with CSDs were women, compared with 54.6% of those without CSDs (difference 4.6%, 95% CI 2.1% to 7.1%). A total of 17.9% of people with CSDs were admitted from a care home, compared with only 1.7% of those without (difference 16.2%, 95% CI 14.6% to 17.8%), with 29.9% of people with dementia alone and 34.1% of people with DSD residing in a care home. There were no significant differences by socioeconomic deprivation status.

A total of 4846 (73%) people had an ADL assessment recorded. In general, the presence of any CSD was strongly associated with low functional ability, with 81% of patients with CSDs having a persistently low ADL or changed ADL; the corresponding figure for patients without a CSD was 58.2% (difference 22.8%, 95% CI 20.3% to 25.3%). Patterns of ADL score varied by CSD, with > 50% of patients with known dementia having a low ADL score prior to as well as on admission (persistently low ADL score), whereas almost 50% of patients admitted with delirium alone had a reduction in ADL score on admission (changed ADL score).

Primary outcome: being at home 30 days from discharge

The primary outcome of being at home 30 days from discharge was relevant to only those patients who were not admitted from a care home and who were discharged alive. Of the 6724 people admitted to an AMU with an OPRAA, 5570 were eligible for primary outcome analysis.

A total of 90.0% of people were living at home at 30 days from discharge. *Table 5* shows the distribution of the primary outcome depending on whether or not patients had CSDs on admission and the type of CSD. The proportion of people living at home at 30 days was significantly lower in patients with CSDs than in patients without CSDs (81.7% vs. 93.4%, difference 11.7%, 95% CI 9.9% to 13.6%). Among the types of CSD, DSD had the poorest outcome, with only 69.1% of people in this group living at home at 30 days, mainly due to the fact that 25.6% of them were living in care homes.

Unadjusted OR estimates of the logistic regression showed that people with CSDs were less likely to be living at home 30 days from discharge than people without CSDs (*Table 6*). After adjustment for demographics and comorbidity (see *Table 6*), the model also showed that people with any form of CSD had a significantly lower chance of living at home 30 days from discharge, with ORs being particularly low for people with dementia (with or without delirium) (OR 0.33, 95% CI 0.25 to 0.46 for dementia alone and OR 0.18, 95% CI 0.16 to 0.25 for DSD) and slightly higher for delirium alone (OR 0.48, 95% CI 0.38 to 0.46) and unspecified cognitive impairment (OR 0.51, 95% CI 0.34 to 0.75). In addition, the pairwise multiple comparison test indicated that people with DSD were significantly less likely to be living at home at 30 days than people with other forms of CSD (p-values of < 0.017). The other pairwise comparisons for living at home at 30 days associated with delirium alone, dementia alone and unspecified cognitive impairment were not significant (p-values of > 0.242).

TABLE 4 Description of the cohort

Characteristic	Patients (*N* = 6724)					
	No CSD (*n* = 4344)	Any CSD (*n* = 2380)	Delirium alone (*n* = 1065)	Known dementia alone (*n* = 522)	Delirium superimposed on known dementia (*n* = 508)	Unspecified cognitive impairment (*n* = 285)
Sex, % (95% CI)						
Female (*n* = 3784)	54.6 (53.1 to 56.1)	59.2 (57.2 to 61.2)	56.9 (3.9 to 59.8)	61.1 (56.9 to 65.2)	61.2 (56.9 to 65.3)	60.7 (54.9 to 66.2)
Male (*n* = 2940)	45.3 (43.8 to 46.8)	40.8 (38.8 to 42.8)	43.1 (40.2 to 46.1)	38.9 (34.8 to 43.1)	38.8 (34.7 to 43.1)	39.3 (33.8 to 45.1)
Age (years), mean (95% CI)	77.6 (77.4 to 77.9)	82.1 (81.8 to 82.4)	80.8 (80.3 to 81.3)	82.7 (82.1 to 83.3)	83.7 (83.1 to 84.3)	82.9 (81.8 to 83.8)
Age (years), % (95% CI)						
65–69 (*n* = 955)	18.1 (17.0 to 19.3)	7.0 (6.0 to 8.1)	10.4 (8.7 to 12.4)	4.0 (2.6 to 6.0)	3.2 (2.0 to 5.1)	6.7 (4.3 to 10.2)
70–74 (*n* = 1123)	20.0 (18.8 to 21.2)	10.8 (9.6 to 12.1)	13.3 (11.4 to 15.5)	9.0 (6.8 to 11.8)	7.7 (5.7 to 10.3)	9.8 (6.9 to 13.8)
75–79 (*n* = 1322)	20.8 (19.6 to 22.0)	17.7 (16.2 to 19.3)	18.6 (16.4 to 21.0)	18.6 (15.5 to 22.2)	14.8 (12.0 to 18.2)	17.5 (13.5 to 22.3)
80–84 (*n* = 1420)	20.1 (18.9 to 21.3)	23.1 (21.5 to 24.8)	22.3 (19.9 to 24.9)	23.2 (19.8 to 27.0)	24.6 (21.2 to 28.5)	23.2 (18.7 to 28.4)
≥ 85 (*n* = 1904)	21.1 (19.9 to 22.3)	41.5 (39.5 to 43.5)	35.4 (32.6 to 38.3)	45.2 (41.0 to 49.5)	49.8 (45.5 to 54.1)	42.8 (37.2 to 48.6)
Residential status, % (95% CI)						
Care home (*n* = 500)	1.7 (1.4 to 2.1)	17.9 (16.4 to 19.5)	6.9 (5.5 to 8.6)	29.9 (26.1 to 34.0)	34.1 (30.1 to 38.3)	6.3 (4.0 to 9.7)
Private home (*n* = 6224)	98.3 (97.9 to 98.6)	82.1 (80.5 to 83.6)	93.1 (91.4 to 94.5)	70.1 (66.0 to 73.9)	65.2 (61.0 to 69.2)	93.7 (90.3 to 96.0)
SIMD,[a] % (95% CI)						
1 (*n* = 1376)	21.2 (20.0 to 22.4)	19.2 (17.7 to 20.8)	22.1 (19.7 to 24.7)	17.4 (14.4 to 20.9)	14.6 (11.8 to 17.9)	20.0 (15.8 to 25.0)
2 (*n* = 1789)	26.1 (24.8 to 27.4)	27.4 (25.6 to 29.2)	28.2 (25.6 to 31.0)	25.3 (21.8 to 29.1)	26.2 (22.6 to 30.2)	30.9 (25.8 to 36.5)
3 (*n* = 1548)	22.6 (21.4 to 23.9)	23.7 (22.0 to 25.4)	22.1 (19.7 to 24.7)	27.6 (23.9 to 31.6)	24.8 (21.2 to 28.7)	21.1 (16.8 to 26.2)
4 (*n* = 1032)	15.1 (14.1 to 16.2)	15.9 (14.5 to 17.4)	14.7 (12.7 to 17.0)	15.9 (13.0 to 19.3)	19.7 (16.5 to 23.4)	13.3 (9.8 to 17.7)
5 (*n* = 979)	15.0 (14.0 to 16.1)	13.7 (12.4 to 15.1)	13.0 (11.1 to 15.2)	13.8 (11.1 to 15.2)	14.8 (12.0 to 18.2)	14.7 (11.1 to 19.3)

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 4 Description of the cohort (*continued*)

Characteristic	Patients (*N* = 6724)					
	No CSD (*n* = 4344)	Any CSD (*n* = 2380)	Delirium alone (*n* = 1065)	Known dementia alone (*n* = 522)	Delirium superimposed on known dementia (*n* = 508)	Unspecified cognitive impairment (*n* = 285)
CCI score,[b] mean (95% CI)						
0 (*n* = 1629)	22.8 (21.6 to 24.1)	27.2 (25.4 to 29.0)	23.6 (21.1 to 26.2)	31.2 (27.4 to 35.3)	34.7 (30.6 to 38.9)	20.0 (15.8 to 25.0)
1 (*n* = 1728)	26.5 (25.2 to 27.9)	24.2 (22.5 to 26.0)	23.3 (20.9 to 25.9)	26.1 (22.5 to 30.0)	22.6 (19.2 to 26.5)	27.0 (22.2 to 32.5)
2–5 (*n* = 2733)	40.4 (39.0 to 41.9)	41.1 (39.1 to 43.0)	43.5 (40.5 to 46.5)	38.3 (34.2 to 42.6)	38.6 (34.4 to 42.9)	41.4 (35.8 to 47.2)
≥ 6 (*n* = 624)	10.2 (9.4 to 11.2)	7.6 (6.6 to 8.7)	9.7 (8.0 to 11.6)	4.4 (3.0 to 6.5)	4.1 (2.7 to 6.2)	11.6 (8.4 to 15.8)
Number of drugs prescribed in previous 84 days, mean (95% CI)						
0 (*n* = 389)	5.2 (4.6 to 5.9)	6.8 (5.9 to 7.9)	5.0 (3.8 to 6.5)	10.2 (7.8 to 13.0)	7.7 (5.7 to 10.3)	6.0 (3.8 to 9.3)
1–5 (*n* = 1725)	25.5 (24.2 to 26.8)	25.9 (24.2 to 27.7)	25.2 (22.6 to 27.9)	25.1 (21.6 to 29.0)	28.7 (25.0 to 32.8)	25.1 (20.4 to 30.4)
6–10 (*n* = 2650)	39.7 (38.3 to 41.2)	38.8 (36.9 to 40.8)	41.2 (38.3 to 44.2)	37.6 (33.5 to 41.8)	37.0 (32.9 to 41.3)	37.6 (33.5 to 41.8)
≥ 10 (*n* = 1960)	29.5 (28.2 to 30.9)	28.5 (26.7 to 30.3)	28.6 (26.0 to 31.4)	27.2 (23.6 to 31.2)	26.6 (22.9 to 30.6)	27.2 (22.4 to 32.6)
ADL group (*n* = 4846),[c] mean (95% CI)	*n* = 2871	*n* = 1975	*n* = 824	*n* = 390	*n* = 483	*n* = 278
Persistently low (*n* = 1144)	10.9 (9.8 to 12.1)	42.0 (39.9 to 44.2)	29.9 (26.8 to 33.1)	54.1 (49.1 to 59.0)	59.2 (54.8 to 63.5)	31.3 (26.1 to 37.0)
Changed (*n* = 1656)	30.9 (29.2 to 32.6)	39.0 (36.9 to 41.2)	49.9 (46.5 to 53.3)	23.9 (19.9 to 28.3)	30.9 (26.9 to 35.1)	42.8 (37.1 to 48.7)
Persistently high (*n* = 2046)	58.2 (56.4 to 60.0)	19.0 (17.3 to 20.8)	20.3 (17.7 to 23.1)	22.3 (18.4 to 26.7)	10.4 (7.9 to 13.4)	25.9 (21.2 to 31.4)

a SIMD divided into quintiles: 1 = most deprived and 5 = least deprived.
b CCI score groups based on ICD-10 codes in the SMR01 data set.
c ADL groups based on current ADL scores and those 3 months prior to admission, 27% of which are missing.

TABLE 5 Distribution of primary outcome for people with or without CSDs and the type of CSD

	Patients, % (95% CI) (*N* = 5570)					
Primary outcome after 30 days	**No CSD (*n* = 3903)**	**CSD (*n* = 2009)**	**Delirium alone (*n* = 821)**	**Known dementia alone (*n* = 335)**	**Delirium superimposed on known dementia (*n* = 285)**	**Unspecified cognitive impairment (*n* = 226)**
Private home (*n* = 5015)	93.4 (92.6 to 94.1)	81.7 (79.9 to 83.3)	85.7 (83.1 to 97.9)	80.6 (76.0 to 84.5)	69.1 (63.5 to 74.2)	84.5 (79.2 to 88.6)
Other (*n* = 555)	6.6 (5.9 to 7.4)	18.3 (16.7 to 20.1)	14.3 (12.1 to 16.9)	19.4 (15.5 to 24.0)	30.9 (25.8 to 36.5)	15.5 (11.0 to 20.8)
Dead (*n* = 122)	2.2 (1.8 to 2.7)	2.2 (1.6 to 2.9)	2.4 (1.6 to 3.7)	2.1 (1.0 to 4.3)	1.4 (0.5 to 3.5)	2.7 (1.2 to 5.7)
Hospital (*n* = 213)	3.1 (2.6 to 3.7)	5.6 (4.7 to 6.7)	5.9 (4.4 to 7.7)	6.9 (4.6 to 10.1)	3.9 (2.2 to 6.8)	4.9 (2.7 to 8.5)
Care home (*n* = 220)	1.4 (1.0 to 1.8)	10.5 (9.2 to 11.9)	6.0 (4.6 to 7.7)	10.5 (7.6 to 14.2)	25.6 (20.9 to 32.0)	8.0 (5.1 to 12.2)

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 6 The OR estimates of the logistic regression model for living at home 30 days from discharge

	Model, OR (95% CI)		
Model variable	**Unadjusted**	**Adjusted**	**ADL+**
CSD			
Delirium alone vs. no CSD	0.43 (0.34 to 0.55)	0.48 (0.38 to 0.61)	0.57 (0.45 to 0.73)
Known dementia alone vs. no CSD	0.29 (0.22 to 0.40)	0.33 (0.25 to 0.46)	0.43 (0.31 to 0.59)
Delirium and known dementia vs. no CSD	0.16 (0.12 to 0.21)	0.18 (0.16 to 0.25)	0.25 (0.18 to 0.33)
Unspecified cognitive impairment vs. no CSD	0.39 (0.26 to 0.57)	0.51 (0.34 to 0.75)	0.59 (0.40 to 0.89)
Sex			
Male vs. female	1.08 (0.91 to 1.29)	–	–
Age			
Per 5-year increase	0.72 (0.68 to 0.77)	0.76 (0.71 to 0.81)	0.80 (0.75 to 0.85)
SIMD			
1 vs. 5 (least deprived)	1.16 (0.85 to 1.59)	–	–
2 vs. 5 (least deprived)	0.94 (0.71 to 1.26)	–	–
3 vs. 5 (least deprived)	0.90 (0.67 to 1.20)	–	–
4 vs. 5 (least deprived)	0.80 (0.58 to 1.09)	–	–
CCI			
1 vs. 0	1.06 (0.83 to 1.37)	0.86 (0.67 to 1.12)	0.87 (0.67 to 1.13)
2–5 vs. 0	1.06 (0.84 to 1.32)	0.96 (0.76 to 1.21)	0.98 (0.77 to 1.24)
≥ 6 vs. 0	0.50 (0.37 to 0.67)	0.32 (0.23 to 0.45)	0.33 (0.24 to 0.46)
Number of drugs prescribed in previous 84 days			
1–5 vs. 0	0.96 (0.63 to 1.48)	–	–
6–10 vs. 0	0.89 (0.58 to 1.35)	–	–
≥ 11 vs. 0	1.07 (0.69 to 1.64)	–	–
ADL score			
Persistently low vs. persistently high ADL score	0.24 (0.19 to 0.31)	–	0.43 (0.33 to 0.57)
Changed vs. persistently high ADL score	0.50 (0.33 to 0.53)	–	0.65 (0.51 to 0.83)

Increased age was significantly associated with a reduced chance of living at home 30 days from discharge (OR 0.76, 95% CI 0.71 to 0.81), as was having a CCI score of ≥ 6 (OR 0.32, 95% CI 0.23 to 0.45). Sex, socioeconomic deprivation and number of community-dispensed drugs were not associated with living at home at 30 days from discharge in univariate analysis and were not included in the adjusted logistic regression model based on not improving model fit assessed using the AIC (see *Table 6*).

Regardless of their cognitive status, patients with persistently low ADL score and changed ADL score were significantly less likely to be living at home 30 days from discharge than those with a persistently high ADL score (see *Table 6*) (OR 0.43, 95% CI 0.33 to 0.57 for persistently low ADL score and OR 0.65, 95% CI 0.57 to 0.83 for changed ADL score). Reflecting the strong correlation between CSD presence and worse ADL score, adjustment by ADL score somewhat attenuated associations between CSDs and living at home 30 days from discharge. However, patients with CSDs continued to have a significantly lower chance of living at home 30 days from discharge than patients without CSDs. After adjustment for functional ability, patients were significantly less likely to be living at home at 30 days if

they had delirium (OR 0.57, 95% CI 0.45 to 0.79), dementia (either alone or superimposed on delirium) [OR 0.43 (95% CI 0.31 to 0.59) for dementia alone and OR 0.25 (95% CI 0.18 to 0.33) for dementia superimposed on delirium] or unspecified cognitive impairment (OR 0.59, 95% CI 0.40 to 0.89) (see *Table 6*). The sensitivity analysis for the complete-case ADL scores (see *Appendix 4*, *Table 36*) was in agreement with the analysis of data after multiple imputation for missing ADL score.

Mortality

Mortality outcomes were measured in in the entire OPRAA cohort from the date of admission. Mortality was very high in older people with emergency medical admissions, with > 10% of them dying within 30 days of admission and 30% of them dying within 1 year of admission. Mortality was particularly high in people with CSDs, with 40% of them dying within 1 year of admission. Among patients with CSDs, the highest mortality rate was recorded for patients in the DSD group, with 43.9% dying within 1 year of admission (see *Appendix 4*, *Table 35*).

Survival analysis and the Cox proportional hazards model

Survival time at 2-year follow-up was significantly lower in patients with CSDs, with 47.4% surviving at 2 years, compared with 66.5% of those without (*Figure 2a*, log-rank test $p < 0.001$). Increasing age was significantly associated with lower survival (see *Figure 2b*, $p < 0.001$), as was sex, with males being at higher risk (see *Figure 2c*, $p < 0.001$). There was significantly poorer survival for people admitted from a care home (see *Figure 2d*, $p < 0.001$) and people with a high comorbidity index (CCI ≥ 6) (see *Figure 2e*, $p < 0.001$). Survival in patients with persistent low ADL score was generally poor, with only 38.2% of the cohort patients surviving for the 2-year follow-up time; the corresponding figure for those with a changed ADL score and persistently high ADL score was 54.4% and 71.6% (see *Figure 2f*).

The results of the Cox proportional hazards model are shown in *Appendix 4*, *Table 37*. However, the assumption of proportional hazards over time was violated for several covariates, as indicated by the proportional hazard test, and reflected in the crossing of the survival curves in *Figure 2a*. We therefore concluded that the Cox model was misspecified.

Modelling survival in patients with cognitive spectrum disorders: beyond the proportional hazard assumption

Unadjusted HR estimates of the non-proportional hazard model fitted using piecewise constant time-varying coefficients (*Table 7*) indicate that people with CSDs were at higher risk of death than those without CSDs during the 2-year follow-up period. The unadjusted model showed that, compared with patients without CSDs, patients with delirium alone had a significantly higher risk of death in the first 6 months from admission and again after 1 year, whereas risk of death in patients with dementia (with or without delirium) was increased in the first 3 months and further increased over longer follow-up. For patients with unspecified cognitive impairment, the risk of death was increased throughout follow-up compared with patients without CSDs. All other modelled variables, apart from the number of drugs prescribed in the previous 84 days, showed significant associations with mortality in all or most time periods.

After adjustment for demographics and comorbidity, similar patterns of mortality risk over time persisted for people with CSDs (*Table 8*). Patients with delirium alone were at a significantly increased risk of death than those without CSDs in the first 6 months after admission (HR 1.45, 95% CI 1.28 to 1.65) and between 1 and 2 years after admission (HR 1.44, 95% CI 1.17 to 1.77), whereas their risk was not significantly greater than for those without CSDs between 6 months and 1 year (HR 1.07, 95% CI 0.82 to 1.38). Patients with dementia (with or without delirium) were not at a significantly increased risk of death in the first 3 months from admission compared with those without CSDs (HR 1.03, 95% CI 0.84 to 1.28 for dementia alone and HR 1.18, 95% CI 0.96 to 1.45 for DSD), but they became at increased risk of death after 3 months (HR 1.85, 95% CI 1.56 to 2.18 for dementia alone and HR 1.80, 95% CI 1.52 to 2.14 for DSD). Patients with unspecified cognitive impairment were at a significantly increased risk of death only after 6 months from admission (HR 1.55, 95% CI 1.21 to 1.99).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

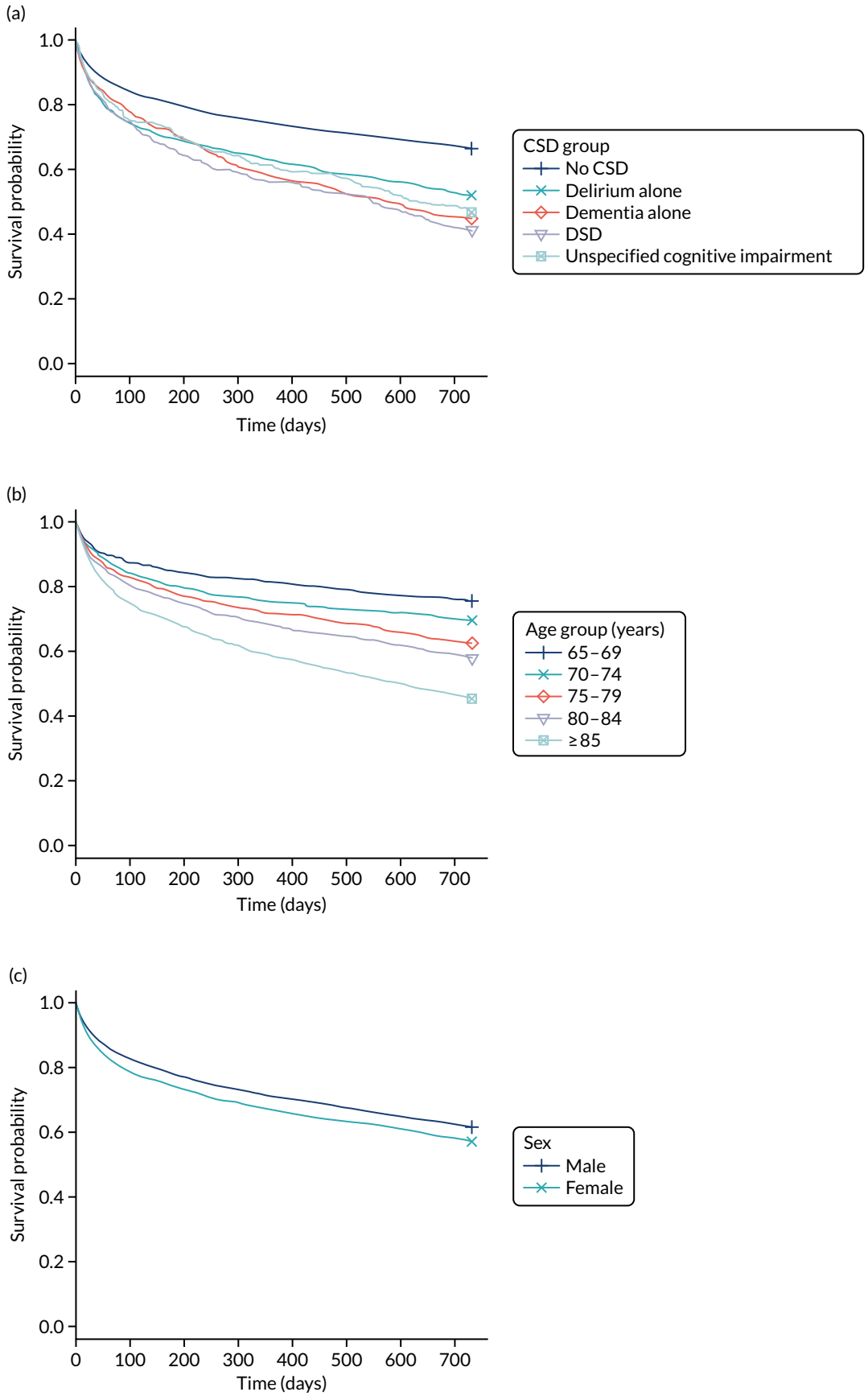


FIGURE 2 Kaplan–Meier survival functions. (a) CSD groups; (b) age groups; (c) sex; (d) residential status; (e) CCI score; and (f) ADL functional status. (*continued*)

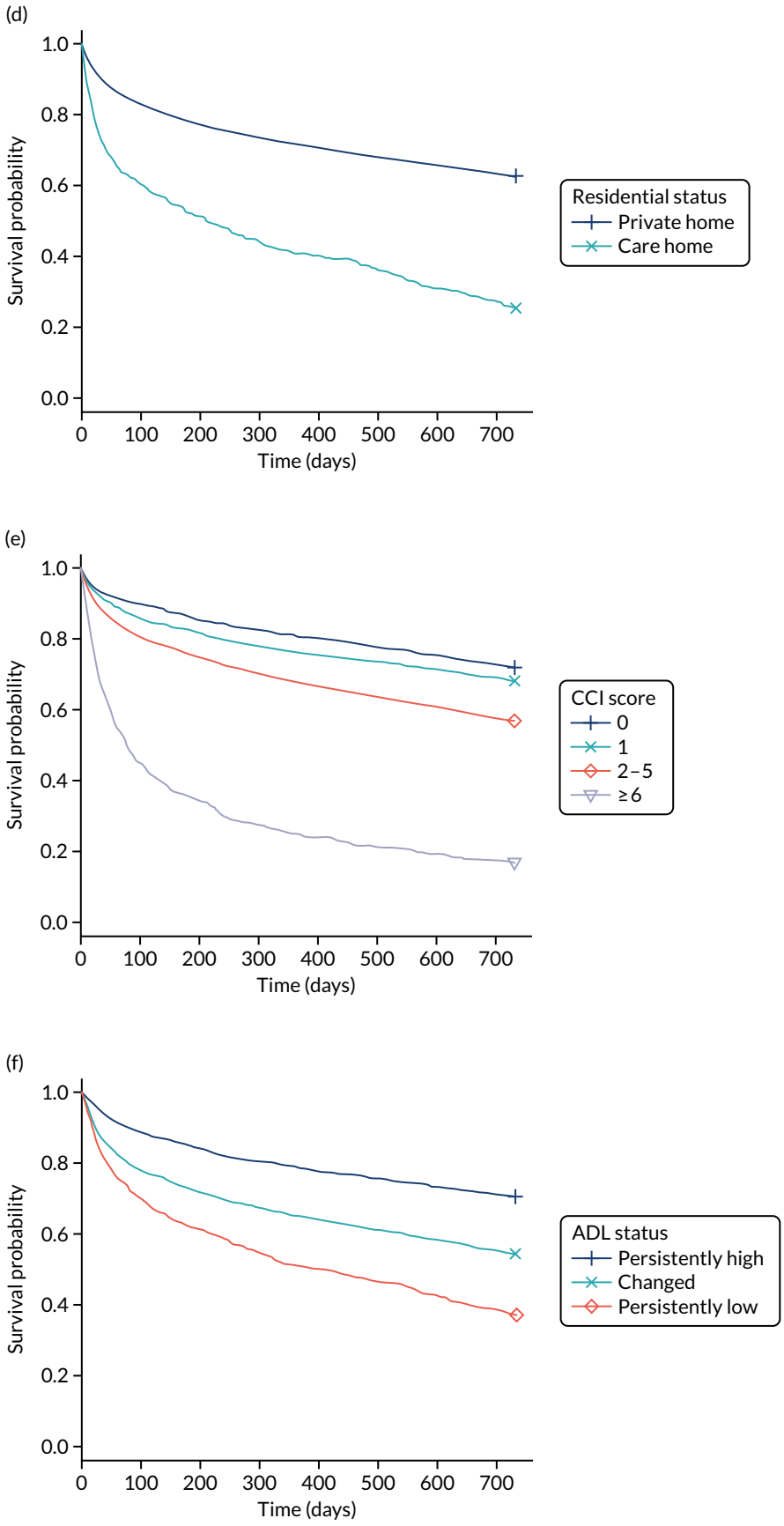


FIGURE 2 Kaplan–Meier survival functions. (a) CSD groups; (b) age groups; (c) sex; (d) residential status; (e) CCI score; and (f) ADL functional status.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 7 Non-proportional model unadjusted HR estimates

	HR (95% CI)				
Model variable	**≤ 30 days**	**31–90 days**	**91–180 days**	**181 days to 1 year**	**1–2 years**
CSD group					
Delirium alone vs. no CSD	1.69 (1.49 to 1.91)			1.23 (0.95 to 1.59)	1.69 (1.37 to 2.08)
Known dementia alone vs. no CSD	1.40 (1.14 to 1.71)		2.37 (2.02 to 2.79)		
Delirium and known dementia vs. no CSD	1.69 (1.40 to 2.04)		2.47 (2.10 to 2.90)		
Unspecified cognitive impairment vs. no CSD	1.65 (1.36 to 2.00)				2.33 (1.68 to 3.21)
Sex					
Male vs. female	1.27 (1.13 to 1.42)			1.10 (0.99 to 1.22)	
Age					
Per 5-year increase	1.15 (1.10 to 1.20)	1.28 (1.25 to 1.32)			
Residence					
Care home vs. private home	3.01 (2.49 to 3.65)	2.56 (2.13 to 2.94)			3.43 (2.20 to 4.35)
SIMD					
1 vs. 5 (least deprived)	1.10 (0.96 to 1.26)				
2 vs. 5 (least deprived)	1.18 (1.04 to 1.34)				
3 vs. 5 (least deprived)	1.10 (0.96 to 1.27)				1.34 (1.10 to 1.65)
4 vs. 5 (least deprived)	1.12 (0.98 to 1.29)				

Model variable	HR (95% CI)				
	≤ 30 days	31–90 days	91–180 days	181 days to 1 year	1–2 years
CCI score					
1 vs. 0	1.22 (0.94 to 1.59)	1.67 (1.21 to 2.30)		1.08 (0.92 to 1.26)	
2–5 vs. 0	1.79 (1.43 to 2.24)	2.33 (1.75 to 3.11)	1.61 (1.41 to 1.85)		
≥ 6 vs. 0	5.36 (4.21 to 6.83)	10.52 (7.78 to 14.22)	5.70 (4.62 to 7.02)		3.51 (2.58 to 4.78)
Number of drugs prescribed in previous 84 days					
1–5 vs. 0	0.91 (0.76 to 1.09)				
5–10 vs. 0	1.10 (0.92 to 1.30)				
≥ 11 vs. 0	1.06 (0.87 to 1.29)		1.50 (1.15 to 1.95)	1.04 (0.81 to 1.34)	1.39 (1.11 to 1.74)
ADL groups					
Low pre ADL score vs. high ADL score	3.03 (2.47 to 3.71)	2.64 (2.37 to 2.95)			
Changed pre ADL score vs. high ADL score	2.10 (1.68 to 2.62)	1.49 (1.30 to 1.70)			

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 8 Non-proportional model HR estimates adjusted for demographics and comorbidity

	HR (95% CI)				
Model variable	**≤ 30 days**	**31–90 days**	**91–180 days**	**181 days to 1 year**	**1–2 years**
CSD groups					
Delirium alone vs. no CSD	1.46 (1.29 to 1.66)			1.04 (0.80 to 1.35)	1.45 (1.18 to 1.78)
Known dementia alone vs. no CSD	1.04 (0.84 to 1.29)		1.84 (1.55 to 2.17)		
Delirium and known dementia vs. no CSD	1.19 (0.97 to 1.46)		1.79 (1.51 to 2.13)		
Unspecified cognitive impairment vs. no CSD	1.18 (0.97 to 1.44)				1.66 (1.20 to 2.30)
Sex					
Male vs. female	1.22 (1.13 to 1.32)				
Age					
Per 5-year increase	1.12 (1.07 to 1.18)	1.27 (1.23 to 1.30)			
Residence					
Care home vs. private home	3.04 (2.45 to 3.77)	1.93 (1.67 to 2.24)			
CCI score					
1 vs. 0	1.32 (1.16 to 1.49)				
2–5 vs. 0	1.75 (1.56 to 1.95)				
≥ 6 vs. 0	6.13 (5.06 to 7.43)	9.67 (7.83 to 11.93)	7.21 (5.89 to 8.84)		4.22 (3.11 to 5.72)
Number of drugs prescribed in previous 84 days					
1–5 vs. 0	1.10 (0.92 to 1.33)				
5–10 vs. 0	1.19 (1.00 to 1.42)				
≥ 11 vs. 0	1.08 (0.89 to 1.32)		1.54 (1.18 to 2.00)	1.06 (0.82 to 1.36)	1.43 (1.14 to 1.80)

Sex and CCI scores of 1 and 2–5 had proportional hazards over the entire 2 years of follow-up, whereas non-constant HRs provided a better fit to the data for all other variables. Increasing age was significantly associated with an increase in mortality risk in the first month (HR 1.12, 95% CI 1.07 to 1.18 per 5-year increase in age), with the risk getting larger after 1 month from admission (HR 1.27, 95% CI 1.23 to 1.30), and patients admitted from a care home had a much higher risk of death in the first month (HR 3.04, 95% CI 2.45 to 3.77) than they did subsequently (HR 1.93, 95% CI 1.67 to 2.24). Increased risk of death consistently rose with increasing CCI, with a HR of 1.32 (95% CI 1.16 to 1.49) for a CCI of 1 and a HR of 1.75 (95% CI 1.56 to 1.95) for a CCI of 2–5 versus a CCI of 0. For patients with a CCI of ≥ 6, the highest risk of death was between 30 and 90 days from admission (HR 9.67, 95% CI 7.83 to 11.93) and the lowest was between 1 and 2 years (HR 4.22, 95% CI 3.11 to 5.72). Associations with the numbers of drugs dispensed were weaker and less consistent. Socioeconomic deprivation was removed from the adjusted model because its inclusion did not improve model fit once other patients' characteristics were accounted for.

Modelling survival of patients with cognitive spectrum disorders in the context of functional ability

Regardless of their cognitive status, patients with persistently low ADL score or changed ADL score were at higher risk of death in the first month following admission than those with persistently high ADL score (*Table 9*; adjusted persistently low ADL score HR 2.26, 95% CI 1.74 to 2.94, and changed ADL score HR 1.95, 95% CI 1.57 to 2.41). These associations weakened but remained statistically significant in the period from 1 month to 2 years (persistently low ADL score HR 1.73, 95% CI 1.52 to 1.96, and changed ADL score HR 1.28, 95% CI 1.13 to 1.47). Reflecting the strong correlation between CSD presence and worse ADL score (see *Table 9*), adjustment attenuated associations between CSD and mortality. However, patients with CSDs remained at increased risk of death compared with those without CSDs, with a similar risk pattern before adjustment for ADL score. After adjustment for functional ability, patients were at a significant risk of death in the first 6 months and again after 1 year if they were delirious (HR 1.24, 95% CI 1.08 to 1.142 and HR 1.27, 95% CI 1.11 to 1.57, respectively) and they were at significant risk of death 3 months following admission if they had dementia (either alone or superimposed on delirium) (HR 1.55, 95% CI 1.31 to 1.84 for dementia alone and HR 1.49, 95% CI 1.25 to 1.78 for dementia superimposed on delirium), whereas patients with unspecified cognitive impairment and high ADL score developed a significant increased risk of death only after 6 months from admission (HR 1.35, 95% CI 1.05 to 1.74). After adjusting for ADL score, the drug count comorbidity variable did not have a significant contribution to the model (according to the AIC) and was removed.

Sensitivity analysis

The sensitivity analysis conducted to account for the effect of missing ADL scores showed agreement between the survival models used on the imputed data (see *Table 9*) and the original data (see *Appendix 4*, *Table 38*), with the exception of HR estimates for patients with delirium after 1 year from admission. In the presence of missing ADL score, the non-proportional survival model adjusted for ADL score indicated that patients admitted with delirium are not at a significant increased risk of death after 6 months from admission until the 2-year end of follow-up time, whereas after multiple imputation this group of patients is still at risk between the 1-year and 2-year follow-up time, a result that is consistent with the results of the unadjusted model, or the model adjusted for demographics and comorbidity only (see *Tables 7* and *8*).

Differences in mortality risks among the different types of cognitive spectrum disorder

The log-likelihood test statistics together with the AIC scores indicated that mortality risks associated with DSD are significantly different from the risk associated with delirium alone (*Figure 3*) ($p = 0.002$ for model B adjusted for demographics and comorbidity and $p = 0.017$ for model C additionally adjusted for ADL status), but it was not significantly different from the risk associated with dementia alone ($p = 0.587$ for model B and $p = 0.257$ for model C). At the same time, mortality risks in people admitted with unspecified cognitive disorder are significantly different from those for people with dementia alone ($p = 0.017$ for model B and $p = 0.032$ for model C), confirming that people with unspecified cognitive impairment become at an increased risk of mortality later on after admission compared with people with dementia alone.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 9 Non-proportional model HR estimates adjusted for demographics, comorbidity and ADL

	HR (95% CI)				
Model variable	**≤ 30 days**	**31–90 days**	**91–180 days**	**181 days to 1 year**	**1–2 years**
CSD groups					
Delirium alone vs. no CSD	1.24 (1.08 to 1.42)			0.94 (0.72 to 1.22)	1.27 (1.11 to 1.57)
Known dementia alone vs. no CSD	0.86 (0.69 to 1.07)		1.55 (1.31 to 1.84)		
Delirium and known dementia vs. no CSD	0.98 (0.80 to 1.20)		1.49 (1.25 to 1.78)		
Unspecified cognitive impairment vs. no CSD	0.97 (0.77 to 1.21)			1.35 (1.05 to 1.74)	
Sex					
Male vs. female	1.27 (1.17 to 1.37)				
Age					
Per 5-year increase	1.07 (1.02 to 1.13)	1.23 (1.20 to 1.27)			
Residence					
Care home vs. private home	2.46 (1.91 to 3.17)	1.63 (1.40 to 1.90)			
CCI score					
1 vs. 0	1.32 (1.17 to 1.50)				
2–5 vs. 0	1.76 (1.57 to 1.96)				
≥ 6 vs. 0	5.91 (4.87 to 7.17)	9.56 (7.75 to 11.79)	7.21 (5.89 to 8.83)		4.21 (3.11 to 5.70)
ADL groups					
Persistently low ADL score vs. persistently high ADL score	2.26 (1.74 to 2.94)	1.73 (1.52 to 1.96)			
Changed ADL score vs. persistently high ADL score	1.95 (1.57 to 2.41)	1.28 (1.13 to 1.47)			

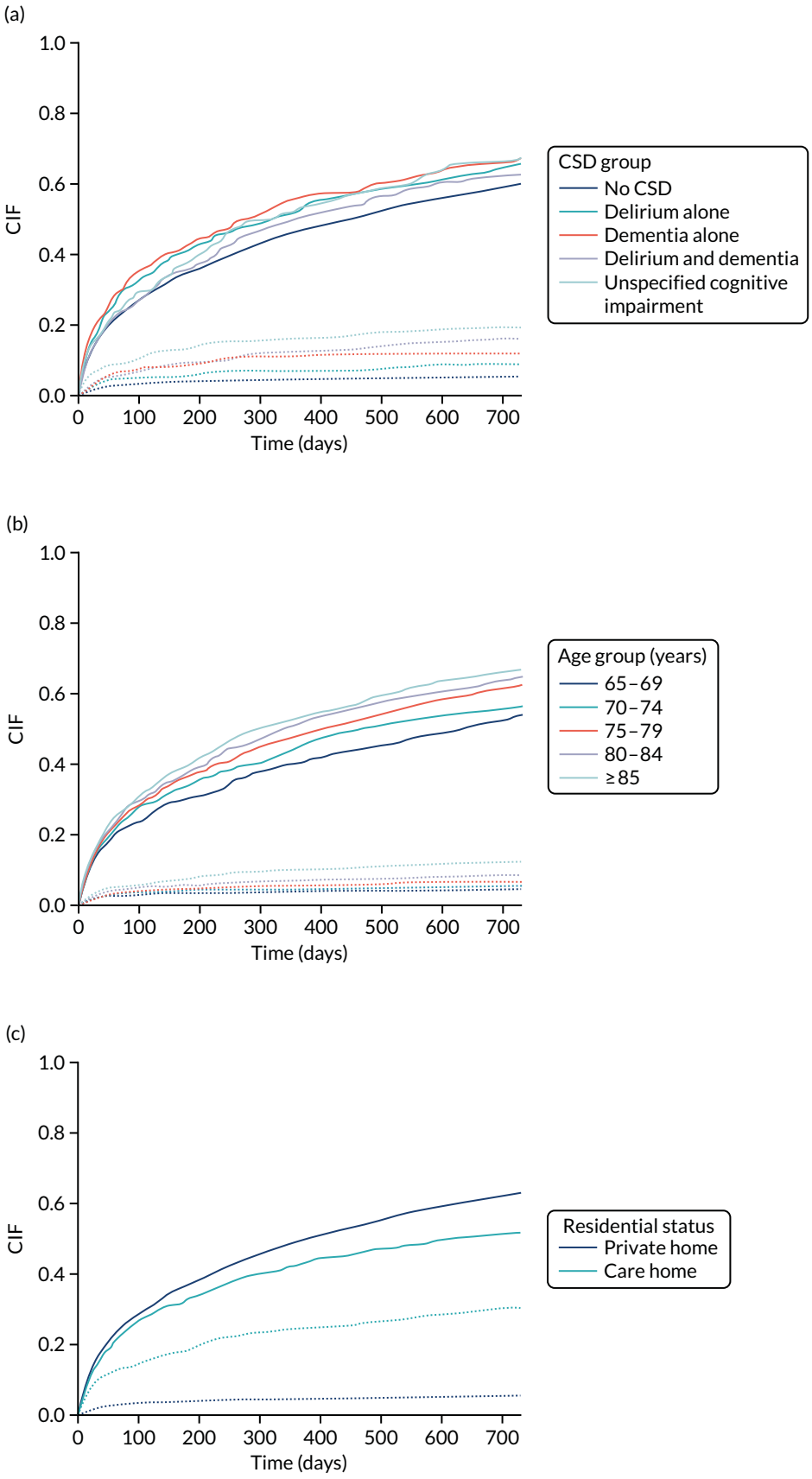


FIGURE 3 Cumulative incidence function for time to re-admission and mortality as competing risks within the 2-year follow-up time from discharge. The solid lines represent time to re-admission and the dotted lines represent mortality. (a) CSD groups; (b) age groups; (c) residential status; (d) CCI score; (e) ADL groups; and (f) number of drugs prescribed in the 84 days prior to admission. (*continued*)

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

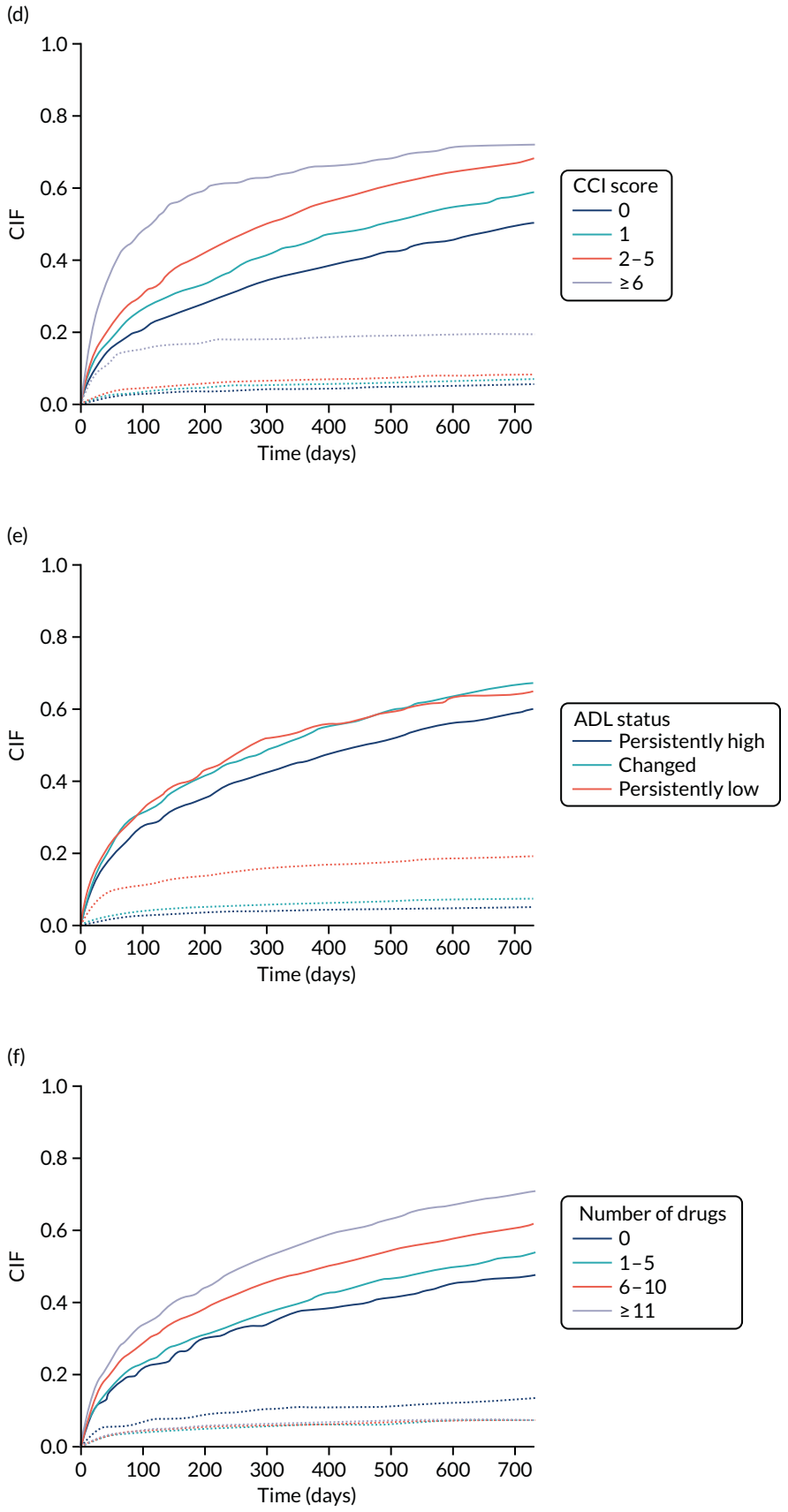


FIGURE 3 Cumulative incidence function for time to re-admission and mortality as competing risks within the 2-year follow-up time from discharge. The solid lines represent time to re-admission and the dotted lines represent mortality. (a) CSD groups; (b) age groups; (c) residential status; (d) CCI score; (e) ADL groups; and (f) number of drugs prescribed in the 84 days prior to admission.

Re-admission

Re-admission outcomes can be assessed only in people discharged from hospital alive. *Table 10* shows in-hospital mortality for the incident OPRAA cohort broken down by CSD status and CSD type. Of the 6724 people admitted to an AMU with an OPRAA, 745 (11.1%, 95% CI 10.4% to 11.9%) died in hospital, with the remaining 5978 being discharged alive either to their private home or to a care home.

Patients within the incident OPRAA cohort who were discharged alive were, on average, aged 78.9 (95% CI 78.7 to 79.1) years, 56.7% (95% CI 55.4% to 58.0%) were female and 10.7% (95% CI 9.9% to 11.5%) were discharged to a care home. In addition, 20.4% (95% CI 19.4% to 21.4%) of patients lived in the most deprived fifth of areas (SIMD 1), whereas 14.8% (95% CI 13.9% to 15.7%) of them lived in the most affluent fifth (SIMD 5).

One or more CSDs were present in 33.6% (95% CI 32.4% to 34.8%) of the incident OPRAA admissions discharged alive, delirium alone was present in 14.8% (95% CI 13.9% to 15.7%) and known dementia alone was present in 7.6% (95% CI 7.0% to 8.8%). DSD was present in 7.1% (95% CI 6.5% to 7.8%) of the incident OPRAA admissions discharged alive, and a further 4.1% (95% CI 3.6% to 4.6%) were patients with unspecified cognitive impairment (AMT score of < 8 points in the absence of delirium or known dementia).

A total of 4307 (72%) people discharged alive had an ADL score recorded. In general, the presence of any CSD was strongly associated with low functional ability, with 79% of patients with CSDs having a persistently low ADL score or changed ADL score; the corresponding figure for patients without a CSD was 38.5% (difference 40.5%, 95% CI 37.7% to 43.1%). Patterns of ADL score varied by CSD condition, with $> 50\%$ of patients with dementia (either alone or superimposed on delirium) having a low ADL score prior to admission (persistently low ADL score), whereas almost 50% of patients admitted with delirium alone had a change in ADL score at admission (changed ADL).

Time to re-admission with death as competing risk

Re-admission at the 2-year follow-up was significantly higher in patients with CSDs than in patients without CSDs (*Table 11*) (65.6% vs. 60.1%, difference 5.5%, 95% CI 2.9% to 8.0%). By the end of the 2-year follow-up time, 13.2% of patient with CSDs died without being re-admitted, compared with 5.3% of patients without CSDs (difference 8.0%, 95% CI 6.4% to 9.7%). At the 2-year follow-up, among people with CSDs, those with DSD had the lowest re-admission rate (62.8%, 95% CI 58.1% to 67.3%) and the highest rate of mortality without re-admission (19.5%, 95% CI 16.0% to 23.6%).

Analysis of the CIF for time to re-admission with mortality as competing risk indicated that rates of re-admission were significantly higher in patients with CSDs than in patients without CSDs (see *Figure 3a*; $p < 0.001$), and increased significantly with age (see *Figure 3b*; $p < 0.001$). Re-admission rates over time were significantly lower in patients discharged to a care home than in those discharged to a private home

TABLE 10 In-hospital mortality for people admitted to an AMU

Patients	In-hospital mortality, % (95% CI) ($n = 745$ died in hospital)
All patients ($n = 6724$)	11.1 (10.4 to 11.9)
No CSD ($n = 4344$)	8.6 (7.8 to 9.5)
CSD ($n = 2380$)	15.6 (14.1 to 17.1)
Delirium alone ($n = 1065$)	16.8 (14.7 to 19.2)
Known dementia alone ($n = 522$)	12.6 (10.1 to 15.8)
DSD ($n = 508$)	16.1 (13.2 to 19.6)
Unspecified cognitive impairment ($n = 285$)	15.1 (11.4 to 19.7)

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 11 Re-admission or death (with no re-admission)

	Time to re-admission/death without re-admission, % (95% CI)							
	30 days		90 days		1 year		2 years	
Patients	Re-admission	Death	Re-admission	Death	Re-admission	Death	Re-admission	Death
All patients ($n = 5978$)	16.1 (15.2 to 17.1)	2.6 (2.3 to 3.1)	27.4 (26.3 to 28.5)	4.2 (3.7 to 4.7)	48.6 (47.4 to 49.9)	6.5 (5.9 to 7.1)	61.9 (60.7 to 63.2)	8.0 (7.3 to 8.7)
No CSD ($n = 3969$)	15.3 (14.2 to 16.4)	2.0 (1.6 to 2.5)	26.0 (24.6 to 27.4)	3.1 (2.6 to 3.7)	46.6 (45.0 to 48.1)	4.4 (3.8 to 5.1)	60.1 (58.6 to 61.6)	5.3 (4.6 to 6.0)
CSD ($n = 2009$)	17.8 (16.2 to 19.5)	3.8 (3.1 to 3.8)	30.2 (28.2 to 32.2)	6.3 (5.3 to 7.5)	52.8 (50.6 to 54.9)	10.6 (9.3 to 12.0)	65.6 (63.4 to 67.6)	13.2 (11.8 to 14.8)
Delirium alone ($n = 886$)	18.4 (16.0 to 21.1)	2.8 (1.9 to 4.1)	31.2 (28.2 to 34.3)	4.9 (3.6 to 6.5)	52.4 (49.1 to 55.6)	6.9 (5.4 to 8.7)	65.6 (62.4 to 68.6)	9.3 (7.5 to 11.3)
Known dementia alone ($n = 456$)	20.6 (17.2 to 24.6)	3.7 (2.3 to 5.9)	34.0 (29.8 to 38.5)	6.1 (4.3 to 8.7)	55.7 (51.1 to 60.2)	12.3 (9.6 to 15.6)	67.1 (62.7 to 71.3)	15.8 (12.7 to 19.4)
DSD ($n = 425$)	14.8 (11.8 to 18.5)	6.1 (4.2 to 8.8)	25.4 (21.5 to 29.8)	9.4 (7.0 to 12.6)	50.1 (45.4 to 54.8)	16.0 (12.8 to 19.8)	62.8 (58.1 to 67.3)	19.5 (16.0 to 23.6)
Unspecified cognitive impairment ($n = 242$)	15.7 (11.7 to 20.8)	3.7 (2.0 to 6.9)	27.7 (22.4 to 33.6)	6.6 (4.1 to 10.5)	53.3 (47.0 to 59.5)	11.2 (7.8 to 15.7)	67.4 (61.2 to 79.9)	12.0 (8.50 to 16.7)

(see *Figure 3c*; $p < 0.001$), and the rate of mortality without re-admission was > 30% at the end of the 2 years for this group. People with a high comorbidity index (CCI of ≥ 6) had a higher re-admission rate, but also a higher rate of mortality without re-admission (see *Figure 3d*; $p < 0.001$), and so did people with persistently high ADL score or changed ADL score (see *Figure 3e*; $p < 0.001$). At the same time, the proportion of people being re-admitted increased significantly with an increase in the number of drugs prescribed in the previous 84 days (see *Figure 3f*; $p < 0.001$), and mortality without re-admission was higher in people treated with no drugs.

Initial estimates of the Fine and Gray[189] competing risk model assuming proportional subdistribution hazards are presented in *Appendix 4*, *Table 39*. However, the assumption of the proportional hazards over time was violated for several covariates and so a model with time-varying coefficients was implemented to correctly estimate the changes in HRs over time.

Modelling time to re-admission in older people: the Fine and Gray[189] competing risk model with time-varying coefficients

Unadjusted HR estimates of the non-proportional subdistribution hazard model indicate that people with CSDs have higher re-admission rates than those without CSDs (*Table 12*). The model showed that people with delirium alone or known dementia alone were at a significant risk of re-admission for the whole 2-year follow-up period, that patients with DSD had a higher risk of re-admission from 3 months to 1 year and that patients with unspecified cognitive impairment were at a significantly increased risk of re-admission after 3 months from discharge until the end of the 2-year follow-up time. At the same time, people with CSDs who were discharged alive were at a significantly increased risk of death without re-admission (*Table 13*), with the risk being particularly high after 1 year from discharge for patients with delirium alone, and after 3 months from discharge for patients with dementia (with or without delirium), whereas patients with unspecified cognitive impairment were at a significant increased risk of death without re-admission in the first year from discharge. All other modelled variables showed significant associations with re-admission or death without re-admission in all or most time periods.

TABLE 12 Unadjusted HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to re-admission under the competing risk of death

	HR (95% CI)			
Model variable	**≤ 30 days**	**31–90 days**	**91 days to 1 year**	**1–2 years**
CSD groups				
Delirium alone vs. no CSD	1.18 (1.08 to 1.29)			
Known dementia alone vs. no CSD	1.25 (1.10 to 1.41)			
Delirium and known dementia vs. no CSD	0.96 (0.79 to 1.56)		1.25 (1.02 to 1.53)	1.05 (0.79 to 1.38)
Unspecified cognitive impairment vs. no CSD	1.06 (0.83 to 1.35)		1.30 (1.07 to 1.60)	
Sex				
Male vs. female	1.15 (1.01 to 1.30)	1.03 (0.94 to 1.13)		0.88 (0.76 to 1.02)
Age				
Per 5-year increase	1.03 (0.99 to 1.07)	1.09 (1.07 to 1.12)		
Residence				
Care home vs. private home	0.91 (0.78 to 1.02)		0.72 (0.60 to 0.84)	0.55 (0.42 to 0.82)

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 12 Unadjusted HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to re-admission under the competing risk of death (*continued*)

	HR (95% CI)			
Model variable	**≤ 30 days**	**31–90 days**	**91 days to 1 year**	**1–2 years**
SIMD				
1 vs. 5 (least deprived)	1.14 (1.02 to 1.27)			
2 vs. 5 (least deprived)	1.13 (1.02 to 1.26)			
3 vs. 5 (least deprived)	1.00 (0.90 to 1.12)			
4 vs. 5 (least deprived)	1.03 (0.91 to 1.16)			
CCI score				
1 vs. 0	1.21 (1.10 to 1.33)			
2–5 vs. 0	1.45 (1.29 to 1.63)		1.76 (1.56 to 2.00)	1.52 (1.30 to 1.76)
≥ 6 vs. 0	2.61 (2.22 to 3.01)		1.86 (1.46 to 2.38)	0.91 (0.59 to 1.41)
Number of drugs prescribed in previous 84 days				
1–5 vs. 0	1.17 (0.99 to 1.38)			
5–10 vs. 0	1.47 (1.25 to 1.73)			
≥ 11 vs. 0	1.86 (1.58 to 2.19)			
ADL groups				
Persistently low ADL score vs. persistently high ADL score	1.20 (1.04 to 1.37)		1.41 (1.20 to 1.65)	0.87 (0.70 to 1.09)
Changed pre ADL score vs. persistently high ADL score	1.10 (0.93 to 1.29)	1.27 (1.15 to 1.40)		

TABLE 13 Unadjusted HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to death without re-admission under the competing risk of re-admission

	HR (95% CI)			
Model variable	**≤ 30 days**	**31–90 days**	**91 days to 1 year**	**1–2 years**
CSD groups				
Delirium alone vs. no CSD	1.57 (1.18 to 2.09)			2.77 (1.60 to 4.79)
Known dementia alone vs. no CSD	2.04 (1.37 to 3.04)		4.74 (3.32 to 6.78)	
Delirium and known dementia vs. no CSD	3.20 (2.26 to 4.52)		4.96 (3.43 to 7.17)	
Unspecified cognitive impairment vs. no CSD	2.58 (1.73 to 3.84)			1.11 (0.27 to 4.59)
Sex				
Male vs. female	1.53 (1.13 to 2.08)	0.93 (0.74 to 1.17)		
Age				
Per 5-year increase	1.16 (1.07 to 1.25)		1.59 (1.42 to 1.78)	1.33 (1.14 to 1.54)
Residence				
Care home vs. private home	4.75 (3.68 to 6.14)		9.43 (7.21 to 12.35)	

TABLE 13 Unadjusted HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to death without re-admission under the competing risk of re-admission (*continued*)

	HR (95% CI)			
Model variable	**≤ 30 days**	**31–90 days**	**91 days to 1 year**	**1–2 years**
SIMD				
1 vs. 5 (least deprived)	0.79 (0.57 to 1.09)			
2 vs. 5 (least deprived)	0.98 (0.73 to 1.32)			
3 vs. 5 (least deprived)	1.20 (0.90 to 1.61)			
4 vs. 5 (least deprived)	1.11 (0.80 to 1.54)			
CCI score				
1 vs. 0	0.74 (0.56 to 0.97)			
2–5 vs. 0	0.99 (0.79 to 1.25)			
≥ 6 vs. 0	4.39 (3.21 to 6.01)		0.99 (0.56 to 1.73)	
Number of drugs prescribed in previous 84 days				
1–5 vs. 0	0.54 (0.40 to 0.76)			
5–10 vs. 0	0.56 (0.41 to 0.76)			
≥ 11 vs. 0	0.53 (0.38 to 0.74)			
ADL groups				
Persistently low ADL score vs. persistently high ADL score	4.14 (3.24 to 5.28)			
Changed pre ADL score vs. persistently high ADL score	1.50 (1.14 to 1.97)			

After adjustment for demographics and comorbidity (*Table 14*), it was shown that patients with delirium alone or dementia alone were at a significant risk of re-admission after discharge for the whole follow-up period (HR 1.18, 95% CI 1.08 to 1.30 for delirium alone and HR 1.40. 95% CI 1.23 to 1.59 for dementia alone) and that patients with DSD were at increased risk of re-admission only after 3 months from discharge (HR 1.50, 95% CI 1.26 to 1.79), whereas patients with unspecified cognitive impairment were not at a significantly increased risk of re-admission after discharge (HR 1.12, 95% CI 0.96 to 1.31). At the same time, after adjustment, people with delirium alone were at a significant risk of death without re-admission after 1 year from discharge (*Table 15*) (HR 1.94, 95% CI 1.15 to 3.28), or after 3 months from discharge for patients with dementia alone (HR 1.83, 95% CI 1.29 to 2.68). Patients with DSD were at a significant increased risk of death after discharge for all of the follow-up time (HR 1.49, 95% CI 1.10 to 2.01), whereas patients with unspecified cognitive impairment were at a significant increased risk of death with no re-admission in the first year from discharge (HR 1.64, 95% CI 1.07 to 2.01).

Sex was significantly associated with re-admission, with males having an increased risk of re-admission in the first year from discharge (see *Table 14*) (HR 1.10, 95% CI 1.02 to 1.18), but also a significant increased risk of death without re-admission in the first month following discharge (see *Table 15*) (HR 1.64, 95% CI 1.07 to 2.51). The risk of re-admission also significantly increased with increasing age after 1 month from discharge (HR 1.11 per 5-year increase, 95% CI 1.08 to 1.13 per 5-year increase), with the risk of death without re-admission increasing significantly with increasing age from 3 months to 1 year from discharge (HR 1.32, 95% CI 1.18 to 1.48). In turn, the rate of re-admission in patients discharged to a care home gradually decreased over time, with the risk of re-admission becoming particularly small after 1 year from discharge (HR 0.39, 95% CI 0.30 to 0.52), with this group of people being at a particularly high risk of death after discharge, with no re-admission during the

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 14 The HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to re-admission under the competing risk of death, adjusted for demographics and comorbidity

	HR (95% CI)			
Model variable	**≤ 30 days**	**31–90 days**	**91 days to 1 year**	**1–2 years**
CSD groups				
Delirium alone vs. no CSD	1.18 (1.08 to 1.30)			
Known dementia alone vs. no CSD	1.40 (1.23 to 1.59)			
Delirium and known dementia vs. no CSD	1.07 (0.86 to 1.32)		1.50 (1.26 to 1.79)	
Unspecified cognitive impairment vs. no CSD	1.12 (0.96 to 1.31)			
Sex				
Male vs. female	1.10 (1.02 to 1.18)			0.91 (0.79 to 1.05)
Age				
Per 5-year increase	1.04 (0.99 to 1.08)	1.11 (1.08 to 1.13)		
Residence				
Care home vs. private home	0.83 (0.69 to 0.99)		0.54 (0.44 to 0.67)	0.39 (0.30 to 0.52)
SIMD				
1 vs. 5 (least deprived)	1.10 (0.99 to 1.23)			
2 vs. 5 (least deprived)	1.10 (0.98 to 1.22)			
3 vs. 5 (least deprived)	0.98 (0.88 to 1.10)			
4 vs. 5 (least deprived)	1.00 (0.89 to 1.13)			
CCI score				
1 vs. 0	1.18 (1.08 to 1.30)			
2–5 vs. 0	1.32 (1.18 to 1.49)		1.51 (1.36 to 1.68)	
≥ 6 vs. 0	2.51 (2.13 to 2.96)		1.72 (1.35 to 2.21)	0.89 (0.58 to 1.37)
Number of drugs prescribed in previous 84 days				
1–5 vs. 0	1.11 (0.94 to 1.31)			
5–10 vs. 0	1.29 (1.10 to 1.52)			
≥ 11 vs. 0	1.57 (1.33 to 1.85)			

2-year follow-up period (HR 4.42, 95% CI 3.26 to 5.98 in the first year and HR 5.92, 95% CI 4.29 to 8.17 in the second year from discharge). People with CCI scores of 1 or 2–5 were at a significant risk of re-admission over the entire 2 years of follow-up from discharge, and at no risk of death without re-admission, whereas people with high comorbidity (CCI score of ≥ 6) were at a significant increased risk of re-admission in the first 3 months from discharge (HR 2.51, 95% CI 2.13 to 2.96) and from 3 months to 1 year (HR 1.72, 95% CI 1.35 to 2.21), but also at a significant risk of death without re-admission in the first 3 months from discharge (HR 5.75, 95% CI 4.15 to 7.96). Risk of re-admission consistently rose with the increase in the number of drugs prescribed in the 84 days prior to admission (HR 1.29, 95% CI 1.10 to 1.52 for 5–10 drugs and HR 1.57, 95% CI 1.33 to 1.85 for ≥ 11 drugs), but the number of drugs was not significantly associated with death without re-admission, and so it was removed from the adjusted model. Socioeconomic deprivation was only marginally associated with re-admission in the adjusted model, but it was not associated with death without re-admission and so it was removed from the adjusted mortality model as its inclusion did not improve model fit (see *Table 15*).

TABLE 15 The HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to death without re-admission under the competing risk of re-admission, adjusted for demographics and comorbidity

	HR (95% CI)			
Model variable	**≤ 30 days**	**31–90 days**	**91 days to 1 year**	**1–2 years**
CSD groups				
Delirium alone vs. no CSD	1.15 (0.87 to 1.54)			1.94 (1.15 to 3.28)
Known dementia alone vs. no CSD	1.11 (0.78 to 1.73)		1.83 (1.29 to 2.68)	
Delirium and known dementia vs. no CSD	1.49 (1.10 to 2.01)			
Unspecified cognitive impairment vs. no CSD	1.64 (1.07 to 2.51)			0.68 (0.17 to 2.82)
Sex				
Male vs. female	1.64 (1.07 to 2.50)	1.14 (0.90 to 1.43)		
Age				
Per 5-year increase	1.07 (0.98 to 1.16)		1.32 (1.18 to 1.48)	1.13 (0.97 to 1.31)
Residence				
Care home vs. private home	4.42 (3.26 to 5.98)		5.92 (4.29 to 8.17)	
CCI score				
1 vs. 0	0.89 (0.67 to 1.17)			
2–5 vs. 0	1.11 (0.89 to 1.40)			
≥ 6 vs. 0	5.75 (4.15 to 7.96)		1.61 (0.90–2.80	

Modelling time to re-admission in older patients in the context of functional ability

Regardless of their cognitive status and other characteristics at discharge, patients with persistently low ADL score were at a significantly increased risk of re-admission in the first year from discharge (HR 1.18, 95% CI 1.01 to 1.38 in the first 3 months and HR 1.41, 95% CI 1.18 to 1.68 afterwards), whereas patients with changed ADL score were at a significantly higher risk of re-admission for all of the follow-up time (HR 1.15, 95% CI 1.05 to 1.27).

Reflecting the strong correlation between CSD presence and worse ADL score, adjustment with ADL score attenuated associations between CSDs and time to re-admission (*Table 16*) or CSDs and risk of death without re-admission (*Table 17*), but preserved similar risk patterns.

Patients with delirium alone or dementia alone remained at increased risk of re-admission compared with those without CSDs over the whole follow-up period (HR 1.13, 95% CI 1.03 to 1.25 for delirium alone and HR 1.33, 95% CI 1.16 to 1.52 for dementia alone), and patients with DSD were at significantly increased risk after 3 months from discharge until the end of follow-up (HR 1.41, 95% CI 1.17 to 1.69), whereas patients with unspecified cognitive impairment were not at a significantly increased risk of re-admission (HR 1.08, 95% CI 0.92 to 1.27).

After adjusting for ADL score, the rest of the model's covariates preserved similar patterns in terms of risk of re-admission, with males being particularly at risk in the first year from discharge (HR 1.11, 95% CI 1.03 to 1.20); the risk also increased significantly with increase in age after 1 month from discharge (HR 1.10, 95% CI 1.07 to 1.13 per 5-year increase in age). People discharged to a care home had a significantly reduced risk of being re-admitted, in particular after 3 months from discharge (HR 0.46, 95% CI 0.36 to 0.56). Increased CCI score and increased number of drugs prescribed in the previous 84 days were also significantly associated with increased risk of re-admission in all or most time periods (see *Table 16*).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 16 The HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to re-admission under the competing risk of death, adjusted for demographics, comorbidity and functional status

	HR (95% CI)			
Model variable	**≤ 30 days**	**31–90 days**	**91 days to 1 year**	**1–2 years**
CSD groups				
Delirium alone vs. no CSD	1.13 (1.03 to 1.25)			
Known dementia alone vs. no CSD	1.33 (1.16 to 1.52)			
Delirium and known dementia vs. no CSD	1.01 (0.81 to 1.25)		1.41 (1.7 to 1.69)	
Unspecified cognitive impairment vs. no CSD	1.08 (0.92 to 1.27)			
Sex				
Male vs. female	1.11 (1.03 to 1.20)			0.90 (0.78 to 1.04)
Age				
Per 5-year increase	1.03 (0.99 to 1.07)	1.10 (1.07 to 1.13)		
Residence				
Care home vs. private home	0.79 (0.66 to 0.96)		0.46 (0.38 to 0.56)	
CCI				
1 vs. 0	1.18 (1.08 to 1.30)			
2–5 vs. 0	1.32 (1.17 to 1.48)		1.50 (1.35 to 1.67)	
≥ 6 vs. 0	2.49 (2.12 to 2.94)		1.71 (1.33 to 2.20)	0.89 (0.57 to 1.36)
Number of drugs prescribed in previous 84 days				
1–5 vs. 0	1.11 (0.94 to 1.31)			
5–10 vs. 0	1.29 (1.10 to 1.52)			
≥ 11 vs. 0	1.57 (1.35 to 1.86)			
ADL groups				
Persistently low ADL score vs. persistently high ADL score	1.18 (1.01 to 1.38)	1.41 (1.18 to 1.68)		0.88 (0.68 to 1.14)
Changed ADL score vs. persistently high ADL score	1.15 (1.05 to 1.27)			

Similarly, the risk of death without re-admission in people with CSDs was partially explained after adjusting for ADL score (see *Table 17*). The fully adjusted model (see *Table 17*) indicated that the risk of death without re-admission was still high in people with delirium after 1 year from discharge (HR 1.68, 95% CI 0.98 to 2.87) or in people with unspecified cognitive impairment in the first year from discharge (HR 1.46, 95% CI 0.95 to 2.23), although this was only marginally significant ($p < 0.10$). After adjusting for ADL status, people with dementia alone were still at a significantly increased risk of death without re-admission after 3 months from discharge (HR 1.59, 95% CI 1.09 to 2.34), whereas for people with DSD the risk of death without re-admission was fully explained by their ADL status (HR 1.24, 95% CI 0.91 to 1.68). People with a significantly increased risk of death without re-admission were males in the first month from discharge (HR 1.67, 95% CI 1.22 to 2.27), people discharged to a care home [HR 3.19 (95% CI 2.33 to 4.36) in the first 3 months and HR 5.78 (95% CI 4.04 to 8.26) after 3 months until the 2-year end of follow-up time] and people with a very high comorbidity index (CCI of ≥ 6) in the first 3 months from discharge (HR 5.66, 95% CI 4.06 to 7.89). The risk of death without re-admission was also significantly

TABLE 17 The HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to death without re-admission under the competing risk of re-admission, adjusted for demographics, comorbidity and functional status

	HR (95% CI)			
Model variable	**≤ 30 days**	**31–90 days**	**91 days to 1 year**	**1–2 years**
CSD groups				
Delirium alone vs. no CSD	1.02 (0.75 to 1.39)			1.68 (0.98 to 2.87)
Known dementia alone vs. no CSD	0.84 (0.53 to 1.31)		1.68 (0.98 to 2.87)	
Delirium and known dementia vs. no CSD	1.24 (0.91 to 1.68)			
Unspecified cognitive impairment vs. no CSD	1.46 (0.95 to 2.23)			0.62 (0.15 to 2.58)
Sex				
Male vs. female	1.67 (1.22 to 2.27)	1.15 (0.92 to 1.45)		
Age				
Per 5-year increase	1.03 (0.94 to 1.12)		1.32 (1.17 to 1.47)	1.12 (0.96 to 1.30)
Residence				
Care home vs. private home	3.19 (2.33 to 4.36)		5.78 (4.04 to 8.26)	
CCI score				
1 vs. 0	0.87 (0.66 to 1.15)			
2–5 vs. 0	1.07 (0.85 to 1.35)			
≥ 6 vs. 0	5.66 (4.06 to 7.89)		1.55 (0.87 to 2.76)	
ADL groups				
Persistently low ADL score vs. persistently high ADL score	2.60 (1.83 to 3.70)	1.26 (0.86 to 1.85)		
Changed pre ADL score vs. persistently high ADL score	1.09 (0.81 to 1.47)			

increased with the increase in age after 3 months from discharge to 1 year (HR 1.32, 95% CI 1.17 to 1.47 per 5-year increase). Finally, people with persistently low ADL score were at a particularly high risk of death without re-admission in the first 3 months from discharge (HR 2.60, 95% CI 1.83 to 3.70), whereas changed ADL score did not pose such a risk during the follow-up period.

The sensitivity analysis for the missing ADL scores (see *Appendix 4*, *Tables 40* and *41*) was in agreement with the analysis of the imputed data, with the exception of subdistribution HR estimates for patients with dementia alone, for whom the risk of death without re-admission after 3 months, although high, was only marginally significant (see *Appendix 4*, *Table 41*; HR 1.47, 95% CI 0.96 to 2.25).

Length of stay

People aged ≥ 65 years admitted to an AMU had an average LoS of 16.4 days (95% CI 15.7 to 17.2 days) (*Table 18*), with LoS being more than doubled for people with CSDs compared with those without CSDs (24.8 vs. 11.8 days; RR 2.1, 95% CI 1.97 to 2.24).

Unadjusted RR estimates of the gamma regression model indicated that people with CSDs had a LoS that was significantly longer than that for people without CSDs (*Table 19*).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 18 Unadjusted means and 95% CIs for LoS for people admitted, by CSD type

Patients	LoS (days), mean (95% CI)
All patients ($n = 6724$)	16.4 (15.7 to 17.2)
No CSD ($n = 4344$)	11.8 (11.1 to 12.6)
CSD ($n = 2380$)	24.8 (23.2 to 26.5)
Delirium alone ($n = 1065$)	22.8 (20.4 to 24.1)
Known dementia alone ($n = 522$)	19.5 (16.6 to 22.3)
DSD ($n = 508$)	34.2 (29.5 to 38.9)
Unspecified cognitive impairment ($n = 285$)	25.7 (21.7 to 2.7)

TABLE 19 The RR estimates of the generalised gamma regression model for LoS

	Model, RR (95% CI)		
Model variable	Unadjusted	Adjusted	Adjusted + ADL
CSD groups			
Delirium alone vs. no CSD	1.92 (1.77 to 2.10)	1.91 (1.76 to 2.08)	1.53 (1.41 to 1.68)
Known dementia alone vs. no CSD	1.65 (1.46 to 1.84)	1.73 (1.54 to 1.94)	1.51 (1.35 to 1.70)
Delirium and known dementia vs. no CSD	2.89 (2.59 to 3.22)	3.09 (2.74 to 3.46)	2.52 (2.24 to 2.83)
Unspecified cognitive impairment vs. no CSD	2.18 (1.86 to 2.53)	1.94 (1.68 to 2.25)	1.66 (1.44 to 1.91)
Sex			
Male vs. female	0.86 (0.81 to 0.92)	0.90 (0.84 to 0.95)	0.96 (0.90 to 1.02)
Age			
5-year increase	1.21 (1.18 to 1.23)	1.18 (1.15 to 1.20)	1.10 (1.08 to 1.12)
Residence			
Care home vs. private home	0.64 (0.57 to 0.72)	0.38 (0.33 to 0.42)	0.32 (0.29 to 0.37)
SIMD			
1 vs. 5 (least deprived)	0.84 (0.75 to 0.93)	0.87 (0.78 to 0.96)	0.84 (0.75 to 0.95)
2 vs. 5 (least deprived)	0.98 (0.89 to 1.09)	1.03 (0.94 to 1.14)	1.00 (0.90 to 1.12)
3 vs. 5 (least deprived)	0.93 (0.84 to 1.04)	0.91 (0.82 to 1.01)	0.91 (0.81 to 1.01)
4 vs. 5 (least deprived)	1.08 (0.97 to 1.22)	1.06 (0.9 to 1.18)	1.02 (0.91 to 1.13)
CCI			
1-unit increase	1.03 (1.02 to 1.05)	1.08 (1.06 to 1.10)	1.08 (1.06 to 1.10)
Number of drugs prescribed in previous 84 days			
Increase of five drugs	0.90 (0.87 to 0.93)	0.89 (0.86 to 0.92)	0.89 (0.80 to 0.92)
ADL groups			
Persistently low ADL score vs. persistently high ADL score	3.07 (2.80 to 3.35)	–	2.58 (2.31 to 2.88)
Changed pre ADL score vs. persistently high ADL score	3.07 (2.85 to 3.31)	–	2.64 (2.45 to 2.84)

After adjustment for demographics and comorbidity (see *Table 19*), the model showed that hospital stay for people with DSD is more than three times longer than for people without CSDs (RR 3.10, 95% CI 2.76 to 3.48), almost twice as long for people with delirium alone or cognitive impairment (RR 1.92, 95% CI 1.77 to 2.09, and RR 1.95, 95% CI 1.69 to 2.26, respectively) and significantly increased to a lesser degree for dementia alone (RR 1.75, 95% CI 1.56 to 1.96). In addition, the pairwise multiple comparison test indicated that LoS for people with DSD was significantly higher than for people with other forms of CSD (p-values < 0.001). The rest of the pairwise comparisons between delirium alone, dementia alone and unspecified cognitive impairment in terms of LoS were not significant ($p > 0.508$).

Sex was significantly associated with LoS, with men having a significantly shorter LoS than women (RR 0.90, 95% CI 0.84 to 0.95), and increased age was significantly associated with an increase in LoS (RR 1.18, 95% CI 1.15 to 1.20, per 5-year increase in age). Patients admitted from a care home had a significantly shorter LoS that those admitted from a private home (RR 0.38, 95% CI 0.33 to 0.42), as did patients living in the most deprived areas compared with those living in the least deprived areas (RR 0.87, 95% CI 0.78 to 0.96). Increased CCI was significantly associated with longer LoS (RR 1.08, 95% CI 1.06 to 1.10 per 1-unit increase in CCI), whereas an increase in the number of drugs dispensed in the 84 days prior to admission was significantly associated with shorter LoS (RR 0.89, 95% CI 0.86 to 0.92).

Length of stay was significantly associated with ADL functional status. Further model adjustment by ADL status showed that patients with persistently low ADL score and changed ADL score had a LoS that was significantly longer than for those with a persistently high ADL score (see *Table 19*) [RR 2.58 (95% CI 2.31 to 2.88) for persistently low ADL score vs. persistently high ADL score, and RR 2.64 (95% CI 2.45 to 2.84) for changed ADL score vs. persistently high ADL score]. Reflecting the strong correlation between CSD presence and worse ADL score (see *Table 4*), adjustment by ADL score attenuated associations between CSDs and LoS. However, patients with CSDs still had a significantly longer LoS than patients without CSDs. After adjustment for functional ability, patients had a significantly longer LoS if they were delirious (RR 1.53, 95% CI 1.41 to 1.68), if they had dementia [either alone (RR 1.51, 95% CI 1.35 to 1.70) or superimposed on delirium (RR 2.52, 95% CI 2.24 to 2.82)] or if they were cognitively impaired in the absence of delirium or dementia (OR 1.66, 95% CI 1.44 to 1.91).

The sensitivity analysis for the complete-case ADL scores (see *Appendix 4*, *Table 42*) was in agreement with the analysis of data after multiple imputations.

Generalisability

It is difficult to be precise about generalisability but, given the proportion of the population covered (7% of the Scottish population), the characteristics of the ageing population and the standard mode of emergency admission into non-specialised acute hospital care in the UK, parts of Europe, North and South America and Australasia, it is assumed that, owing to the large sample size and time period covered, these findings will not be dissimilar to those in other parts of the world where similar health-care systems exist. The size of the population examined is notable. By using routine data, the study included 12,673 emergency medical admissions in 8374 patients, which is more than the total number of patients in all studies included in the most recent systematic reviews.

Limitations of the quantitative study

The key limitations and possible sources of bias reflect the use of routine health-care data and the cross-sectional nature of the OPRAA. The OPRAA was introduced to support the initial multidisciplinary assessment and management of frail older patients as part of a clinical service. This raises six areas that require further discussion: (1) coverage, (2) accuracy of brief assessment tools, (3) cross-sectional nature

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

of assessment, (4) lack of full dementia diagnostic workup, (5) differences between admission and incident cohorts and (6) lack of adjustment for other factors.

Coverage

By design, the OPRAA was not carried out in patients with brief admissions to exclude serious illness such as myocardial infarction in people with chest pain, who required immediate escalation to critical care or who were admitted for palliative care. OPRAA coverage was, therefore, 79.0% of all admissions and 77.3% of incident admissions. However, this compares favourably with most consented research cohorts including those with the highest coverage, such as Sampson *et al.*,[12] who, in their study of dementia prevalence, screened 88.2% of people aged ≥ 70 years admitted for ≥ 48 hours, and included 76.7% of patients (617 patients in total) after exclusions. For comparison, 88.3% of all admissions of > 48 hours in those aged > 70 years were included in this analysis.

Accuracy of brief assessment tools

The OPRAA used relatively simple instruments suitable for identifying delirium and cognitive impairment in a routine clinical context, which may not always match assessment using gold standard research instruments, although the OPRAA was carried out by trained, experienced specialist nurses. The sensitivities of the screening tools used in OPRAA have been discussed in the literature.

Only 31% of people diagnosed with delirium in this data set were CAM positive. This contrasts with the literature comparing CAM with a gold standard assessment of delirium, where CAM sensitivity ranges from 46% to 100%.[191] This probably reflects the difference between assessments carried out by dedicated staff during research studies and assessments such as OPRAA carried out in routine clinical practice where high workload and competing clinical demands constrain when assessments can be undertaken, and make it difficult to repeatedly return to carry out an optimal assessment (e.g. with an informant present). During the period of the study, the nurses applied the original scoring for the CAM in terms of CAM positivity requiring an acute *and* fluctuating course, which the CAM developers have since recognised is often difficult to assess when using the CAM in routine clinical practice. The CAM manual was updated in 2014 to allow two methods of scoring this criterion.[192] It states that the original scoring ('*and*') maximises specificity but reduces sensitivity in clinical use, and suggests using a course that fluctuates or is acute in order to maximise sensitivity at the cost of specificity. In addition, delirium by its nature is fluctuant, and others have found that CAM positivity varies over time in people with delirium, with, for example, 35% of assessments being CAM negative in people with hip fracture who were ever CAM positive.[193] As implemented in this study, CAM would therefore be expected to be highly specific but less sensitive, which is consistent with the observed patterns and with the conclusion of a recent systematic review of the CAM that 'the use of these tools should not replace clinical judgement'.[194]

Similar discussions are present for the AMT in the literature. Initial reports of the accuracy of the AMT in screening for cognitive impairment suggested that 'The best cut-off point was 8, with less than 8 suggesting abnormal cognitive function'.[195] A recent systematic review and meta-analysis examines its accuracy when used as an instrument to screen for dementia.[196] In this meta-analysis, with a cut-off point of < 7 points, pooled analysis of the AMTs showed a sensitivity of 81% and a specificity of 84% for a diagnosis of dementia. As noted in this paper,[196] a cut-off point of < 8 points is considered more usual in clinical practice. In the current study, we use a cut-off point of < 8 points to report unspecified cognitive impairment.

The cross-sectional nature of the assessment

The OPRAA was carried out within the first 24 hours of admission, and therefore captures prevalent cases of CSD at time of admission. Any changes in a patient's cognitive status during the course of admission are not captured in the study design. For example, patients admitted to hospital with no CSDs or with known dementia alone may develop incident delirium through the course of their admission, and their outcomes will be narrowing the divide between the CSD subgroups in the reported analyses.

Lack of full dementia diagnostic workup

Data on results of further diagnostic workups for definitive diagnoses of dementia are not included. For this reason, the categories of the CSDs are based on the diagnoses that were known about at the time of admission (i.e. known dementia), along with diagnoses that can be attributed as a result of the brief assessment. It is therefore most likely that those patients with a low AMT score (unspecified cognitive impairment) are those with undiagnosed dementia.

Differences between admission and incident cohorts

Two cohorts were examined for the analysis. Within the admission (prevalence) cohort, each hospital episode is featured and therefore an individual may be counted a number of times with each re-admission to hospital. The incident cohort differs from the admission cohort in that it identifies individuals at the beginning of their interaction with acute health-care services and follows them through that journey, capturing all re-admissions and mortality. Outcomes reported from this incident cohort are therefore applicable to individual patients. Data from the admission (prevalence) cohort can be seen as reporting the impact that this population has on the acute hospital.

Lack of adjustment for other factors

The analysis reported here is unadjusted for other factors that may be associated with the outcomes, including physical health, function and nutrition. The OPRAA did not include evaluation of nutrition. It did include an assessment of ADL and variation in function may explain some of the observed associations. This is an area that requires further in-depth analysis because declines in ADL may reflect physical and/or cognitive impairment, making adjustment complicated, and any interaction between cognitive status and ADL may vary with time.

Conclusions of the quantitative study

In this study, 35% of people aged ≥ 65 years with an incident admission to the AMU had a CSD. Delirium was present in 23.4% of admissions and dementia was present in 15.3% of admissions. Almost one-third of people with delirium and almost half of those with dementia had both (7.6% DSD). A further 4.2% of people admitted had unspecified cognitive impairment, defined as a low AMT score without known dementia or delirium. CSDs were strongly associated with low functional ability, with $> 50\%$ of patients with known dementia (either alone or superimposed on delirium) having a low ADL score prior to admission (persistently low ADL score) and almost 50% of patients admitted with delirium alone having a decline in ADL score from their functional status 3 months prior to admission (changed ADL score). Only 19% of people admitted with CSDs had a persistently high ADL score, compared with 58.2% of people admitted without CSDs.

Outcomes following hospital admission in older people with CSDs are significantly worse than those for older people without CSDs. The proportion of people living at home 30 days from discharge was significantly lower in patients with CSDs than in patients without CSDs (81.7% vs. 93.4%), with DSD having the poorest outcome: only 69.1% of people in this group were living at home 30 days from discharge.

Mortality from the date of admission was high, with 52.6% of people with CSDs dying within 2 years, compared with 33.5% of people without CSD. The presence of any CSD was associated with increased mortality over the entire period of follow-up, but with different temporal patterns depending on the type of CSD. Compared with no CSDs, delirium alone was associated with increased mortality risk in the 6 months after admission and 1 year from admission until the end of follow-up. Having dementia alone and DSD was not associated with mortality in the first 3 months, but was associated with higher mortality from 3 months to 2 years post admission. Having unspecified cognitive impairment was not associated with mortality in the first 6 months post admission, but was associated afterwards.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Re-admission at the 2-year follow-up was high, with 65.6% of people with CSDs being re-admitted within 2 years, compared with 60.1% of people without CSDs. At the same time, 13.2% of patients with CSDs died without being re-admitted, compared with 5.3% of patients without CSDs at the end of the 2-year follow-up. Compared with no CSDs, delirium alone or dementia alone was associated with increased re-admission risk during the whole follow-up period. Having DSD was not associated with an increased risk of re-admission in the first 3 months, but was associated with higher re-admission from 3 months to 2 years post admission. Having unspecified cognitive impairment was not associated with an increased risk of re-admission at any time after discharge.

Finally, older people with CSDs have an average LoS of almost 25 days, compared with 12 days for people without a CSD. At the same time, LoS for people with CSDs varied depending on the type of CSD, with hospital stay for people with DSD being more than three times longer than that for people without CSDs and almost twice as long for people with delirium alone, dementia alone or an unspecified form of cognitive impairment.

Over one-third of admissions to hospital among the older population have a CSD, and this is associated with worse outcomes. Further research is needed to determine direct causal relationships and predictors of decline to help develop and evaluate specific interventions in different types of CSD in the acute hospital. Health systems are required to address the needs of this large and vulnerable population of inpatients, including effectively identifying those who may benefit from aggressive management (many people with delirium), those for whom a palliative approach to care is more appropriate (some people with dementia) and those people with unspecified cognitive impairment who need formal diagnostic assessment.

Chapter 4 Economic analysis of hospitalisation costs within the Older Persons Routine Acute Assessment cohort

Introduction

According to the Scottish Health Service Costs Report,[197] £11.2B was spent in operating costs by the NHS in Scotland in 2015/16, an increase of 3.9% compared with the 2014/15 financial year after adjusting for inflation. As shown in *Figure 4*, there has been a steady increase in NHS expenditure since 2011, with a higher increase rate in recent years. The accelerating spending growth trend is likely to continue owing to population ageing. It is projected that in Scotland the number of older people aged ≥ 80 years will double between 2014 and 2039.[198] Accordingly, the number of people with CSDs is likely to increase markedly. In this section, we discuss the cost implication of CSDs, addressing questions including 'Is there any difference between CSD patients and non-CSD patients in terms of hospital costs?' and 'Is there any difference between patients with different CSDs?'.

The systematic review by Mukadam and Sampson[13] found that those individuals with dementia have worse outcomes, including increased length of hospital stay, functional decline and discharge to institutional care. It also found that the cost of treatment was higher for those patients with dementia. The current understanding of the health economic impact of dementia is often defined by intervention rather than health-care setting, and estimates for cost of care for those with dementia in general hospitals are sparse. The literature generally suggests that patients with CSDs impose a large cost and resource burden on hospitals.[23,199–203] Most of the literature has focused on an estimation of total or per-capita costs of a particular type of CSD. In contrast, there are fewer studies exploring how the costs of CSD patients differ from those of patients without CSDs and the cost variations between patients with different CSDs. Moreover, some of the existing studies have methodological drawbacks, for example lack of proper control for potential confounders and not taking into account the influence of mortality when modelling the cumulative costs.

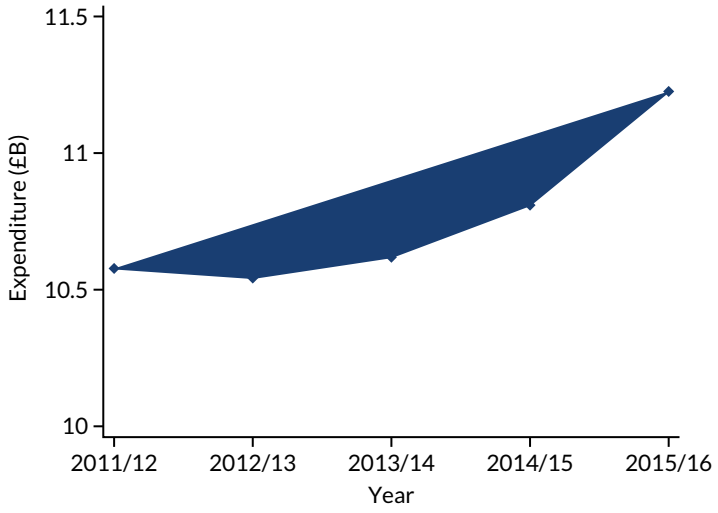


FIGURE 4 Trend in total NHS expenditure (2011/12 to 2015/16).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Study question

The health economics strand of this project sought to examine differences in average hospital costs and cost trajectories between the diagnosis subgroups. We ask whether or not there are significant differences in the patterns of cost between groups, and estimate the extent to which these differences are explained by observable characteristics of the individual patients.

We employed a longitudinal approach to investigate how the cumulative hospital costs changed over a 2-year study period and whether or not there is any difference in the growth of hospital costs between CSD patients and non-CSD patients, and patients with different CSDs.

Methods

Care must be taken in modelling health-care costs to ensure that the cost data satisfy the relevant assumptions and remedial action is taken to address any issues. This is particularly true in multivariate analysis of cost. The results of economic analysis can be sensitive to model choice, leading to a risk of spurious results.[204]

A number of recent reviews have provided detailed assessment of the range of cost-modelling methods available.[204–207] Although a number of non-parametric methods with less stringent assumptions are available for the analysis of costs, it is robust estimates of differences in mean costs that are of most interest to policy-makers.[205] Mihaylova *et al.*[205] provide practical guidance to analysts attempting to analyse multivariate cost models. The cohort used in this study falls in the 'amber orbit', where our data succumb to only a relatively small number of violations of the assumptions, and the large sample size means that the distribution of means follows a near-normal distribution by the central limit theorem, even if the underlying observations are drawn from a skewed distribution. In this situation, Mihaylova *et al.*[205] recommend the use of relatively simple methods of analysis combined with the examination of the sensitivity of the findings to distributional assumptions and model specification.

With this in mind, the health economics analysis methods used in this study are largely descriptive, focusing on estimating conditional averages of the level and growth of patient-level costs. Modelling approaches are used to control for potentially confounding effects in comparing cost profiles between subgroups.

For the cross-sectional cost models, we used gamma regression models with a log-link considering that hospital costs are positive, continuous and right skewed. For the longitudinal analyses, one methodological challenge is that an increase in hospital costs is associated with worsening conditions and, subsequently, a higher risk of mortality. This is to say that any censoring due to death is not independent of the accumulation process of hospital costs and informative censoring is likely to present. To deal with this issue, we employed a joint modelling approach that models the longitudinal costs model and a survival model simultaneously, while taking into account the association between the two.[208–210] More specifically, we used a joint random-coefficient modelling approach in which the longitudinal cost model and survival model of mortality are linked by a shared random coefficient of time that influences both longitudinal costs and mortality. Analyses were undertaken using Stata® version 14 (StataCorp LP, College Station, TX, USA). The joint model was fitted using the user-written *stjm* command.[211]

Data limitations meant that we were not able to take account of costs incurred outside hospital, such as social or informal care. We also do not attempt to estimate the cost/benefit or effectiveness of interventions undertaken with different subgroups.

Data

The cost data used in the health economics analysis were generated using the Scottish Government's Patient Level Information Costing System.[212] Under this costing methodology, various direct cost unit tariffs, for example pharmacy cost per day, nursing cost per day, medical cost per admission and laboratory cost per admission, are calculated from the direct cost pools in the NHS Scotland costs book and activity totals. In addition, there are overhead costs that are mostly indirect costs, such as heating, lighting and hospital administration. The costs book used was supplied by the Scottish Government.

All of these costs are allocated across hospitals, across specialties and by patient type (i.e. inpatients, day cases and outpatients). Therefore, the cost data can be applied to individual patients' SMR records by linking the hospital and specialty codes. The direct total costs plus the overhead allocation gives the total cost for each episode, which can then be aggregated at the level of continuous hospital stays and further at the patient level within the follow-up period. This has the advantage that the aggregated total cost of a hospital stay reflects both the specialty mix and length of that stay.

Costs of the incident admission

Descriptive analysis

We start with the cost of incident admission, defined as the first hospital admission between January 2012 and December 2013 given that the patient had not been admitted to a hospital in the 6 months prior to this admission. As shown in *Figure 5*, on average, patients with DSD incur a higher cost than patient groups. We can also observe the greatest variation in costs among this group of patients. By contrast, non-CSD patients have both the lowest average cost and the lowest variation in stay length.

Patient cost is primarily driven by the length of hospital stay. *Figure 6* shows the group comparison of the LoS. The trend is very similar to the patterns of cost. Patients with DSD have the longest stay, followed by patients with unspecified cognitive impairment, patients with delirium and patients with dementia. Patients without any CSDs have the shortest stay, as well as the smallest variation.

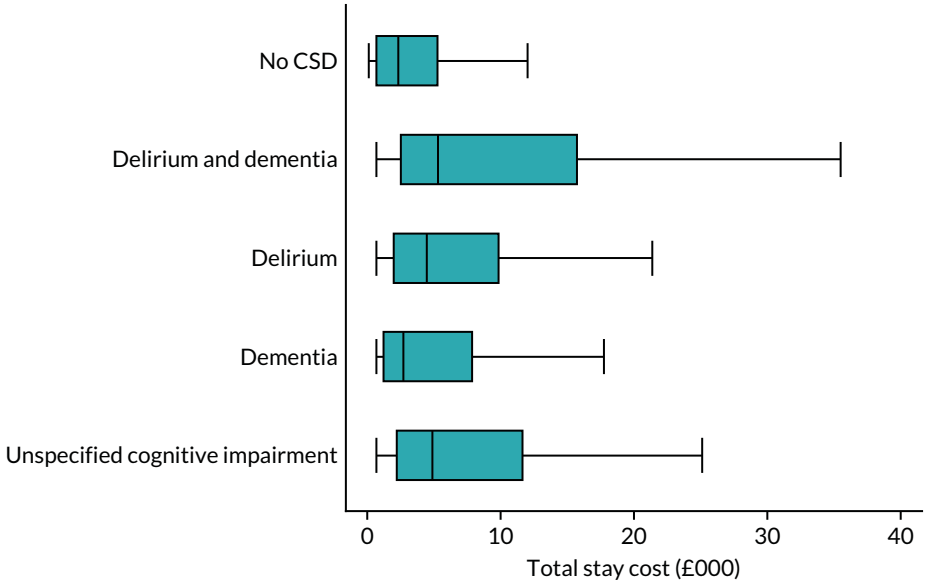


FIGURE 5 Incident hospital admission costs, by CSD conditions.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

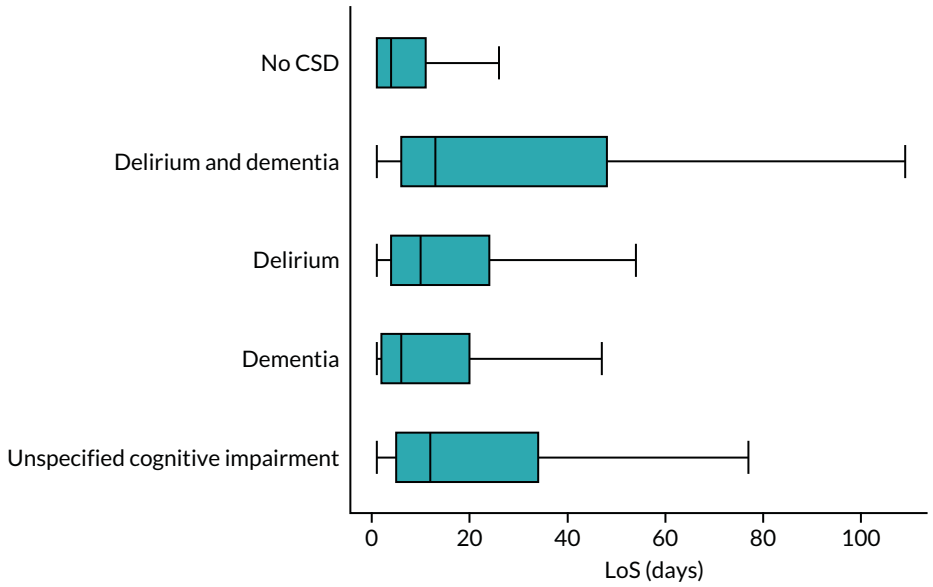


FIGURE 6 Length of stay for the incident admission, by CSD conditions.

However, it is important to note that LoS is not the only factor that influences the total cost. The specialty that a patient was admitted or transferred to also plays a role. In order to examine the influence of specialty on costs, we selected 10 of the most commonly used specialties by our cohort of patients and grouped the rest into an 'other' category, resulting in 11 groups of specialties. We ranked these specialties by their day costs from the highest to the lowest: coronary care unit, high-dependency unit, 'other' specialties, general/acute medicine, communicable diseases, nephrology, gastroenterology, cardiology, respiratory medicine, geriatric medicine and geriatric long stay.

Figure 7 shows the cost ratio of each specialty to the least costly specialty (geriatric long stay), with the size of the marker indicating the specialty usage by patients, which is weighted by the total number of days that patients spent in a specific specialty. For example, we see that the total number of patient hospital days of geriatric long stay is about 19 times higher than that of coronary care unit, whereas the day costs of coronary care unit and high-dependency unit are over three times higher than the cost

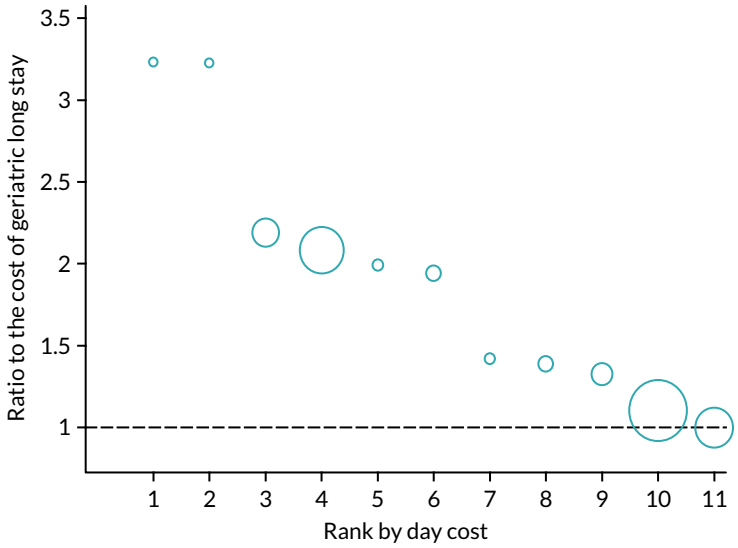


FIGURE 7 Ratio of specialty day cost to the lowest cost (geriatric long stay). 1, Coronary care unit; 2, high-dependency unit; 3, other specialty; 4, general/acute medicine; 5, communicable diseases; 6, nephrology; 7, gastroenterology; 8, cardiology; 9, respiratory medicine; 10, geriatric medicine; 11, geriatric long stay.

of geriatric long stay. However, these two units are among the least used specialties. The most commonly used are geriatric medicine, general/acute medicine and geriatric long stay. These three specialties account for > 77% of patient days for incident admissions.

The distribution of hospital days among specialties is very different between CSD and non-CSD patients, as shown in *Figure 8*. Generally speaking, non-CSD patients are equally likely to be admitted or transferred to high- and low-cost specialties, whereas CSD patients, those with DSD in particular have a tendency to use low-cost hospital services. For CSD patients, 77% of hospital stays are in geriatric medicine or geriatric long stay, compared with 40% for patients with no CSDs. The specialty distributions for patient groups with different CSDs are very similar.

Figure 9 shows the pathways of individual patients' moves between different specialties, omitting patients who had more than four episodes (5%). The individual-level data confirm what we observe in *Figure 7*. Nearly all patients, regardless of their CSD, were initially admitted to the specialty of general/acute medicine. However, CSD patients were more likely to have multiple episodes than non-CSD patients. In addition, they were more likely to be transferred to geriatric medicine or geriatric long stay, in which the day costs are significantly lower.

To sum up, there are two main factors that influence the cost of incident admission for each patient: LoS and the specialties in which the patient was staying. We see that CSD patients tend to stay longer, which drives up their hospital costs. However, they are more likely to stay in specialties with lower day costs, which suppresses their costs.

Modelling hospital stay costs

Arguably, the relationship between CSDs and hospital costs observed previously may be confounded by other factors, such as age and comorbidity. Therefore, a regression method is used to adjust for potential confounders and to include other variables of interest. Considering that the distribution of cost data is positive and skewed, we fitted a gamma regression model with the incident admission costs as the dependent variable. The results are presented in *Table 20*. We see that patients with any CSD incur significantly greater costs than non-CSD patients, even after adjusting for potential confounders. There is also heterogeneity within the CSD group. The costs of patients with DSD are significantly higher than the costs of other CSD patients, including those with delirium alone, dementia alone or unspecified cognitive impairment.

Sex is not related to costs, but the source of admission is. The costs of patients admitted from a care home are significantly lower than the costs of those not admitted from a care home. Moreover, patients who are less deprived tend to cost more than those from areas with the highest deprivation level, which could indicate the existence of inequality in how health resources are distributed. Age has almost no influence on costs, with only the oldest age group being more costly. Not surprisingly, comorbidity (measured by CCI) and ADL are strongly related to costs.

Hospital costs over time

Given that the OPRAA cohort was followed for 2 years since the incident admission, we are able to look at hospital costs from a longitudinal perspective. This allows us to model the growth of patient costs over time across the cohort groups.

Descriptive analysis

Figure 10 shows the average total cost per patient for five groups of the OPRAA patients over different time periods following their incident admissions. In the first 12 months, the group with delirium and dementia had the highest average cost. However, the cost grows more steeply for the unspecified cognitive impairment group, so that it exceeds the delirium and dementia group. The delirium group also catches up by the end of the follow-up period. The flattening of the delirium and dementia group's average total cost is likely to be explained by the significantly higher mortality rate among this group after 1 year.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

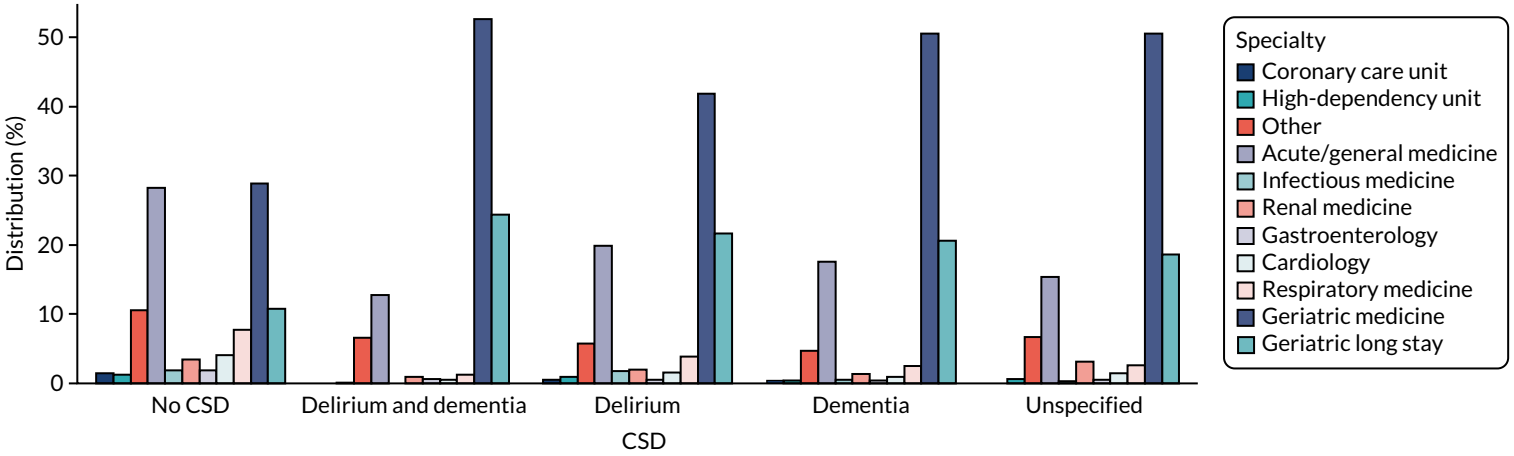


FIGURE 8 Distribution of days by specialty and CSD conditions. The darker the colour, the higher the specialty's day cost. From left to right, coronary care unit, high-dependency unit, other, acute/general medicine, infectious medicine, renal medicine, gastroenterology, cardiology, respiratory medicine, geriatric medicine, and geriatric long stay.

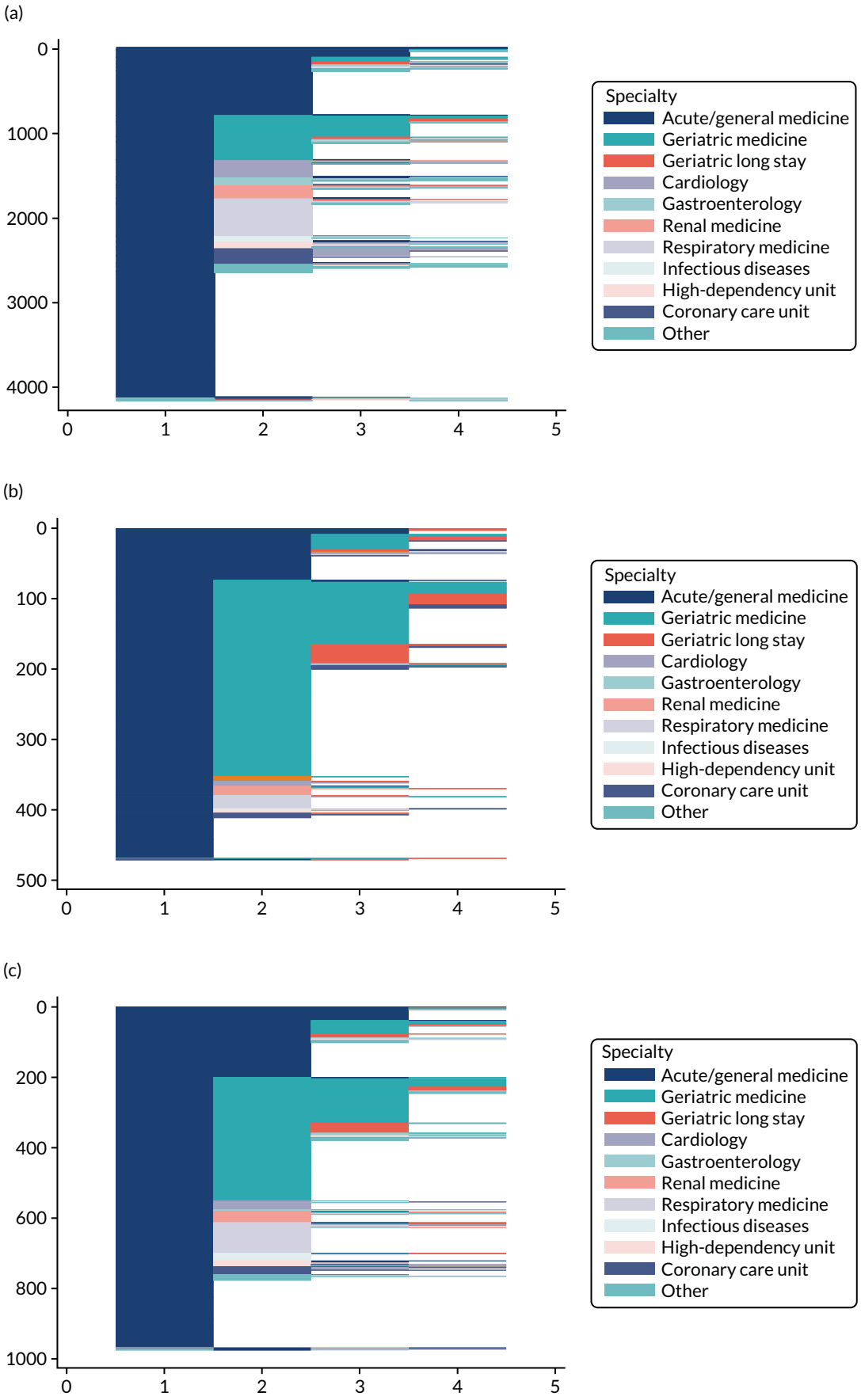


FIGURE 9 Specialty pathways for individual patients by CSD group. (a) No CSD; (b) DSD; (c) delirium; (d) dementia; and (e) unspecified cognitive impairment. (*continued*)

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

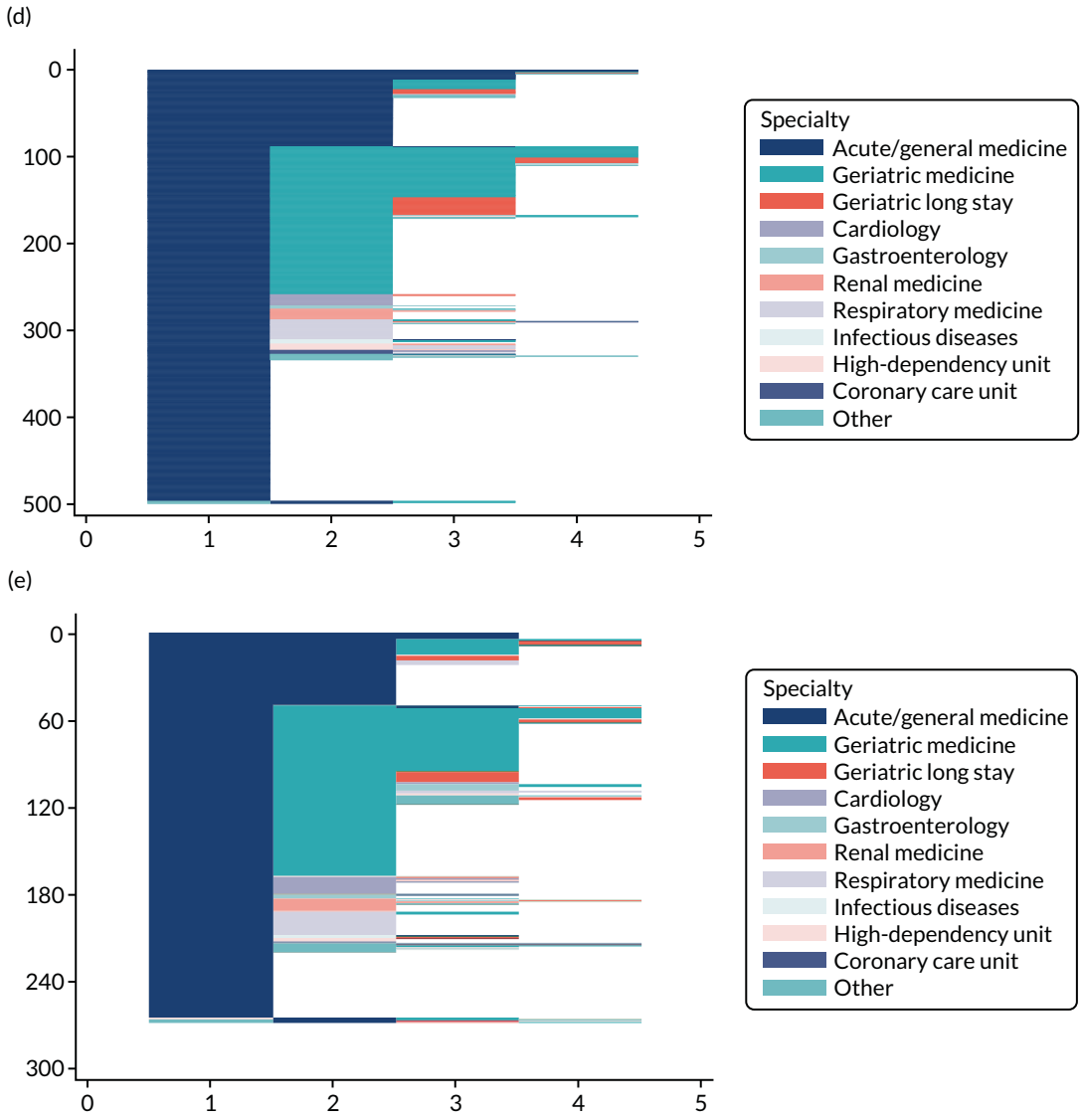


FIGURE 9 Specialty pathways for individual patients by CSD group. (a) No CSD; (b) DSD; (c) delirium; (d) dementia; and (e) unspecified cognitive impairment.

TABLE 20 Estimates from the gamma regression model of incident admission costs

Characteristic	Coefficient	Standard error
CSD conditions		
Delirium and dementia	0.56***	0.09
Delirium alone	0.29***	0.06
Dementia alone	0.18*	0.08
Unspecified cognitive impairment	0.29**	0.11
Female	0.02	0.04
Age group (years)		
70–74	−0.08	0.08
75–79	−0.02	0.07
80–84	0.04	0.07
≥ 85	0.14*	0.07
Admitted from a care home	−0.64***	0.09

TABLE 20 Estimates from the gamma regression model of incident admission costs (*continued*)

Characteristic	Coefficient	Standard error
CCI score		
1	0.16**	0.06
2–5	0.28***	0.05
≥ 6	0.59***	0.08
ADL score		
Changed	0.10	0.07
High	−0.79***	0.07
Missing	−0.84***	0.07
SIMD		
2	0.17**	0.06
3	0.08	0.06
4	0.19**	0.07
5 (least deprived)	0.16**	0.07
Cons	8.65***	0.10

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Note

The reference category of the CSDs is the non-CSD group, the reference age group is 65–69 years, the reference CCI score is 0, the reference ADL score is low and the reference SIMD is 1 (the highest deprivation).

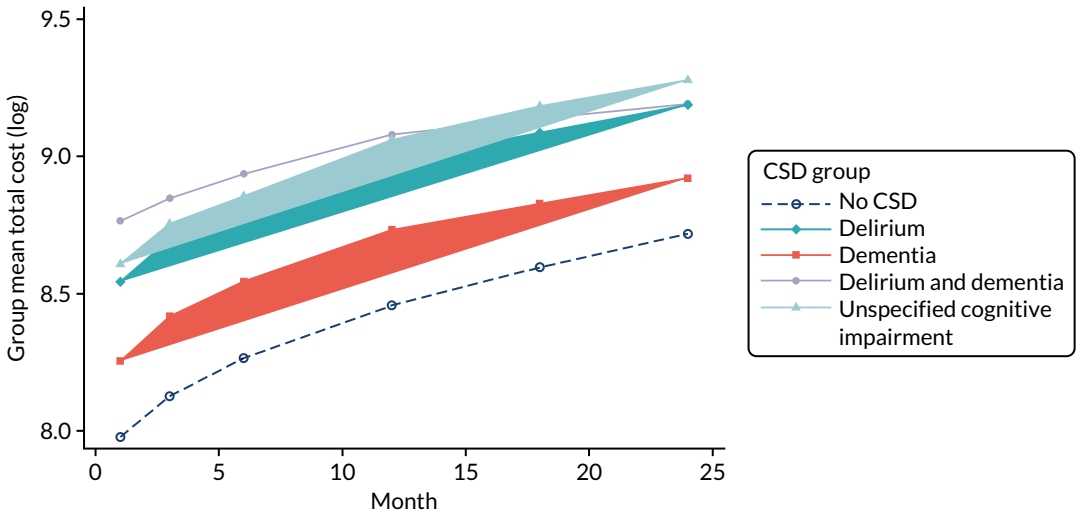


FIGURE 10 Cumulated total cost over time, by CSD conditions. This graph shows the average total cost per patient at five time points: 30 days, 90 days, 12 months, 18 months and 24 months from index admission. It is calculated by adding the costs of all hospital days from the index admission to the respective time point, divided by the number of patients.

Gamma regression models of the cumulative costs over time

In this section, we model the cumulative cost as a function of individual characteristics in order to estimate cost differences between different groups, after controlling for the differences in the composition of patient groups. The results are presented in *Table 21*, with the gamma models estimated over different time periods. We can see that the cumulative total costs for patients with any CSD are significantly higher than those for non-CSD patients if we constrain the time period to up to 6 months (models I and II).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 21 Results from gamma regression models: cumulative total cost by follow-up periods

	Model							
	I (cost within 3 months)		II (cost within 6 months)		III (cost within 1 year)		IV (cost within 2 years)	
Characteristic	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
CSD conditions								
Delirium and dementia	0.43***	0.08	0.38***	0.07	0.31***	0.07	0.12	0.06
Delirium alone	0.25***	0.05	0.23***	0.05	0.21***	0.05	0.18***	0.04
Dementia alone	0.20**	0.07	0.22**	0.07	0.18**	0.07	0.03	0.06
Unspecified cognitive impairment	0.23*	0.09	0.22*	0.09	0.17	0.09	0.11	0.08
Female	0.02	0.04	0.02	0.04	−0.00	0.04	0.03	0.03
Age group (years)								
70–74	−0.04	0.06	−0.04	0.07	−0.01	0.06	0.01	0.06
75–79	0.08	0.06	0.12	0.06	0.13*	0.06	0.14**	0.06
80–84	0.12	0.06	0.14*	0.06	0.15*	0.06	0.15**	0.06
≥ 85	0.18**	0.06	0.19**	0.06	0.21**	0.06	0.17**	0.05
Admitted from a care home	−0.71***	0.08	−0.77***	0.08	−0.79***	0.07	−0.86***	0.06
CCI score								
1	0.14**	0.05	0.10	0.05	0.10*	0.05	0.10*	0.04
2–5	0.28***	0.05	0.25***	0.05	0.25***	0.04	0.27***	0.04
≥ 6	0.65***	0.07	0.61***	0.07	0.53***	0.07	0.27***	0.06
ADL score								
Changed	0.04	0.06	0.01	0.06	0.02	0.06	0.02	0.05
High	−0.60***	0.06	−0.55***	0.06	−0.51***	0.06	−0.35***	0.05
Missing	−0.72***	0.06	−0.71***	0.06	−0.67***	0.06	−0.50***	0.05
SIMD								
2	0.10	0.05	0.10	0.05	0.11*	0.05	0.06	0.04
3	−0.01	0.06	−0.00	0.05	0.03	0.05	0.01	0.05
4	0.14*	0.06	0.15*	0.06	0.17**	0.06	0.11*	0.05
5 (least deprived)	0.08	0.06	0.04	0.06	0.05	0.06	−0.01	0.05
_cons	8.92***	0.09	9.09***	0.09	9.26***	0.08	9.61***	0.08

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Note

The reference category of the CSD conditions is the non-CSD group, the reference age group is 65–69 years, the reference CCI score is 0, the reference ADL score is low and the reference SIMD is 1 (the highest deprivation).

If we prolong the follow-up period to 2 years, only patients with delirium alone cost significantly more than those in the non-CSD group. There is no difference in costs for patients with other CSDs compared with the non-CSD group. The estimated coefficient for patients with DSD is significantly higher than the coefficients for patients with other CSDs in model I only. There appears to be no significant difference between patients with different CSDs if the follow-up period is > 3 months.

We can plot the estimated log costs and their CIs obtained from the gamma regression models based on different lengths of time. *Figure 11a* illustrates how patients with DSD differ from patients with no CSDs across models. It is clear that the gap between these two groups gets narrower, becoming insignificant in model IV, which accounts for all costs that were cumulated within the 2-year period. *Figure 11b* compares the delirium alone with the delirium and dementia group. Although patients with DSD start with a significantly higher cost, their costs seem to accumulate at a lower rate over time than patients with delirium alone.

Longitudinal growth model

The gamma regression models provide snapshots of the cumulative costs over different follow-up periods, giving a description of how the influence of CSDs on the cumulative cost changes over time. To gain a better understanding, we can model the growth trajectory of the cumulative costs by using a growth modelling approach. The results are presented in *Table 22*.

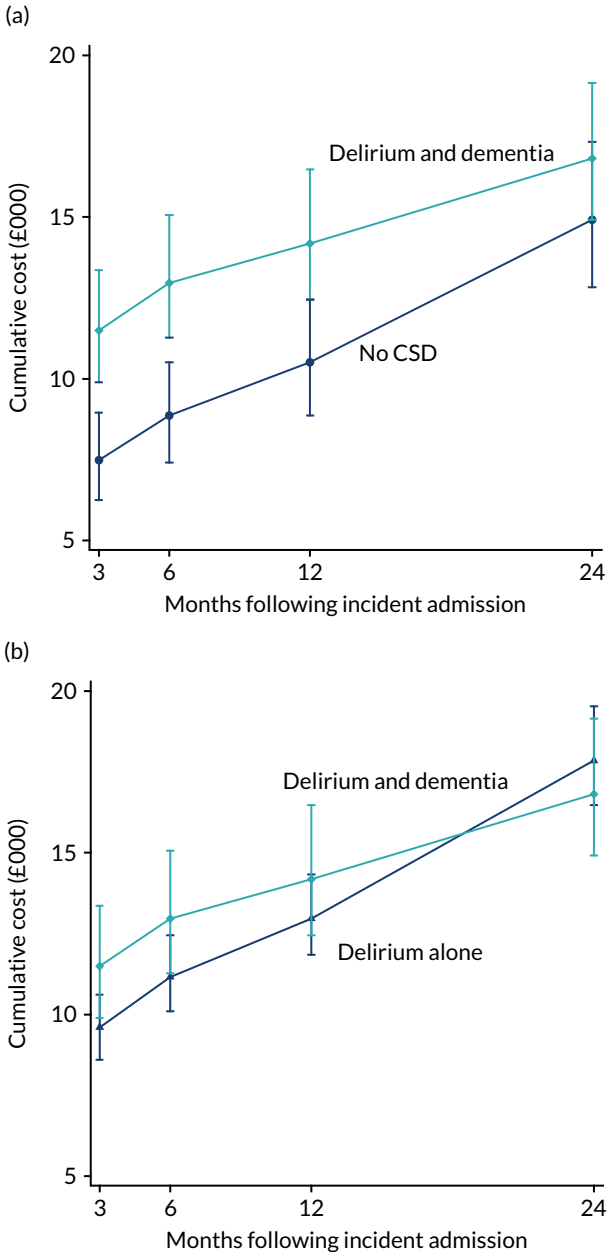


FIGURE 11 Cost estimates and CIs from the gamma regression models. (a) Patients with DSD vs. patients with no CSDs; (b) patients with delirium alone vs. patients with delirium and dementia.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 22 Results from longitudinal models of the cumulative costs

	Unadjusted model		Adjusted model	
Characteristic	Coefficient	Standard error	Coefficient	Standard error
Month	0.041***	0.001	0.053***	0.001
Delirium and dementia	−0.010**	0.003	−0.014**	0.004
Delirium alone	−0.001	0.002	0.001	0.003
Dementia alone	0.006*	0.003	−0.003	0.004
Unspecified cognitive impairment	0.004	0.004	−0.012*	0.005
CSD conditions				
Delirium and dementia	0.486***	0.053	0.424***	0.054
Delirium alone	0.270***	0.035	0.249***	0.036
Dementia alone	0.217***	0.049	0.273***	0.051
Unspecified cognitive impairment	0.185**	0.062	0.248***	0.064
Female	−0.038	0.024	−0.015	0.025
Age group (years)				
70–74	0.068	0.043	0.074	0.045
75–79	0.109**	0.042	0.175***	0.043
80–84	0.212***	0.042	0.277***	0.044
≥ 85	0.291***	0.041	0.370***	0.043
Admitted from a care home	−0.786***	0.051	−0.878***	0.054
CCI score				
1	0.145***	0.034	0.131***	0.035
2–5	0.305***	0.031	0.281***	0.032
≥ 6	0.693***	0.046	0.550***	0.049
ADL score				
Changed	0.053	0.040	0.032	0.042
High	−0.693***	0.041	−0.636***	0.043
Missing	−0.966***	0.041	−0.888***	0.043
SIMD				
2	0.111**	0.035	0.100**	0.037
3	0.048	0.036	0.030	0.038
4	0.098*	0.040	0.076	0.042
5 (least deprived)	0.041	0.041	0.015	0.043
Cons random effects	8.258***	0.060	8.547***	0.063
SD (month)	0.038***	0.001	0.043***	0.001
SD (cons)	0.899***	0.009	0.971***	0.009
SD (residual)	0.525***	0.003	0.354***	0.003

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
SD, standard deviation.
Note
The reference category of the CSD conditions is the non-CSD group, the reference age group is 65–69 years, the reference CCI score is 0, the reference ADL score is low and the reference SIMD is 1 (the highest deprivation).

The unadjusted model is simply a longitudinal random slope model, in which we allow the influence of time (months) to vary across patients, and allow the CSD variable to influence both the intercept and the growth rate. The adjusted model shows the longitudinal estimates from a joint random-coefficient model in which the longitudinal model is jointly fitted with a survival function (results are presented in *Appendix 5*, *Table 43*). This takes into account the fact that the growth trajectory of hospital cost is related to mortality. Generally speaking, the estimates from these two models are fairly close; however, we do see some differences in the estimated influence of the CSD variable on the growth rate.

Figure 12 shows the predicted linear growth trajectories estimated by the unadjusted and adjusted models for different CSD groups. The predicted lines are plotted separately in four subfigures to show the differences more clearly. *Figure 12a* shows the trajectories for the delirium and dementia and no-CSD groups. We see that the estimated starting costs and the growth rates for both groups from the adjusted model are higher than the costs from the unadjusted model. Moreover, the magnitude of the cost difference between these two groups shrinks over time in both models, but the adjusted model has a higher rate whereby the cost difference becomes non-significant by the end of the 2-year follow-up period. This is consistent with the estimates of the gamma regression model in *Gamma regression models of the cumulative costs over time* (see model IV in *Table 21*). In contrast, the cost difference in the unadjusted model is still statistically significant ($p < 0.05$). *Figure 12b* shows the comparison between the unspecified cognitive impairment and no-CSD groups. According to the unadjusted model, the cumulative costs for these two groups grow almost in parallel. However, in the adjusted model, the no-CSD group clearly has a significantly higher rate, allowing it to quickly catch up with the unspecified cognitive impairment group.

In *Figure 12c*, we see that the growth trajectories of the delirium alone and dementia alone groups almost overlap in both models. According to the unadjusted model, they are also very similar to the growth trajectories of the unspecified cognitive impairment group. However, if we look at the adjusted model, despite having close starting points, the unspecified cognitive impairment group has a relatively lower growth rate and a significantly lower cumulative cost by the end of the follow-up period ($p < 0.05$). *Figure 12d* shows that the delirium and dementia group has a significant higher starting cost than the delirium alone or dementia alone groups. However, given it has a lower growth rate, it will be overtaken by the other two groups, but the predicted difference between the delirium and dementia and delirium alone or dementia alone groups is not statistically significant in either model.

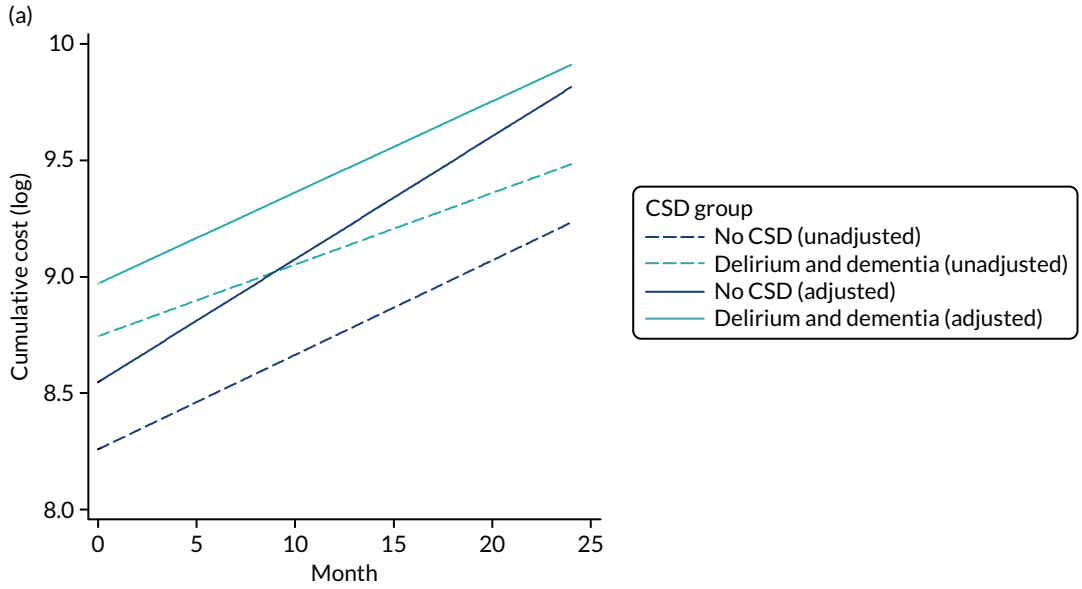


FIGURE 12 Predicted linear growth lines of the cumulative costs. (a) Delirium and dementia vs. no CSD; (b) unspecified cognitive impairment vs. no CSD; (c) delirium alone, dementia alone and unspecified cognitive impairment; (d) delirium and dementia vs. delirium alone and dementia alone. (*continued*)

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

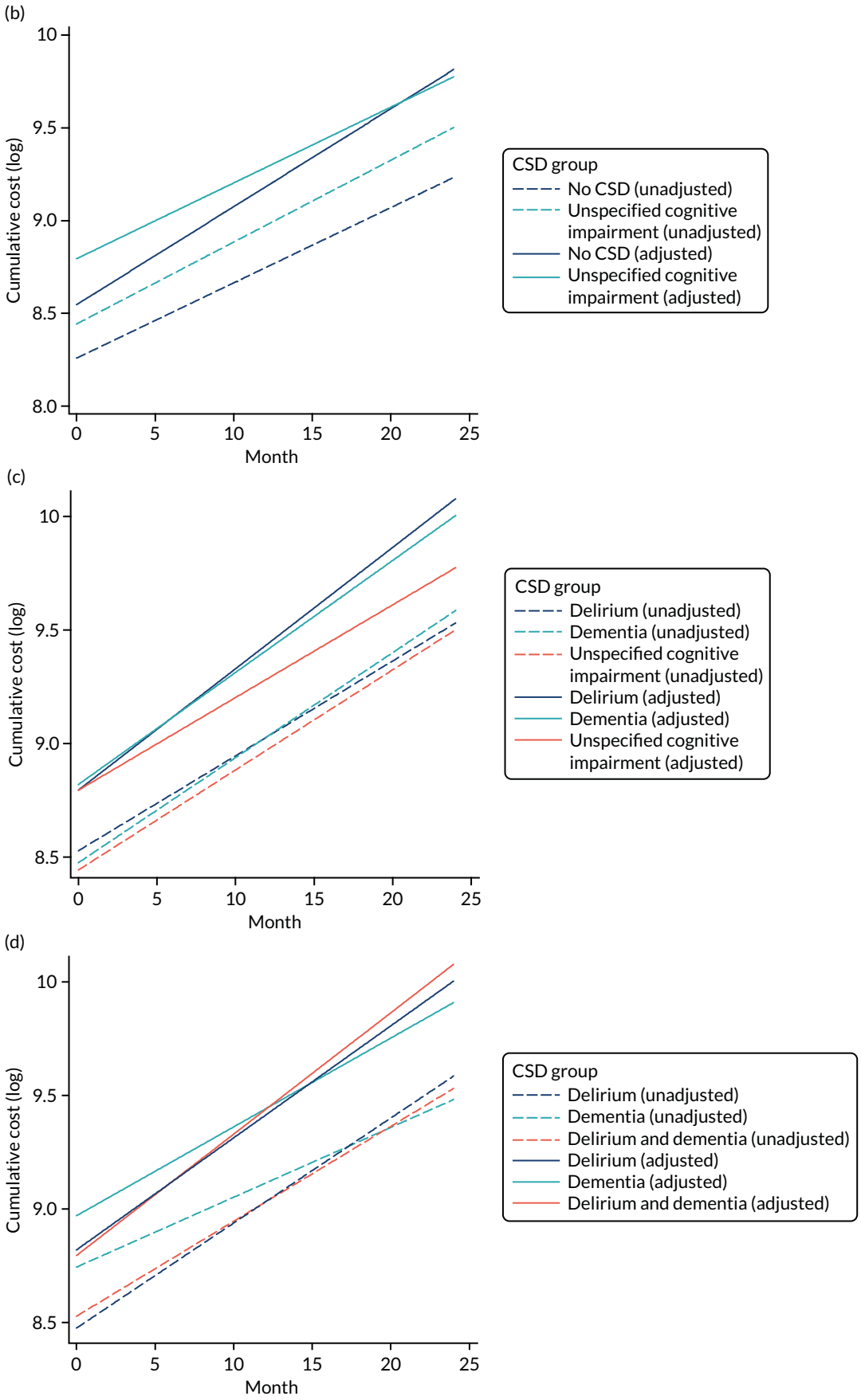


FIGURE 12 Predicted linear growth lines of the cumulative costs. (a) Delirium and dementia vs. no CSD; (b) unspecified cognitive impairment vs. no CSD; (c) delirium alone, dementia alone and unspecified cognitive impairment; (d) delirium and dementia vs. delirium alone and dementia alone.

Conclusion

This study examined hospital costs of patients with and without CSDs, both cross-sectionally and longitudinally. We found that patients with CSDs had significantly higher hospital costs at their incident admission than non-CSD patients did. However, if we looked at it from a longitudinal perspective, the costs of patients with CSDs, particularly those patients with DSD and those with unspecified cognitive impairment, cumulated at a lower rate than for patients with no CSDs. The cost difference between CSD and non-CSD patients generally became negligible in the long run. Moreover, we demonstrated that the CSD group was not homogeneous. Patients with different CSDs might differ in their one-off incident costs, as well as in the growth rate of their cumulative costs if examined longitudinally. This finding of the narrowing difference in costs between the two groups may be attributed to the difference in specialty costs: the delivery of care in geriatric medicine settings being less costly per day than that in acute medicine/gastroenterology or respiratory medicine.

Finally, our study highlighted the importance of accounting for mortality while making longitudinal predictions of costs for patients with different conditions. In our case, patients with CSDs tended to have a higher hazard rate of death than that for non-CSD patients. If we ignore this while fitting a longitudinal model, we risk overestimating the cost growth rate of CSD patients and, accordingly, the differences in their cumulated totals.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Chapter 5 Survey

Context

Cognitive spectrum disorders are common in older inpatients and having a CSD is associated with considerably worse outcomes than not having a CSD.[184]

The measure for outcome has mainly been a measure of health service outcomes (mortality, LoS, etc.), with less than one-third of studies focusing on functional outcomes and only 13% measuring QoL.[213] This poses the question of what is relevant to the individual and their family and friends.

With outcomes from a hospital admission generally being reported as poor for patients with CSDs, this leads to adverse consequences for the individual in addition to increased health service costs.[15] Plausible interventions are complex and multifaceted as they will have to address the multiple clinical and social scenarios encountered. This requires a good understanding of the population with cognitive impairment in the acute general hospital, and their outcomes.

This study aims to provide insight into the perception of outcomes from the viewpoint of the person with CSD and their carers and family.

Research objectives

The aim of this survey was to investigate which outcomes are the most important to people with CSDs in general hospitals. CSDs include cognitive impairment, dementia and/or delirium. This will complement the findings from the systematic review.

Methodology

To understand what is perceived and understood by those experiencing the hospital admission, this study employed qualitative methods using thematic analysis as outlined by Braun and Clarke.[214]

A semistructured survey was conducted online, inviting participation from across the UK and internationally. The survey was constructed to elicit responses from two groups. Version A was presented to people who had experienced a hospital admission in the previous 2 years (during which they had CSDs) and version B was presented to families and friends of people who had experienced a hospital admission in the previous 2 years (during which the admitted people had CSDs).

Limitations

Although it is recognised that an online survey would have some inherent sampling issues with regard to access, the use of online media has increased for the over 65s, with those looking for health-related information increasing from 24% of those surveyed in 2008 to 54% of those surveyed in 2018.[215]

It is possible that the method of recruitment used – advertisements on social media – had implications for the generalisability of the study. We had responses from six people with CSDs. We did not expect responses from those with more advanced CSDs, as they are unlikely to be able to take part, but we had responses from the friends and families of such people, which reflect their experiences. It is also

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

recognised that the online media do have certain advantages. The most obvious is that they are less time-consuming and costly for the researcher, but, more importantly, this method also provided flexibility around location and time: both the researchers and respondents can be located anywhere and participate at any time. This can be of great importance to this target group, as they are often not able to participate during the day and have to take the time when they can. An online survey is also more anonymous than face-to-face or telephone methods; it might allow the respondent to be more frank in replies and at the same time avoid the interviewer/interviewee effect.

With the above in mind, if the time and resources had been available, the addition of a smaller group of face-to-face interviews to validate the responses would have been an advantage.[216]

The survey

After a consensus was reached within the External Advisory Board on the survey format, a test survey was produced and distributed to an expert panel from the Alzheimer's Society. This review, performed by people with dementia, resulted in some further amendments to some of the questions and to the introduction of the survey (*Appendix 9*). Two versions of the survey were created:

1. Version A consisted of four closed-ended questions on demographics – sex, age, country and living situation.
2. Version B consisted of eight closed-ended questions, which included the four from version A with additional questions for the demographics of the carer's sex, age, country and relationship to the person they care for.

In addition to the closed-ended questions, the survey consisted of three open-ended research questions, as follows.

Research question 1 was presented to the person living with CSDs:

1. After an admission to hospital, what do you think are the most important outcomes for people with confusion? (Confusion: dementia, cognitive impairment, memory problems and/or delirium.)

Research questions 2 and 3 were presented to the carer or family member of a person living with CSDs:

2. After an admission to hospital, what do you think are the most important outcomes for people with confusion? (Confusion: dementia, cognitive impairment, memory problems and/or delirium.)
3. After an admission to hospital, what do you think are the most important outcomes to their family and friends? (Confusion: dementia, cognitive impairment, memory problems and/or delirium.)

The survey was coded into Bristol Online Surveys.[217] See *Appendix 6* for a full copy of the survey.

A link to this survey was then made available from the Dementia Services Development Centre (DSDC) website and (https://dementia.stir.ac.uk; accessed 23 January 2020) disseminated in by social media (see *Appendix 7*), and hard copies of the survey were made available when requested.

The survey was available online for 4 months from 11 April to 10 August 2017.

Survey participants

We sought responses from people who have experienced dementia or confusion and have been admitted to hospital within the previous 2 years and from people who provide support to such a person. The hospital admission must have been while the person had dementia or confusion.

Respondents were recruited online through the mailing lists of the DSDC carers' panel, the Alzheimer's Society Research Network and through social media [Twitter (Twitter, Inc., San Francisco, CA, USA; www.twitter.com), Facebook (Facebook, Inc., Menlo Park, CA, USA; www.facebook.com) and LinkedIn (Sunnyvale, CA, USA; www.linkedin.com)]. Specifically, an e-mail was sent out to the DSDC e-mail list of carers and those with dementia.

A total of 78 people responded to the survey; of these, six were people with dementia and 72 were family members ($n = 66$) or carers ($n = 6$) of a person with dementia. *Table 23* provides a further breakdown of respondents. At the time of answering the survey, all participants had the capacity to consent to being involved in this study.

TABLE 23 Characteristics of the 78 survey respondents

Characteristic	Respondents (*n*)	
	People with dementia ($N = 6$)	Family/carers ($N = 72$)
Age of the person with dementia (years)		
≤ 55	1	2
56–65	1	3
66–75	3	5
76–85	1	31
86–95		29
> 95		1
Not submitted		1
Sex of person with dementia		
Female	4	52
Male	2	19
Prefer not to say		1
Living situation of person with dementia		
Lives in a care/nursing home	3	22
Lives with spouse/partner	3	18
Lives on their own		18
The person lives with another carer (not spouse/partner)		12
Not submitted		2
Country of residence		
Scotland	4	35
England	1	27
Northern Ireland		4
Wales	1	2
USA		2
Australia		1
Belgium		1

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 23 Characteristics of the 78 survey respondents (*continued*)

Characteristic	Respondents (*n*)	
	People with dementia (*N* = 6)	Family/carers (*N* = 72)
Age of carer (years)		
18–25		1
26–35		3
36–45		8
46–55		35
56–65		19
66–75		4
76–85		1
Not submitted		1
Sex of carer		
Female		65
Male		7
Relationship of carer to person with dementia		
Child		45
Other family member		7
Professional (paid carer, care home manager, occupational therapist)		6
Sibling		5
Spouse/partner		4
Grandchild		3
Friend		2
Frequency of carer support		
Daily		41
Weekly		23
Monthly		8

One respondent had responded as a person living with a CSD; however, it was clear from the answers that it was a response from a spouse, so the response has been reclassified as such.

Analysis

An initial review of the responses was conducted to gain some insight into the types of response received. The responses were initially analysed using an inductive approach and, from this review, it became evident that some respondents mainly focused on the process of the actual hospital stay and others focused on the outcome from the stay. In both instances, the respondents would list both positive and negative aspects, and, for some respondents, their evaluation of the process was equated to their evaluation of outcome.

After this initial review, the survey responses were imported into NVivo (QSR International, Warrington, UK), and a first level of grouping was coded into observations relating to the actual hospital admission. Those related directly to an outcome from the admission and, for both groups, whether they were positive or negative statements.

The four main groups from the initial categorisation were analysed to identify themes, using techniques such as word frequency clouds, and, although some responses were focused on process and others on outcome, the terms used to describe positive and negative process versus positive and negative outcome were sufficiently similar.

Across all expressed statements, the following six themes emerged: care and treatment, communication, carers and family, hospital staff, hospital environment, and health and functionality. Each of these themes appeared across the four groups of statements.

Although these themes do interact with each other (e.g. communication is related to how hospital staff interact with the carers and family, but also what treatment and care is provided, and what care and treatment is provided has an impact on the health and functionality of the patient), the themes were considered distinct enough to be evaluated individually (*Figure 13*).

Results of the qualitative study

Each theme was analysed to identify its constituents and how it contributes to the perceived outcome. For samples of participant responses, see *Appendix 8*, *Table 44*.

Responses were assigned identifier (ID) codes, as per *Table 24*.

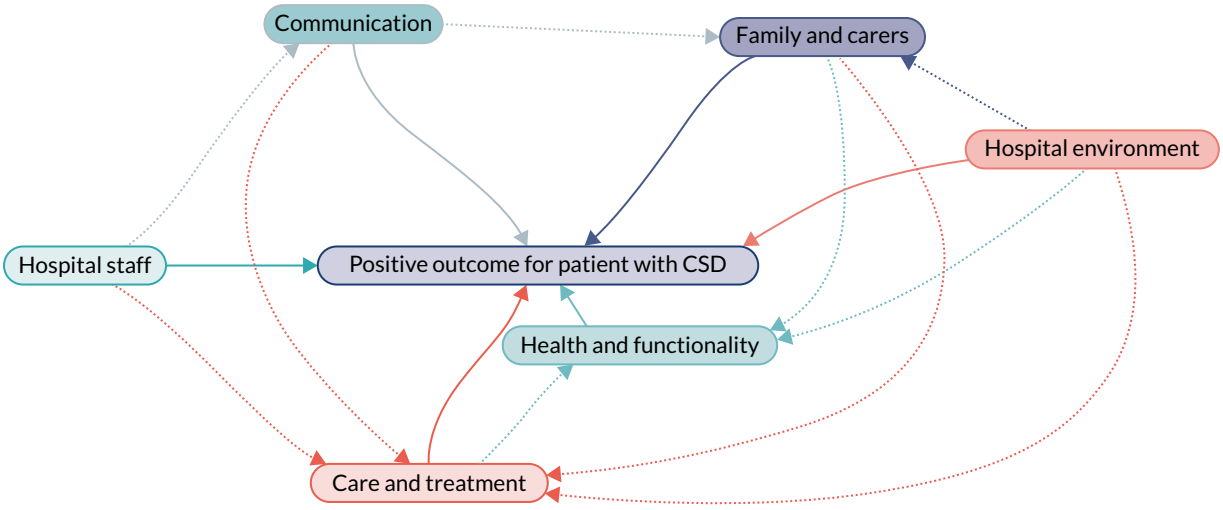


FIGURE 13 The six themes and their inter-relationships.

TABLE 24 Conventions used to assign data ID codes

ID element	Convention
Participant code	PwC = person with CSD
	FC = family carer
	PC = professional carer other than a physician or nurse (e.g. chaplain, social worker, therapist)
Number	Consecutive numbers were assigned for each respondent
Demographic data	F = female
	M = male
	Age group (years)

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Care and treatment

The role of the care and treatment was referred to 59 times in reference to hospital admissions and 62 times in reference to outcomes from an admission. *Box 1* contains examples.

BOX 1 Quotations relating to the theme care and treatment

That the cause of the problem is appropriately identified and treated.
PwC77, M 76–85

To be treated like a person be given time to adjust.
PwC76, F 66–75

To not here [sic] hospital staff say 'that one' when talking about a person.
FC61, F 36–45

. . . cared for with kindness and dignity.
FC28, F 46–55

. . . is patronised or spoken to as if he were a child and it makes him deeply upset.
FC67, F 26–35

Not labelled as someone with behavioural issues that they cannot manage.
FC45, F 56–65

. . . hurried by physio[therapist] with no idea how to alleviate dementia stress.
FC41, 56–65

Nurses regularly ignored signs of pain.
FC42, F 56–65

Asking if they wanted paracetamol when clinically they did not understand what it was . . .
FC20, F 56–65

To not catheterise when not needed.
FC61, F 36–45

. . . care is taken to ensure the patient is well hydrated and nourished.
FC62, F 56–65

She lost weight and there did not seem to be any effort to encourage her to eat.
FC13, F 66–75

Potentially supports in place quickly.
FC2, F 46–55

. . . any additional care needs are addressed.
FC50, F 46–55

[. . .] they put immense pressure [. . .] to move her into a nursing home to recover – no rehab[ilitation] wards [. . .]
FC32, F 56–65

. . . comprehensive explanation of planned care and follow up.
FC64, M 46–55

. . . get as much help to take care of the of the person who has just came out of hospital.
FC24, F 66–75

Family are educated on how to spot signs of infection before it has taken a proper hold.
FC12, F 36–45

The survey highlights that, while in hospital, carers and those living with CSDs expect to:

- be treated with dignity and receive the same level of care as other patients
- experience minimal waiting time, as this can increase anxiety
- be treated appropriately (e.g. are there problems with swallowing, will the treatment increase anxiety?)
- have access to family and carers (i.e. someone who understands and knows the patient).

It also highlights that aspects of lack of focus in care and treatment can have a negative impact:

- Medication is administrated without the carers and patient understanding why and for what.
- Inappropriate medication is administrated.
- Pain is not managed appropriately, or the patient is asked about pain when they are not able to communicate their needs.
- There is a lack of focus on rehabilitation, which leads to a reduced level of mobility and abilities post admission. Some respondents felt that there was very little focus on rehabilitation at all, as if it had no value for this group of patients.
- There is not sufficient focus on ensuring that the patient receives the right fluids and nutrition while in hospital.
- Other aspects of care not directly related to the admission were missed out, such as mouth hygiene.

A positive care situation after the admission was mentioned by several respondents as a positive outcome, including:

- The person feeling settled again after returning from hospital.
- Getting back home, this being their private home or the place in which they were cared for prior to admission. For several patients, this needed to happen sooner rather than later, although some were also concerned that they were discharged too early.
- That support was in place at discharge to ensure that the transition was successful.
- That any change in a care package was evaluated and put in place prior to the discharge.
- That they were back to the level of health they had prior to the condition that necessitated a hospital admission.
- That a proper follow-up was carried out with all involved, including family and carers, regarding any changes in care plan and medication as a result of the admission.

Many respondents shared negative outcomes from a hospital admission. These fell into categories such as:

- The person was less mobile owing to additional illness contracted as a result of the admission.
- Contracting a urinary tract infection during the admission.
- Being more confused or having delirium as a result of the admission.
- Dying as a result of the admission.
- Being on increased medication, or inappropriate medication, after an admission.
- A lack of rehabilitation after a hospital admission.

Hospital staff

The role of staff was referred to 109 times in reference to hospital admissions and eight times in reference to outcomes from an admission (*Box 2* contains examples).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

BOX 2 Quotations relating to the theme hospital staff

> *Prior to discharge, it is important [for] myself, [that] those who know me, those who have a good knowledge/ understanding of my illness and symptoms have my best interest [at heart].*
>
> *PwC73, F 56–65*
>
> *Hospitals say they are receptive to carers and in my experience sometimes do not engage appropriately.*
>
> *FC51, F 46–55*
>
> *To have trained staff who understand dementia and how to communicate patiently and how to anticipate need.*
>
> *FC5, F 56–65*
>
> *It seems that hospital staff are not fully aware of people with dementia and memory problems. They are treated as normal when they are not. More awareness needs to be made to hospital staff for people with dementia and in turn more patience and understanding needs to [be] adopted.*
>
> *FC47, F 26–35*
>
> *It was very confusing to be met with a number of new Doctors/Nurses who seemed to know where they fitted within service provision.*
>
> *FC21, F 46–55*

Staff who demonstrated the following behaviours were part of ensuring that the hospital admission was a positive experience:

- provided assurance and comfort
- respected the patient
- were trained
- recognised the family as key to the care of the patient
- were flexible
- provided assistance when eating and drinking
- were not patronising.

Staff who demonstrated the following behaviours contributed to a negative experience around a hospital admission for both carers and the person with dementia or confusion:

- did not actively encourage the patient to eat and drink
- changed a lot
- did not listen to carers relating to the individual patient's needs, pain, etc.
- did not recognise dementia and its challenges or lacked the appropriate training
- were too busy, or too thin on the ground
- did not care enough
- did not treat the individual with respect.

Staff who demonstrated the following behaviours had a positive impact on the outcome of an admission:

- understood and recognised dementia
- engaged with carers and family and made them a part of the care
- took the time to get to know and understand the patient
- treated the patient with dignity and respect.

Staff who demonstrated the following behaviours had a negative impact on the outcome of an admission:

- labelled patients as difficult
- did not understand what dementia is
- did not engage with carers in the treatment.

Communication

Communication was referred to 57 times in reference to hospital admissions and 31 times in reference to outcomes from an admission (*Box 3* gives examples).

Several respondents mentioned communication as being key to a positive experience and a positive outcome from a hospital admission: communication with the person admitted but especially communication with the family and carers of the person admitted.

BOX 3 Quotations relating to the theme communication

. . . being dismissed [. . .] as a confused older person who has no feelings or emotions.

PC9, F 36–45

. . . not to patronise or speak in a condescending way when talking to the person.

FC67, F 26–35

. . . to receive clear and appropriate communication from staff, taking cognitive disability into account [. . .] without technical jargon or too much detail.

FC23, F 46–55

The person's family are the people who know the person the best so therefore can be useful to the medical staff for information.

FC7, F 46–55

To be listened to as the dementia persons [sic] expert.

FC41, F 56–65

There seemed no point in me telling anyone the things she had done or liked doing if no-one was going to do anything with it [. . .]

FC32, F 56–65

Dieticians [sic] ordering yoghurt when the person does not like this, and no attempt to ask visiting family.

FC20, F 56–65

To be respected as family or attorney of the person [. . .] To be asked about the person's wishes and needs if they can't speak for themselves.

FC5, F 56–65

. . . to be included as the primary point of contact & to have knowledge and views taken into account re treatment & care plans.

FC23, F 46–55

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

The aspects of communication that are highlighted as beneficial to ensure a positive stay are:

- Communication with the patient includes talking with the patient not across the patient.
- Constant reassurance to both the patients and the carers involved.
- Involvement of carers throughout the admission through to discharge, to be kept informed of changes in treatment and/or health.
- When hospital staff consider the carers and family as part of the wider caring team and treat their knowledge with respect. In most cases, they have the most in-depth knowledge about the person.
- A focus on keeping communication simple so carers can understand, avoiding excess jargon.

Often carers commented that communication had failed, listing issues such as:

- The patient being dismissed or not being included in communication or being spoken to in a condescending way.
- Disregarding communication from carers or simply not taking the time to listen to the carers, which led to problems during admission. These could be problems around eating or taking medicine or other functional and/or emotional problems.

Communication comes through as key to a positive admission and outcome: communication throughout the admission from arrival, while in hospital and around the plan for discharge, and communication including the immediate carers and family, but also the wider care team, so that those who are involved after discharge are fully aware of any changes and needs arising from the admission.

Some of the negative experiences shared included patients with dementia being discharged without their immediate family and/or carers being informed and changes to medication while in hospital without informing carers.

Family and carers

The role of carers and family was referred to 70 times in reference to hospital admissions and 21 times in reference to outcomes from an admission (*Box 4* gives examples).

BOX 4 Quotations relating to the theme family and carers

My experience was of feeling I was like a watch dog and if I hadn't been there things would have been even worse.
FC32, F 56–65

. . . continuity of routine.
FC37, F 56–65

. . . keeping a daily routine for the person with dementia prevents confusion [. . .] this also prevents further confusion.
FC3, F 46–55

. . . there should be facilities for the carer to become engaged in the patients [sic] care.
FC51, F 46–55

Be given access to a phone [. . .] to speak to their family/carer if they become very anxious.
FC29, F 46–55

. . . stay by his side and support him, feed him etc. making it easier for staff to administer drugs etc.
FC71, F 46–55

Opp[ortunity] to continue to contribute to care.
FC37, F 56–65

BOX 4 Quotations relating to the theme family and carers (*continued*)

. . . carer knows the person inside out and has the best understanding of what works and what doesn't.
FC4, F 46–55

. . . to feel that the staff are responding to my [carer's] knowledge of my relative's needs and abilities.
FC65, F 56–65

. . . use the time for me to have a bit of a break from caring . . . to build up reserves.
FC29, F 46–55

That the main carers [sic] needs are assessed and supported for them.
FC50, F 46–55

The whole visiting experience was very depressing.
FC13, F 66–75

. . . traumatic in extreme to witness all this and not be listened to and then at [night] when mum needs most reassurance as pain med[ication]s not given, told to leave ward as privacy needed by others.
FC41, F 56–65

It was still a very distressing, frustrating and exhausting time.
FC42, F 56–65

. . . caring for the carer during the period of hospitalisation would be helpful. There should be a key member of the health-care team assigned to the person with dementia and their carer – it's a very upsetting and worrying time entering a hospital environment for carers.
FC51, F 46–55

I was left to deal with everything on my own.
FC75, F ≤ 55

A large number of carers and family members indicated a strong desire to continue to take an active part in the care while the person with dementia was in hospital. They felt that taking part would:

- help to keep a routine that the patient was used to outside hospital
- allow them to give valuable input into the care of the person
- allow them to provide some of the care, easing the situation for both the person with dementia and the hospital staff.

To enable these, there is a demand for greater access with regard to visiting hours, car parking and information (communication).

Carers and family also voiced a need for them to be reassured throughout the hospital admission and beyond, and that it is recognised that this time is stressful for them too.

Often, carers felt they were being ignored and that their lack of involvement had a detrimental effect on the hospital admission. They felt that if they were more closely involved they could also assist in the identification of signs of further illness.

Carers indicated that, after a hospital admission, their role was more difficult than before and it was therefore not always possible for the patient to return home.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Health and functionality

The role of health and functionality was referred to 19 times in reference to hospital admissions and 44 times in reference to outcomes from an admission (*Box 5* gives examples).

While in hospital, the main comment around health and functionality that ensures a positive outcome relates to mobility and hydration: ensuring that the patient is kept mobile and properly hydrated. There were several mentions of problems relating to health and functionality during a hospital admission:

- Increased confusion and delirium while in hospital.
- Pain was not managed appropriately.
- Lack of stimulation.
- Lack of rehabilitation.
- Going in with one condition and contracting additional conditions during the hospital admission.

A positive outcome relating to health and functionality can be summarised as:

- Dementia has not worsened.
- The patient is back to the same or close to same level of mobility and functionality as they had prior to the admission.

However, the experiences shared by respondents indicate that often the patient's dementia has worsened as a result of the hospital admission, their mobility is reduced and their functionality and QoL have deteriorated, so the patient cannot return to their previous living arrangements. If they do, the carer finds the situation unmanageable.

BOX 5 Quotations relating to the theme health and functionality

The most importance outcome is that the person gets well and out of hospital ASAP.

FC10, F 46–55

Feeling safe and care free.

PwC74, F 66–75

More confused dementia is worse mobility is gone.

PwC72, F ≤ 55

. . . her dementia is hugely more apparent since this episode.

FC13, F 66–75

My mum was more confused out of her own home and passed away.

FC39, F 56–65

. . . delirium, cannot distinguish hospital from apartment. Trying to have hospital procedures in apartment (blood draws, see doctor, show urine, show stool).

FC53, F 56–65

Lost ability to walk more than 5 steps when out from hospital/forgot how to put one foot in front of the other.

FC1, F 26–35

My dad became 'incontinent' from this hospital admission.

FC42, F 56–65

ASAP, as soon as possible.

Hospital environment

The role of the hospital environment was referred to 56 times in reference to hospital admissions and once in reference to outcomes from an admission (*Box 6* gives examples).

BOX 6 Quotations relating to the theme hospital environment

. . . that places are Dementia friendly, so when someone is disorientated that someone spots it and can try to talk to the person and reassure them.

FC58, F 46–55

. . . the space and things that the person with dementia need, easily findable and identifiable in the space they are in.

FC29, F 46–55

. . . with effects of strange environment minimised to reduce confusion & anxiety.

FC32, F 56–65

To be moved as few times as possible.

FC23, F 46–55

A single room would be ideal.

FC67, F 26–35

Quiet surroundings, private room.

FC70, F 36–45

If in a shared ward letting others know the difficulty the person is living with.

FC71, F 46–55

As clear as possible routes.

FC21, F 46–55

Be able to get to the loo easily . . . know/find it easily.

FC29, F 46–55

The environment was too hot, no directional signage to toilets etc., no social areas, noisy with phones constantly ringing.

FC42, F 56–65

Their environment is as settled and quiet as possible, not noisy and distracting.

FC67, F 26–35

Be more flexible over visiting times.

FC62, F 56–65

. . . provide easy parking so I can visit easily.

FC29, F 46–55

To be offered something to do if [well] enough to calm or stimulate and avoid stress and agitation.

FC5, F 56–65

Access to daily outdoors.

FC15, F 46–55

To have a family area to relax, to wait when personal care is carried out.

FC42, F 56–65

[. . .] even a comfortable [chair] to sit.

FC51, F 46–55

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

The hospital can help to ensure that a hospital admission is a positive experience for the person with dementia or confusion and their family and carers by:

- Providing flexible visiting hours. This was the most stated wish by family and carers, and several would like the ability to stay 24 hours per day/7 days per week to assist in the care of their loved one.
- Ensuring that the environment is safe and secure, so the patient feels safe and the family and carers feel at ease.
- Keeping the environment as familiar and navigable as possible. This includes not moving the patient multiple times and also keeping the staff consistent throughout the admission. This also includes the ability to make the patient feel 'at home' by bringing some familiar items in.
- Keeping the environment as quiet and calm as possible, even having the option of a private room.
- Easing wayfinding for the patient, such as clear access to the bathroom.
- Providing access for carers; this includes the availability and price of parking.
- Providing facilities for carers within the hospital, including a room to retreat to and a comfortable chair to sit on when spending many hours on the ward.

Several respondents stated that the person with dementia found the admission to hospital very confusing, and the environment of the hospital added to the state of confusion. Some examples, all of which would add to the distress and confusion, were:

- The patient not getting enough fluid, as fluid was left out of reach.
- The patient could easily get lost.
- The environment would be too noisy and too hot.

Discussion of survey results

This study provides an insight into the challenges facing general hospitals in relation to an admission of a person with CSDs to ensure that the outcome is perceived as positive for the patient and/or their carers/family.

The overall expectation relating to health and well-being when discussing a positive outcome for this group of patients is no different from the expectation for the general population, in that they wish to return home with the same functionality and cognitive ability as they had prior to the event that led to the admission. However, the focus by many when asked about a positive outcome is on the process of the actual hospital stay, and the issues surrounding this highlight that there are some challenges here that the respondents feel are important to a positive outcome.

Communication comes through as key to a positive experience of the hospital admission and outcome; starting at the time of admission through to discharge, communication should include treating the patient with dignity and continuously involving the immediate carers and family, but also communication to the wider care team, so that those who are involved after discharge are fully aware of any changes and needs arising from the admission. Communication was listed as an issue to address by the Alzheimer's Society report *Counting the Cost*,[15] with 72% of nursing staff commenting that training in the area of communication was vital. Now, a decade years later, communication and involvement in decision-making remain issues for carers.

There is evidence that a patient with a CSD will stay in hospital twice as long as a similar patient without a CSD. This increased LoS comes at a considerable cost.[184] This study shows that there is a range of areas that could potentially improve the outcome from the stay. As voiced by several respondents, there is still a lack of focus on some of the basic care aspects for patients with a CSD, such as staying hydrated, eating well, staying pain free and keeping mobile.

While in hospital, involving the carers in the day-to-day care, treating them as the experts they are in the individual case, might avoid or curb the deterioration of the patient's functionality and QoL to a level at which they cannot return to their previous living arrangements and, if they do return, the carer finds the situation unmanageable.

The analysis of this survey shows that there is still scope for improvement relating to staff; the survey highlights that staff on hospital wards need dementia training. Staff are perceived to be very busy and not appreciative of the resource the carer could provide. As suggested by Walker and Dewar,[218] professional staff need to take the initiative to involve the carers, which requires both training and time.

Even as hospital environments strive to become dementia friendly, it is clear from some of the feedback that they are falling short on some of the basics, such as signposting, clear pathways to toilets, quiet space and by charging for or making parking difficult for carers who wish to be involved.

This survey adds a valuable insight from the perspective of those who experience the hospital admission first hand. The design of future interventions to improve outcomes for this population in the acute hospital should consider these aspects as part of the intervention.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Chapter 6 Discussion

Principal findings

The systematic review highlights the significant overlap in conditions of patients presenting to general hospitals with confusion (CSDs). Methodological heterogeneity, especially concerning diagnostic criteria, results in some dementia cohorts including patients with concurrent delirium (DSD), some delirium cohorts differentiating between those with pre-existing cognitive impairment (DSD) and those with isolated delirium, and some cohorts screening using cognitive function alone.

Despite considerable methodological differences, CSDs are common in the inpatient population over the age of 65 years, and result in significantly longer LoSs and worse survival in the short and longer term. Differences in outcome between individual conditions are less clear and may benefit from some standardisation of diagnostic categorisation across conditions.

From the analysis of the OPRAA cohort, we have found that over one-third of admissions in those aged $\geq$ 65 years were for patients with CSDs, most commonly delirium (in 24.6% of all admissions), either on its own (16.7%) or superimposed on dementia (7.9%). Known dementia was less common than delirium (17.3% of all admissions) and almost half of admissions for people with known dementia were complicated by superimposed delirium. There were, additionally, 4.5% of admissions in which there was unspecified cognitive impairment, many of whom were likely to have undiagnosed dementia and therefore warranted post-discharge follow-up. As expected, the prevalence of CSDs rose steeply with age, and CSDs of some kind were present in half of admissions for patients aged $\geq$ 85 years. Older people with CSDs had significantly worse outcomes than those without CSDs: mean LoS was 13.2 days longer, they had higher mortality in the year after admission (40.0% vs. 26.0%) and higher mortality or re-admission in the year after discharge (62.4% vs. 51.5%). All categories of CSD were associated with poor outcomes, although LoS was greatest in those with DSD, and, once discharged, patients with dementia alone had a higher mortality/risk of re-admission or death than those with delirium alone.

The economic analysis found that patients with CSDs had significantly higher hospital costs than those without CSDs at their incident admission. However, the average day costs of patients with CSDs were significantly lower than those of patients without CSDs when examining the main cost drivers because they were more likely to be transferred to relatively less costly specialties following their initial admission. Nevertheless, patients with CSDs still accumulated higher costs because they generally had much longer hospital stays.

Findings from the survey report the informed public's view that people admitted to hospital with confusion often do not regain their pre-admission level of autonomy, despite that being their desired outcome. This finding corroborates the research findings from both the systematic review and the OPRAA analysis that the population admitted to hospital with CSDs experience poor outcomes.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Chapter 7 Conclusions

Implications of the project

This project sits in phase 0/1 of the MRC Framework for the Development and Evaluation of Complex Interventions and aimed to systematically develop an understanding of current outcomes in order to support the development of a multidomain intervention to improve outcomes for people with dementia and cognitive impairment in general hospitals in the future.

In this project, three distinct research methodologies have been used to develop this understanding. All have demonstrated the consistent finding that those patients admitted to hospital with confusion (whether due to delirium, diagnosed or undiagnosed dementia or a combination of these) have poor outcomes.

The evidence suggests that the key implication is that health-care systems have to systematically identify, diagnose and manage CSDs in older people admitted as medical emergencies, but avoid focusing on only dementia or delirium alone.

Condition-specific care plans/pathways, such as those for dementia or delirium alone, risk missing the complexities of a person-centred approach to CSDs. Standardised and feasible identification of patients with confusion coupled with a comprehensive diagnostic pathway for all CSD conditions will allow the creation and implementation of a longer-term management plan, bearing in mind that those with CSDs have the same expectation as the general population does: they do not anticipate being 'worse off' when leaving hospital than they were before they were admitted. The development of a multicomponent intervention to specifically meet the identification, diagnostic and management needs of this population is the future goal.

Implications for health care

Health systems are required to address the needs of this large and vulnerable population of inpatients, including effectively identifying those who may benefit from aggressive management (many people with delirium), those for whom a palliative approach to care is more appropriate (some people with dementia) and those people with unspecified cognitive impairment who need formal diagnostic assessment. This suggests a need for health-care systems to systematically identify, diagnose and develop care pathways for older people with CSDs, and avoid only focusing on condition-specific pathways. In addition, those with likely undiagnosed dementia (low AMT without known dementia or delirium) need follow-up for diagnosis after the acute episode.

Future research implications

Further standardisation of case finding and diagnostic criteria will aid further stratification and result in increased understanding of the CSDs. Longitudinal research and analysis adjusting for physical comorbidity and function is needed to examine whether cognitive impairment is an independent predictor of poor outcome or whether worse outcome is mediated by physical comorbidity, functional status or frailty. In addition, research designed to elucidate whether these poor outcomes are a result of the pathological processes themselves or the care delivered within the hospital setting will further our understanding of clinical management. This information will aid the design and development of a multicomponent intervention to be tested within the MRC Framework for the Development and Evaluation of Complex Interventions.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Areas for future research

- Further standardisation of case-finding and diagnostic criteria will aid further stratification and result in increased understanding of the CSDs and their attributable outcomes.
- Longitudinal research and analysis adjusting for physical comorbidity and function is needed to examine whether cognitive impairment is an independent predictor of poor outcome or whether worse outcome is mediated by physical comorbidity, functional status or frailty.
- Further research is needed to determine direct causal relationships and predictors of decline to help develop and evaluate specific interventions in different types of CSD in the acute hospital.
- Further research is needed to define or develop meaningful outcomes for this vulnerable population.
- The findings from this work will be used to develop and evaluate a multidomain intervention for the management of patients with CSDs in hospital. This will be done within the MRC Framework for the Development and Evaluation of Complex Interventions.
- Research designed to elucidate whether these poor outcomes are as a result of the pathological processes themselves or the care delivered within the hospital setting will further our understanding of clinical management.

Acknowledgements

The OPRAA study was funded by a grant from the NIHR Health Services and Delivery Research programme.

The authors would like to acknowledge the members of the External Advisory Board:

- Gordon Wilcock
- Alison Dawson
- Alison Irving
- Alex McConnachie
- Christine McGregor
- Corinne Greasley-Adams
- Jim Galloway
- Matt Murray
- Suzanne Timmons
- Malcolm MacLeod
- Elizabeth Sampson
- Paul McNamee
- Rowan Harwood.

We acknowledge the support of the HIC, University of Dundee, for managing and supplying the anonymised data.

The development and implementation of the OPRAA was undertaken by the Dementia Co-ordinating Group in the Scottish regional health board where the study was conducted. OPRAAs were carried out by the comprehensive geriatric assessment nurses in the NHS. The electronic clinical page for data recording was developed by the e-health team in the regional health board.

Contributions of authors

Emma Reynish (https://orcid.org/0000-0002-9076-3911) (Professor and Chair in Dementia) was chief investigator, designed the study, was responsible for its conduct, designed the OPRAA, led the data collection and contributed to the writing and editing of the report.

Simona Hapca (https://orcid.org/0000-0003-3148-9657) (Statistician, Biostatistics) conducted the data linkage and data analysis and contributed to the interpretation of the quantitative study and to the writing and editing of the report.

Rebecca Walesby (https://orcid.org/0000-0001-5004-8967) (Research Fellow, Dementia and Ageing) contributed to the systematic review and the design of the outcomes survey.

Angela Pusram (https://orcid.org/0000-0001-6760-1220) (Research Fellow, Dementia and Ageing) contributed to the systematic review and the writing of the report.

Feifei Bu (https://orcid.org/0000-0003-2060-3768) (Research Fellow, Quantitative Methods) contributed to the data analysis, interpretation of the economic analysis and the writing of the report.

Jennifer K Burton (https://orcid.org/0000-0002-4752-6988) (Clinical Research Fellow) contributed to the data analysis, interpretation of the quantitative study and the systematic review.

Vera Cvoro (https://orcid.org/0000-0002-3913-5100) (Consultant Geriatrician and Stroke Physician) led the data collection and contributed to the analysis.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

James Galloway (Technical Customer Relationship Manager, Health Informatics) was responsible for the University of Dundee HIC data management.

Henriette Ebbesen Laidlaw (https://orcid.org/0000-0002-2299-2472) (Research Fellow, Dementia and Ageing) contributed to the design of the outcomes survey, was responsible for survey analysis and contributed to the writing and editing of the report.

Marion Latimer (https://orcid.org/0000-0002-7010-7386) (Lay Researcher, Dementia and Ageing) contributed to the outcomes survey and provided patient and public involvement oversight for the project.

Siobhan McDermott (https://orcid.org/0000-0002-7263-653X) (Research Assistant, Dementia and Ageing) contributed to the systematic review and the writing and editing of the report.

Alasdair C Rutherford (https://orcid.org/0000-0003-2530-1195) (Senior Lecturer in Quantitative Methods) was co-investigator, led the economic analysis and contributed to the writing and editing of the report.

Gordon Wilcock (Emeritus Professor, Oxford Institute of Population Ageing, University of Oxford) provided critical guidance throughout the study.

Peter Donnan (https://orcid.org/0000-0001-7828-0610) (Professor of Epidemiology and Biostatistics) was co-investigator, contributed to the design of the study, led the quantitative study and contributed to the writing and editing of the report.

Bruce Guthrie (https://orcid.org/0000-0003-4191-4880) (Professor of Primary Care Medicine) conducted the data linkage and data analysis and contributed to the interpretation of the quantitative study and to the writing and editing of the report.

Data permissions

Data linkage used the CHI number, and was carried out by the University of Dundee HIC. HIC SOPs have been reviewed and approved by the NHS East of Scotland Research Ethics Service, which does not require review of individual projects provided they follow SOPs and obtain Caldicott permission to use the data. This project used HIC SOPs and consent for research using these data was obtained from the NHS board's Caldicott Guardian, based on researcher access only to anonymised data held in the University of Dundee HIC ISO27001 and Scottish Government accredited safe haven.

Publication

Reynish EL, Hapca SM, De Souza N, Cvoro V, Donnan PT, Guthrie B. Epidemiology and outcomes of people with dementia, delirium, and unspecified cognitive impairment in the general hospital: prospective cohort study of 10,014 admissions. *BMC Med* 2017;**15**:140.

Data-sharing statement

All data requests should be submitted to the corresponding author for consideration. Access to available anonymised data may be granted following review and if appropriate agreements are in place.

Patient data

This work uses data provided by patients and collected by the NHS as part of their care and support. Using patient data is vital to improve health and care for everyone. There is huge potential to make better use of information from people's patient records, to understand more about disease, develop new treatments, monitor safety, and plan NHS services. Patient data should be kept safe and secure, to protect everyone's privacy, and it's important that there are safeguards to make sure that it is stored and used responsibly. Everyone should be able to find out about how patient data are used. #datasaveslives You can find out more about the background to this citation here: https://understandingpatientdata.org.uk/data-citation.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

References

1. Corrada MM, Brookmeyer R, Berlau D, Paganini-Hill A, Kawas CH. Prevalence of dementia after age 90: results from the 90+ study. *Neurology* 2008;**71**:337–43. https://doi.org/10.1212/01.wnl.0000310773.65918.cd
2. Department of Health and Social Care. *Prime Minister's Challenge on Dementia*. London: Department of Health and Social Care; 2012. URL: www.gov.uk/government/publications/prime-ministers-challenge-on-dementia (accessed 10 February 2020).
3. Department of Health and Social Care. *Living Well with Dementia: A National Dementia Strategy*. London: Department of Health and Social Care; 2009.
4. Scottish Government. *Scotland's National Dementia Strategy 2013–2016*. Edinburgh: Scottish Government; 2013. URL: www2.gov.scot/Topics/Health/Services/Mental-Health/Dementia/DementiaStrategy1316 (accessed 10 February 2020).
5. National Institute for Health and Care Excellence. *Dementia: Supporting People with Dementia and their Carers in Health and Social Care. NICE Clinical Guideline 42*. London: NICE/SCIE; 2006.
6. Department of Health and Social Care. *Dementia: A State of the Nation Report on Dementia Care and Support in England*. London: Department of Health and Social Care; 2013.
7. Department of Health and Social Care. *Equity and Excellence: Liberating the NHS*. London: The Stationery Office; 2010.
8. Department of Health and Social Care. *The NHS Outcomes Framework 2013/14*. London: Department of Health and Social Care; 2012.
9. Department of Health and Social Care. *Adult Social Care Outcomes Framework 2014/15*. London: Department of Health and Social Care; 2014.
10. Department of Health and Social Care. *National Service Framework for Older People*. London: The Stationery Office; 2001.
11. Royal College of Psychiatrists. *Who Cares Wins: Improving the Outcome for Older People Admitted to the General Hospital*. London: Royal College of Psychiatrists; 2005.
12. Sampson EL, Blanchard MR, Jones L, Tookman A, King M. Dementia in the acute hospital: prospective cohort study of prevalence and mortality. *Br J Psychiatry* 2009;**195**:61–6. https://doi.org/10.1192/bjp.bp.108.055335
13. Mukadam N, Sampson EL. A systematic review of the prevalence, associations and outcomes of dementia in older general hospital inpatients. *Int Psychogeriatr* 2011;**23**:344–55. https://doi.org/10.1017/S1041610210001717
14. Alzheimer's Society. *Fix Dementia Care: Hospitals*. London: Alzheimer's Society; 2016. URL: www.alzheimers.org.uk/sites/default/files/migrate/downloads/fix_dementia_care_-_hospitals.pdf (accessed 1 February 2018).
15. Lakey L. *Counting the Cost: Caring for People with Dementia on Hospital Wards*. London: Alzheimer's Society; 2009.
16. Ardern M, Mayou R, Feldman E, Hawton K. Cognitive impairment in the elderly medically ill: how often is it missed? *Int J Geriatr Psychiatry* 1993;**8**:929–37. https://doi.org/10.1002/gps.930081107
17. Erkinjuntti T, Wikström J, Palo J, Autio L. Dementia among medical inpatients. Evaluation of 2000 consecutive admissions. *Arch Intern Med* 1986;**146**:1923–6. https://doi.org/10.1001/archinte.1986.00360220067013

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

18. Erkinjuntti T, Autio L, Wikström J. Dementia in medical wards. *J Clin Epidemiol* 1988;**41**:123–6. https://doi.org/10.1016/0895-4356(88)90086-8

19. Margiotta A, Bianchetti A, Ranieri P, Trabucchi M. Clinical characteristics and risk factors of delirium in demented and not demented elderly medical inpatients. *J Nutr Health Aging* 2006;**10**:535–9.

20. Torian L, Davidson E, Fulop G, Sell L, Fillit H. The effect of dementia on acute care in a geriatric medical unit. *Int Psychogeriatr* 1992;**4**:231–9. https://doi.org/10.1017/S1041610292001066

21. Wancata J, Windhaber J, Krautgartner M, Alexandrowicz R. The consequences of non-cognitive symptoms of dementia in medical hospitals departments. *Int J Psychiatry Med* 2003;**33**:257–71. https://doi.org/10.2190/ABXK-FMWG-98YP-D1CU

22. Zekry D, Herrmann FR, Grandjean R, Meynet MP, Michel JP, Gold G, Krause KH. Demented versus non-demented very old inpatients: the same comorbidities but poorer functional and nutritional status. *Age Ageing* 2008;**37**:83–9. https://doi.org/10.1093/ageing/afm132

23. Knapp M, Iemmi V, Romeo R. Dementia care costs and outcomes: a systematic review. *Int J Geriatr Psychiatry* 2013;**28**:551–61. https://doi.org/10.1002/gps.3864

24. Witlox J, Eurelings LS, de Jonghe JF, Kalisvaart KJ, Eikelenboom P, van Gool WA. Delirium in elderly patients and the risk of postdischarge mortality, institutionalization, and dementia: a meta-analysis. *JAMA* 2010;**304**:443–51. https://doi.org/10.1001/jama.2010.1013

25. British Geriatrics Society. *Guidelines for the Prevention, Diagnosis and Management of Delirium in Older People in Hospital*. British Geriatrics Society. 2006. URL: www.bgs.org.uk/clinicalguides/resources/catclinguidelines/clinguidedeliriumtreatment (accessed 22 April 2018).

26. McCusker J, Cole M, Abrahamowicz M, Primeau F, Belzile E. Delirium predicts 12-month mortality. *Arch Intern Med* 2002;**162**:457–63. https://doi.org/10.1001/archinte.162.4.457

27. Stevens LE, de Moore GM, Simpson JM. Delirium in hospital: does it increase length of stay? *Aust N Z J Psychiatry* 1998;**32**:805–8. https://doi.org/10.3109/00048679809073869

28. Fann JR, Alfano CM, Roth-Roemer S, Katon WJ, Syrjala KL. Impact of delirium on cognition, distress, and health-related quality of life after hematopoietic stem-cell transplantation. *J Clin Oncol* 2007;**25**:1223–31. https://doi.org/10.1200/JCO.2006.07.9079

29. Inouye SK. The dilemma of delirium: clinical and research controversies regarding diagnosis and evaluation of delirium in hospitalized elderly medical patients. *Am J Med* 1994;**97**:278–88. https://doi.org/10.1016/0002-9343(94)90011-6

30. Leslie DL, Marcantonio ER, Zhang Y, Leo-Summers L, Inouye SK. One-year health care costs associated with delirium in the elderly population. *Arch Intern Med* 2008;**168**:27–32. https://doi.org/10.1001/archinternmed.2007.4

31. Levkoff SE, Besdine RW, Wetle T. Acute confusional states (delirium) in the hospitalized elderly. *Annu Rev Gerontol Geriatr* 1986;**6**:1–26.

32. Goldberg SE, Bradshaw LE, Kearney FC, Russell C, Whittamore KH, Foster PE, *et al.* Care in specialist medical and mental health unit compared with standard care for older people with cognitive impairment admitted to general hospital: randomised controlled trial (NIHR TEAM trial). *BMJ* 2013;**347**:f4132. https://doi.org/10.1136/bmj.f4132

33. Bradshaw LE, Goldberg SE, Lewis SA, Whittamore K, Gladman JR, Jones RG, Harwood RH. Six-month outcomes following an emergency hospital admission for older adults with co-morbid mental health problems indicate complexity of care needs. *Age Ageing* 2013;**42**:582–8. https://doi.org/10.1093/ageing/aft074

34. Bogardus ST, Desai MM, Williams CS, Leo-Summers L, Acampora D, Inouye SK. The effects of a targeted multicomponent delirium intervention on postdischarge outcomes for hospitalized older adults. *Am J Med* 2003;**114**:383–90. https://doi.org/10.1016/S0002-9343(02)01569-3

35. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ* 2008;**337**:a1655. https://doi.org/10.1136/bmj.a1655

36. Sheehan B, Stinton C, Mitchell K. The care of people with dementia in general hospital. *J Qual Res Dement* 2009.

37. Walesby R, Reynish E, Bowes A, Harrison J, Pusram A, Dawson A, *et al.* Understanding the Outcomes of People with Cognitive Impairment (CI) and/or Dementia Admitted to the General Hospital (GH). PROSPERO 2015 CRD42015024492. URL: www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42015024492 (accessed 1 February 2018).

38. Siddiqi N, House AO, Holmes JD. Occurrence and outcome of delirium in medical in-patients: a systematic literature review. *Age Ageing* 2006;**35**:350–64. https://doi.org/10.1093/ageing/afl005

39. The Cochrane Collaboration. *Cochrane Dementia and Cognitive Improvement*. URL: http://dementia.cochrane.org (accessed 27 March 2017).

40. Boyle M. Guidelines for evaluating prevalence studies. *Evid Based Ment Health* 1998;**1**:37–9. https://doi.org/10.1136/ebmh.1.2.37

41. Baron JH, Bush A. An inner-city general medical ward round in the mid-1980s. *J R Soc Med* 1987;**80**:547–8. https://doi.org/10.1177/014107688708000905

42. Barba R, Martínez JM, Zapatero A, Plaza S, Losa JE, Canora J, *et al.* Mortality and complications in very old patients (90+) admitted to departments of internal medicine in Spain. *Eur J Intern Med* 2011;**22**:49–52. https://doi.org/10.1016/j.ejim.2010.11.001

43. Esmayel EM, Eldarawy MM, Hassan MM, Mahmoud AA, Mohamed SY. Mental health problems and sociodemographic correlates in elderly medical inpatients in a university hospital in egypt. *Curr Gerontol Geriatr Res* 2013;**2013**:923710. https://doi.org/10.1155/2013/923710

44. Lorén Guerrero L, Gascón Catalán A. Biopsychosocial factors related to the length of hospital stay in older people. *Rev Lat Am Enfermagem* 2011;**19**:1377–84. https://doi.org/10.1590/S0104-11692011000600014

45. Marengoni A, Agüero-Torres H, Timpini A, Cossi S, Fratiglioni L. Rehabilitation and nursing home admission after hospitalization in acute geriatric patients. *J Am Med Dir Assoc* 2008;**9**:265–70. https://doi.org/10.1016/j.jamda.2008.01.005

46. Orsitto G. Different components of nutritional status in older inpatients with cognitive impairment. *J Nutr Health Aging* 2012;**16**:468–71. https://doi.org/10.1007/s12603-012-0024-1

47. Raymont V, Bingley W, Buchanan A, David AS, Hayward P, Wessely S, Hotopf M. Prevalence of mental incapacity in medical inpatients and associated risk factors: cross-sectional study. *Lancet* 2004;**364**:1421–7. https://doi.org/10.1016/S0140-6736(04)17224-3

48. Zuliani G, Bonetti F, Magon S, Prandini S, Sioulis F, D'Amato M, *et al.* Subsyndromal delirium and its determinants in elderly patients hospitalized for acute medical illness. *J Gerontol A Biol Sci Med Sci* 2013;**68**:1296–302. https://doi.org/10.1093/gerona/glt021

49. Jitapunkul S, Hanvivadhanakul P. Outcomes and predicting factors of mortality among newly admitted female medical inpatients. *J Med Assoc Thai* 1998;**81**:491–6.

50. Deshpande SN, Sundaram KR, Wig NN. Psychiatric disorders among medical in-patients in an Indian hospital. *Br J Psychiatry* 1989;**154**:504–9. https://doi.org/10.1192/bjp.154.4.504

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

51. Gottlieb GL, Johnson J, Wanich C, Sullivan E. Delirium in the medically ill elderly: operationalizing the DSM-III criteria. *Int Psychogeriatr* 1991;**3**:181–96. https://doi.org/10.1017/S1041610291000650

52. Rozzini R, Sleiman I, Maggi S, Noale M, Trabucchi M. Gender differences and health status in old and very old patients. *J Am Med Dir Assoc* 2009;**10**:554–8. https://doi.org/10.1016/j.jamda.2009.04.005

53. Cattin L, Bordin P, Fonda M, Adamo C, Barbone F, Bovenzi M, *et al.* Factors associated with cognitive impairment among older Italian inpatients. Gruppo Italiano di Farmacovigilanza nell'Anziano (G.I.F.A.). *J Am Geriatr Soc* 1997;**45**:1324–30. https://doi.org/10.1111/j.1532-5415.1997.tb02931.x

54. Pedone C, Ercolani S, Catani M, Maggio D, Ruggiero C, Quartesan R, *et al.* Elderly patients with cognitive impairment have a high risk for functional decline during hospitalization: the GIFA study. *J Gerontol A Biol Sci Med Sci* 2005;**60**:1576–80. https://doi.org/10.1093/gerona/60.12.1576

55. Bellelli G, Nobili A, Annoni G, Morandi A, Djade CD, Meagher DJ, *et al.* Under-detection of delirium and impact of neurocognitive deficits on in-hospital mortality among acute geriatric and medical wards. *Eur J Intern Med* 2015;**26**:696–704. https://doi.org/10.1016/j.ejim.2015.08.006

56. Inouye SK, Peduzzi PN, Robison JT, Hughes JS, Horwitz RI, Concato J. Importance of functional measures in predicting mortality among older hospitalized patients. *JAMA* 1998;**279**:1187–93. https://doi.org/10.1001/jama.279.15.1187

57. Khurana V, Gambhir IS, Kishore D. Evaluation of delirium in elderly: a hospital-based study. *Geriatr Gerontol Int* 2011;**11**:467–73. https://doi.org/10.1111/j.1447-0594.2011.00710.x

58. Goldberg SE, Whittamore KH, Harwood RH, Bradshaw LE, Gladman JR, Jones RG, Medical Crises in Older People Study Group. The prevalence of mental health problems among older adults admitted as an emergency to a general hospital. *Age Ageing* 2012;**41**:80–6. https://doi.org/10.1093/ageing/afr106

59. Adamis D, Treloar A, Martin FC, Macdonald AJ. Recovery and outcome of delirium in elderly medical inpatients. *Arch Gerontol Geriatr* 2006;**43**:289–98. https://doi.org/10.1016/j.archger.2005.11.005

60. Edlund A, Lundström M, Karlsson S, Brännström B, Bucht G, Gustafson Y. Delirium in older patients admitted to general internal medicine. *J Geriatr Psychiatry Neurol* 2006;**19**:83–90. https://doi.org/10.1177/0891988706286509

61. Franco JG, Valencia C, Bernal C, Ocampo MV, Trzepacz PT, Pablo Jd, Mejía MA. Relationship between cognitive status at admission and incident delirium in older medical inpatients. *J Neuropsychiatry Clin Neurosci* 2010;**22**:329–37. https://doi.org/10.1176/appi.neuropsych.22.3.329

62. Isfandiaty R, Harimurti K, Setiati S, Roosheroe AG. Incidence and predictors for delirium in hospitalized elderly patients: a retrospective cohort study. *Acta Med Indones* 2012;**44**:290–7.

63. McAvay GJ, Van Ness PH, Bogardus ST, Zhang Y, Leslie DL, Leo-Summers LS, Inouye SK. Older adults discharged from the hospital with delirium: 1-year outcomes. *J Am Geriatr Soc* 2006;**54**:1245–50. https://doi.org/10.1111/j.1532-5415.2006.00815.x

64. Wilson K, Broadhurst C, Diver M, Jackson M, Mottram P. Plasma insulin growth factor-1 and incident delirium in older people. *Int J Geriatr Psychiatry* 2005;**20**:154–9. https://doi.org/10.1002/gps.1265

65. Collins N, Blanchard MR, Tookman A, Sampson EL. Detection of delirium in the acute hospital. *Age Ageing* 2010;**39**:131–5. https://doi.org/10.1093/ageing/afp201

66. Wakefield BJ. Behaviors and outcomes of acute confusion in hospitalized patients. *Appl Nurs Res* 2002;**15**:209–16. https://doi.org/10.1053/apnr.2002.35961

67. Wakefield BJ. Risk for acute confusion on hospital admission. *Clin Nurs Res* 2002;**11**:153–72. https://doi.org/10.1177/105477380201100205

68. Bourdel-Marchasson I, Vincent S, Germain C, Salles N, Jenn J, Rasoamanarivo E, *et al.* Delirium symptoms and low dietary intake in older inpatients are independent predictors of institutionalization: a 1-year prospective population-based study. *J Gerontol A Biol Sci Med Sci* 2004;**59**:350–4. https://doi.org/10.1093/gerona/59.4.M350

69. Cole MG, McCusker J, Ciampi A, Belzile E. The 6- and 12-month outcomes of older medical inpatients who recover from subsyndromal delirium. *J Am Geriatr Soc* 2008;**56**:2093–9. https://doi.org/10.1111/j.1532-5415.2008.01963.x

70. Lam CY, Tay L, Chan M, Ding YY, Chong MS. Prospective observational study of delirium recovery trajectories and associated short-term outcomes in older adults admitted to a specialized delirium unit. *J Am Geriatr Soc* 2014;**62**:1649–57. https://doi.org/10.1111/jgs.12995

71. Martínez-Velilla N, Alonso-Bouzon C, Cambra-Contin K, Ibañez-Beroiz B, Alonso-Renedo J. Outcomes in complex patients with delirium and subsyndromal delirium one year after hospital discharge. *Int Psychogeriatr* 2013;**25**:2087–8. https://doi.org/10.1017/S1041610213000975

72. Faezah S, Zhang D, Yin L. The prevalence and risk factors of delirium amongst the elderly in acute hospital. *Singapore Nurs J* 2008;**35**:11–4.

73. Fortini A, Morettini A, Tavernese G, Facchini S, Tofani L, Pazzi M. Delirium in elderly patients hospitalized in internal medicine wards. *Intern Emerg Med* 2014;**9**:435–41. https://doi.org/10.1007/s11739-013-0968-0

74. Basic D, Khoo A. Admission variables predicting short lengths of stay of acutely unwell older patients: relevance to emergency and medical short-stay units. *Aust Health Rev* 2009;**33**:502–12. https://doi.org/10.1071/AH090502

75. Basic D, Hartwell TJ. Falls in hospital and new placement in a nursing home among older people hospitalized with acute illness. *Clin Interv Aging* 2015;**10**:1637–43. https://doi.org/10.2147/CIA.S90296

76. Díez-Manglano J, Palazón-Fraile C, Diez-Massó F, Martínez-Álvarez R, Del Corral-Beamonte E, Carreño-Borrego P, *et al.* Factors associated with onset of delirium among internal medicine inpatients in Spain. *Nurs Res* 2013;**62**:445–9. https://doi.org/10.1097/NNR.0000000000000004

77. Aminoff BZ. Prognosis of short survival in patients with advanced dementia as diagnosed by Aminoff suffering syndrome. *Am J Alzheimers Dis Other Demen* 2014;**29**:673–7. https://doi.org/10.1177/1533317514539543

78. Dramé M, Lang PO, Jolly D, Narbey D, Mahmoudi R, Lanièce I, *et al.* Nursing home admission in elderly subjects with dementia: predictive factors and future challenges. *J Am Med Dir Assoc* 2012;**13**:83.e17–20. https://doi.org/10.1016/j.jamda.2011.03.002

79. Lang PO, Zekry D, Michel JP, Dramé M, Novella JL, Jolly D, Blanchard F. Early markers of prolonged hospital stay in demented inpatients: a multicentre and prospective study. *J Nutr Health Aging* 2010;**14**:141–7. https://doi.org/10.1007/s12603-009-0182-y

80. Sahadevan S, Lim PP, Choo PW. Dementia in the hospitalized elderly – a study of 100 consecutive cases in Singapore. *Int J Geriatr Psychiatry* 1999;**14**:266–71. https://doi.org/10.1002/(SICI)1099-1166(199904)14:4<266::AID-GPS895>3.0.CO;2-H

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

81. Briggs R, Coary R, Collins R, Coughlan T, O'Neill D, Kennelly SP. Acute hospital care: how much activity is attributable to caring for patients with dementia? *QJM* 2016;**109**:41–4. https://doi.org/10.1093/qjmed/hcv085

82. Bogaisky M, Dezieck L. Early hospital readmission of nursing home residents and community-dwelling elderly adults discharged from the geriatrics service of an urban teaching hospital: patterns and risk factors. *J Am Geriatr Soc* 2015;**63**:548–52. https://doi.org/10.1111/jgs.13317

83. Rockwood K. Acute confusion in elderly medical patients. *J Am Geriatr Soc* 1989;**37**:150–4. https://doi.org/10.1111/j.1532-5415.1989.tb05874.x

84. Di Iorio A, Longo A, Mitidieri Costanza A, Palmerio T, Benvenuti E, Giardini S, *et al.* Factors related to the length of in-hospital stay of geriatric patients. *Aging* 1999;**11**:150–4. https://doi.org/10.1007/BF03399656

85. Di Iorio A, Longo AL, Mitidieri Costanza A, Bandinelli S, Capasso S, Gigante M, *et al.* Characteristics of geriatric patients related to early and late readmissions to hospital. *Aging* 1998;**10**:339–46. https://doi.org/10.1007/BF03339797

86. Furlanetto LM, da Silva RV, Bueno JR. The impact of psychiatric comorbidity on length of stay of medical inpatients. *Gen Hosp Psychiatry* 2003;**25**:14–19. https://doi.org/10.1016/S0163-8343(02)00236-0

87. Iseli RK, Brand C, Telford M, LoGiudice D. Delirium in elderly general medical inpatients: a prospective study. *Intern Med J* 2007;**37**:806–11. https://doi.org/10.1111/j.1445-5994.2007.01386.x

88. Jackson TA, MacLullich AM, Gladman JR, Lord JM, Sheehan B. Undiagnosed long-term cognitive impairment in acutely hospitalised older medical patients with delirium: a prospective cohort study. *Age Ageing* 2016;**45**:493–9. https://doi.org/10.1093/ageing/afw064

89. Aljishi M, Parekh K. Risk factors for general medicine readmissions and association with mortality. *N Z Med J* 2014;**127**:42–50.

90. Dramé M, Jovenin N, Novella JL, Lang PO, Somme D, Laniece I, *et al.* Predicting early mortality among elderly patients hospitalised in medical wards via emergency department: the SAFES cohort study. *J Nutr Health Aging* 2008;**12**:599–604. https://doi.org/10.1007/BF02983207

91. Lattanzio F, Laino I, Pedone C, Corica F, Maltese G, Salerno G, *et al.* Geriatric conditions and adverse drug reactions in elderly hospitalized patients. *J Am Med Dir Assoc* 2012;**13**:96–9. https://doi.org/10.1016/j.jamda.2011.04.006

92. Hsieh SJ, Madahar P, Hope AA, Zapata J, Gong MN. Clinical deterioration in older adults with delirium during early hospitalisation: a prospective cohort study. *BMJ Open* 2015;**5**:e007496. https://doi.org/10.1136/bmjopen-2014-007496

93. Fick DM, Agostini JV, Inouye SK. Delirium superimposed on dementia: a systematic review. *J Am Geriatr Soc* 2002;**50**:1723–32. https://doi.org/10.1046/j.1532-5415.2002.50468.x

94. McCusker J, Cole M, Dendukuri N, Belzile E, Primeau F. Delirium in older medical inpatients and subsequent cognitive and functional status: a prospective study. *CMAJ* 2001;**165**:575–83.

95. Gallerani M, Manfredini R. Seasonal variation in the occurrence of delirium in patients admitted to medical units of a general hospital in Italy. *Acta Neuropsychiatr* 2013;**25**:179–83. https://doi.org/10.1111/j.1601-5215.2012.00677.x

96. Jitapunkul S, Pillay I, Ebrahim S. Delirium in newly admitted elderly patients: a prospective study. *Q J Med* 1992;**83**:307–14.

97. Kolbeinsson H, Jónsson A. Delirium and dementia in acute medical admissions of elderly patients in Iceland. *Acta Psychiatr Scand* 1993;**87**:123–7. https://doi.org/10.1111/j.1600-0447.1993.tb03342.x

98. Bickel H, Mosch E, Seigerschmidt E, Siemen M, Forstl H. Prevalence and persistence of mild cognitive impairment among elderly patients in general hospitals. *Dement Geriatr Cogn Disord* 2006;**21**:242–50. https://doi.org/10.1159/000091397

99. Orsitto G, Cascavilla L, Franceschi M, Aloia RM, Greco A, Paris F, *et al.* Influence of cognitive impairment and comorbidity on disability in hospitalized elderly patients. *J Nutr Health Aging* 2005;**9**:194–8.

100. Orsitto G, Fulvio F, Tria D, Turi V, Venezia A, Manca C. Nutritional status in hospitalized elderly patients with mild cognitive impairment. *Clin Nutr* 2009;**28**:100–2. https://doi.org/10.1016/j.clnu.2008.12.001

101. Petersen RC, Smith GE, Waring SC, Ivnik RJ, Tangalos EG, Kokmen E. Mild cognitive impairment: clinical characterization and outcome. *Arch Neurol* 1999;**56**:303–8. https://doi.org/10.1001/archneur.56.3.303

102. Dinescu A, Korc-Grodzicki B, Farber J, Ross JS. Discharge disposition disagreements and re-admission risk among older adults: a retrospective cohort study. *BMJ Open* 2012;**2**:e001646. https://doi.org/10.1136/bmjopen-2012-001646

103. Martínez-Velilla N, Cambra-Contin K, Ibanez-Beroiz B. Comorbidity and prognostic indices do not improve the 5-year mortality prediction of components of comprehensive geriatric assessment in hospitalized older patients. *BMC Geriatr* 2014;**14**:64. https://doi.org/10.1186/1471-2318-14-64

104. Freedberg DE, Dave J, Kurth T, Gaziano JM, Bludau JH. Cognitive impairment over the age of 85: hospitalization and mortality. *Arch Gerontol Geriatr* 2008;**46**:137–45. https://doi.org/10.1016/j.archger.2007.03.006

105. Zekry D, Herrmann FR, Graf CE, Giannelli S, Michel JP, Gold G, Krause KH. Mild cognitive impairment, degenerative and vascular dementia as predictors of intra-hospital, short- and long-term mortality in the oldest old. *Aging Clin Exp Res* 2011;**23**:60–6. https://doi.org/10.1007/BF03324953

106. Sonnenblick M, Raveh D, Gratch L, Yinnon A. Clinical and demographic characteristics of elderly patients hospitalised in an internal medicine department in Israel. *Int J Clin Pract* 2007;**61**:247–54. https://doi.org/10.1111/j.1742-1241.2006.00925.x

107. Sampson EL, Leurent B, Blanchard MR, Jones L, King M. Survival of people with dementia after unplanned acute hospital admission: a prospective cohort study. *Int J Geriatr Psychiatry* 2013;**28**:1015–22. https://doi.org/10.1002/gps.3919

108. Ponzetto M, Maero B, Maina P, D'Agostino E, Scarafiotti C, Speme S, *et al.* Risk factors in the elderly. *Arch Gerontol Geriatr* 2002;**35**:283–90. https://doi.org/10.1016/S0167-4943(02)00144-9

109. McCusker J, Cole M, Dendukuri N, Han L, Belzile E. The course of delirium in older medical inpatients: a prospective study. *J Gen Intern Med* 2003;**18**:696–704. https://doi.org/10.1046/j.1525-1497.2003.20602.x

110. Marengoni A, Corrao S, Nobili A, Tettamanti M, Pasina L, Salerno F, *et al.* In-hospital death according to dementia diagnosis in acutely ill elderly patients: the REPOSI study. *Int J Geriatr Psychiatry* 2011;**26**:930–6. https://doi.org/10.1002/gps.2627

111. Forasassi C, Golmard JL, Pautas E, Piette F, Myara I, Raynaud-Simon A. Inflammation and disability as risk factors for mortality in elderly acute care patients. *Arch Gerontol Geriatr* 2009;**48**:406–10. https://doi.org/10.1016/j.archger.2008.03.011

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

112. Francis J, Kapoor WN. Prognosis after hospital discharge of older medical patients with delirium. *J Am Geriatr Soc* 1992;**40**:601–6. https://doi.org/10.1111/j.1532-5415.1992.tb02111.x

113. de Boissieu P, Mahmoudi R, Hentzien M, Toquet S, Novella JL, Blanchard F, *et al.* Predictors of long-term mortality in oldest old patients (90+) hospitalized to medical wards via the emergency department: the SAFES Cohort. *J Nutr Health Aging* 2015;**19**:702–7. https://doi.org/10.1007/s12603-015-0515-y

114. Saravay SM, Kaplowitz M, Kurek J, Zeman D, Pollack S, Novik S, *et al.* How do delirium and dementia increase length of stay of elderly general medical inpatients? *Psychosomatics* 2004;**45**:235–42. https://doi.org/10.1176/appi.psy.45.3.235

115. Dramé M, Fierobe F, Lang PO, Jolly D, Boyer F, Mahmoudi R, *et al.* Predictors of institution admission in the year following acute hospitalisation of elderly people. *J Nutr Health Aging* 2011;**15**:399–403. https://doi.org/10.1007/s12603-011-0004-x

116. Martínez-Velilla N, Bouzon C, Contin K, Beroiz B, Herrero A, Renedo J. Differential functional outcomes in patients with delirium and subsyndromal delirium one month after hospital discharge. *Dement Geriatr Cogn Disord* 2013;**34**:332–6. https://doi.org/10.1159/000345609

117. White S, Calver BL, Newsway V, Wade R, Patel S, Bayer A, O'Mahony MS. Enzymes of drug metabolism during delirium. *Age Ageing* 2005;**34**:603–8. https://doi.org/10.1093/ageing/afi189

118. Silva TJ, Jerussalmy CS, Farfel JM, Curiati JA, Jacob-Filho W. Predictors of in-hospital mortality among older patients. *Clinics* 2009;**64**:613–18. https://doi.org/10.1590/S1807-59322009000700002

119. Praditsuwan R, Sirisuwat A, Assanasen J, Eiamjinnasuwat W, Pakdeewongse S, Limmathuroskul D, Srinonprasert V. Short-term clinical outcomes in delirious older patients: a study at general medical wards in a university hospital in Thailand. *Geriatr Gerontol Int* 2013;**13**:972–7. https://doi.org/10.1111/ggi.12041

120. Pendlebury ST, Lovett NG, Smith SC, Dutta N, Bendon C, Lloyd-Lavery A, *et al.* Observational, longitudinal study of delirium in consecutive unselected acute medical admissions: age-specific rates and associated factors, mortality and re-admission. *BMJ Open* 2015;**5**:e007808. https://doi.org/10.1136/bmjopen-2015-007808

121. O'Keeffe S, Lavan J. The prognostic significance of delirium in older hospital patients. *J Am Geriatr Soc* 1997;**45**:174–8. https://doi.org/10.1111/j.1532-5415.1997.tb04503.x

122. O'Keeffe ST, Lavan JN. Clinical significance of delirium subtypes in older people. *Age Ageing* 1999;**28**:115–19. https://doi.org/10.1093/ageing/28.2.115

123. Lima DP, Ochiai ME, Lima AB, Curiati JA, Farfel JM, Filho WJ. Delirium in hospitalized elderly patients and post-discharge mortality. *Clinics* 2010;**65**:251–5. https://doi.org/10.1590/S1807-59322010000300003

124. González M, Martínez G, Calderón J, Villarroel L, Yuri F, Rojas C, *et al.* Impact of delirium on short-term mortality in elderly inpatients: a prospective cohort study. *Psychosomatics* 2009;**50**:234–8. https://doi.org/10.1176/appi.psy.50.3.234

125. Feldman J, Yaretzky A, Kaizimov N, Alterman P, Vigder C. Delirium in an acute geriatric unit: clinical aspects. *Arch Gerontol Geriatr* 1999;**28**:37–44. https://doi.org/10.1016/S0167-4943(98)00124-1

126. Eeles EM, Hubbard RE, White SV, O'Mahony MS, Savva GM, Bayer AJ. Hospital use, institutionalisation and mortality associated with delirium. *Age Ageing* 2010;**39**:470–5. https://doi.org/10.1093/ageing/afq052

127. Dasgupta M, Brymer C. Prognosis of delirium in hospitalized elderly: worse than we thought. *Int J Geriatr Psychiatry* 2014;**29**:497–505. https://doi.org/10.1002/gps.4032

128. Buurman BM, Hoogerduijn JG, de Haan RJ, Abu-Hanna A, Lagaay AM, Verhaar HJ, *et al.* Geriatric conditions in acutely hospitalized older patients: prevalence and one-year survival and functional decline. *PLOS ONE* 2011;**6**:e26951. https://doi.org/10.1371/journal.pone.0026951

129. Boustani M, Baker MS, Campbell N, Munger S, Hui SL, Castelluccio P, *et al.* Impact and recognition of cognitive impairment among hospitalized elders. *J Hosp Med* 2010;**5**:69–75. https://doi.org/10.1002/jhm.589

130. Adamis D, Treloar A, Darwiche FZ, Gregson N, Macdonald AJ, Martin FC. Associations of delirium with in-hospital and in 6-months mortality in elderly medical inpatients. *Age Ageing* 2007;**36**:644–9. https://doi.org/10.1093/ageing/afm094

131. Francis J, Martin D, Kapoor WN. A prospective study of delirium in hospitalized elderly. *JAMA* 1990;**263**:1097–101. https://doi.org/10.1001/jama.1990.03440080075027

132. Beauchet O, Launay C, de Decker L, Fantino B, Kabeshova A, Annweiler C. Who is at risk of long hospital stay among patients admitted to geriatric acute care unit? Results from a prospective cohort study. *J Nutr Health Aging* 2013;**17**:695–9. https://doi.org/10.1007/s12603-013-0333-z

133. Lang PO, Heitz D, Hédelin G, Dramé M, Jovenin N, Ankri J, *et al.* Early markers of prolonged hospital stays in older people: a prospective, multicenter study of 908 inpatients in French acute hospitals. *J Am Geriatr Soc* 2006;**54**:1031–9. https://doi.org/10.1111/j.1532-5415.2006.00767.x

134. McCusker J, Cole MG, Dendukuri N, Belzile E. Does delirium increase hospital stay? *J Am Geriatr Soc* 2003;**51**:1539–46. https://doi.org/10.1046/j.1532-5415.2003.51509.x

135. Thomas RI, Cameron DJ, Fahs MC. A prospective study of delirium and prolonged hospital stay. Exploratory study. *Arch Gen Psychiatry* 1988;**45**:937–40. https://doi.org/10.1001/archpsyc.1988.01800340065009

136. Adamis D, Treloar A, Gregson N, Macdonald AJ, Martin FC. Delirium and the functional recovery of older medical inpatients after acute illness: the significance of biological factors. *Arch Gerontol Geriatr* 2011;**52**:276–80. https://doi.org/10.1016/j.archger.2010.04.006

137. Adamis D, Meagher D, Treloar A, Dunne C, Larvin M, Martin FC, Macdonald AJ. Phenomenological and biological correlates of improved cognitive function in hospitalized elderly medical inpatients. *Arch Gerontol Geriatr* 2014;**59**:593–8. https://doi.org/10.1016/j.archger.2014.08.007

138. Espallargues M, Philp I, Seymour DG, Campbell SE, Primrose W, Arino S, *et al.* Measuring case-mix and outcome for older people in acute hospital care across Europe: the development and potential of the ACMEplus instrument. *QJM* 2008;**101**:99–109. https://doi.org/10.1093/qjmed/hcm136

139. Fields SD, MacKenzie CR, Charlson ME, Sax FL. Cognitive impairment. Can it predict the course of hospitalized patients? *J Am Geriatr Soc* 1986;**34**:579–85. https://doi.org/10.1111/j.1532-5415.1986.tb05763.x

140. Marengoni A, Nobili A, Romano V, Tettamanti M, Pasina L, Djade S, *et al.* Adverse clinical events and mortality during hospitalization and 3 months after discharge in cognitively impaired elderly patients. *J Gerontol A Biol Sci Med Sci* 2013;**68**:419–25. https://doi.org/10.1093/gerona/gls181

141. Inouye SK, Zhang Y, Han L, Leo-Summers L, Jones R, Marcantonio E. Recoverable cognitive dysfunction at hospital admission in older persons during acute illness. *J Gen Intern Med* 2006;**21**:1276–81. https://doi.org/10.1111/j.1525-1497.2006.00613.x

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

142. Torisson G, Minthon L, Stavenow L, Londos E. Cognitive impairment is undetected in medical inpatients: a study of mortality and recognition amongst healthcare professionals. *BMC Geriatr* 2012;**12**:47. https://doi.org/10.1186/1471-2318-12-47

143. Conde-Martel A, Hemmersbach-Miller M, Marchena-Gomez J, Saavedra-Santana P, Betancor-Leon P. Five-year survival and prognostic factors in a cohort of hospitalized nonagenarians. *Eur J Intern Med* 2012;**23**:513–18. https://doi.org/10.1016/j.ejim.2012.02.007

144. Beauchet O, Launay CP, Fantino B, Lerolle N, Maunoury F, Annweiler C. Screening for elderly patients admitted to the emergency department requiring specialized geriatric care. *J Emerg Med* 2013;**45**:739–45. https://doi.org/10.1016/j.jemermed.2012.11.110

145. Forti P, Maioli F, Zagni E, Lucassenn T, Montanari L, Maltoni B, *et al.* The physical phenotype of frailty for risk stratification of older medical inpatients. *J Nutr Health Aging* 2014;**18**:912–18. https://doi.org/10.1007/s12603-014-0493-5

146. Marengoni A, Agüero-Torres H, Cossi S, Ghisla MK, De Martinis M, Leonardi R, Fratiglioni L. Poor mental and physical health differentially contributes to disability in hospitalized geriatric patients of different ages. *Int J Geriatr Psychiatry* 2004;**19**:27–34. https://doi.org/10.1002/gps.1027

147. Helvik AS, Skancke RH, Selbæk G, Engedal K. Nursing home admission during the first year after hospitalization–the contribution of cognitive impairment. *PLOS ONE* 2014;**9**:e86116. https://doi.org/10.1371/journal.pone.0086116

148. Joray S, Wietlisbach V, Büla CJ. Cognitive impairment in elderly medical inpatients: detection and associated six-month outcomes. *Am J Geriatr Psychiatry* 2004;**12**:639–47. https://doi.org/10.1097/00019442-200411000-00010

149. Adamis D, Treloar A, Martin FC, Gregson N, Hamilton G, Macdonald AJ. APOE and cytokines as biological markers for recovery of prevalent delirium in elderly medical inpatients. *Int J Geriatr Psychiatry* 2007;**22**:688–94. https://doi.org/10.1002/gps.1732

150. Dhaussy G, Dramé M, Mahmoudi R, Blanchard F, Jolly D, Novella J-L. Is health-related quality of life an independent prognostic factor for 12-month mortality and nursing home placement in frail elderly patients? *J Am Med Dir Assoc* 2012;**13**:453–8. https://doi.org/10.1016/j.jamda.2011.10.002

151. Jarrett PG, Rockwood K, Carver D, Stolee P, Cosway S. Illness presentation in elderly patients. *Arch Intern Med* 1995;**155**:1060–4. https://doi.org/10.1001/archinte.1995.00430100086010

152. Johnson JC, Gottlieb GL, Sullivan E, Wanich C, Kinosian B, Forciea MA, *et al.* Using DSM-III criteria to diagnose delirium in elderly general medical patients. *J Gerontol* 1990;**45**:M113–9. https://doi.org/10.1093/geronj/45.3.M113

153. Joosten E, Demuynck M, Detroyer E, Milisen K. Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients. *BMC Geriatr* 2014;**14**:1. https://doi.org/10.1186/1471-2318-14-1

154. Korevaar JC, van Munster BC, de Rooij SE. Risk factors for delirium in acutely admitted elderly patients: a prospective cohort study. *BMC Geriatr* 2005;**5**:6. https://doi.org/10.1186/1471-2318-5-6

155. Lakhan P, Jones M, Wilson A, Courtney M, Hirdes J, Gray LC. A prospective cohort study of geriatric syndromes among older medical patients admitted to acute care hospitals. *J Am Geriatr Soc* 2011;**59**:2001–8. https://doi.org/10.1111/j.1532-5415.2011.03663.x

156. Maia E, Steglich MS, Lima AP, Zanella Troncoso IH, da Silva KI, Martins TR, *et al.* Dementia in elderly inpatients admitted to medical wards in Brazil: diagnosis and comorbidity with other clinical diseases. *Psychogeriatrics* 2016;**16**:177–84. https://doi.org/10.1111/psyg.12136

157. Matzen LE, Jepsen DB, Ryg J, Masud T. Functional level at admission is a predictor of survival in older patients admitted to an acute geriatric unit. *BMC Geriatr* 2012;**12**:32. https://doi.org/10.1186/1471-2318-12-32

158. Sampson EL, White N, Leurent B, Scott S, Lord K, Round J, Jones L. Behavioural and psychiatric symptoms in people with dementia admitted to the acute hospital: prospective cohort study. *Br J Psychiatry* 2014;**205**:189–96. https://doi.org/10.1192/bjp.bp.113.130948

159. Sleiman I, Rozzini R, Barbisoni P, Morandi A, Ricci A, Giordano A, Trabucchi M. Functional trajectories during hospitalization: a prognostic sign for elderly patients. *J Gerontol A Biol Sci Med Sci* 2009;**64**:659–63. https://doi.org/10.1093/gerona/glp015

160. Srinonprasert V, Pakdeewongse S, Assanasen J, Eiamjinnasuwat W, Sirisuwat A, Limmathuroskul D, Praditsuwan R. Risk factors for developing delirium in older patients admitted to general medical wards. *J Med Assoc Thai* 2011;**94**(Suppl. 1):99–104.

161. Travers C, Byrne G, Pachana N, Klein K, Gray L. Prospective observational study of dementia and delirium in the acute hospital setting. *Intern Med J* 2013;**43**:262–9. https://doi.org/10.1111/j.1445-5994.2012.02962.x

162. Wierenga PC, Buurman BM, Parlevliet JL, van Munster BC, Smorenburg SM, Inouye SK, de Rooij SE. Association between acute geriatric syndromes and medication-related hospital admissions. *Drugs Aging* 2012;**29**:691–9. https://doi.org/10.2165/11632510-000000000-00000

163. Balan S, Leibovitz A, Freedman L, Blagman B, Ruth M, Ady S, Habot B. Seasonal variation in the incidence of delirium among the patients of a geriatric hospital. *Arch Gerontol Geriatr* 2001;**33**:287–93. https://doi.org/10.1016/S0167-4943(01)00192-3

164. Eeles EM, White SV, O'Mahony SM, Bayer AJ, Hubbard RE. The impact of frailty and delirium on mortality in older inpatients. *Age Ageing* 2012;**41**:412–16. https://doi.org/10.1093/ageing/afs021

165. Egberts A, Wijnbeld EH, Fekkes D, van der Ploeg MA, Ziere G, Hooijkaas H, *et al.* Neopterin: a potential biomarker for delirium in elderly patients. *Dement Geriatr Cogn Disord* 2015;**39**:116–24. https://doi.org/10.1159/000366410

166. Gehi M, Strain JJ, Weltz N, Jacobs J. Is there a need for admission and discharge cognitive screening for the medically ill? *Gen Hosp Psychiatry* 1980;**2**:186–91. https://doi.org/10.1016/0163-8343(80)90060-2

167. Levenson J, Hamer R, Rossiter L. Psychopathology and pain in medical in-patients predict resource use during hospitalization but not rehospitalization. *J Psychosom Res* 1992;**36**:585–92. https://doi.org/10.1016/0022-3999(92)90043-2

168. Watkin L, Blanchard MR, Tookman A, Sampson EL. Prospective cohort study of adverse events in older people admitted to the acute general hospital: risk factors and the impact of dementia. *Int J Geriatr Psychiatry* 2012;**27**:76–82. https://doi.org/10.1002/gps.2693

169. Weber P, Meluzinova H, Matejovska-Kubesova H, Polcarova V, Jarkovsky J, Bielakova K, Weberova D. Geriatric giants – contemporary occurrence in 12,210 in-patients. *Bratisl Lek Listy* 2015;**116**:408–16. https://doi.org/10.4149/BLL_2015_078

170. Adamis D, Lunn M, Martin FC, Treloar A, Gregson N, Hamilton G, Macdonald AJ. Cytokines and IGF-I in delirious and non-delirious acutely ill older medical inpatients. *Age Ageing* 2009;**38**:326–32. https://doi.org/10.1093/ageing/afp014

171. Corrao S, Santalucia P, Argano C, Djade CD, Barone E, Tettamanti M, *et al.* Gender-differences in disease distribution and outcome in hospitalized elderly: data from the REPOSI study. *Eur J Intern Med* 2014;**25**:617–23. https://doi.org/10.1016/j.ejim.2014.06.027

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

172. Corsinovi L, Bo M, Ricauda Aimonino N, Marinello R, Gariglio F, Marchetto C, *et al.* Predictors of falls and hospitalization outcomes in elderly patients admitted to an acute geriatric unit. *Arch Gerontol Geriatr* 2009;**49**:142–5. https://doi.org/10.1016/j.archger.2008.06.004

173. Hossain H, Arefin M, Sultana N, Siddiqui F. Acute confusional state: a common clinical condition with versatile variability – a prospective study. *J Med* 2012;**13**:46–50. https://doi.org/10.3329/jom.v13i1.10047

174. Macdonald A, Adamis D, Treloar A, Martin F. C-reactive protein levels predict the incidence of delirium and recovery from it. *Age Ageing* 2007;**36**:222–5. https://doi.org/10.1093/ageing/afl121

175. Nair B, O'Dea I, Lim L, Thakkinstian A. Prevalence of geriatric 'syndromes' in a tertiary hospital. *Australas J Ageing* 2000;**19**:81–4. https://doi.org/10.1111/j.1741-6612.2000.tb00149.x

176. Praditsuwan R, Limmathuroskul D, Assanasen J, Pakdeewongse S, Eiamjinnasuwat W, Sirisuwat A, Srinonprasert V. Prevalence and incidence of delirium in Thai older patients: a study at general medical wards in Siriraj Hospital. *J Med Assoc Thai* 2012;**95**(Suppl. 2):245–50.

177. Rozzini R, Sabatini T, Cassinadri A, Boffelli S, Ferri M, Barbisoni P, *et al.* Relationship between functional loss before hospital admission and mortality in elderly persons with medical illness. *J Gerontol A Biol Sci Med Sci* 2005;**60**:1180–3. https://doi.org/10.1093/gerona/60.9.1180

178. Inouye SK, Foreman MD, Mion LC, Katz KH, Cooney LM. Nurses' recognition of delirium and its symptoms: comparison of nurse and researcher ratings. *Arch Intern Med* 2001;**161**:2467–73. https://doi.org/10.1001/archinte.161.20.2467

179. Johnson JC, Kerse NM, Gottlieb G, Wanich C, Sullivan E, Chen K. Prospective versus retrospective methods of identifying patients with delirium. *J Am Geriatr Soc* 1992;**40**:316–19. https://doi.org/10.1111/j.1532-5415.1992.tb02128.x

180. Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, *et al.* Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care* 2005;**43**:1130–9. https://doi.org/10.1097/01.mlr.0000182534.19832.83

181. Scottish Government. *Scottish Index of Multiple Deprivation*. URL: www.gov.scot/topics/statistics/simd (accessed 4 October 2017).

182. Joint Formulary Committee. *British National Formulary* (online) London: BMJ Group and Pharmaceutical Press. URL: www.medicinescomplete.com (accessed 18 February 2021).

183. Brilleman SL, Salisbury C. Comparing measures of multimorbidity to predict outcomes in primary care: a cross sectional study. *Fam Pract* 2013;**30**:172–8. https://doi.org/10.1093/fampra/cms060

184. Reynish EL, Hapca SM, De Souza N, Cvoro V, Donnan PT, Guthrie B. Epidemiology and outcomes of people with dementia, delirium, and unspecified cognitive impairment in the general hospital: prospective cohort study of 10,014 admissions. *BMC Med* 2017;**15**:140. https://doi.org/10.1186/s12916-017-0899-0

185. Scottish Government. *Delivering Innovation Through Research – Scottish Government Health and Social Care Research Strategy*. Edinburgh: Scottish Government; 2015.

186. Lin D, Wei L, Ying Z. Checking the Cox model with cumulative sums of martingale-based residuals. *Biometrika* 1993;**80**:557–72. https://doi.org/10.1093/biomet/80.3.557

187. Thomas L, Reyes E. Tutorial: survival estimation for Cox regression models with time-varying coefficients using SAS and R. *J Stat Softw* 2014;**61**. https://doi.org/10.18637/jss.v061.c01

188. Gray R. A class of K-sample tests for comparing the cumulative incidence of a competing risk. *Ann Stat* 1988;**16**:1141–54. https://doi.org/10.1214/aos/1176350951

189. Fine J, Gray R. A proportional hazards model for the subdistribution of a competing risk. *J Am Stat Assoc* 1999;**94**:496–509. https://doi.org/10.1080/01621459.1999.10474144

190. Fox J. *Applied Regression Analysis and Generalized Linear Models*. Thousand Oaks, CA: SAGE Publications Inc.; 2008.

191. Wei LA, Fearing MA, Sternberg EJ, Inouye SK. The Confusion Assessment Method: a systematic review of current usage. *J Am Geriatr Soc* 2008;**56**:823–30. https://doi.org/10.1111/j.1532-5415.2008.01674.x

192. Inouye S. *The Short Confusion Assessment Method (Short CAM): Training Manual and Coding Guide*. Boston, MA: Hospital Elder Life Program; 2014. URL: www.hospitalelderlifeprogram.org/uploads/disclaimers/Short_CAM_Training_Manual_10-9-14.pdf (accessed 22 April 2018).

193. Albrecht JS, Marcantonio ER, Roffey DM, Orwig D, Magaziner J, Terrin M, *et al.* Stability of postoperative delirium psychomotor subtypes in individuals with hip fracture. *J Am Geriatr Soc* 2015;**63**:970–6. https://doi.org/10.1111/jgs.13334

194. Shi Q, Warren L, Saposnik G, Macdermid JC. Confusion assessment method: a systematic review and meta-analysis of diagnostic accuracy. *Neuropsychiatr Dis Treat* 2013;**9**:1359–70. https://doi.org/10.2147/NDT.S49520

195. Jitapunkul S, Pillay I, Ebrahim S. The Abbreviated Mental Test: its use and validity. *Age Ageing* 1991;**20**:332–6. https://doi.org/10.1093/ageing/20.5.332

196. Jackson TA, Naqvi SH, Sheehan B. Screening for dementia in general hospital inpatients: a systematic review and meta-analysis of available instruments. *Age Ageing* 2013;**42**:689–95. https://doi.org/10.1093/ageing/aft145

197. Information Services Division Scotland. *Scottish Health Service Costs, Year Ended 31 March 2016*. Edinburgh: ISD Scotland; 2016.

198. National Records of Scotland. *Projected Population of Scotland (2014-based)*. Edinburgh: National Records of Scotland; 2015.

199. Annear MJ, Tierney LT, Vickers JC, Palmer AJ. Counting the cost of dementia-related hospital admissions: a regional investigation. *Australas J Ageing* 2016;**35**:E32–5. https://doi.org/10.1111/ajag.12318

200. Bail K, Goss J, Draper B, Berry H, Karmel R, Gibson D. The cost of hospital-acquired complications for older people with and without dementia; a retrospective cohort study. *BMC Health Serv Res* 2015;**15**:91. https://doi.org/10.1186/s12913-015-0743-1

201. Ernst RL, Hay JW. The US economic and social costs of Alzheimer's disease revisited. *Am J Public Health* 1994;**84**:1261–4. https://doi.org/10.2105/AJPH.84.8.1261

202. Langa KM, Larson EB, Wallace RB, Fendrick AM, Foster NL, Kabeto MU, *et al.* Out-of-pocket health care expenditures among older Americans with dementia. *Alzheimer Dis Assoc Disord* 2004;**18**:90–8. https://doi.org/10.1097/01.wad.0000126620.73791.3e

203. Menzin J, Lang K, Friedman M, Neumann P, Cummings JL. The economic cost of Alzheimer's disease and related dementias to the California Medicaid program ('Medi-Cal') in 1995. *Am J Geriatr Psychiatry* 1999;**7**:300–8. https://doi.org/10.1097/00019442-199911000-00005

204. Gregori D, Petrinco M, Bo S, Desideri A, Merletti F, Pagano E. Regression models for analyzing costs and their determinants in health care: an introductory review. *Int J Qual Health Care* 2011;**23**:331–41. https://doi.org/10.1093/intqhc/mzr010

205. Mihaylova B, Briggs A, O'Hagan A, Thompson SG. Review of statistical methods for analysing healthcare resources and costs. *Health Econ* 2011;**20**:897–916. https://doi.org/10.1002/hec.1653

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

206. Jones AM. *Models For Health Care*. York: University of York; 2010.

207. Mandelblatt JS, Fryback DG, Weinstein MC, Russell LB, Gold MR. Assessing the effectiveness of health interventions for cost-effectiveness analysis. Panel on Cost-Effectiveness in Health and Medicine. *J Gen Intern Med* 1997;**12**:551–8. https://doi.org/10.1046/j.1525-1497.1997.07107.x

208. Henderson R, Diggle P, Dobson A. Joint modelling of longitudinal measurements and event time data. *Biostatistics* 2000;**1**:465–80. https://doi.org/10.1093/biostatistics/1.4.465

209. Liu L. Joint modeling longitudinal semi-continuous data and survival, with application to longitudinal medical cost data. *Stat Med* 2009;**28**:972–86. https://doi.org/10.1002/sim.3497

210. Tsiatis A, Davidian M. Joint modeling of longitudinal and time-to-event data: an overview. *Stat Sin* 2004;**14**:809–34.

211. Crowther M, Abrams K, Lambert P. Joint modeling of longitudinal and survival data. *Stata J* 2013;**1**:165–84. https://doi.org/10.1177/1536867X1301300112

212. Information Services Division Scotland. *Summary of 'PLICS' Costing Methodology Used in IRF Mapping*. ISD Scotland; 2014. URL: www.isdscotland.org/Health-Topics/Health-and-Social-Community-Care/Health-and-Social-Care-Integration/Analytical-Outputs/_docs/IRF-Mapping-Summary-of-PLICS-costing-methodology.pdf (accessed 1 February 2018).

213. Harrison JK, Noel-Storr AH, Demeyere N, Reynish EL, Quinn TJ. Outcomes measures in a decade of dementia and mild cognitive impairment trials. *Alzheimers Res Ther* 2016;**8**:48. https://doi.org/10.1186/s13195-016-0216-8

214. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;**3**:77–101. https://doi.org/10.1191/1478088706qp063oa

215. Office for National Statistics. *Internet Access – Households and Individuals, Great Britain: 2018*. 2018. URL: www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2018 (accessed 5 October 2018).

216. Szolnoki G, Hoffmann D. Online, face-to-face and telephone surveys—comparing different sampling methods in wine consumer research. *Wine Economics and Policy* 2013;**2**:57–66. https://doi.org/10.1016/j.wep.2013.10.001

217. Jisc. *Bristol Online Surveys*. URL: www.onlinesurveys.ac.uk (accessed 1 February 2018).

218. Walker E, Dewar BJ. How do we facilitate carers' involvement in decision making? *J Adv Nurs* 2001;**34**:329–37. https://doi.org/10.1046/j.1365-2648.2001.01762.x

219. Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the Confusion Assessment Method. A new method for detection of delirium. *Ann Intern Med* 1990;**113**:941–8. https://doi.org/10.7326/0003-4819-113-12-941

220. Katz S, Stroud M. Functional assessment in geriatrics. *J Am Geriatr Soc* 1989;**37**:267–72. https://doi.org/10.1111/j.1532-5415.1989.tb06820.x

221. Dementia Services Development Centre. *Dementia Research*. 2017. URL: https://dementia.stir.ac.uk/information/dementia-research (accessed 1 November 2018).

222. Dagani J, Ferrari C, Boero ME, Geroldi C, Giobbio GM, Maggi P, *et al.* A prospective, multidimensional follow-up study of a geriatric hospitalised population: predictors of discharge and well-being. *Aging Clin Exp Res* 2013;**25**:691–701. https://doi.org/10.1007/s40520-013-0153-3

223. Winblad B, Palmer K, Kivipelto M, Jelic V, Fratiglioni L, Wahlund LO, *et al.* Mild cognitive impairment – beyond controversies, towards a consensus: report of the International Working Group on Mild Cognitive Impairment. *J Intern Med* 2004;**256**:240–6. https://doi.org/10.1111/j.1365-2796.2004.01380.x

224. Reynish E. *The OPRAA Cohort*. 2018. URL: https://dementia.stir.ac.uk/information/dementia-research/dementia-and-ageing-research-group-seminar-understanding-and-improvi-3 (accessed 1 November 2018).

225. Reynish E. *Hospital Patients with Dementia and Other Causes of Confusion have Worse Outcomes*. 2017. URL: https://dementia.stir.ac.uk/blogs/dementia-centred/2017-08-03/hospital-patients-dementia-and-other-causes-confusion-have-worse (accessed 1 November 2018).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Appendix 1 Definitions and categorisation

Definitions of cognitive spectrum disorder

Known dementia was defined as documentation during the OPRAA of the presence of a pre-admission diagnosis of dementia from self-report/informant report and/or hospital and primary care records; or a prior ICD-10 code for dementia recorded during an acute hospital (SMR01) or psychiatric (SMR04) admission); or prior community prescribing of a drug for dementia (acetylcholinesterase inhibitors or memantine as listed in the *British National Formulary*, chapter 4.11[182]).

Delirium was defined as a clinical diagnosis of delirium made by the trained specialist nurse completing the OPRAA.[184] The OPRAA included administration of the CAM using the original (pre-2014) recommended scoring, which was subsequently revised to address low sensitivity in clinical applications, so for the purposes of this analysis we used the overall clinical assessment made by the trained nurses.[219]

Delirium superimposed on dementia was defined as the presence of delirium in a patient with known dementia.

Unspecified cognitive impairment was defined as an AMT score of < 8 points in people with no delirium and no known dementia.[184]

Categorisation of functional status

Functional status was assessed during the OPRAA using the ADL assessment of six basic activities [eating, bathing, dressing, toileting, transferring (walking) and continence], adding up to a maximum score of 6.[220] Based on patient and/or informant report, functional status was assessed at 12 weeks before admission (pre-ADL score) and on admission (current ADL score) based on direct observation. Participants were then defined as having:

- persistently low ADL score (pre-ADL score of < 5, all of whom had a current ADL score of < 5)
- changed ADL score (pre-ADL score of ≥ 5 and a current ADL score of < 5)
- persistently high ADL score (both pre and current ADL scores of ≥ 5).

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Appendix 2 Systematic review

Literature searches

TABLE 25 Search databases, platforms and dates for the systematic review

Source database	Platform	Dates of coverage	Date search performed
EMBASE	Ovid	1980–2016, week 4	29 January 2016
MEDLINE	Ovid	1946 to 26 January 2016	27 January 2016
CINAHL	EBSCO*host*	1946 to 26 January 2016	29 January 2016
PsycINFO	Ovid	1806 to January week 4 2016	28 January 2016
Cochrane Database of Systematic Reviews	The Cochrane Library, Wiley Online Library	1946 to 26 January 2016	1 February 2016

EMBASE

Date range searched: 1980–2016, week 4.

Date searched: 29 January 2016.

Search strategy

1. exp dementia/
2. dementi*.ti,ab.
3. alzheimer*.ti,ab.
4. AD.ti,ab.
5. ('lewy bod*' or DLB or LBD).ti,ab.
6. 1 or 2 or 3 or 4 or 5
7. cognition disorders.mp.
8. (cognit* adj2 (impair* or disorder* or declin* or fail* or function*)).ti,ab.
9. (memory adj2 (complain* or declin* or function*)).ti,ab.
10. 'cognitive spectrum disorder'.af.
11. (geriatric adj (condition* or syndrom*)).ti,ab.
12. (impair* adj2 (mental stat* or intellect)).ti,ab.
13. MCI.ti,ab.
14. 7 or 8 or 9 or 10 or 11 or 12 or 13
15. delirium/
16. deliri*.ti,ab.
17. 'acute confusion*'.ti,ab.
18. ('acute organic psychosyndrome*' or 'acute organic psycho-syndrome*').ti,ab.
19. 'acute brain syndrome*'.ti,ab.
20. 'acute brain failure*'.ti,ab.
21. 'metabolic encephalopathy'.ti,ab.
22. 'acute psycho-organic syndrome*'.ti,ab.
23. 'clouded state*'.ti,ab.
24. 'clouding of consciousness'.ti,ab.
25. 'exogenous psychos#s'.ti,ab.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

26. 'toxic psychos#s'.ti,ab.
27. 'toxic confusion'.ti,ab.
28. obnubilat*.ti,ab.
29. 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28
30. 6 or 14 or 29
31. exp hospital/
32. hospitalization/
33. hospital patient/
34. (hospital* adj2 (acute or emergen* or unschedul*)).af.
35. 'general hospital*'.ti,ab.
36. (acute adj2 medicine).ti,ab.
37. ('geriatric medicine' or 'gerontol* medicine').ti,ab.
38. inpatient*.ti,ab.
39. 'elderly patient*'.ti,ab.
40. 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39
41. prevalence/
42. incidence/
43. morbidity/
44. mortality/
45. hospital readmission/
46. 'length of stay'/
47. institutionalization/
48. daily life activity/
49. 'quality of life'/
50. 'cost of illness'/
51. exp 'health care cost'/
52. prevalence*.af.
53. incidence*.af.
54. mortalit*.af.
55. readmission*.af.
56. 'length of stay'.af.
57. institutionali#ation.af.
58. (activit* adj2 daily li*).af.
59. 'quality of life'.af.
60. (health* adj2 cost*).af.
61. 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60
62. 30 and 40 and 64

This search resulted in 15,479 articles.

MEDLINE [Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) <1946 to Present>, Ovid MEDLINE(R) Daily Update <January 26, 2016>]

Date range searched: 1946 to 26 January 2016.

Date searched: 14.15 on 27 January 2016.

Search strategy

1. exp Dementia/
2. dement*.ti,ab.
3. alzheimer*.ti,ab.
4. AD.ti,ab.

5. ('lewy bod*' or DLB or LBD).ti,ab.
6. 1 or 2 or 3 or 4 or 5
7. exp Cognition Disorders/
8. (cognit* adj2 (impair* or disorder* or declin* or fail* or function*)).ti,ab.
9. (memory adj2 (complain* or declin* or function*)).ti,ab.
10. 'cognitive spectrum disorder'.af.
11. (geriatric adj (condition* or syndrome*)).ti,ab.
12. (impair* adj2 (mental stat* or intellect)).ti,ab.
13. MCI.ti,ab.
14. 7 or 8 or 9 or 10 or 11 or 12 or 13
15. Delirium/
16. deliri*.ti,ab.
17. 'acute confusion*'.ti,ab.
18. ('acute organic psychosyndrome*' or 'acute organic psycho-syndrome*').ti,ab.
19. 'acute brain syndrome*'.ti,ab.
20. 'acute brain failure*'.ti,ab.
21. 'metabolic encephalopathy'.ti,ab.
22. 'acute psycho-organic syndrome*'.ti,ab.
23. 'clouded state*'.ti,ab.
24. 'clouding of consciousness'.ti,ab.
25. 'exogenous psychos#s'.ti,ab.
26. 'toxic psychos#s'.ti,ab.
27. 'toxic confusion'.ti,ab.
28. obnubilat*.ti,ab.
29. 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28
30. 6 or 14 or 29
31. exp Hospitals/
32. Hospitalization/
33. Inpatients/
34. Patients/
35. (hospital* adj2 (acute or emergen* or unschedul*)).af.
36. 'general hospital*'.ti,ab.
37. (acute adj2 medicine).ti,ab.
38. ('geriatric medicine' or 'gerontol* medicine').ti,ab.
39. inpatient*.ti,ab.
40. 'elderly patient*'.ti,ab.
41. 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40
42. 30 and 41
43. Prevalence/
44. Incidence/
45. Morbidity/
46. Mortality/
47. Patient Readmission/
48. 'Length of Stay'/
49. Institutionalization/
50. 'Activities of Daily Living'/
51. 'Quality of Life'/
52. 'Cost of Illness'/
53. exp Health Care Costs/
54. prevalence*.af.
55. incidence*.af.
56. mortalit*.af.
57. readmission*.af.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

58. 'length of stay'.af.
59. institutionali#ation.af.
60. (activit* adj2 daily li*).af.
61. 'quality of life'.af.
62. (health* adj2 cost*).af.
63. 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62
64. 42 and 63

This led to 5780 articles (5754 after removal of duplicates).

CINAHL Plus

Date range searched: 1946 to 26 January 2016.

Date of search: Friday 29 January 2016 at 12:05:42.

Search strategy

S1 (MH "Dementia+")
S2 TI dementi* OR AB dementi*
S3 TI alzheimer* OR AB alzheimer*
S4 TI AD OR AB AD 9,773
S5 TI ("lewy bod*" or DLB or LBD) OR AB ("lewy bod*" or DLB or LBD)
S6 S1 OR S2 OR S3 OR S4 OR S5
S7 "cognitive impairment"
S8 TI ((cognit* N2 (impair* or disorder* or declin* or fail* or function*))) OR AB ((cognit* N2 (impair* or disorder* or declin* or fail* or function*)))
S9 TI ((memory N2 (complain* or declin* or function*))) OR AB ((memory N2 (complain* or declin* or function*)))
S10 TI "cognitive spectrum disorder" OR AB "cognitive spectrum disorder"
S11 TI ((geriatric N1 (condition* or syndrom*))) OR AB ((geriatric N1 (condition* or syndrom*)))
S12 TI ((impair * N2 (mental stat* or intellect))) OR AB ((impair * N2 (mental stat* or intellect)))
S13 TI MCI OR AB MCI
S14 S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13
S15 (MH "Delirium")
S16 TI delir* OR AB delir*
S17 TI "acute confusion" OR AB "acute confusion"
S18 TI "acute organic psychosyndrom*" OR AB "acute organic psychosyndrom*" OR TI "acute organic psycho-syndrom*" OR AB "acute organic psycho-syndrom*"
S19 TI "acute brain syndrom*" OR AB "acute brain syndrom*"
S20 TI "acute brain failure" OR AB "acute brain failure"
S21 TI "metabolic encephalopathy" OR AB "metabolic encephalopathy"
S22 TI "acute psycho-organic syndrome" OR AB "acute psycho-organic syndrome"
S23 TI "clouded state*" OR AB "clouded state*"
S24 TI "clouding of consciousness" OR AB "clouding of consciousness"
S25 TI "exogenous psychos*s" OR AB "exogenous psychos*s"
S26 TI "toxic psychos*s" OR AB "toxic psychos*s"
S27 TI "toxic confusion" OR AB "toxic confusion"
S28 TI obnubilat* OR AB obnubilat*
S29 S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28
S30 S6 OR S14 OR S29
S31 (MH "Hospitals")
S32 (MH "Hospitalization")

S33 (MH "Inpatients")
S34 TX hospital* N2 (acute or emergen* or unschedul*)
S35 TI "general hospital" OR AB "general hospital"
S36 TI acute N2 medicine OR AB acute N2 medicine
S37 TI "geriatric medicine" OR AB "geriatric medicine"
S38 TI "gerontol* medicine" OR AB "gerontol* medicine"
S39 TI inpatient* OR AB inpatient*
S40 TI "elderly patient" OR AB "elderly patient"
S41 S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40
S42 S30 AND S41
S43 (MH "Morbidity")
S44 (MH "Mortality")
S45 "hospital discharge"
S46 (MH "Treatment Duration")
S47 (MH "Treatment Outcomes")
S48 (MH "Institutionalization")
S49 (MH "Activities of Daily Living")
S50 (MH "Quality of Life")
S51 (MH "Health Care Costs")
S52 TX prevalence*
S53 TX incidence*
S54 TX mortalit*
S55 TX readmission*
S56 TX "length of stay"
S57 TX institutionali?ation
S58 TX activit* N2 daily li*
S59 TX "quality of life"
S60 TX health* N2 costs*
S61 S43 OR S44 OR S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55 OR S56 OR S57 OR S58 OR S59 OR S60
S62 S42 AND S61

This resulted in 3431 articles.

PsycINFO (via Ovid)

Date range searched: 1806 to January week 4 2016.

Date searched: 28 January 2016.

Search strategy

1. exp Dementia/
2. dementi*.ti,ab.
3. alzheimer*.ti,ab.
4. AD.ti,ab.
5. ('lewy bod*' or DLB or LBD).ti,ab.
6. 1 or 2 or 3 or 4 or 5
7. exp Memory Disorders/
8. (cognit* adj2 (impair* or disorder* or declin* or fail* or function*)).ti,ab.
9. (memory adj2 (complain* or declin* or function*)).ti,ab.
10. 'cognitive spectrum disorder'.af.
11. (geriatric adj (condition* or syndrom*)).ti,ab.
12. (impair* adj2 (mental stat* or intellect)).ti,ab.
13. MCI.ti,ab.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

14. 7 or 8 or 9 or 10 or 11 or 12 or 13
15. Delirium/
16. deliri*.ti,ab.
17. 'acute confusion'.ti,ab.
18. ('acute organic psychosyndrome*' or 'acute organic psycho-syndrome*').ti,ab.
19. 'acute brain syndrome*'.ti,ab.
20. 'acute brain failure*'.ti,ab.
21. 'metabolic encephalopathy'.ti,ab.
22. 'acute psycho-organic syndrome*'.ti,ab.
23. 'clouded state*'.ti,ab.
24. 'clouding of consciousness'.ti,ab.
25. 'exogenous psychos#s'.ti,ab.
26. 'toxic psychos#s'.ti,ab.
27. 'toxic confusion'.ti,ab.
28. obnubilat*.ti,ab.
29. 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28
30. 6 or 14 or 29
31. exp Hospitals/
32. Hospitalization/
33. Hospitalized Patients/
34. Patients/
35. (hospital* adj2 (acute or emergen* or unschedul*)).af.
36. 'general hospital'.ti,ab.
37. (acute adj2 medicine).ti,ab.
38. ('geriatric medicine' or 'gerontol* medicine').ti,ab.
39. inpatient*.ti,ab.
40. 'elderly patient*'.ti,ab.
41. 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40
42. 30 and 41
43. prevalence.mp.
44. incidence.mp.
45. Morbidity/
46. mortality.mp.
47. Hospital Admission/
48. 'length of stay'.mp.
49. Institutionalization/
50. 'Activities of Daily Living'/
51. 'Quality of Life'/
52. 'cost of illness'.mp.
53. exp Health Care Costs/
54. prevalence*.af.
55. incidence*.af.
56. mortalit*.af.
57. readmission*.af.
58. 'length of stay'.af.
59. institutionali#ation.af.
60. (activit* adj2 daily li*).af.
61. 'quality of life'.af.
62. (health* adj2 cost*).af.
63. 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62
64. 42 and 63

This resulted in 4255 articles.

Cochrane Database of Systematic Reviews

Date range searched: 1946 to 26 January 2016.

Date searched: 1 February 2016.

Search strategy

ID	Search
#1	MeSH descriptor:[221] explode all trees
#2	dement*:ti,ab
#3	alzheimer*:ti,ab
#4	AD:ti,ab
#5	('lewy bod*' or DLB or LBD):ti,ab
#6	{or #1-#5}
#7	MeSH descriptor: [Cognition Disorders] explode all trees
#8	(cognit* near/2 (impair* or disorder* or declin* or fail* or function*)):ti,ab
#9	(memory near/2 (complain* or declin* or function*)):ti,ab
#10	'cognitive spectrum disorder'
#11	(geriatric next (condition* or syndrome*)):ti,ab
#12	(impair* near/2 (mental stat* or intellect)):ti,ab
#13	MCI:ti,ab
#14	{or #7-#13}
#15	MeSH descriptor: [Delirium] explode all trees
#16	deliri*:ti,ab
#17	'acute confusion*':ti,ab
#18	('acute organic psychosyndrome*' or 'acute organic psycho-syndrome*'):ti,ab
#19	'acute brain syndrome*':ti,ab
#20	'acute brain failure*':ti,ab
#21	'metabolic encephalopathy':ti,ab
#22	'acute psycho-organic syndrome*':ti,ab
#23	'clouded state*':ti,ab
#24	'clouding of consciousness':ti,ab
#25	'exogenous psychos?s':ti,ab
#26	'toxic psychos?s':ti,ab
#27	'toxic confusion':ti,ab
#28	obnubilat*:ti,ab
#29	{or #15-#28}
#30	#6 or #14 or #29
#31	MeSH descriptor: [Hospitals] explode all trees
#32	MeSH descriptor: [Hospitalization] this term only
#33	MeSH descriptor: [Inpatients] this term only
#34	MeSH descriptor: [Patients] this term only
#35	(hospital* near/2 (acute or emergen* or unschedul*))
#36	'general hospital*':ti,ab
#37	acute near/2 medicine:ti,ab
#38	('geriatric medicine' or 'gerontol* medicine'):ti,ab
#39	inpatient*:ti,ab
#40	'elderly patient*':ti,ab
#41	{or #31-#40}
#42	#30 and #41
#43	MeSH descriptor: [Prevalence] this term only
#44	MeSH descriptor: [Incidence] this term only
#45	MeSH descriptor: [Morbidity] this term only

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

#46 MeSH descriptor: [Mortality] this term only
#47 MeSH descriptor: [Patient Readmission] this term only
#48 MeSH descriptor: [Length of Stay] this term only
#49 MeSH descriptor: [Institutionalization] this term only
#50 MeSH descriptor: [Activities of Daily Living] this term only
#51 MeSH descriptor: [Quality of Life] this term only
#52 MeSH descriptor: [Cost of Illness] this term only
#53 MeSH descriptor: [Health Care Costs] explode all trees
#54 prevalence*
#55 incidence*
#56 mortalit*
#57 readmission*
#58 'length of stay'
#59 institutionali?ation
#60 activit* near/2 daily li*
#61 'quality of life'
#62 health* near/2 cost*
#63 {or #43-#62}
#64 #42 and #63

This resulted in 542 articles.

Appendix 3 Included studies

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 26 Summary of included studies

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Adamis 2006[59]	Delirium and cognitive impairment	94	UK	Prospective	Cohort	3	Acute hospital/ geriatric medicine	Medical inpatients aged ≥ 70 years
Adamis 2011[136]	Delirium	164	UK	Prospective	Cohort	1	Acute hospital/ geriatric medicine	Medical inpatients aged ≥ 70 years
Adamis 2009[170]	Delirium	67	UK	Prospective	Cohort	10	Acute hospital/ geriatric medicine	Medical inpatients aged ≥ 70 years
Adamis 2014[137]	Dementia and delirium	142	UK	Prospective	Cohort	14	Acute hospital/ geriatric medicine	Medical inpatients aged > 70 years
Adamis 2007[130]	Delirium	164	UK	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Hospital inpatients aged ≥ 70 years
Adamis 2007[149]	Delirium	164	UK	Prospective	Cohort	10	Acute hospital/ geriatric medicine	Acutely ill adults aged ≥ 70 years
Aljishi 2014[89]	Dementia	394	New Zealand	Prospective	Case–control	6	Acute hospital/ general medicine	Patients re-admitted to general medicine
Aminoff 2014[77]	Dementia	183	Israel	Prospective	Cohort	6	Acute hospital/ geriatric medicine	Patients with advanced dementia
Balan 2001[163]	Delirium	4929	Israel	Retrospective	Cohort	84	Acute hospital/ geriatric medicine	People aged ≥ 65 years without prevalent delirium admitted to geriatric medical wards
Barba 2011[42]	Dementia	1,135,423	Spain	Retrospective	Cohort	36	Acute hospital/ general medicine	People aged ≥ 65 years discharged from departments of internal medicine
Baron 1987[41]	Dementia	18	UK	Prospective	Cohort	36	Acute hospital/ general medicine	Patients with major social problems, self-neglect and dementia
Basic 2009[74]	Dementia and delirium	2186	Australia	Prospective	Cohort	62	Acute hospital/ geriatric medicine	Older patients admitted from the ED to an acute geriatric medicine service

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Basic 2015[75]	Dementia and delirium	2945	Australia	Prospective	Cohort	24	Acute hospital/ geriatric medicine	Older people hospitalised with acute illness
Beauchet 2013[132]	Delirium	531	France	Prospective	Cohort	12	Acute hospital/ geriatric medicine	Unplanned admissions to hospital aged ≥ 75 years
Beauchet 2013[144]	Cognitive impairment	424	France	Prospective	Cohort	10	Acute hospital/ geriatric medicine	Elderly inpatients aged > 75 years admitted from ED
Bellelli 2015[55]	Dementia, delirium and DSD	2521	Italy	Retrospective	Cohort	24	Acute hospital/ geriatric and general medicine	Patients aged > 65 years
Bickel 2006[98]	Dementia and cognitive impairment	794	Germany	Prospective	Cohort	NR	Acute hospital/ general medicine	Non-demented inpatients aged 65–85 years
Bogaisky 2015[82]	Dementia	1038	USA	Retrospective	Cohort	12	Acute hospital/ geriatric medicine	People aged ≥ 65 years re-admitted to hospital within 30 days of discharge
Bourdel-Marchasson 2004[68]	Delirium and cognitive impairment	427	France	Prospective	Cohort	12	Acute hospital/ geriatric medicine	Patients aged > 75 years admitted to acute care geriatric unit
Boustani 2010[129]	Delirium and cognitive impairment	242	USA	Prospective	Cohort	21	Acute hospital/ geriatric medicine	Adults aged ≥ 65 years admitted to hospital
Briggs 2016[81]	Dementia	69,718	Ireland	Retrospective	Secondary analysis	36	Acute hospital/ general medicine	Patients with dementia
Buurman 2011[128]	Delirium and cognitive impairment	639	The Netherlands	Prospective	Cohort	48	Acute hospital/ geriatric medicine	Acutely hospitalised patients aged ≥ 65 years
Cattin 1997[53]	Cognitive impairment	3628	Italy	Retrospective	Cohort	Not clear – patients were followed until discharge but data not reported	Multiple sites/ general and geriatric medicine	Hospitalised people aged ≥ 65 years
Cole 2008[69]	Dementia, delirium and cognitive impairment	129	Canada	Retrospective	Secondary analysis	NR	Acute hospital/ general medicine	Inpatients with prevalent, incident or subsyndromal delirium
Collins 2010[65]	Dementia, delirium and cognitive impairment	710	UK	Retrospective	Secondary analysis	6	Acute hospital/ general medicine	Patients aged > 70 years

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 26 Summary of included studies (*continued*)

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Conde-Martel 2012[143]	Cognitive impairment	124	Spain	Prospective	Cohort	74	Acute hospital/ general medicine	People aged ≥ 90 years admitted to hospital
Corrao 2014[171]	Cognitive impairment	1380	Italy	Retrospective	Cohort	NR	Acute hospital/ geriatric medicine	Hospitalised patients aged ≥ 65 years
Corsinovi 2009[172]	Delirium and cognitive impairment	620	Italy	Prospective	Cohort	16	Acute hospital/ geriatric medicine	Hospitalised inpatients
Dasgupta 2014[127]	Delirium	1235	Canada	Prospective	Cohort	25	Acute hospital/ general medicine	Medical inpatients aged ≥ 70 years
de Boissieu 2015[113]	Dementia and delirium	291	France	Prospective	Cohort	36	Acute hospital/ geriatric medicine	Patients aged > 90 years
Deshpande 1989[50]	Delirium	350	India	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	General medical inpatients
Dhaussy 2012[150]	Dementia and confusion syndrome	1306	France	Prospective	Cohort	24	Acute hospital/ general medicine	Patients aged ≥ 75 years hospitalised through an emergency department
Di Iorio 1998[85]	Cognitive impairment	379	Italy	Prospective	Cohort	2	Acute hospital/ geriatric medicine	Patients aged > 65 years
Di Iorio 1999[84]	Dementia and cognitive impairment	402	Italy	Prospective	Cohort	36	Acute hospital/ geriatric medicine	Patients aged > 65 years
Díez-Manglano 2013[76]	Delirium	744	Spain	Retrospective	Cohort	12	Acute hospital/ general medicine	Hospital inpatients
Dinescu 2012[102]	Cognitive impairment	514	USA	Retrospective	Cohort	12	Acute hospital/ geriatric medicine	Hospital discharges of older patients admitted to a geriatric inpatient service
Dramé 2008[90]	Dementia and delirium	1306	France	Prospective	Cohort	10	Acute hospital/ geriatric medicine	Patients aged > 75 years
Dramé 2012[78]	Dementia	425	France	Prospective	Cohort	11	Acute hospital/ geriatric medicine	Patients with dementia aged > 75 years drawn from the SAFES cohort described in previous study[90]

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Dramé 2011[115]	Dementia and delirium	1047	France	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Patients aged > 75 years/ SAFES cohort
Edlund 2006[60]	Dementia, delirium and DSD	400	Sweden	Prospective	Cohort	8	Acute hospital/ general medicine	Patients aged > 70 years
Eeles 2010[126]	Dementia and delirium	278	UK	Prospective	Cohort	6	Acute hospital/ general medicine	Patients aged > 75 years
Eeles 2012[164]	Delirium	273	UK	Prospective	Cohort	60	Acute hospital/ general medicine	Patients aged > 75 years
Egberts 2015[165]	Delirium and cognitive impairment	86	The Netherlands	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Acutely admitted patients aged > 65 years
Erkinjuntti 1986[17]	Dementia, delirium, DSD and cognitive impairment	2000	Finland	Prospective	Cohort	14	Acute hospital/ general medicine	Patients aged ≥ 55 years admitted to a department of medicine
Erkinjuntti 1988[18]	Dementia	367	Finland	Prospective	Cohort	3	Acute hospital/ general medicine	Patients aged > 65 years
Esmayel 2013[43]	Cognitive impairment	200	Egypt		Cross-sectional	11	Acute hospital/ general medicine	Patients aged > 65 years
Espallargues 2008[138]	Cognitive impairment	1667	Spain, UK, Finland, Greece, Italy and Poland	Prospective	Cohort	36	Acute hospital/ general medicine	Patients aged > 65 years in eight hospitals in six European countries
Faezah 2008[72]	Delirium and cognitive impairment	400	Malaysia	Prospective	Cohort	6	Acute hospital/ geriatric medicine	Patients aged > 65 years
Feldman 1999[125]	Dementia, delirium, DSD and cognitive impairment	61	Israel	Prospective	Cohort	6	Acute hospital/ geriatric medicine	Patients aged > 70 years
Fields 1986[139]	Cognitive impairment	116	USA	Prospective	Cohort	1	Acute hospital/ general medicine	Patients admitted directly to hospital medical services
Fortini 2014[73]	Delirium and cognitive impairment	560	Italy	Prospective	Cohort	2	Acute hospital/ general medicine	Patients aged > 65 years
Forti 2014[145]	Cognitive impairment	470	Italy	Prospective	Cohort	9	Acute hospital/ general medicine	Patients aged > 65 years

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 26 Summary of included studies (*continued*)

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Francis 1992[112]	Delirium, DSD and cognitive impairment	205	USA	Descriptive cohort		36 including 2-year follow-up	Acute hospital/ general medicine	Patients aged > 70 years who had lived in the community prior to hospital admission
Francis 1990[131]	Dementia and delirium	229	USA	Prospective	Cohort	12	Acute hospital/ general medicine	Elderly patients admitted to medical services
Franco 2010[61]	Delirium and cognitive impairment	291	Colombia	Prospective	Case–control	NR	Acute hospital/ general medicine	Patients aged > 60 years
Freedberg 2008[104]	Cognitive impairment	200	USA	Retrospective	Matched cohort	12	Acute hospital/ general medicine	Patients aged > 85 years
Furlanetto 2003[86]	Cognitive impairment	317	Brazil	Prospective	Cohort	NR	Acute hospital/ general medicine	Medical inpatients consecutively admitted to general medical wards
Gallerani 2013[95]	Delirium and DSD	42,625	Italy	Retrospective	Cohort	96	Acute hospital/ general medicine	All patients admitted to medical units in Italy in 2002–10
Gehi 1980[166]	Organic mental syndromes	106	USA	Prospective	Cohort	NR	Acute hospital/ general medicine	Patients on the medical ward of a general hospital
Goldberg 2012[58]	Delirium and cognitive impairment	807	UK	Prospective	Cohort	6	Acute hospital/ general medicine	Adults aged ≥ 70 years admitted to general hospitals
Golmard 2009[111]	Dementia	224	France	Retrospective	Cohort	5	Acute hospital/ geriatric medicine	Elderly patients with available medical files admitted to acute care wards
González 2009[124]	Delirium	542	Chile	Prospective	Cohort	8	Acute hospital/ general medicine	Patients aged ≥ 65 years admitted to a hospital medical ward
Gottlieb 1991[51]	Delirium	235	USA	Prospective	Cohort	10	Acute hospital/ general medicine	Patients aged ≥ 70 years admitted to non-critical care internal medicine services

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Helvik 2014[147]	Cognitive impairment	463	Norway	Prospective	Cohort	48	Acute hospital/ general medicine	Hospitalised patients aged ≥ 65 years
Hossain 2012[173]	Acute confusional state	345	Bangladesh	Prospective	Cohort	4	Acute hospital/ general medicine	Adult patients presenting with acute confusional state
Hsieh 2015[92]	Delirium	260	USA	Prospective	Cohort	5	Acute hospital/ general medicine	Adults aged ≥ 65 years admitted to the inpatient ward from the ED
Inouye 1998[56]	Dementia and delirium	Development cohort: 207. Validation cohort: 318		Prospective	Cohort	Development study: 8. Validation study: 13	Acute hospital/ general medicine	Patients aged ≥ 70 years with no clinical evidence of delirium admitted to a general medicine department
Inouye 2006[141]	Dementia, delirium and RCD	460	USA	Prospective	Cohort	48	Acute hospital/ general medicine	Patients aged > 70 years
Iseli 2007[87]	Delirium and cognitive impairment	104	Australia	Prospective	Cohort	2	Acute hospital/ general medicine	Patients aged ≥ 65 years admitted to a general medical unit
Isfandiaty 2012[62]	Delirium and cognitive impairment	457	Indonesia	Retrospective	Cohort	36	Acute hospital/ geriatric medicine	Patients aged ≥ 60 years
Jackson 2016[88]	Dementia, delirium, DSD and cognitive impairment	82	UK	Prospective	Cohort	20	Acute hospital/ general medicine	Patients aged > 70 years
Jarrett 1995[151]	Delirium	193	Canada	Prospective	Cohort	11	Acute hospital/ geriatric medicine	Patients aged ≥ 65 years admitted to general medical services
Jitapunkul 1998[49]	Dementia, delirium and cognitive impairment	190	Thailand	Prospective	Cohort	2	Acute hospital/ general medicine	Female acutely admitted inpatients
Jitapunkul 1992[96]	Dementia, delirium and DSD	184	UK	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Patients aged > 60 years
Johnson 1990[152]	Delirium and DSD	235	USA	Prospective	Cohort	8	Acute hospital/ general medicine	Patients aged ≥ 70 years

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 26 Summary of included studies (*continued*)

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Joosten 2014[153]	Delirium	220	Belgium	Prospective	Cohort	8	Acute hospital/ geriatric medicine	Patients aged ≥ 70 years admitted to acute geriatric ward
Joray 2004[148]	Cognitive impairment	401	Switzerland	Prospective	Cohort	6	Acute hospital/ general medicine	Patients aged ≥ 75 years admitted to a general internal medical service
Khurana 2011[57]	Delirium and cognitive impairment	400	India	Prospective	Cohort	23	Acute hospital/ general medicine	People aged ≥ 60 years admitted to hospital with delirium
Kolbeinsson 1993[97]	Dementia, delirium and DSD	331	Iceland	Prospective	Cohort	5	Acute hospital/ general medicine	Patients aged ≥ 70 years
Korevaar 2005[154]	Delirium and cognitive impairment	126	The Netherlands	Prospective	Cohort	24	Acute hospital/ general medicine	Patients aged ≥ 65 years admitted to an internal medicine department
Lakhan 2011[155]	Cognitive impairment	577	Australia	Prospective	Cohort	3	Acute hospital/ general medicine	Patients aged ≥ 70 years
Lam 2014[70]	Dementia, delirium and DSD	234	Singapore	Prospective	Cohort	24	Acute hospital/ geriatric medicine	Patients aged > 65 years with delirium
Lang 2010[79]	Dementia, delirium and DSD	178	France	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Drawn from SAFES cohort; patients aged > 75 years
Lang 2006[133]	Delirium and cognitive impairment	908	France	Prospective	Cohort	10	Acute hospital/ geriatric medicine	Patients aged > 75 years
Lattanzio 2012[91]	Dementia	506	Italy	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Patients aged > 65 years
Levenson 1992[167]	Cognitive impairment	1020	USA	Prospective	Cohort	21	Acute hospital/ general medicine	Patients with psychopathology or pain
Lima 2010[123]	Delirium	199	Brazil	Prospective	Cohort	23	Acute hospital/ geriatric medicine	Hospital patients aged > 60 years
Lorén Guerrero 2011[44]	Dementia and cognitive impairment	81	Spain	Descriptive	Cross-sectional	2	Acute hospital/ general medicine	Patients aged > 65 years

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Macdonald 2007[174]	Delirium and cognitive impairment	86	UK	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Patients aged > 70 years
Maia 2016[156]	Dementia, delirium and cognitive impairment	224	Brazil	Prospective	Cohort	11	Acute hospital/ general medicine	Patients aged > 60 years screened for dementia
Marengoni 2008[45]	Dementia and cognitive impairment	830	Italy		Cross-sectional	23	Acute hospital/ geriatric medicine	Patients aged > 65 years
Marengoni 2011[110]	Dementia	1221	Italy	Prospective	Cohort	12	Acute hospital/ geriatric medicine	Patients aged > 65 years
Marengoni 2004[146]	Dementia and cognitive impairment	830	Italy	Prospective	Cohort	23	Acute hospital/ geriatric medicine	Patients aged > 65 years
Marengoni 2013[140]	Cognitive impairment	1201	Italy	Prospective	Cohort	15 (including follow-up of 3 months)	Acute hospital/ geriatric medicine	Patients aged > 65 years
Margiotta 2006[19]	Dementia, delirium and DSD	330	Italy		Cross-sectional	6	Acute hospital/ general medicine	Patients aged > 65 years
Martínez-Velilla 2013[116]	Delirium and SSD	85	Spain	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Patients aged > 74 years
Martínez-Velilla 2013[71]	Cognitive impairment	85	Spain	Prospective	Cohort	1-year follow-up	Acute hospital/ geriatric medicine	Patients aged > 75 years
Martínez-Velilla 2014[103]	Dementia	122	Spain	Prospective	Cohort	5 years follow-up	Acute hospital/ geriatric medicine	Patients aged > 75 years
Matzen 2012[157]	Dementia, delirium and cognitive impairment	5087	Denmark	Prospective	Cohort	57	Acute hospital/ geriatric medicine	Patients aged > 65 years
McAvay 2006[63]	Dementia, delirium and DSD	433	USA	Retrospective	Secondary analysis	48	Acute hospital/ general medicine	Patients aged ≥ 70 years without delirium at hospital admission
McCusker 2002[26]	Dementia and delirium	361	Canada	Prospective	Cohort	12	Acute hospital/ general medicine	Medical inpatients aged ≥ 65 years

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 26 Summary of included studies (*continued*)

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
McCusker 2001[94]	Dementia, delirium, DSD and cognitive impairment	315	Canada	Prospective	Cohort	36	Acute hospital/ general medicine	Patients aged ≥ 65 years admitted from the emergency department to the medical services
McCusker 2003[109]	Dementia and delirium	193	Canada	Prospective	Cohort	12	Acute hospital/ general medicine	Patients aged > 65 years with delirium
McCusker 2003[134]	Cognitive impairment	359	Canada	Prospective	Cohort	12	Acute hospital/ general medicine	Medical admissions of patients aged ≥ 65 years from the ED with delirium diagnosed during the first week in hospital
Nair 2000[175]	Dementia and delirium	100	Australia	Prospective	Cohort	NR	Acute hospital/ general medicine	Patients aged ≥ 70 years admitted to medical wards
O'Keeffe 1999[122]	Delirium and cognitive impairment	225	Ireland	Retrospective	Secondary analysis	18	Acute hospital/ geriatric medicine	Described in a separate article
O'Keeffe 1997[121]	Dementia and cognitive impairment	225	Ireland	Prospective	Cohort	24	Acute hospital/ geriatric medicine	Emergency admissions to an acute geriatric unit
Orsitto 2005[99]	Dementia and cognitive impairment	179	Italy	Prospective	Cohort	5	Acute hospital/ geriatric medicine	Patients aged > 65 years with suspected or ascertained cognitive impairment
Orsitto 2012[46]	Dementia and cognitive impairment	560	Italy		Cross-sectional	12	Acute hospital/ geriatric medicine	People aged ≥ 65 years with no past or present medical or psychiatric conditions, or psychoactive substance use that can cause cerebral dysfunction admitted to hospital

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Orsitto 2009[100]	Dementia, delirium and cognitive impairment	588	Italy	Prospective	Cohort	12	Acute hospital/ geriatric medicine	Hospitalised patients aged ≥ 65 years
Pedone 2005[54]	Delirium	9061	Italy	Prospective	Cohort	84	Multi centre study/ geriatric and general medicine	People aged ≥ 65 years admitted to hospital
Pendlebury 2015[120]	Dementia and cognitive impairment	503	UK	Prospective	Cohort	60	Acute hospital/ general medicine	Patients aged 16–99 years
Ponzetto 2002[108]	Dementia and delirium	817	Italy	Prospective	Cohort	84	Acute hospital/ general medicine	People aged ≥ 70 years consecutively admitted to a geriatric ward
Praditsuwan 2012[176]	Dementia, delirium and DSD	225	Thailand	Prospective	Cohort	3	Acute hospital/ general medicine	Patients aged ≥ 70 years admitted to general medical wards
Praditsuwan 2013[119]	Cognitive impairment	225	Thailand	Prospective	Cohort	NR	Acute hospital/ general medicine	Patients aged ≥ 70 years admitted to general medical wards
Raymont 2004[47]	Dementia, delirium and cognitive impairment	302	UK		Cross-sectional	NR	Acute hospital/ general medicine	Mixed sample of adults aged > 18 years
Rockwood 1989[83]	Dementia and delirium	80	USA	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Patients aged > 65 years
Rozzini 2009[52]	Dementia and cognitive impairment	2171	Italy	Prospective	Cohort	42	Acute hospital/ geriatric medicine	Patients aged ≥ 70 years admitted for acute care to a geriatric ward
Rozzini 2005[177]	Dementia	950	Italy	Prospective	Cohort	15	Acute hospital/ geriatric medicine	Patients with average age of > 60 years
Sahadevan 1999[80]	Dementia and delirium	100	Singapore	Retrospective	Cohort	9	Acute hospital/ geriatric medicine	Patients aged > 75 years
Sampson 2013[107]	Dementia, delirium and cognitive impairment	616	UK	Prospective	Cohort	6	Acute hospital/ general medicine	Patients aged > 70 years
Sampson 2009[12]	Dementia and delirium	805	UK	Prospective	Cohort	6	Acute hospital/ general medicine	Patients aged > 70 years

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 26 Summary of included studies (*continued*)

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
Sampson 2014[158]	Dementia, delirium and cognitive impairment	230	UK	Prospective	Cohort	6	Acute hospital/ general medicine	Patients with dementia aged > 70 years
Saravay 2004[114]	Delirium	93	USA	Prospective	Cohort	8	Acute hospital/ general medicine	Patients aged > 65 years
Silva 2009[118]	Dementia and cognitive impairment	856	Brazil	Prospective	Cohort	8	Acute hospital/ geriatric medicine	Patients aged 60–104 years
Sonnenblick 2007[106]	Dementia, delirium and cognitive impairment	779	Israel	Prospective	Cohort	3	Acute hospital/ general medicine	Patients aged ≥ 65 years
Srinonprasert 2011[160]	Delirium	225	Thailand	Prospective	Cohort	NR	Acute hospital/ general medicine	Patients aged ≥ 70 years
Thomas 1988[135]	Dementia	133	Israel	Prospective	Cohort	1	Acute hospital/ general medicine	Hospitalised patients
Torian 1992[20]	Dementia	143	USA	Prospective	Cohort	12	Acute hospital/ geriatric medicine	Frail elderly
Torisson 2012[142]	Dementia, delirium and DSD	200	Sweden	Prospective	Cohort	21	Acute hospital/ general medicine	Patients aged ≥ 60 years
Travers 2013[161]	Dementia and delirium	294	Australia	Prospective	Cohort	19	Acute hospital/ general medicine	Patients aged > 70 years
Wakefield 2002[66]	Dementia and delirium	117	USA	Prospective	Cohort	8	Acute hospital/ general medicine	Male patients aged > 65 years
Wakefield 2002[67]	Dementia and delirium	117	USA	Prospective	Cohort	8	Acute hospital/ general medicine	Male patients aged > 65 years
Wancata 2003[21]	Dementia	360	Austria	Prospective	Cohort	NR	Acute hospital/ geriatric medicine	Patients aged > 60 years
Watkin 2012[168]	Dementia, delirium and cognitive impairment	710	UK	Prospective	Cohort	6	Acute hospital/ general medicine	Patients aged > 70 years
Weber 2015[169]	Dementia	12,210	Czech Republic	Prospective	Cohort	204	Acute hospital/ geriatric medicine	Patients aged ≥ 65 years

Study (first author and year)	CSD(s)	Number of participants	Country	Study design	Design	Duration (months)	Setting	Population of interest
White 2005[117]	Dementia, delirium and DSD	283	UK	Prospective	Cohort	6	Acute hospital/ geriatric medicine	Patients aged > 75 years
Wierenga 2012[162]	Delirium and cognitive impairment	641	The Netherlands	Prospective	Cohort	52	Acute hospital/ geriatric medicine	Patients aged > 65 years
Wilson 2005[64]	Delirium	100	UK	Prospective	Cohort	14	Acute hospital/ general medicine	Non-delirious patients with severe physical illness aged > 75 years
Zekry 2011[105]	Dementia and cognitive impairment	444	Switzerland	Prospective	Cohort	12	Acute hospital/ geriatric medicine	Very old people discharged from acute care
Zuliani 2013[48]	Cognitive impairment and SSD	438	Italy		Cross-sectional	NR	Acute hospital/ geriatric medicine	Patients aged > 64 years

ED, emergency department; NR, not reported.
Note
Bold denotes studies with high scores in the quality assessment.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Cognitive spectrum disorder prevalence

TABLE 27 Delirium prevalence

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Adamis 2006[59]	CAM; DRS	33	28.7%	82.8 (6.5)	40.4	94	Included: aged ≥ 70 years needing specialist assessment Excluded: severe aphasia, inclusion on an earlier admission, non-English speaking
Adamis 2011[136]	CAM; DRS	47	25.6%	84.6 (6.57)	32.9	164	Included: aged ≥ 70 years admitted to unit within 3 days of admission Excluded: terminally ill, included on earlier admission
Adamis 2009[170]	CAM; DRS	63	37.3%	84.2 (6.3)	28.4	67	Included: aged > 70 years admitted from hospital/home to EMU within 3 days of admission Excluded: terminally ill, included on earlier admission, non-English speaking, intubated, severe aphasia, severe sensory problems
Adamis 2014[137]	CAM; DRS	41	28.8%	84.8 (6.4)	33	142	Included: aged > 70 years needing specialist assessment assessed within 3 days of admission to elderly medical unit Excluded: terminally ill, severe aphasia, hearing or visual impairment, intubated, non-English speaking

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Adamis 2007[130]	CAM; DRS	47	25.6%	84.6 (6.57)	32.9	164	Included: admitted to EMU within 3 days of acute admission Excluded: included in study on a previous admission, patients with known terminal illness and patients whose performance of cognitive tests was precluded by severe aphasia, hearing or visual impairment
Adamis 2007[149]	CAM; DRS	47	25.6%	84.6 (6.57)	32.9	164	Included: aged ≥ 70 years, admitted to elderly care unit within 3 days of admission to hospital Excluded: in hospital for > 3 days, included on a previous admission, known terminal illness, severe aphasia, hearing or visual impairment, intubated or did not speak English
Balan 2001[163]	ICD-9-CM	546	6.3%	76 (18)	46.3	4929	Included: aged ≥ 65 years admitted to hospital medical wards Excluded: unable to communicate as a result of either an extremely deteriorated mental state or a coma. Patients admitted with only delirium developed outside the hospital did not enter the study so as to exclude specific factors related to one's home environment

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Basic 2009[74]	Diagnosis active on admission	NR	NR	LoS > 3 days: 82.6 (7.5) LoS ≤ 3 days: 82.6 (7.1)	LoS > 3 days: 39.8 LoS ≤ 3 days: 37.9	2186	Included: older patients admitted through the ED of a university hospital. Most patients were selected based on geriatric targeting criteria that included functional impairment, gait abnormality and falls, multiple medical problems, psychosocial problems, delirium, polypharmacy, deconditioning, malnutrition and multiple unplanned admissions
Basic 2015[75]	NR	NR	Fall group ($n = 257$): 51.0% No-fall group ($n = 2688$): 29.4%	82.8 (7.6)	38.3	2945	Included: admitted to acute geriatric medicine service Excluded: admitted from a nursing home or died in hospital
Beauchet 2013[132]	CAM	102	19.2%	85.0 (7.2)	40.9	531	Included: unplanned admission to hospital and aged ≥ 75 years
Bellelli 2015[55]	Neuropsychiatric disorder/as per ICD-9 codes. Note that cognitive performance was assessed using SBT to establish neurocognitive performance on one or more of following: orientation, memory and attention	74	1.8%	79.1 (7.3)	49.2	2521	Included: aged > 65 years, underwent SBT assessment within 72 hours of admission Excluded: in coma, incomplete data, alcohol-withdrawal delirium

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Bourdel-Marchasson 2004[68]	CAM algorithm. Patients with one or more CAM symptom but not fulfilling CAM algorithm were considered as having SSD	49	Delirium: 8% SSD: 20.6%	Discharged to community: 84.6 (6.2) Discharged to geriatric institutions: 85.6 (6.8)	Discharged to community: male-to-female ratio 0.52 Discharged to geriatric institutions: male-to-female ratio 0.26	427	Included: aged > 75 years on their first admission to the unit during the study period Excluded: generally living in an institution, deceased before discharge, stay of < 3 days
Boustani 2010[129]	CAM. Patient displaying both (1) acute and fluctuating changes in mental status and (2) inattention, and at least one of (3) disorganised or incoherent thinking and (4) altered level of consciousness	163	NR	74.8 (7.5)	32.2	424	Included: aged ≥ 65 years, hospitalised on a medical ward, able to speak English and with cognitive impairment at time of hospital admission Excluded: previously enrolled on the study, enrolled in another clinical study at time of admission, or aphasic or unresponsive at the time of screening
Buurman 2011[128]	CAM	118	19.0%	78.2 (7.8)	46.2	639	Included: aged ≥ 65 years acutely admitted to general internal medical wards Excluded: patient or relatives did not give informed consent, unable to speak or understand Dutch, transferred from another ward inside or outside the hospital, transferred to the ICU, coronary care unit or another ward inside or outside the hospital within 48 hours of admission, terminally ill

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Cole 2008[69]	SSD: symptoms preceding or following episode of full-blown delirium or never progress to full-blown delirium. Three mutually exclusive groups: SSD recovered, SSD non-recovered and no SSD. Prevalent SSD: presence of two or more of four core symptoms on admission. Incident SSD: the presence of one or more new symptoms using DI during week 1. Prevalent SSD: SSD at 8 weeks determined by two or more core symptoms. Incident SSD: presence of SSD at 8 weeks determined by one or more new symptoms (not present at admission) CAM; DSM-III-R; DI	Delirium: 186 SSD: 162	Prevalent delirium: 161/1552 (10.4%) Prevalent SSD: 129/200 (65%)	SSD recovered: 82.3 (6.6) SSD not recovered: 84.5 (7.1) No SSD: 81.2 (5.6)	SSD recovered: 29.8 SSD not recovered: 24 No SSD: 29	At enrolment, 1552 screened for delirium. 200 selected for inclusion 129 (at 8 weeks – SSD recovered: 51; SSD not recovered: 47; no SSD: 31)	Included: aged > 65 years Excluded: stroke, admission to oncology/terminal, ICU/cardiac monitoring unless transferred to medical unit within 48 hours
Collins 2010[65]	CAM; DSM-III-R	110	16%	Mean 83	41	710	Included: patients aged > 70 years, unplanned acute admission to medical unit from A&E and GPs Excluded: inhibitive lack of English for CAM, if admitted for < 48 hours, stroke, surgery or coronary procedures

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Corsinovi 2009[172]	DSM-IV; CAM	NR	*Delirious symptoms, as defined in the CAM scale, were also associated with superior incidence of falls (27.3% vs. 10.7%). 70/620 patients fell*	79.3 (8.9)	55	620	NR
Dasgupta 2014[127]	Delirium screening comprised a chart audit tool assessing for documentation of key delirium symptoms and brief mental status screening, using the SPMSQ	355	28.70%	82.6	57.1	1235	Included: aged ≥ 70 years, consent given. In cases of questionable consent, and for all delirious patients, consent from the caregiver was required Excluded: lack of a willing caregiver or substitute decision-maker, transfer to another non-medical service within 7 days of admission, admission for palliative or long-term institutionalisation purposes only, inability to speak English, known pre-terminal medical condition (expected life expectancy of < 6 months), severe hearing impairment or communication difficulties, pre-hospitalisation residence in a nursing home or complete dependence for ADL, direct transfer from other inpatient units, enrolment in other interventional studies

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
de Boissieu 2015[113]	DSM-IV	69	24%	93 (2.7)	24	291	Included: aged > 75 years Excluded: admitted to surgery or ICU after ED, or discharged after ED
Deshpande 1989[50]	ICD-9	21	6%	NR	39.6 (of *n* = 326 screened with self-reporting questionnaire)	350	Included: those speaking English or Hindi Excluded: patients in extremis, those who died within 3 days of admission, those aged < 15 years, those admitted for < 3 days, 10 re-admissions formerly included, and failure to complete questionnaires
Díez-Manglano 2013[76]	Diagnosed if nursing/ administrative records stated 'delirium' or 'confusion'	97	13%	Median 74.5 (IQR 16)	48	744	Included: admitted to one of two nursing home units at time periods between 2010 and 2011 No exclusion criteria reported
Dramé 2008[90]	DSM-IV; MMSE	261	20.10%	85 (5.9)	35	1306	Included: aged > 75 years and hospitalised in same hospital as the ED ward to which admitted Excluded: ICU or surgery patients or if admission did not occur after admission to ED
Dramé 2011[115]	DSM-IV	213	20.5%	84 (5.9)	39.5	1047	No inclusion criteria reported Excluded: prior institutionalisations pre admission

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Edlund 2006[60]	DSM-IV; MMSE	125	Overall: 31% Hypoactive delirium: 24% Mixed delirium: 15.2% Unclassified delirium: 39.2% Emotional delirium: 48% Psychotic delirium: 19.2% Mixed emotional and psychotic delirium: 12%	Delirious group: 81.8 (6.3) Non-delirious group: 79.4 (5.7)	Delirious group: 53 Non-delirious group: 40	400	No inclusion criteria reported Excluded: aged < 70 years and unwilling to participate
Eeles 2010[126]	DSM-IV	103	37%	82.5 (5.6)	42	278	Included: aged > 75 years No exclusion criteria reported
Eeles 2012[164]	DSM-IV	102	37.40%	82.3 (7.5)	41	273	Included: aged > 75 years Excluded: lack of consent
Egberts 2015[165]	DSM-IV; delirious observation screening scale scores	23	24%	No delirium mean: 81.0 Delirium mean: 87.0	No delirium: 47.6 Delirium: 43.5	86	Included: aged > 65 years Excluded: Lewy body dementia, PD, neuroleptic malignant syndrome, tardive dyskinesia, antipsychotic treatment course, other psychiatric medications except benzodiazepines/ haloperidol, aphasia, insufficient understanding of Dutch, MMSE score of < 10

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Erkinjuntti 1986[17]	CAM	Prevalent: 301	15.10%	Dementia group: 79.2 (7.3) Non-dementia group: 70.7 (8.8)	43.5	2000	Included: aged ≥ 55 years admitted to department of medicine No exclusion criteria reported
Faezah 2008[72]	CAM	112	Overall, 28%; hyperactive delirium, 66%; hypoactive delirium, 27%; mixed delirium, 7%	65–70 (3%); 71–74 (6%); 71–75 (27%); > 81 (48%)	NR	400	Included: aged > 65 years Excluded: not able to respond to verbal stimuli
Feldman 1999[125]	CAM; DRS	11	18%	With delirium: 83.2 (6.8) Without delirium: 80.5 (6.9)	With delirium (*n* = 11): 72.7 Without delirium (*n* = 50): 50	61	Included: aged > 70 years admitted to geriatric unit on first admission only Excluded: those not admitted to geriatric unit on day of admission, elective patients, aphasia/ deafness, turnaround of < 48 hours, moribund conditions, patients not assessed within 48 hours of admission
Fortini 2014[73]	CAM	63 (44 incident, 19 prevalent) Of incident cases: 32 hyperactive, 5 hypoactive, 7 mixed	3%	80.35 (7.63)	49.64	560	Included: aged > 65 years

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Francis 1990[131]	DSM-III-R	50	15.7%	Mean 78	37	229	Included: aged ≥ 70 years admitted directly to medical ward from community Excluded: patients admitted from nursing homes, patients admitted for terminal care or treatment of metastatic cancer, patients currently under psychiatric treatment, patients whose dementia and impairment in ADL required continual supervision, patients who were blind, deaf, aphasic or unable to speak English
Francis 1992[112]	DSM-III-R	45	45/205 (19.7%). Note 50/229 in original cohort but five died or were unable to be followed up	Delirium: 78.9 (6.1) Control: 77.7 (5.6)	Delirium: 47 Controls: 36	205 (delirium: 45; controls: 160)	Included: all admissions aged ≥ 70 years Excluded patients from other hospitals or nursing homes, terminal illness, severe dementia, aphasia, non-English speaking, deafness/blindness, admission < 48 hours
Franco 2010[61]	CAM-S for prevalent delirium to exclude such patients; DRS to assess incidence	34	Not applicable	74.4 (8.79)	With delirium (*n* = 34): 38 Without delirium (*n* = 257): 35.8	291	Included: aged > 60 years Excluded: prevalent delirium, coma, or stupor. At pre-discharge follow-up, exclude died, transferred to ICU/ surgery, or delirium diagnosis

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Gallerani 2013[95]	ICD-9-CM codes	1300 overall; 51.4% in females; 48.6% in males	749/42,625 (1.8%)	70.9 (16.4)	47.3	42,625	No inclusion criteria reported Excluded: all alcohol/drug-related deliriums
Goldberg 2012[58]	DRS score of > 17.75	NR	27% (95% CI 46% to 54%)	Median 83; range 70–105	45.1	807	Included: aged > 70 years with unplanned admissions to 1 of 12 wards Exclusion: unwillingness to be screened, being unconscious or too ill to be interviewed up to fifth day of admission, inability to speak English with no available interpreter
González 2009[124]	CAM	192	30.80%	77.9 (7.6)	38.4	542	Included: aged ≥ 65 years admitted to the medical ward in the previous 48 hours where informed consent was obtained from the patient or their legal representative Excluded: evidence of severe aphasia, coma and inability to participate in cognitive assessments
Gottlieb 1991[51]	DSM-III	48	38 (16%, 95% CI 11% to 21%)	NR	39	235	Included: aged ≥ 70 years admitted to general medicine wards between Sunday afternoon and Friday evening Excluded: transferred from another unit within the hospital, patients admitted for an anticipated short stay such as chemotherapy, transfusion or specific medical diagnosis study, or admitted for terminal care

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Hsieh 2015[92]	CAM-ICU	38	NR	Never delirious: 76 (8) Ever delirious: 83 (8)	Never delirious: 39 Ever delirious: 47	260 (222 never delirious; 38 delirious on at least 1 of their first 3 days in hospital)	Included: aged ≥ 65 years, listed for admission to a non-ICU inpatient ward, consent given verbally or, if lacking capacity to make clinical decisions or delirious, from a surrogate Excluded: admitted from the ED to the ICU, non-English speaking, unable to be assessed for delirium or unavailable owing to diagnostic tests or procedures. Patients admitted to the hospital but subsequently discharged from the ED, left or signed out against medical advice
Inouye 1998[56]	CAM	NR	5%	Development cohort: 79 (6) Validation cohort: 79 (6)	Development study: 41 Validation cohort: 46	Development cohort: 207 Validation cohort: 318	Included: aged ≥ 70 years admitted to the general medicine department Excluded: clinical evidence of delirium at enrolment; could not be interviewed for reasons including intubation, coma, severe aphasia or terminal condition; discharged in < 48 hours, patient or physician declined participation, enrolled in study on previous admission
Inouye 2006[141]	CAM	60	13%	80 (6.5)	39.8	460	Included: aged ≥ 70 years admitted to general medical service Excluded: lack of two MMSE scores during hospitalisation

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Iseli 2007[87]	CAM; AMT score of < 8 points	21	19/104 (18%)	80.1 (6.95)	43.3	104	Included: aged ≥ 65 years admitted to a general medical unit from the ED Excluded: patients with aphasia, in a coma, admitted to the ICU, unable to speak English (with no interpreter available) or refused consent
Isfandiaty 2012[62]	Diagnosis of delirium by treating doctors, based on the presence of acute mental change in patients with previously fully alert marked by disorientation, sleep disturbance and/or agitation	86	NR	69.6 (7.09)	52.5	457	Included: aged > 60 years Excluded: admission-based delirium or acute confusional state
Jackson 2016[88]	DSM-IV-TR	82	100%	84.4 (6.5)	34.1	82	Inclusion: meeting DSM-IV-TR criteria for delirium, informed consent from participant or next of kin if the participant lacked the mental capacity to give it Excluded: declined follow-up or could not be contacted for follow-up, died before follow-up, unable to communicate because of severe sensory impairment or inability to communicate in English, those deemed to be at risk of imminent death

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Jarrett 1995[151]	DSM-III-R	48	Well elderly ($n = 19$) presentation of delirium – 6 (32%) Frail elderly ($n = 69$) presentation of delirium – 42 (61%)	78.3 (7.6)	46	193	Included: not described. Cohort was a subset of a larger cohort described in another paper Excluded: patients transferred from other services or from ICUs
Jitapunkul 1998[49]	DSM-III-R to assess delirium in the first 48 hours of admission. 'History of acute confusion'? Taken at admission but not defined in paper	13	6.80%	47.7 (19.3)	All female	190	Included: aged > 60 years No exclusion criteria reported
Jitapunkul 1992[96]	DSM-III-R	40	21.70%	81.7 (6.6)	41	184	Included: aged > 60 years Excluded: respite or rehabilitation
Johnson 1990[152]	DSM-III	48	16%		39	235	Included: aged ≥ 70 years, admitted between Sunday afternoon and Friday evening Excluded: transferred from another unit within the hospital, admitted for an anticipated short stay such as chemotherapy, or a diagnostic study, or terminal care
Joosten 2014[153]	CAM	24	NR	Non-frail and pre-frail (CHS frailty index): 83.7 (4.8) Frail: 83.3 (5.4)	43	220	Excluded: declined to participate, dropped out of study, terminally ill, non-Dutch speaking, aged < 70 years, unable to converse minimally, severe hearing or visual problems, isolation due to acute infectious diseases, very poor health condition, re-admission during study period, discharge or death within 24 hours of admission, incomplete CHS frailty index data

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Khurana 2011[57]	CAM; DSM-IV	400 (hypoactive: 259; hyperactive: 102; mixed: 39)	85.50%	Men: 70.87 (9.26) Women: 70.81 (8.4)	Male-to-female ratio: 1.27 : 1	400	Included: patients aged ≥ 60 years were selected on the basis of the following criteria of delirium in DSM-IV – acute onset; fluctuating course; difficulty in focusing, maintaining or shifting attention and disorganised thinking/ altered levels of consciousness Excluded: patients with dementia, psychosis or incommunicability
Kolbeinsson 1993[97]	Patients scoring ≤ 22 MMSE points and ≤ 8 MSQ points classed into OBS of delirium or dementia according to DSM-III-R	37	37/272 (14%)	Delirium group: 81.7 (7.2) Dementia group: 84.9 (5.9) Normals group: 79.3 (6.2)	Delirium group (*n* = 37): 62.2 Dementia group (*n* = 50): 40 Normals group (*n* = 185): 49.7	331	Included: aged > 70 years Excluded: cerebral bleeding, cardiac arrest, unconsciousness
Korevaar 2005[154]	CAM	36	29%	79.1 (7.8)	41	126	Included: consecutive patients aged ≥ 65 years acutely admitted to the department of internal medicine Excluded: unable to speak or understand Dutch or English, patient or relatives did not give permission for the study, patients who came from or were transferred to a ward other than internal medicine, patients who left the ward within 48 hours

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Lam 2014[70]	DRS-R98 to assess severity: primary outcome was rSSD – DRS-R98 severity of ≥ 13 on discharge at resolution from full SSD. SSD analysed as part of study but not predefined during data collection at first admission. CMMSE scores used to measure trajectory of delirium. Delirium subtype classification: hyperactive, hypoactive and mixed documented during first admission to GMU	155 (rSSD)	66.20%	84.1 (7.4)	43.6	234	Included: aged > 65 years with definite delirium as diagnosed by CAM delivered by primary geriatrician – incident or present on admission Excluded: medical illnesses needing special monitoring, respiratory precautions, contact precautions; dangerously ill, coma, terminal illness, severely uncommunicative/aphasic, combative behaviour, contraindications of use of bright light therapy, refusal to consent to GMU stay; premature transfer out of GMU or admissions to long-term care
Lang 2010[79]	DSM-IV	90	51%	86 (6)	33.1	178	Included: dementia diagnosis, aged > 75 years Excluded: surgery/ICU/ admission not from ED
Lang 2006[133]	1/15 Geriatric Syndromes Classification Part of Geriatric Syndromes Classification	NR	21.60%	84.1 (5.8)	36.6 (data as reported)	908	Included: aged > 75 years Excluded: surgical/ICU
Lima 2010[123]	DSM-IV	66	44/66 (66.60%)	77.9	46.7	199	Included: aged > 60 years hospitalised in geriatric unit Excluded: length of hospital stay of < 48 hours, death during hospital admission, not possible to obtain information about post-discharge survival

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Macdonald 2007[174]	CAM	32	26/86 (30.2%)	82.7 (6.6)	43	86	NR
Maia 2016[156]	CAM	41	18.5% (95% CI 13.5% to 23.5%)	72 (8.9)	62.1	224	Included: aged > 60 years No exclusion criteria reported
Marengoni 2011[110]	NR	16 (incidence)	Not applicable	79.4	55.9	1221	Included: aged > 65 years Excluded: incomplete data, patients not discharged home, terminally ill, transfer to rehabilitation units, surgical diseases, transfer to other hospital units
Margiotta 2006[19]	CAM; DRS for those developing delirium and ODFS to assess severity/fluctuations; DSM-III	63	10.4%. Note that, in paper, prevalence referred to as 'incidence' (i.e. 'defined as delirium present at hospital admission') Hyperactive delirium: 41%; hypoactive: 11%; mixed: 48%; without dementia/ presenting with delirium (*n* = 286): 13%	79.8 (8)	42 Delirium: 41	330	Included: aged > 65 years No exclusion criteria reported
Martínez-Velilla 2013[71]	CAM; DSM-IV; to diagnose SSD – defined SSD as non-full presence of each and every CAM definitive delirium criterion	64: delirium (*n* = 45); SSD (*n* = 19)	53% delirium; 22.3% SSD	87.0 (6.0)	43.5	85	Included: aged > 75 years Excluded: lack of consent to take part, comatose patients or life expectancy of < 3 months, alcohol withdrawal delirium and refusal

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
McAvay 2006[63]	CAM	55: 24 delirium at discharge, 31 cases resolved during hospitalisation	NR	79.8 (6.3)	39.7; delirium at discharge group: 33.3; delirium-resolved group: 45.2; never delirious group: 39.7	433	Included: patients aged ≥ 70 years who did not have delirium on admission to general medicine service, agreed to participate Excluded: unable to participate in interview (e.g. profound dementia, aphasia, intubation), death during hospitalisation, admitted to hospital from nursing home – desired to focus on new nursing home admissions
McCusker 2002[26]	CAM; SPMSQ	243	67.3%	Delirium: 65–74 (*n* = 29), 75–84 (*n* = 99), ≥ 85 (*n* = 115) Control: 65–74 (*n* = 11), 75–84 (*n* = 53), ≥ 85 (*n* = 54)	Delirium cohort: 39.5 Non-delirium cohort: 27.1	361	Included: patients aged ≥ 65 years admitted from ED to medical services Excluded: patients with primary diagnosis of stroke, patients admitted to oncology unit, patients who spoke neither English nor French, patients admitted to the ICU or cardiac monitoring unit unless transferred to a medical ward within 48 hours of admission.
McCusker 2001[94]	CAM	220	190/220 (86.4%)	Delirium and dementia: 65–74 (*n* = 15), 75–84 (*n* = 64), ≥ 85 (*n* = 85) Delirium only: 65–74 (*n* = 13), 75–84 (*n* = 27), ≥ 85 (*n* = 16)	37.1	315	Excluded: primary diagnosis of stroke, admitted to oncology unit, admitted to ICU or cardiac monitoring unit unless transferred to a medical unit within 48 hours of admission, did not speak French or English
McCusker 2003[109]	DSM-III-R; CAM; SPMSQ	193	85.5%	83.4 (7.3)	38.3	193	Included: aged > 65 years Excluded: stroke and non-English/French speakers

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
McCusker 2003[134]	SPMSQ; CAM	241	204/241	Prevalent delirium: 83.61 (7.40). Incident delirium: 82.30 (6.28). No delirium: 83.64 (6.58)	35.4	359. Prevalent delirium: 204; incident delirium: 37; no delirium: 118	Included: medical admissions of patients aged ≥ 65 years from ED Excluded: patients admitted to ICU or oncology, patients with a primary diagnosis of stroke
O'Keeffe 1999[122]	DAS, based on DSM-III	94. Retarded delirium: 27. Agitated delirium: 20. Mixed delirium: 40. Neither: 7	Incident and prevalent cases not defined	Retarded delirium: 83 (5). Agitated delirium: 82 (4). Mixed delirium: 82 (4). Neither: 84 (7)	NR	225	Excluded: patients not admitted to geriatric unit on days of admission, patients admitted electively for investigations, rehabilitation or respite care, patients expected to remain in hospital for < 48 hours, patients not assessed by a research doctor within 48 hours of admission
O'Keeffe 1997[121]	DAS to elicit presence and severity of individual DSM-III criteria for delirium, MMSE	Prevalent: 41; incident: 53	18%	Delirium: 82 (4); no delirium: 82 (6)	Delirium: 39; no delirium: 32	225	Included: patients admitted consecutively to an acute care geriatric unit, first admission during study period Excluded: patients not admitted to geriatric unit on day of admission, patients admitted electively for investigations, rehabilitation or respite care, patients with severe aphasia or deafness, patients expected to remain in hospital for < 48 hours, patients not assessed by a study doctor within 48 hours of admission

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Pedone 2005[54]	DSM-III-R criteria	NR	NR	77.4 (7)	47.7	9061	Included: aged ≥ 65 years Excluded: patients who died, those with an admission ADL score of 0 or missing ADL data, those with LoS of > 90 days or a diagnosis of mental retardation
Pendlebury 2015[120]	CAM; DSM-IV	101. Prevalent: 71. Incident: 30. Both: 17	71/503	Range: 16–99, median 72	48	503	Included: consecutive hospital patients
Praditsuwan 2012[176]	DSM-IV	110	40.40%	78 (5.9)	50.7	225	Inclusion: patients aged ≥ 70 years admitted to general medical wards Exclusion: endotracheal intubation at admission, aphasia, comatose or un-co-operative patients
Praditsuwan 2013[119]	DSM-IV	110	NR	78.0 (5.9)	50.7. Delirium: 41.8. Non-delirium: 59.1	225	Included: patients aged ≥ 70 years admitted to general medical wards who were able to communicate Excluded: being endotracheal intubated, unable to communicate, un-co-operative, transferred to other units, death within 24 hours, too unwell to be assessed
Rockwood 1989[83]	DSM-IV	24	25%	76.8	44	80	Excluded: admissions to coronary care or ICU
Rozzini 2009[52]	NR	Cumulative delirium: 310	NR	NR	49.9	2171	

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Sampson 2013[107]	CAM	93 cases excluded from analysis	43%	83.2 (7.3)	41	616	Included: aged > 70 years Excluded: admission < 48 hours or insufficient English speaking
Sampson 2009[12]	CAM	87 (56 delirium resolved and thus included)	14%	83	31	805	Included: aged > 70 years Excluded: discharged before assessment, refusal to consent or persistent delirium
Sampson 2014[158]	CAM	26	11.4%	87.2 (5.9)	44.2	230	Included: aged ≥ 70 years, unplanned acute medical admission, able to given written consent or with an informal carer or 'professional consultee' available to give assent, sufficient English language to complete the study ratings, AMT score of ≤ 7/10 points on admission Excluded: did not wish to participate, non-English speaking, moribund or where there were clinical concerns about them being approached
Saravay 2004[114]	DRS	NR	NR	Cognitive impairment: 79 (6.6); no cognitive impairment: 74.3 (96.2)	44	93	Included: aged > 65 years Excluded: transfer from psychiatric inpatient service, transfer from nursing home, elective admission or surgery or expected to be in hospital for < 48 hours

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Silva 2009[118]	DSM-IV	279	32.60%	78.43 (8.62)	38.2	856	Include: aged > 60 years Excluded: palliative care, refusal to consent, incomplete data
Srinonprasert 2011[160]	DSM-IV	110	91/225 (40%)	Mean 78	50.7	225	Included: aged ≥ 70 years Excluded: patients who were endotracheal intubated at admission, aphasia, comatose, refusal to participate
Thomas 1988[135]	DSM-III	NR	15%	Non delirious: 62.8 (17.97) Delirious: 68.8 (18.24)	Delirious: 49 Non delirious: 40	133	Excluded: transfers from surgery or ICU or subspecialty medical service; drug abuse
Travers 2013[161]	CAM/DSM-IV	55	37/294 (12.6%)	80.4 (6.5)	41.6	294	Included: aged > 70 years. Surgical, general and orthopaedic ward patients included; however, separate data are presented for general medical wards
Wakefield 2002[67]	Acute confusion – Neelon and Champagne (NEECHAM) Confusion Scale	'Acute confusion': 16	NR	73 (4.6)	All male	117	Included: aged > 65 years Excluded: too ill or could not communicate, admitted for hydration during chemotherapy, had a sedating medications procedure, had participated in a previous admission or had suspected tuberculosis

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 27 Delirium prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Watkin 2012[168]	CAM	NR	12.5% (of 710)	83.0 (7.4)	42	710	Included: aged > 70 years with unplanned admission Excluded: admitted for < 48 hours or did not speak sufficient English for cognitive assessment
White 2005[117]	CAM and DSM-IV	105	76 (26.9% of 283)	82.4 (0.3)	41	283	Included: aged > 75 years
Wierenga 2012[162]	CAM; DSM-IV; DOS	NR	25.90%	77.8 (7.9)	45.6	641	Included: aged > 65 years Excluded: unable to speak or understand Dutch or English, relatives did not consent, intensive care/cardiac monitoring, transfer to other wards
Wilson 2005[64]	CAM/DSM-III	12 (incidence)	Not applicable	84.5 (4.2)	31	100	Included: severe physical illness, APACHE II score of > 8, aged > 75 years Excluded: coma, delirium on admission, insulin-dependent diabetes mellitus, visual/hearing deficits preventing psychometric assessment, discharge or transfer within 48 hours, blood transfusion, too ill to communicate

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of delirium	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Inclusion/exclusion criteria
Zuliani 2013[48]	SSD only – excluded patients with full-blown delirium/DSM-IV used to distinguish these core symptoms of SSD: at least two of DSM-IV criteria for delirium. Diagnosis made within 48 hours of admission. Note that MMSE was used to evaluate deficit of attention (countdown), disorientation (time orientation) and memory deficit (three items delayed recall). Presence of disturbance of consciousness assessed by continuous observation and daily reviews but no standardised tool used. No cases of perceptual disturbances 'probably associated with full-blown delirium or dementia' and therefore excluded. DSM-IV; MMSE for clarity; daily reviews and continued clinical assessment	SSD: 166 Full-blown delirium (excluded patients: 129)	166/438 (37.9%)	80.6	39.9	438	Excluded: delirium and dementia patients

A&E, accident and emergency; APACHE, Acute Physiology and Chronic Health Evaluation; CAM-ICU, Confusion Assessment Method for the Intensive Care Unit; CAM-S, Confusion Assessment Method – Spanish; CHS, Cardiovascular Health Study; DAS, Delirium Assessment Scale; DI, Delirium Index; DOS, Delirium Observation Rating Scale; DRS, Delirium Rating Scale; DRS-R98, Delirium Rating Scale; Revised-98; DSM-III-R, *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition, Revised; ED, emergency department; EMU, emergency medical unit; GMU, general medical unit; GP, general practitioner; ICD-9-CM, *International Classification of Diseases*, Ninth Edition, Clinical Modification; IQR, interquartile range; MSQ, Mental Status Questionnaire; NR, not reported; OBS, organic brain syndrome; ODFS, One Day Fluctuation Scale; PD, Parkinson's disease; SBT, Short Blessed Test; SPMSQ, Short Portable Mental Status Questionnaire.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Adamis 2014[137]	DSM-IV – based on clinical history	64	45%	84.8 (6.4)	33	142	Yes	Included: patients needing specialist assessment aged > 70 years assessed within 3 days of admission to elderly medical unit Excluded: terminally ill, severe aphasia, hearing or visual impairment, intubated, non-English speaking
Aljishi 2014[89]	Any long-term cognitive deficit documented in patient's clinical record, regardless of aetiology	56	14%	Mean 68.7 (95% CI 68.80 to 68.80)	36.5	394	No	Included: patients re-admitted to general medicine within 30 days of discharge Excluded: patients admitted to specialised medical departments
Aminoff 2014[77]	DSM-IV, to include all dementias MMSE	183	100%	Demise in hospital: 85.2 (7.3) Discharged from hospital: 86.8 (7.9)	40	183	No	Included: those with impaired verbal communication (MMSE 0/30); complete dependence on ADL/functional movement; stage 7c or more on FAST scale (AD; poststroke; multi-infarct; unknown dementias included)
Barba 2011[42]	ICD-9-CM	88,356. Aged > 90 years: 13,698. Aged 65–90 years: 74,658	Aged > 90 years: 15.1% Aged 65–90 years: 7.1%	Mean ≥ 65	Aged 65–90 years: 51.3 Aged > 90 years: 32.9	1,135,423	No	NR

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Baron 1987[41]	Insufficient information; two cases of dementia derived from multi-infarcts and 'phenothiazine-induced parkinsonism'	6	33%	Range: 24–85	44	18	No	NR
Basic 2015[75]	NR	1282	44%	82.8 (7.6)	38.3	2945	Yes	Included: patients admitted to acute geriatric medicine service Excluded: patients admitted from a nursing home or who died in hospital
Bellelli 2015[55]	ICD-10. Note that cognitive performance assessed SBT to establish neurocognitive performance on one or more of following: orientation, memory and attention	196	7.8%	79.1 (7.3)	49.2	2521	Yes	Included: aged > 65 years, underwent SBT assessment within 72 hours of admission Excluded: those in coma/ with incomplete data; alcohol-withdrawal delirium
Bickel 2006[98]	Structured interview for diagnosis of dementia of the Alzheimer's type; multi-infarct dementia; other dementias according to DSM-III-R/ DSM-IV/ ICD-10, MMSE	59	7%	75.2 (5.5)	40.9	794	No	Included: aged 65–85 years; resided in Munich Excluded: severe/fatal physical illness; pre-existing dementia; nursing home residence; blind/deaf; imminent release within 2 days; inadequate facility in Germany

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Bogaisky 2015[82]	NR	509	49%	82.2 (8.4)	33	1038	No	Included: patients aged ≥ 65 years with 30-day re-admission to hospital No exclusion criteria reported
Briggs 2016[81]	Using HIPE 16, which codes diagnoses using ICD-10, a review was conducted of dementia-specific hospital activity from 2010 to 2012 compared with non-dementia groups, specifically comparing outcomes in patients aged > 65 years with the outcomes of dementia with those without dementia. Codes used were dementia in AD, vascular dementia, dementia in other diseases classified elsewhere and unspecified dementia	1433	929/69,718 (1.33%). There were 69,718 hospital admissions during the study period	Dementia group mean: 80.0 Non-dementia group mean: 39.4	NR	69,718	No	Included: people with dementia and without dementia aged > 65 years No other criteria reported
Cole 2008[69]	IQCODE	66	66/125 (53%)	SSD recovered: 82.3 (6.6) SSD not recovered: 84.5 (7.1) No SSD: 81.2 (5.6)	SSD recovered: 29.8; SSD not recovered: 24; no SSD: 29	200	Yes	Included: patients aged > 65 years Excluded: stroke; admission to oncology/ terminal; ICU/cardiac monitoring unless transferred to medical unit within 48 hours

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Collins 2010[65]	DSM-III-R; AMT; CAM used to discriminate between delirium and dementia	54	54/110 (49%)	Mean 83	41	710	Yes	Included: all patients aged > 70 years, unplanned acute admission to medical unit from A&E and GPs Excluded: inhibitive lack of English for CAM; if admitted for < 48 hours; stroke, surgery or coronary procedures
de Boissieu 2015[113]	DSM-IV	160	55%	93 (2.7)	24	291	Yes	Included: patients aged > 75 years; subjects not eligible if admitted to surgery or ICU after ED; or discharged after ED
Dhaussy 2012[150]	DSM-IV	589	45.50%	85 (6)	35.3	1306	No	Included: patients aged ≥ 75 years hospitalised in a medical department via ED in any of nine participating French university hospitals No exclusion criteria reported
Di Iorio 1998[85]	Existing clinical diagnosis of dementia; MMSE	104	27%	Chieti: 79.0 (0.8); Perugia: 77.8 (0.9); Pescara: 82.4 (0.7); Prato: 80.4 (0.6)	48	379	No	Included: non-planned; aged > 65 years; non-terminal Excluded were opposite of above
Di Iorio 1999[84]	'Dementia/psychiatric disorders' as defined using Cumulative Illness Rating Scale: presence measured as 1 = not present to 4 = present	NR	At Chieti site: 34.8%; Perugia: 41.7%; Precara: 37.6%; Prato: 42.0%	NR	45.5	402	No	Included: patients aged ≥ 65 years Excluded: stay of < 3 days or terminally ill No further criteria reported

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Dramé 2008[90]	Defined by presence of dementia diagnosis in medical records or assessment by senior practitioner – no assessment tools specified	589	45.40%	85 (5.9)	35	1306	Yes	Included: aged > 75 years and hospitalised in same hospital as the EMU ward to which admitted Excluded: intensive care or surgery patients or if admission did not occur after admission to EMU
Dramé 2012[78]	DSM-IV; MMSE	425	100%	86 (6)	37	425	No	Included: patients aged > 75 years; in same hospital as ED to which admitted Excluded: surgery/ICU, or if admission did not occur after ED admission
Dramé 2011[115]	DSM-IV	425	41%	84 (5.9)	39.5	1047	Yes	Excluded: prior institutionalisations pre admission
Edlund 2006[60]	DSM-IV; repeated cognitive testing with MMSE	10	2.50%	Delirious: 81.8 (6.3) Non-delirious: 79.4 (5.7)	Delirious group: 53 Non-delirious group: 40	400	Yes	No inclusion criteria reported Excluded: those aged < 70 years and unwillingness to participate
Eeles 2010[126]	Pre-existing dementia using IQCODE	NR	Delirium group: 57% Non-delirium group: 20%	82.5 (5.6)	42	278	Yes	Included: aged > 75 years

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Erkinjuntti 1986[17]	(1) cognitive decline sufficient to interfere with social and occupational functioning and to cause inability to care for oneself; (2) evidence of global cognitive impairment, impairment of memory and abstract thinking; (3) absence of delirium or other conditions (e.g. intoxication) that may disturb alertness or cloud consciousness SPMSQ The patient, a close informant or both, indicated a decline in cognitive function sufficient to affect the patient's ability to recognise people, perform everyday activities or get around in familial surroundings, as well as causing inability to take adequate care of oneself	181	9.10% overall prevalence Vascular dementia: 72.4% of 152 demented PDD: 23.0% of 152 demented Specific causes: 4.6% of 152 demented	Dementia group: 79.2 (7.3) Non-dementia group: 70.7 (8.8)	43.5	2000	Yes	Included: all patients aged ≥ 55 years admitted to department of medicine No exclusion criteria specified

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Erkinjuntti 1988[18]	SPMSQ; MMSE	One-day sample: 34 patients with dementia Consecutively admitted patients: 34 demented patients; six were admitted twice or more. Of 62 demented patients, 16.1% had PDD, 69.4% had vascular dementia and 14.5% had specific causes of dementia	One-day sample: 40% Consecutively admitted: 12.1%	The mean age (+ SEM) of the whole series of demented patients was 78.0 ± 0.9 years and that of the non-demented patients 75.3 ± 0.4 years ($p < 0.01$)	Dementia: 26.5 Non-dementia: 37.5	367	No	Included: aged > 65 years No other criteria reported
Faezah 2008[72]	NR	NR	25%	65–70 (3%); 71–74 (6%); 71–75 (27%); > 81 (48%)	NR	400	Yes	Included: aged > 65 years Excluded: those not able to respond to verbal stimuli
Feldman 1999[125]	MMSE	33	54%	With delirium: 83.2 (6.8) Without delirium: 80.5 (6.9)	With delirium ($n = 11$): 72.7 Without delirium ($n = 50$): 50	61	Yes	Included: all patients aged > 70 years admitted to geriatric unit on first admission only Excluded: those not admitted to geriatric unit on day of admission; elective patients; aphasia/deafness; turnaround of < 48 hours; moribund conditions; patients not assessed within 48 hours of admission

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Francis 1992[112]	DRS score of ≥ 4 indicates moderate dementia severity	32	15.60%	Delirium: 78.9 (6.1) Control: 77.7 (5.6)	Delirium: 47 Controls: 36	205 (Delirium: *n* = 45; controls: *n* = 160)	Yes	Included: all admissions aged ≥ 70 years Excluded: patients from other hospitals or nursing homes; terminal illness; severe dementia; aphasia; non-English speaking, deafness/blindness; admission < 48 hours
Golmard 2009[111]	MMSE score of < 25 or diagnosis reported on medical file	111	49.80%	85 (7.8)	29	224	No	Included: patients admitted consecutively to acute care wards Excluded: patients without available medical files
Hsieh 2015[92]	Dementia prospectively assessed by trained research assistants; assessment tool not specified	Never delirious: 15/222 Ever delirious: 14/38	Never delirious: 7% Ever delirious: 37%	Never delirious: 76 (8) Ever delirious: 83 (8)	Never delirious: 39 Ever delirious: 47	260 (never delirious: *n* = 222; delirious on at least 1 of their first 3 days in hospital *n* = 38)	Yes	Included: aged ≥ 65 years, listed for admission to a non-ICU inpatient ward, consent given verbally or, if lacking capacity to make clinical decisions or delirious, from a surrogate Excluded: admitted from ED to ICU, non-English speaking, unable to be assessed for delirium (e.g. comatose, severe dementia, severe psychiatric illness) or unavailable owing to diagnostic tests or procedures. Patients admitted to the hospital but subsequently discharged from the ED, left or signed out against medical advice

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Inouye 1998[56]	MMSE; mBDRS; composite measure of MMSE and mBDRS[a]	NR	17%	Development cohort: 79 (6) Validation cohort: 79 (6)	Development cohort: 41 Validation cohort: 46	Development cohort: $n = 207$ Validation cohort: $n = 318$	Yes	Included: patients aged ≥ 70 years admitted to the general medicine department Excluded: clinical evidence of delirium at enrolment; could not be interviewed for reasons including intubation, coma, severe aphasia or terminal condition; discharge in < 48 hours, patient or physician declined participation, enrolled in study on previous admission
Inouye 2006[141]	Presence of cognitive symptoms for at least 6 months and mBDRS score of ≥ 4	56	56/425 (13.2%)	80 (6.5)	39.8	460	Yes	Included: patients aged ≥ 70 years admitted to general medical service Excluded: lack of two MMSE scores during hospitalisation

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Jackson 2016[88]	A chronic neurodegenerative syndrome with multiple causes, usually characterised by progressive cognitive change, including amnestic and executive deficits and functional decline. Standardised history and examination, including ACE III, DSM-IV-TR	47; 31/47 (66%) AD, 12/47 (26%) vascular dementia, 3/47 (6%) mixed dementia, 1/47 (2%) dementia with Lewy bodies: 17 (21%) probable dementia present at index admission but not diagnosed	57%	84.4 (6.5)	34.1	82	Yes	Included: meeting DSM-IV-TR criteria for delirium, informed consent from participant or next of kin if the participant lacked the mental capacity to give it Excluded: declined follow-up or could not be contacted for follow-up, died before follow-up; unable to communicate because of severe sensory impairment or inability to communicate in English, those deemed to be at risk of imminent death
Jitapunkul 1998[49]	Does not specify – only that patients had a history of dementia from notes	9	4.70%	47.7 (19.3)	All female	190	Yes	Included: patients aged > 60 years No exclusion criteria specified
Jitapunkul 1992[96]	DSM-III-R	21	11%	81.7 (6.6)	41	184	Yes	Included: aged > 60 years Excluded: respite or rehabilitation
Kolbeinsson 1993[97]	MSQ – 10-item measures severe (0–3), moderate (4–6) dementia. Normal scores are 8–10 or minimal cognitive dysfunction (7–10). MMSE used for MSQ scores of < 7. DSM-III-R used to classify into one of two of dementia or delirium	50	50/272 (18%)	Delirium: 81.7 (7.2) Dementia: 84.9 (5.9) Normals: 79.3 (6.2)	Delirium group (*n* = 37): 62.2 Dementia group (*n* = 50): 40 Normal group: (*n* = 185): 49.7	331	Yes	Included: aged > 70 years Excluded: cerebral bleeding, cardiac arrest, unconsciousness

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Lam 2014[70]	Medical records checked on admission; family member also interviewed to establish cognitive functioning. In patients with no recorded diagnosis, diagnosis made on current admission using DSM-IV criteria for dementia of ≥ 6 months' duration	174 (67 had dementia with BPSD)	74.40%	84.1 (7.4)	43.6	234	Yes	Included: aged > 65 years with definite delirium as diagnosed by CAM delivered by primary geriatrician – incident or present on admission Excluded: medical illnesses needing special monitoring, respiratory precautions, contact precautions; dangerously ill, coma, terminal illness, severely uncommunicative/aphasic, combative behaviour, contraindications of use of bright light therapy, refusal to consent to GMU stay; premature transfer out of GMU or those admitted to long-term care
Lang 2010[79]	Confirmed diagnosis prior to admission – medical notes. Diagnostic tool unspecified	178	100%	86 (6)	33.1	178	Yes	Included: dementia diagnosis, aged > 75 years Excluded: surgery/ICU/ admission not from ED
Lattanzio 2012[91]	Unspecified: 'described in previous study'	261	51.60%	80.1 (6)	45.7	506	No	Unspecified
Lorén Guerrero 2011[44]	AD and dementias – collected in medical notes; SPMSQ	NR	54.55% (40.74% of which were AD)	81.24 (7.338)	53.7	81	No	Included: aged > 65 years Excluded: 'death' or 'no consent'

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Maia 2016[156]	Screening of dementia in two stages: 1. Identify causes of dementia (i.e. subjects with CFI) by interviewing patient/and companion. Used MMSE; Bayer ADL scale; CAM; Geriatric Depression Scale; sociodemographic variables; clinical conditions; family history of cognitive impairment; hospital and medical records 2. Diagnose dementia among CFI cases with Cambridge Mental Disorders of the Elderly Examination – structured interview for dementia. Diagnosis made using DSM-IV MMSE; Cambridge Mental Disorders of the Elderly Examination	84 (probable case of dementia or CFI in stage 1). Of 84 patients screened positive for dementia or CFI stage 1, 31 were diagnosed at stage 2 with dementia	17.2% (95% CI 12.3% to 22.1%) Note that 25% of those diagnosed with dementia had history of dementia/cognitive impairment	72 (8.9)	62.1	224	Yes	Included: aged > 60 years No exclusion criteria
Marengoni 2008[45]	DSM-IV	NR	7% home (*n* = 704); 17.1% rehabilitation unit (*n* = 82); 30.4% nursing home (*n* = 23)	78.5 (7.2)	49.5	830	No	

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Marengoni 2011[110]	DSM-IV ICD-9 codes used to indicate dementia diagnoses were 290 and 331	117	9.60%	Mean 79.4	55.9	1221	Yes	Included: patients aged > 65 years Excluded: incomplete data; patients not discharged home; terminally ill; transfer to rehabilitation units; surgical diseases; transfer to other hospital units
Marengoni 2004[146]	DSM-IV	NR	14%	65–74 ($n = 276$); ≥ 75 ($n = 554$)	49.5	830	No	Included: aged > 65 years No exclusion criteria
Margiotta 2006[19]	DSM-IV	44	13.3%	79.8 (8)	42	330	Yes	Included: aged > 65 years No exclusion criteria
Martínez-Velilla 2013[116]	GDS	NR	NR	87.0 (6.0)	43.5	85	Yes	Included: aged > 75 years Excluded: lack of consent; comatose or life expectancy of < 3 months; alcohol withdrawal delirium and refusal
Matzen 2012[157]	ICD-10	NR	71%	Males: 81.8 (6.8) Females: 83.9 (7.0)	36.4	5087	No	Included: aged > 65 years and LoS of > 1 day No exclusion criteria reported

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
McAvay 2006[63]	NR	53	12.2%	79.8 (6.3)	Dementia at discharge group: 33.3; delirium resolved group: 45.2; never delirious group: 39.7	433	Yes	Included: patients aged ≥ 70 years who did not have delirium on admission to general medicine service, agreed to participate Excluded: unable to participate in interview (e.g. profound dementia, aphasia, intubation), death during hospitalisation, admitted to hospital from nursing home – desired to focus on new nursing home admissions
McCusker 2002[26]	IQCODE score of ≥ 3.5	222	68.9%	Delirium: 65–74 (*n* = 29), 75–84 (*n* = 99), ≥ 85 (*n* = 115) Control: 65–74 (*n* = 11), 75–84 (*n* = 53), ≥ 85 (*n* = 54)	Delirium cohort: 39.5; non-delirium cohort: 27.1	361	Yes	Included: patients aged ≥ 65 years admitted from ED to medical services Excluded: patients with primary diagnosis of stroke, patients admitted to oncology unit, patients who spoke neither English nor French, patients admitted to the ICU or cardiac monitoring unit unless transferred to a medical ward within 48 hours of admission

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
McCusker 2001[94]	IQCODE score of ≥ 3.5	217	68.9%	Delirium and dementia: 65–74 ($n = 15$), 75–84 ($n = 64$), ≥ 85 ($n = 85$) Delirium only: 65–74 ($n = 13$), 75–84 ($n = 27$), ≥ 85 ($n = 16$)	37.1	315	Yes	Excluded: primary diagnosis of stroke, admitted to oncology unit, admitted to ICU or cardiac monitoring unit unless transferred to a medical unit within 48 hours of admission, did not speak French or English
McCusker 2003[109]	Explore role of dementia in clinical course of delirium in 12-month follow-up study of delirium cohort who were discharged from hospital alive. IQCODE	136	70.50%	83.4 (7.3)	38.3	193	Yes	Included: aged > 65 years Excluded: stroke and non-English/French speakers
McCusker 2003[134]	IQCODE score of ≥ 3.5	220	61.3%	Prevalent delirium: 83.61 (7.40) Incident delirium: 82.30 (6.28) No delirium: 83.64 (6.58)	35.4	359. Prevalent delirium: 204; incident delirium: 37; no delirium: 118	Yes	Included: medical admissions of patients aged ≥ 65 years from ED Excluded: intensive care or oncology patients, patients with a primary diagnosis of stroke

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
O'Keeffe 1999[122]	Evidence of cognitive impairment of at least 6 months' duration, which was sufficient to interfere with social functioning, or BDRS score of ≥ 4	NR	NR	Retarded delirium: 83 (5) Agitated delirium: 82 (4) Mixed delirium: 82 (4) Neither: 84 (7)	NR	225	Yes	Excluded: patients not admitted to geriatric unit on days of admission, patients admitted electively for investigations, rehabilitation or respite care, patients expected to remain in hospital for < 48 hours, patients not assessed by a research doctor within 48 hours of admission
Orsitto 2005[99]	NINCDS–ADRDA and NINDS–AIREN Work Group and DSM-IV for AD and vascular dementia. Petersen criteria for MCI and presence of a subjective memory complaint/ absence of dementia/ memory impairment using cognitive testing	73 (49 AD; 24 vascular dementia)	40.10%	77.8 (6.8)	Dementia group: 32.8 MCI group: 45.7 No cognitive impairment group: 53	179	No	Included: aged > 65 years with suspected or ascertained cognitive impairment No exclusion criteria specified

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Orsitto 2012[46]	MMSE	78	13.9%	76.9 (6.7)	42.7	560	No	Included: all patients aged ≥ 65 years admitted to hospital. Written informed consent obtained from patients or relatives of critically ill patients or those with dementia Excluded: patients with short-term prognosis tumours, serious anaemia, primary or secondary malignant brain neoplasms, blood infections, alcohol abuse, disorders of the thyroid, disorders of the kidneys and hydrocephalus. Subjects with past or present medical or psychiatric conditions, or psychoactive substance use that can cause cerebral dysfunction were excluded to rule out the possibility of cognitive impairment due to medical or psychiatric conditions
Orsitto 2009[100]	MMSE; CDR	84	14.3%	Dementia: 79.4 (6.1) MCI: 76.3 (6.9) No cognitive impairment: 75.8 (7.0)	42.9	588: dementia *n* = 84; MCI *n* = 65; no cognitive impairment *n* = 439	No	Included: patients aged ≥ 65 years admitted to geriatric ward Excluded: diagnosis of primary or secondary malignant brain neoplasms, alcohol abuse, head trauma, blood infections, serious anaemia, thyroid disorders

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Pedone 2005[54]	NR	NR	NR	77.4 (7)	47.7	9061	Yes	Included: patients aged ≥ 65 years Excluded: patients who died, those with an admission ADL score of 0 or missing ADL data, those with LoS of > 90 days or a diagnosis of mental retardation
Ponzetto 2002[108]	SPMSQ	110	13.5%	80.6 (6.3)	51.4	817	No	Included: patients aged ≥ 70 years consecutively admitted to the geriatric ward Excluded: patients who died during hospitalisation, patients without complete follow-up data
Praditsuwan 2012[176]	Thai Mental State Examination, Modified IQCODE	94	41.80%	78 (5.9)	50.7	225	Yes	Inclusion: patients aged ≥ 70 years admitted to general medical wards Exclusion: endotracheal intubation at admission, aphasia, comatose or un-co-operative patients

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Praditsuwan 2013[119]	IQCODE; Thai Mental State Examination	94	41.8%	78.0 (5.9) Delirium: 78.8 (6) Non-delirium: 77.3 (5.8)	50.7. Delirium: 41.8. Non-delirium: 59.1	225	Yes	Included: patients aged ≥ 70 years admitted to general medical wards who were able to communicate Excluded: being endotracheal intubated, unable to communicate, un-co-operative, transferred to other units, death within 24 hours, too unwell to be assessed
Rockwood 1989[83]	Presence of dementia was explored in relation to its correlation with confusion. Diagnosis was unspecified	NR	NR	Mean 76.8	44	80	Yes	No inclusion criteria specified Excluded: admissions to coronary care or intensive care
Rozzini 2009[52]	MMSE score of < 18	505	23.20%		49.9	2171	Yes	
Rozzini 2005[177]	MMSE score of < 18	150	15.80%	78.3 (8.5)	31.7	950	No	Included: patients aged > 60 years Excluded: made on basis of premorbid BI of > 25 as study was to examine association between change in functional ability due to acute disease and mortality Excluded: patients with major stroke (affects disability severely); intensive care and those who died in hospital, and patients lost at follow-up

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Sahadevan 1999[80]	DSM-III-R: presence of memory impairment with at least one of dysphasia, apraxia, agnosia or impairments in abstract thinking, judgement, personality changes, or constructional difficulties. AD by NINCDS–ADRDA with one exception – detailed psychological assessment not done. AMT to adjunct clinical diagnosis. Vascular dementia diagnosed when in the presence of dementia, patient had CT evidence of stroke disease. Diagnosed with ADDTC criteria. When evidence of multiple stroke disease by CT scan, assign 'probable vascular dementia' in accordance with ADDTC criteria; or possible vascular dementia if single-stroke lesion and its relationship to cognitive impairment unestablished. Dementia of PD when cognitive impairment coexisted with extrapyramidal disorder	100 (55 vascular dementia; 40 AD)	100%	65–74 ($n = 20$); 75–84 ($n = 49$); ≥ 85 ($n = 31$)	44	100	No	Included: dementia diagnosis

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Sampson 2013[107]	DSM-IV comprising MMSE, structured review of clinical notes plus discussion with family/carers. FAST used to describe continuum of seven successive stages of dementia	261	42.40%	83.2 (7.3)	41	616	Yes	Included: aged > 70 years Excluded: admission < 48 hours or insufficient English speaking
Sampson 2009[12]	DSM-IV; FAST scale	NR	42%	Mean 83	31	805	Yes	Included: aged > 70 years Excluded: discharged before assessment, refusal to consent or persistent delirium
Sampson 2014[158]	MMSE score of ≤ 24	230	100%	87.2 (5.9)	34.3	230	Yes	Included: aged ≥ 70 years, unplanned acute medical admission, able to given written consent or with an informal carer or 'professional consultee' available to give assent, sufficient English language to complete the study ratings, AMT score of ≤ 7/10 points on admission Excluded: did not wish to participate, non-English speaking, moribund or where there were clinical concerns about them being approached

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Saravay 2004[114]	MMSE score of ≤ 23; BDRS	NR	NR	Cognitive impairment group: 79 (6.6) Without cognitive impairment: 74.3 (96.2 – as reported)	44	93	Yes	Included: aged > 65 years Excluded: transfer from psychiatric inpatient service, transfer from nursing home, elective admission or surgery or expected to be in hospital for under 48 hours
Sonnenblick 2007[106]	GDS score of ≥ 2. 2–3: mild dementia. 4–5: moderate dementia. 6–7: severe dementia. Reisberg GDS	268	34%	80 (8)	50	779	No	Included: patients aged ≥ 65 years admitted to medical, cardiology or acute medical ward
Srinonprasert 2011[160]	Score of < 3.42 on modified IQCODE or pre-existing diagnosis	94	41.80%	Mean 78	50.7	225	Yes	Included: patients aged ≥ 70 years Excluded: patients who were endotracheal intubated at admission, aphasia, comatose, refusal to participate
Torian 1992[20]	DSM-III-R	90	63%	Mean 82	22	143	No	Included: all patients admitted to acute care unit devoted to treatment of frail elderly for whom complete information was available

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Travers 2013[161]	Two independent physicians carried out case reviews to determine dementia presence prior to current illness. Cases reviewed where MMSE not completed owing to incapacity or where score was ≤ 26; 50% of cases where MMSE was between 27 and 30 were also reviewed. DSM-IV criteria A and B were used to consider dementia likely	76	25.90%	80.4 (6.5)	41.6 (includes those admitted to medical, surgical and orthopaedic wards)	294	Yes	Included: aged > 70 years. Surgical, general and orthopaedic ward patients included; however, separate data are presented for general medical wards
Wakefield 2002[67]	Historical medical records to determine presence of diagnosis and to differentiate it from acute confusion, as well as to determine relationship between dementia and onset of acute confusion as dementia is a risk factor for acute confusion, or establish presence of acute confusion superimposed on dementia; MMSE (score 0–17 is cognitive impairment, and < 23 is cognitive impairment) and clock-drawing test to supplement these records	3	2.56%	73 (4.6)	All male	117	Yes	Included: aged > 65 years Excluded: too ill or could not communicate, admitted for hydration during chemotherapy, had a sedating medications procedure, had participated in a previous admission or had suspected tuberculosis

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Wakefield 2002[66]	Documented in physician notes; no definition	3	2.60%	73 (4.6)	All male	117	Yes	Included: aged > 65 years Excluded: unable to participate for reasons of comatose, deafness, blindness, mute or aphasia); LoS of < 48 hours
Wancata 2003[21]	DSM-III-R	NR	27.4% (61.8% AD; 21.6% multi-infarct dementia; 2.5% pre-senile dementia; 14.1% unidentified dementia)	75.9 (8.4)	26.7	360	No	Included: aged > 60 years Excluded: dementia with history of alcohol/drug abuse, history of psychosis; patients awaiting nursing home admission (they might stay in hospital for prolonged time); referrals from other hospital departments; patients who died in hospital
Watkin 2012[168]	DSM-IV criteria; information on premorbid social function and ADL gathered from relatives or carers and review of hospital notes. Severity of functional impairment measured using FAST to describe continuum of seven successive stages of dementia	NR	42.8% (of 621)	83.0 (7.4)	42	710	Yes	Included: all patients aged > 70 years with unplanned admission Excluded: admitted for < 48 hours or did not speak sufficient English for cognitive assessment

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 28 Dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Weber 2015[169]	Careful consideration of the results of all of the below assessments. MMSE, CT, nuclear magnetic resonance, SPECT of brain, EEG, ultrasonography of major brain vessels, etc., performed according to clinical status and medical need when cognitive functions were changed or decreased	3140. Women aged 65–74 years: 203. Men aged 65–74 years: 174. Women aged 75–84 years: 1962. Men aged 75–84 years: 933. Women aged ≥ 85 years: 1168. Men aged ≥ 85 years: 620	Women aged 65–74 years: 13.4%. Men aged 65–74 years: 15.8%. Women aged 75–84 years: 23.4%. Men aged 75–84 years: 24.3%. Women aged ≥ 85 years: 38.1%. Men aged ≥ 85 years: 33.2%	80.5 (7.0)	33.4. 31.4 of those with dementia were male; $n = 2155$ women had dementia	12,210	No	Included: all patients admitted non-selectively via GPs, internists or other outpatient departments via emergency room
White 2005[117]	Previous diagnosis made by geriatrician. IQCODE also used	NR	25% of patients with delirium had previously diagnosed dementia; 6% of non-delirious patients had dementia; 60% of delirium patients had probable dementia based on IQCODE; compared with 24% without delirium	82.4 (0.3)	41	283	Yes	Included: aged > 75 years

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of dementia	Prevalence	Age (years), mean (standard deviation)	Male (%)	Sample size (*n*)	Delirium screen?	Inclusion/exclusion criteria
Zekry 2011[105]	MMSE; Short Cognitive Evaluation Battery	190: 75 AD, 20 vascular dementia, 82 mixed dementia, 13 other types of dementia	43%	85.3 (6.7)	26	444	No	Included: patients aged ≥ 75 years admitted to hospital Excluded: those with disorders interfering with psychometric assessment (severe deafness or blindness, or major behavioural problems); terminal illness

ACE III, Addenbrooke's Cognitive Examination III; ADDTC, Alzheimer's Disease Diagnostic and Treatment Centers; ADRDA, Alzheimer's Disease and Related Disorders Association; A&E, accident and emergency; AIREN, Association Internationale pour la Recherche et l'Enseignement en Neurosciences; BDRS, Blessed Dementia Rating Scale; BPSD, Behavioural and Psychological Symptoms of Dementia; CFI, cognitive and functional impairment; CT, computed tomography; DRS, Delirium Rating Scale; DSM-III-R, *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition, Revised; ED, emergency department; EEG, electroencephalogram; EMU, emergency medical unit; FAST, Functional Assessment Staging of Alzheimer's Disease; GDS, Global Deterioration Score; GMU, general medical unit; GP, general practitioner; HIPE, (Irish) hospital inpatient enquiry portal; ICD-9-CM, *International Classification of Diseases*, Ninth Edition, Clinical Modification; mBDRS, Modified Blessed Dementia Rating Scale; MSQ, Mental Status Questionnaire; NINCDS, National Institute of Neurological and Communicative Disorders and Stroke; NINDS, National Institute of Neurological Disorders and Stroke; NR, not reported; PD, Parkinson's disease; SBT, Short Blessed Test; SEM, standard error of measurement; SPMSQ, Short Portable Mental Status Questionnaire.

a Composite measure of MMSE and mBDRS. The composite dementia variable, incorporating both the MMSE and mBDRS, is a highly specific measure for the presence of dementia and is a reference standard, defined as (1) mBDRS score of > 4 or (2) mBDRS score of > 2 and MMSE score of < 20 and duration of cognitive symptoms of > 6 months.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 29 Delirium superimposed on dementia prevalence

Study (first author and year)	Assessment tools and diagnostic criteria	Number of potential cases of DSD	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Bellelli 2015[55]	Senile dementia and delirium; arteriosclerotic dementia with delirium; pre-senile dementia with delirium; senile dementia with delusion (e.g. stupor/confusion) ICD-9	16	0.5%	79.1 (7.3)	49.2	2521	Included: aged > 65 years; underwent SBT assessment within 72 hours of admission Excluded: those in coma/with incomplete data; alcohol withdrawal delirium
Edlund 2006[60]	DSM-IV criteria; OBS and repeated MMSE assessment. In patients with dementia, the cognitive impairment found by MMSE on admission could be either cognitive impairment by dementia or cognitive impairment by combination of delirium and dementia. MMSE assessment on day 3 and/or day 7 in combination with fluctuation of symptoms indicating delirium using OBS scale validates delirium diagnosis on day of admission in those with dementia	7	7/125 (5.6%)	Delirious 81.8 (6.3); non-delirious 79.4 (5.7)	Delirious group: 53 Non-delirious group: 40	400	No inclusion criteria reported Excluded: aged < 70 years, unwillingness to participate
Eeles 2010[126]	DSM-IV for delirium; IQCODE-10 (pre-existing dementia); delirium measured continuously throughout stay	NR	57% of 103 delirious patients had pre-existing dementia	82.5 (5.6)	42	278	Included: aged > 75 years No exclusion criteria specified

Study (first author and year)	Assessment tools and diagnostic criteria	Number of potential cases of DSD	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Erkinjuntti 1986[17]	NR	75	Delirium diagnosed on admission in 41.4% of demented group ($n = 152$)	Dementia group: 79.2 (7.3) Non-dementia group: 70.7 (8.8)	43.5	2000	Included: all patients aged ≥ 55 years admitted to department of medicine No exclusion criteria specified
Faezah 2008[72]	'25% of patients had existing dementia' – refers to 25% of delirious patients Insufficient information	NR	NR	65–70 (3%); 71–74 (6%); 71–75 (27%); > 81 (48%)	NR	400	Included: aged > 65 years Excluded: not able to respond to verbal stimuli
Feldman 1999[125]	DSD not explicitly referenced. Cognition via MMSE assessed prior to hospitalisation was charted for both delirium and non-delirium groups; delirium measured every 48 hours for 14 days using experienced geriatrician; CAM/DRS	6	9.80%	With delirium: 83.2 (6.8) Without delirium: 80.5 (6.9)	With delirium ($n = 11$): 72.7 Without delirium ($n = 50$): 50	61	Aimed to include all patients aged > 70 years to geriatric unit on first admission only Excluded: those not admitted to geriatric unit on day of admission; elective patients; aphasia/ deafness; turnaround of < 48 hours; moribund conditions; patients not assessed within 48 hours of admission
Gallerani 2013[95]	Using ICD-9-CM coding to specifically diagnose DSD – seasonal variation in delirium	NR	NR	70.9 (16.4)	47.3	42,625	Excluded: alcohol/drug-related deliriums

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 29 Delirium superimposed on dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of potential cases of DSD	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Jackson 2016[88]	No explicit reference to DSD. Delirium presented in 17.9% of older patients, and 82 participants with delirium were assessed at 3 months: 47 (57%) of 82 had dementia. Diagnosis of prior dementia had not been recognised in 17/82 patients with delirium Standardised history and examination using ACE III, DSM-IV-TR	47	57%	84.4 (6.5)	34.1	82	Inclusion: meeting DSM-IV-TR criteria for delirium, informed consent from participant or next of kin if the participant lacked the mental capacity Excluded: declined follow-up or could not be contacted for follow-up, died before follow-up; unable to communicate because of severe sensory impairment or inability to communicate in English, those deemed at risk of imminent death
Jitapunkul 1992[96]	No explicit reference to DSD. Delirium plus dementia (both diagnosed using DSM-III-R)	12	6.50%	81.7 (6.6)	41	184	Included: aged > 60 years Excluded: respite or rehabilitation
Johnson 1990[152]	*With careful ascertainment of the patient's history, review of the record, and examination of the patient's state of wakefulness and attention, the psychiatrist was able to determine whether delirium was superimposed on an underlying dementing illness*	NR	NR	NR	39	235	Included: aged ≥ 70 years, admitted between Sunday afternoon and Friday evening Excluded: transferred from another unit within the hospital, admitted for an anticipated short stay, such as chemotherapy, or a diagnostic study, or terminal care

Study (first author and year)	Assessment tools and diagnostic criteria	Number of potential cases of DSD	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Kolbeinsson 1993[97]	Patients followed up to establish if delirium concurrent with dementia using DSM-III-R	NR	70% of delirium patients also had dementia at follow-up	Delirium: 81.7 (7.2) Dementia: 84.9 (5.9) Normals: 79.3 (6.2)	Delirium group (*n* = 37): 62.2 Dementia group (*n* = 50): 40 Normals group (*n* = 185): 49.7	331	Included: aged > 70 years Excluded: cerebral bleeding, cardiac arrest, unconsciousness
Lam 2014[70]	Dementia diagnosis examined as predictor for rSSD DSM-IV	127	54.3% (81.9% of 155 rSSD patients)	84.1 (7.4)	43.6	234	Included: aged > 65 years with definite delirium as diagnosed by CAM delivered by primary geriatrician – incident or present on admission Excluded: medical illnesses needing special monitoring, respiratory precautions, contact precautions; dangerously ill, coma, terminal illness, severely uncommunicative/aphasic, combative behaviour, contraindications of use of bright light therapy, refusal to consent to GMU stay; premature transfer out of GMU or those admitted to long-term care
Lang 2010[79]	Not supplied; but entire cohort presented with dementia. Study looked for early markers of prolonged hospital stay, and 90 patients had delirium as well DSM-IV	90	50.60%	86 (6)	33.1	178	Included: dementia diagnosis, aged > 75 years Excluded: surgery/ICU/ admission not from ED

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 29 Delirium superimposed on dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of potential cases of DSD	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Margiotta 2006[19]	Clinical presentation of risk factors associated with delirium according to existing diagnosis of dementia CAM DSM-III; DSM-IV; DRS; ODFS	26	Patients with delirium represent 19.1% of the sample, 41.0% of whom also had dementia	79.8 (8)	42 Delirium: 41	330	Included: aged > 65 years No exclusion criteria reported
McCusker 2002[26]	SMPQS; CAM; DI; IQCODE. Prevalent and incident delirium separately assessed but cases of each not reported separately	166	166/224 (74.1%)	Delirium: 65–74 ($n = 29$), 75–84 ($n = 99$), ≥ 85 ($n = 115$) Control: 65–74 ($n = 11$), 75–84 ($n = 53$), ≥ 85 ($n = 54$)	Delirium cohort: 39.5 Non-delirium cohort: 27.1	361	Included: patients aged ≥ 65 years admitted from ED to medical services Excluded: patients with primary diagnosis of stroke, patients admitted to oncology unit, patients who spoke neither English nor French, patients admitted to the ICU or cardiac monitoring unit unless transferred to a medical ward within 48 hours of admission
McCusker 2001[94]	CAM; IQCODE Separately reported prevalent and incident delirium cases	164	164/217 (76%)	Dementia ($n = 53$): 65–74 ($n = 4$); 75–84 ($n = 22$); ≥ 85 ($n = 27$) Delirium and dementia ($n = 164$): 65–74 ($n = 15$); 75–84 ($n = 64$); ≥ 85 ($n = 85$) Delirium only ($n = 56$): 65–74 ($n = 13$); 75–84 (n-27); ≥ 85 ($n = 16$)	37.1	315	No inclusion criteria reported Excluded: primary diagnosis of stroke, admitted to oncology unit, admitted to ICU or cardiac monitoring unit unless transferred to a medical unit within 48 hours of admission, did not speak French or English
McCusker 2003[109]	CAM; DSM-III-R; IQCODE Separately reported prevalent and incident delirium cases	42/109 dementia patients had DSD at 6-month follow-up; 45/92 at 12-month follow-up	38.5% at 6-month follow-up; 48.9% at 12-month follow-up	83.4 (7.3)	38.3	193	Included: aged > 65 years Excluded: stroke and non-English/French speakers

Study (first author and year)	Assessment tools and diagnostic criteria	Number of potential cases of DSD	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Praditsuwan 2013[119]	DSD not explicitly referenced DSM-IV for delirium; IQCODE dementia	68	61.8%	78.0 (5.9)	50.7 Delirium: 41.8 Non-delirium: 59.1	225	Included: aged ≥ 70 years admitted to general medical wards who were able to communicate Excluded: being endotracheal intubated, unable to communicate, un-co-operative, transferred to other units, death within 24 hours, too unwell to be assessed
Rockwood 1989[83]	Dementia was explored as a variable that may be associated with presence of acute confusion using DSM-IV Dementia diagnosis unspecified	6 with dementia developed confusion	NR	Mean 76.8	44	80	No inclusion criteria reported Excluded: admissions to coronary care or intensive care
Travers 2013[161]	All cases reviewed for dementia were also reviewed for delirium, with the addition of cases with a positive CAM score or where CAM was repeated DSM-IV/CAM	26	8.8%	80.4 (6.5)	41.6	294	Included: aged > 70 years; surgical, general and orthopaedic ward patients included; however, separate data are presented for general medical wards No exclusion criteria reported

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 29 Delirium superimposed on dementia prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of potential cases of DSD	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
White 2005[117]	Patients were screened for existing dementia; some had prevalent or incident delirium DSM-IV	NR	25% of patients with delirium had previously diagnosed dementia 60% of delirium patients had probable dementia based on IQCODE; compared with 24% without delirium	82.4 (0.3)	41	283	Included: aged > 75 years

ACE III, Addenbrooke's Cognitive Examination III; DI, Delirium Index; DRS, Delirium Rating Scale; DSM-III-R, *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition, Revised; ED, emergency department; GMU, general medical unit; ICD-9-CM, *International Classification of Diseases*, Ninth Edition, Clinical Modification; NR, not reported; OBS, organic brain syndrome; ODFS, One Day Fluctuation Scale; SBT, Short Blessed Test.

TABLE 30 Cognitive impairment prevalence

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Adamis 2006[59]	No explicit definition of cognitive impairment. Cognitive impairment of any cause or 'behavioural or psychomotor types associated with delirium' may also have an impact on clinical recovery rates. However, paper states if cognitive impairment persists for > 3 months, consider diagnosis of dementia MMSE	75	80%: 42 (44.7%) had cognitive impairment at some point but no delirium, and 33 (35.1%) had both at some point. 19 had neither at any point	82.8 (6.5)	40.4	94. Prevalent delirium: 27 Incident delirium: 6 No delirium: 61	Included: patients needing specialist assessment aged ≥ 70 years Excluded: severe aphasia; previous inclusion on an earlier admission; non-English speaking
Beauchet 2013[144]	MMSE	235 (based on MMSE score of ≤ 20)	235 (55%)	84 (6.5)	31.6	424	Included: evaluation by nurse or geriatrician in ED; unplanned admission to unit via ED; aged > 75 years; consent; survival to discharge
Bickel 2006[98]	MCI diagnosed by International Working Group on MCI criteria; fulfil criteria for cognitive impairment but not dementia; functional activities preserved; evidence of cognitive decline Cambridge Examination for Mental Disorders of the Elderly; SKT	287	287/794 (36.1%)	75.2 (5.5)	40.9	794	Included: aged 65–85 years; resided in Munich Excluded: severe/fatal physical illness; pre-existing dementia; nursing home residence; blind/deaf; imminent release within 2 days; inadequate facility in Germany

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Bourdel-Marchasson 2004[68]	DSM-IV; criteria; any known cognitive impairment was systematically sought with the help of the family practitioner and the family. They were asked if the patient: • had a diagnosis of dementia • showed memory impairment • exhibited difficulties in executing everyday tasks • had difficulties recognising those close to them The authors then stated whether or not the person had a cognitive impairment using DSM-IV criteria	220	51.5%	Discharged to community: 84.6 (6.2). Discharged to geriatric institutions: 85.6 (6.8)	Discharged to community: male-to-female ratio 0.52 Discharged to geriatric institutions: male-to-female ratio 0.26	427	Included: patients aged > 75 years on their first admission to the unit during the study period Excluded: patients generally living in an institution, patients deceased before discharge, patients with stay of < 3 days
Boustani 2010[129]	Two or more errors (score of ≤ 8) in SPMSQ	424	42.50%	74.8 (7.5)	32.2	242	Included: patients aged ≥ 65 years, hospitalised on a medical ward, able to speak English and cognitive impairment at time of hospital admission Excluded: patients previously enrolled on the study or another clinical study at time of admission, or aphasic or unresponsive at the time of screening

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Buurman 2011[128]	MMSE score of ≥ 21. Cognitive impairment 1 year after hospital admission: IQCODE-SF score of ≥ 3.9 or more	256	40.10%	78.2 (7.8)	46.2	639	Included: all patients aged ≥ 65 years acutely admitted to general internal medical wards Excluded: patient or relatives did not give informed consent, unable to speak or understand Dutch, transferred from another ward inside or outside the hospital, transferred to the ICU, coronary care unit or another ward inside or outside the hospital within 48 hours of admission, terminally ill
Cattin 1997[53]	Screening level of 6 or lower (four or more errors) in Italian translation of AMT	1047	29%	Median 78	46	3628	Excluded: age criteria, incomplete information, one of the following may have contributed to the abnormal mental state: multiple neuropsychiatric disorders, head trauma, acute cerebrovascular disease or hepatic encephalopathy
Cole 2008[69]	MMSE used to assess cognitive impairment at different time points	NR	NR	SSD recovered: 82.3 (6.6) SSD not recovered: 84.5 (7.1) No SSD: 81.2 (5.6)	SSD recovered: 29.8 SSD not recovered: 24 No SSD: 9 (29%)	129 (SSD recovered: 51; SSD-not recovered: 47; no SSD: 31 at 8 weeks)	Included: patients aged > 65 years Excluded: stroke; admission to oncology/terminal; ICU/cardiac monitoring unless transferred to medical unit within 48 hours
Collins 2010[65]	In relation to AMT score	NR	NR	83	41	710	Included: all patients aged > 70 years, unplanned acute admission to medical unit from A&E and GPs Excluded: inhibitive lack of English for assessment for CAM assessment; if admitted for < 48 hours; stroke, surgery or coronary procedures

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Conde-Martel 2012[143]	MMSE score of < 24. SPMSQ score of ≥ 3	MMSE: 36/52 SPMSQ: 60/82	NR	92.8 (SD 2.6, 95% CI 92.4 to 93.3)	36	124	Included: patients aged ≥ 90 years Excluded: patients admitted for palliative care, patients who died in the first 24 hours
Corrao 2014[171]	SBT	NR	47.6% (51.8% women; 43.2% men; $p = 0.01$)	Mean 79 (95% CI 78.1 to 79.4). Women mean 80.1 (95% CI 79.6 to 80.7). Men mean 77.8 (95% CI 77.3 to 78.4)	49.5	1380	NR
Corsinovi 2009[172]	Mild/moderate/severe impairment according to scoring system of SPMSQ	None/slight: 430 Moderate: 83 Severe: 107	NR	79.3 (8.9)	55	620	NR
Dagani 2013[222]	Defined as 'cognitive impairment and dementia'. No separate diagnoses for each MMSE	186 (grouped as cognitive impairment and dementia)	48/329 (15%)	78.4 (6.6)	41	329	Included: patients aged > 64 years with cognitive impairment and dementia; movement disorders; bone fractures; stroke (according to different missions of the four units)
Di Iorio 1999[84]	MMSE	NR	NR		45.5	402	Included: patients aged ≥ 65 years Excluded: stay of < 3 days or terminally ill No further criteria reported

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Di Iorio 1998[85]	MMSE score of < 21 or clinical diagnosis of dementia	NR	NR	Age at different sites: Chieti 79.0 (0.8); Perugia 77.8 (0.9); Pescara 82.4 (0.7); Prato 80.4 (0.6)	48	379	Included: non-planned; aged > 65 years; non-terminal Excluded: opposite of above
Dinescu 2012[102]	NR	NR	47.10%	83.1 (8.3)	24.3	514	Included: hospitalised patients managed by the mobile acute care of elderly geriatric inpatient service Excluded: patients who died during hospitalisation or were discharged to hospice
Egberts 2015[165]	MMSE score of > 10; excluded if < 10	NR	NR	No delirium: mean 81.0 (95% CI 75 to 85) Delirium: mean 87.0 (95% CI 84 to 88)	No delirium: 46.7 Delirium: average 43.5	86	Included: aged > 65 years Excluded: Lewy body dementia; PD; neuroleptic malignant syndrome; tardive dyskinesia; antipsychotic treatment course; other psychiatric medications except benzodiazepines/ haloperidol; aphasia, insufficient understanding of Dutch, MMSE score of < 10
Erkinjuntti 1986[17]	BDRS; SPMSQ	NR	NR	Dementia group: 79.2 (7.3) Non-dementia group: 70.7 (8.8)	43.5	2000	Included: all patients aged ≥ 55 years admitted to department of medicine No exclusion criteria reported

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Esmayel 2013[43]	MMSE score of ≤ 23	60	30%	Range 65–75: –164 (82%) Range 75–85: –28 (14%) > 85: 8 (4%)	56	200	Excluded: emergency conditions, history of mental illness, psychotropic drug use; communication problems
Espallargues 2008[138]	Orientation–Memory–Concentration test; aspects of 'Geriatric Giants', which included intellectual impairment (confusion)	NR	NR	Mean 78.1	43.5	1667	Included: aged > 65 years Excluded: terminal care/surgical
Faezah 2008[72]	AMT	272	68%	65–70 (3%); 71–74 (6%); 71–75 (27%); > 81 (48%)	NR	400	Included: aged > 65 years Excluded: those not able to respond to verbal stimuli
Feldman 1999[125]	MMSE	33	54%	With delirium: 83.2 (6.8) Without delirium: 80.5 (6.9)	With delirium (*n* = 11): 72.3 Without delirium: 44.4	61	Included: patients aged > 70 years admitted to geriatric unit on first admission only Excluded: not admitted to geriatric unit on day of admission; elective patients; aphasia/deafness; turnaround of < 48 hours; moribund conditions; patients not assessed within 48 hours of admission

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Fields 1986[139]	MMSE	23	19.80%		46	116 Cognitively impaired: 23 Not cognitively impaired: 93	Included: patients admitted directly to three-ward medical service Excluded: unable to understand or read/write English, deaf, mute, aphasic, blind, refused consent, admitted to ICU or transferred to another service before being tested
Fortini 2014[73]	SPMSQ ≥ 3 points	88 (15 with incident delirium; 73 without delirium)	46% (of 541)	80.35 (7.63)	49.64	560	Included: aged > 65 years
Forti 2014[145]	Part of physical and non-physical phenotype of frailty marker assessment; cognitive impairment measured using Mini-Cog test (three-item recall and a simply scored clock drawing test)	245	52.10%	80.8 (7.5)	47.2	470	Included: aged > 65 years Excluded: dead; discharge; transfer to other hospital units within 48 hours of admission; terminal illness; coma; refusal to participate; incomplete data
Francis 1992[112]	MMSE	NR	NR	Delirium: 78.9 (6.1) Control: 77.7 (5.6)	Delirium: 47 Controls: 36	205 (delirium: 45; controls: 160)	Included: all admissions aged ≥ 70 years Excluded: patients from other hospitals or nursing homes; terminal illness; severe dementia; aphasia; not English speaking, deafness/blindness; admission of < 48 hours

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Franco 2010[61]	Colombian MMSE controlled for age, educational level, visual impairment and has a score range of 0–30 points	82	28.20%	74.4 (8.79)	With delirium ($n = 34$): 38 Without delirium ($n = 257$): 36	291	Included: patients aged > 60 years Excluded: prevalent delirium, coma, or stupor. At pre-discharge follow-up, exclude died, transferred to ICU/surgery or delirium diagnosis
Freedberg 2008[104]	Those showing ICD-9 codes for delirium and dementia	100	50%	Cognitively impaired: 89.8 Not cognitively impaired: 88.9	Cognitively impaired: 27 Not cognitively impaired: 39	200. 100 with ICD-9 codes indicating cognitive impairment, 100 without	
Furlanetto 2003[86]	DSM-IV criteria for delirium and/or dementia; SADS, clinical examination. Cognitively impaired patients detected by mental status exam and using all collateral information available (family members, staff) as this group would not be able to answer the SADS questions. Those who were not cognitively impaired were interviewed using the SADS to make all other DSM-IV diagnoses	64	20.20%	53 (18.3)	65	317	Included: consecutive admissions to adult medical wards Excluded: unable to complete baseline interview due to physical illness or treatment, discharge before baseline interview, refusal to participate

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Goldberg 2012[58]	AMT score of ≤ 7 points	331	41%	Median 83 (range 70–105)	45	807	Included: individuals aged > 70 years with unplanned admissions to 1 of 12 wards Excluded: unwillingness to be screened, being unconscious or too ill to be interviewed up to fifth day of admission, inability to speak English with no available interpreter
Helvik 2014[147]	MMSE score of ≤ 24 indicates cognitive impairment; score of 0–3 is severe 'dementia' as measured by CDRS	NR	NR	80.5 (7.4)	49.5	463	Included: patients aged ≥ 65 years, living in the region, admitted to the internal medical inpatients service with an acute medical condition and hospitalised for ≥ 48 hours Excluded: severe cognitive impairment signified by a score of 3 on the CDRS, severe communication difficulties, being in a terminal state or having died before inclusion, reduced physical functioning preventing completion of the protocol, living in a nursing home immediately before admission or refusal to participate

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Hsieh 2015[92]	MIS score of ≤ 4 or IQCODE score > 3.38. MIS if patient was not delirious; IQCODE if patient was delirious	92	35.4%	Never delirious: 76 (8) Ever delirious: 83 (8)	Never delirious: 38.7 Ever delirious: 47.3	260. 222 never delirious. 38 delirious on at least 1 of their first 3 days in hospital	Included: patients aged ≥ 65 years, listed for admission to a non-ICU inpatient ward, consent given verbally or, if lacking capacity to make clinical decisions or delirious, from a surrogate Excluded: patients admitted from the ED to the ICU, non-English speaking, unable to be assessed for delirium (e.g. comatose, severe dementia, severe psychiatric illness) or were unavailable due to diagnostic tests or procedures. Patients admitted to the hospital but subsequently discharged from the ED, eloped or signed out against medical advice were excluded from analysis
Inouye 2006[141]	RCD, defined as ≥ 3-point improvement on MMSE by discharge	179	39%	80 (6.5)	39.8	460	Included: patients aged ≥ 70 years admitted to general medical service Excluded: lack of two MMSE scores during hospitalisation

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Iseli 2007[87]	AMT score of < 8 points or cognitive impairment as defined as previous diagnosis of dementia using IQCODE in 21/32 patients. MMSE used in some patients to assess cognitive status	Delirium group: 17 Non-delirium group: 15	32/104 (31%) with 'documented premorbid cognitive impairment'. By delirium status yes: 89.5% had premorbid cognitive impairment; no delirium: 17.7% had premorbid cognitive impairment. AMT score of < 8 points (another marker of cognitive impairment) delirium 89.5%; no delirium 23.5%	80.1 (6.95)	43.3	104	Included: patients aged ≥ 65 years admitted to a general medical unit from the ED Excluded: patients with aphasia, in a coma, admitted to the ICU, unable to speak English (with no interpreter available) or refused consent
Isfandiaty 2012[62]	MMSE used; unclear how it is defined; reference to cognitive impairment and dementia and are not examined separately. Cognitive impairment used as a factor to predict occurrence of delirium in 14-day hospital period using bivariate/multivariate regression models	41	8.90%	69.6 (7.09)	52.5	457	Included: aged > 60 years Excluded: admission-based delirium or acute confusional state

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Jackson 2016[88]	MCI or dementia. ACE III established presence or absence of dementia or MCI before the onset of the delirium. Dementia and subtype was diagnosed using the DSM-IV-TR criteria. MCI was diagnosed using the current consensus definition[223]	14 cases of MCI	17%	84.4 (6.5)	34.1	82	Inclusion: meeting DSM-IV-TR criteria for delirium, informed consent from participant or next of kin if the participant lacked the mental capacity to give it Excluded: declined follow-up or could not be contacted for follow-up, died before follow-up; unable to communicate because of severe sensory impairment or inability to communicate in English, those deemed to be at risk of imminent death
Jitapunkul 1998[49]	Chula Mental Test and Glasgow Coma Scale for conscious level assessment	NR	NR	47.7 (19.3)	All female	190	Included: patients aged > 60 years No exclusion criteria reported
Joray 2004[148]	MMSE score of < 24	129	32.30%	82.4 (5.0) No cognitive impairment: 81.4 (4.5) Cognitive impairment, not detected: 84.6 (5.3) Cognitive impairment, detected: 84.1 (5.6)	39.1. No cognitive impairment: 41.2; cognitive impairment, not detected: 37.0; cognitive impairment, detected: 31.2	401	Included: patients aged ≥ 75 years Excluded: discharged within 24 hours of admission, previously living in a nursing home, transferred from another hospital for an elective procedure, had private insurance so would not be able to access follow-up data on service utilisation, unstable medical conditions, aphasia or stroke, terminal illness or coma, inability to give a correct name and date of birth, refusal to participate

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Khurana 2011[57]	MMSE score of 23 out of 30	NR	NR	Men: 70.87 (9.26) Women: 70.81 (8.4)	Male-to-female ratio: 1.27 : 1	400	Included: patients aged ≥ 60 years were selected on the basis of the following criteria of delirium in DSM IV: acute onset; fluctuating course; difficulty in focusing, maintaining or shifting attention and disorganised thinking/altered levels of consciousness Excluded: patients with dementia, psychosis or incommunicability
Korevaar 2005[154]	MMSE score of < 24, IQCODE mean score of ≥ 3.9. Final classification based on MMSE score for patients without delirium and the combination of MMSE and IQCODE for patients with delirium. In case of conflicting outcome, IQCODE score was used	NR	NR	79.1 (7.8)	41	126	Included: consecutive patients aged ≥ 65 years acutely admitted to the department of internal medicine Excluded: unable to speak or understand Dutch or English, patient or relatives did not give permission for the study, patients who came from or were transferred to a ward other than internal medicine, patients who left the ward within 48 hours
Lakhan 2011[155]	Cognitive Performance Scale score of > 2 indicates cognitive impairment	Premorbid 163/549; during admission 188/548; discharge 171/524	163/549 (29.7%)	82 (6.9)	45.4	577	Included: aged > 70 years Excluded: coronary or ICU units, terminal care only or transferred out of general medical unit with 24 hours of admission

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Lang 2006[133]	MMSE score of < 25	NR	36.8% of 908	84.1 (5.8)	36.6	908	Included: aged > 75 years Excluded: surgical/ICU
Levenson 1992[167]	MMSE score of < 21, significant cognitive dysfunction	179	17.50%	49 (16.9) high psychopathology or pain; 47.0 (16.3) low psychopathology or pain (NS)	49.5 high psychopathology or pain; 50.9 low psychopathology or pain	1020	
Lorén Guerrero 2011[44]	SPMSQ	47	58%	81.24 (7.338)	53.7	81	Included: aged > 65 years; only information on exclusion is 'death' or 'no consent'
Macdonald 2007[174]	MMSE used to determine if patients could not complete sections owing to severe impairment	NR	NR	82.7 (6.6)	43	86	
Maia 2016[156]	MMSE cut-off score of 20 for illiterate people; 25 for those with ≤ 4 years of schooling, 27 for those with 5–8 years of schooling and 28 for those with ≥ 9 years of schooling	172; of these, 88 did not have recent functional impairment	76.8% of 224	72 (8.9)	62.1	224	Included: aged > 60 years

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Marengoni 2008[45]	MMSE score of < 24	NR	38.70%	78.5 (7.2)	49.5	830	
Marengoni 2004[146]	MMSE adjusted by age and education	NR	24.7% in 65–74 year range ($n = 276$); 46.1% in ≥ 75 years ($n = 554$)	65–74 years ($n = 276$), ≥ 75 years ($n = 554$)	49.5	830	Included: aged > 65 years
Marengoni 2013[140]	SBT: moderate impairment score 10–19; severe impairment score ≥ 20	561	47%	Mean 79.1 (95% CI 78.7 to 79.5)	48.3	1201	Included: aged > 65 years
Martínez-Velilla 2014[103]	Not specified	NR	48.2%; 12.3% severe	85.4 (5.4)	43.4	122	Included: aged > 75 years
McAvay 2006[63]	MMSE score of < 24	189	43.60%	79.8 (6.3)	39.7; delirium at discharge: 33.3% (8/24); delirium resolved: 45.2% (14/31); never delirious: 39.7% (150/378)	433	Included: patients aged ≥ 70 years without delirium on admission to general medicine service, agreed to participate Excluded: unable to participate in interview (e.g. profound dementia, aphasia, intubation), death during hospitalisation, admitted to hospital from nursing home – desired to focus on new nursing home admissions

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
McCusker 2003[109]	MMSE – lower score indicates greater cognitive impairment measured to compare baseline and follow-up scores by dementia stratification (yes or no) and to compare baseline and follow-up scores by in-hospital course of delirium (i.e. recovered, transient or persistent)	NR	NR	83.4 (7.3)	38.3	193	Included: aged > 65 years Excluded: stroke and non-English/French speakers
Nair 2000[175]	MMSE score of ≤ 23	29	29%	79.5 (6.5)	53	100	Excluded: patients admitted to ICU, coronary care unit, neurology unit or who were unconscious, semiconscious or could not communicate in English
O'Keeffe 1997[121]	Diagnosis of chronic cognitive impairment was made if there was evidence of cognitive impairment sufficient to interfere with social functioning of at least 6 months' duration or if the BDRS was ≥ 4	60	26.7%	Delirium 82 (4), no delirium 82 (6)	Delirium: 39 No delirium: 32	225	Included: patients admitted consecutively to an acute care geriatric unit, first admission during study period Excluded: patients not admitted to geriatric unit on day of admission, patients admitted electively for investigations, rehabilitation or respite care, patients with severe aphasia or deafness, patients expected to remain in hospital for < 48 hours, patients not assessed by a study doctor within 48 hours of admission

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Orsitto 2005[99]	Patients with a score of ≤ 7 in SPMSQ underwent MMSE testing and CDRS; MCI made using Petersen criteria and absence of dementia	35	19.50%	80.0 (6.7) dementia, 77.2 (6.6) MCI, 75.9 (6.5) no cognitive impairment, overall mean age 77.8 (6.8)	32.8 dementia; 45.7 MCI; 53 no cognitive impairment	179	Included: aged > 65 years with suspected or ascertained cognitive impairment
Orsitto 2012[46]	MMSE; MCI diagnosed using the following Petersen criteria: presence of subjective memory loss, preferably corroborated by an informant; demonstration of a memory impairment by cognitive testing; preserved general intellectual functioning as estimated by performance on a vocabulary test; intact ability to perform ADL and absence of dementia	MCI: 56	10%	76.9 (6.7)	42.7	560	Included: all patients aged ≥ 65 years admitted to hospital. Written informed consent obtained from patients or relatives of critically ill patients or those with dementia Excluded: patients with short-term prognosis tumours, serious anaemia, primary or secondary malignant brain neoplasms, blood infections, alcohol abuse, disorders of the thyroid, disorders of the kidneys and hydrocephalus. Subjects with past or present medical or psychiatric conditions, or psychoactive substance use that can cause cerebral dysfunction were excluded to rule out the possibility of cognitive impairment due to medical or psychiatric conditions

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Orsitto 2009[100]	Petersen criteria: presence of subjective memory loss, preferably corroborated by an informant; demonstration of a memory impairment by cognitive testing; preserved general intellectual functioning as estimated by performance on a vocabulary test; intact ability to perform ADL and absence of dementia	MCI: 65	11.1%	Dementia: 79.4 (6.1). MCI: 76.3 (6.9). No cognitive impairment: 75.8 (7.0)	42.9	588. 84 with dementia, 65 with MCI, 439 with no cognitive impairment	Included: patients aged ≥ 65 years admitted to geriatric ward Excluded: diagnosis of primary or secondary malignant brain neoplasms, alcohol abuse, head trauma, blood infections, serious anaemia, thyroid disorders
Pedone 2005[54]	AMT score of ≤ 6 points on admission	NR	NR	77.4 (7)	47.7	9061	Included: patients aged ≥ 65 years Excluded: patients who died, those with an admission ADL score of 0 or missing ADL data, those with LoS of > 90 days or a diagnosis of mental retardation
Ponzetto 2002[108]	SPMSQ	NR	NR	80.6 (6.3)	51.2	817	Included: patients aged ≥ 70 years consecutively admitted to the geriatric ward Excluded: patients who died during hospitalisation, patients without complete follow-up data

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Raymont 2004[47]	Focus of paper is mental incapacity; also looks at association between incapacity and cognitive impairment. Patients with cognitive impairment, as measured by MMSE, were grouped into 'mental incapacity'. MMSE score of < 24 denotes significant cognitive impairment. Authors note various definitions of mental incapacity and clinicians sometimes overlooking mental incapacity for various ethical, legal and practical reasons. For those not automatically placed in 'without capacity' group, MacCAT-T and 'vignettes based on those thinking rationally about treatment (TRAT) research method' applied. MacCAT-T is a semistructured interview used for patients – who could respond – measuring (1) understanding of disorder and its treatment, associated	39 'severely cognitively impaired' from non-interviewed group; 40 significantly cognitively impaired from interviewed group; overall: patients without capacity including severely impaired (79 cases of cognitive impairment): 122/302	40% of overall sample 302 without capacity; 25% of 159 interviewed had significant cognitive impairment (MMSE score of < 24)	58.9 (19.9) for adults with capacity; 75.7 (14.4) for adults without capacity	50 in patients with capacity; 44 in patients without capacity	302	

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
	risks and benefits, (2) appreciation of disorder/treatment (i.e. how patient understands how they would be affected), (3) reasoning, (4) ability to express choice about treatments. These are considered the broad spectrum of dimensional underlying processes behind decision-making, arguably enabling clinicians to make informed decisions about judging capacity						
Rockwood 1989[83]	Not specified but relationship between cognitive impairment and acute confusion of interest	9	11.30%	Mean 76.8	44	80	Excluded: admissions to coronary care or ICU
Rozzini 2005[177]	MMSE score of < 18	150	15.80%	78.3 (8.5)	31.7	950	Included: patients aged > 60 years. Exclusions made on basis of premorbid BI of > 25 as study was to examine association between change in functional ability due to acute disease and mortality Excluded: patients with major stroke (affects disability severely); intensive care and those who died in hospital, and patients lost at follow-up

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Sampson 2009[12]	MMSE > 24, normal; MMSE 16–23, moderate impairment; MMSE 0–15, severe cognitive impairment	NR	48% (23% moderate impairment; 25% severe impairment)	Mean 83	31	805	Included: those aged > 70 years Excluded: those discharged before assessment, refusal to consent or persistent delirium
Saravay 2004[114]	MMSE score of ≤ 23	45	48.40%	79 (6.6) for those with cognitive impairment; 74.3 (96.2 – as reported) for those without cognitive impairment	44	93	Included: aged > 65 years Excluded: were transferred from psychiatric inpatient service, transferred from nursing home, elective admission or surgery or expected to be in hospital for < 48 hours
Srinonprasert 2011[160]	Thai Mental State Examination	NR	NR	78	50.1	225	Included: patients aged ≥ 70 years Excluded: patients who were endotracheal intubated at admission, aphasia, comatose, refusal to participate
Torisson 2012[142]	MMSE score of ≤ 23, clock-drawing test score of ≤ 3, informant-completed QoL-AD score of 1–2 Recognition by staff physicians, recognition by staff nurses, memory item of QoL-AD scale, QoL-AD scale completed by an informant	145	72.5%	0 abnormal cognitive test results: 80.6 (8.8) 1 abnormal cognitive test result: 83.1 (8.5) 2 abnormal cognitive test results: 85.8 (6.6)	0 abnormal cognitive test results: 46 1 abnormal cognitive test result: 30 2 abnormal cognitive test results: 31	200	Included: patients aged ≥ 60 years, living in Malmö, not living in a nursing home, admitted to a general internal medicine ward, gave written consent Excluded: patients with terminal disease, severe aphasia, a possible reversible condition such as severe delirium (incoherent speech, inability to focus attention) and/or abnormal laboratory values (haemoglobin < 100 g/l, temperature > 38°, C-reactive protein > 50 mg/l, abnormal electrolytes), in a medical department with a higher degree of specialisation

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 30 Cognitive impairment prevalence (*continued*)

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Watkin 2012[168]	Patients who negatively screened for delirium at baseline were assessed with MMSE. Normal cognition was defined as MMSE score of ≥ 24, mild/moderate impairment 18–23, severe impairment 0–17 DSM-III	NR	48.2% (of 617)	83.0 (7.4)	42	710	Included: all patients aged > 70 years with unplanned admission Excluded: admitted for < 48 hours or did not speak sufficient English for cognitive assessment
Wierenga 2012[162]	All participants screened for global cognitive impairment using MMSE; IQCODE-SF to screen cognitive impairment before admission (over 10-year period) and medical history. Patients with mean score of ≥ 3.9 = serious cognitive impairment	NR	28.6%	77.8 (7.9)	45.6	641	Included: aged > 65 years Excluded: if unable to speak or understand Dutch or English, if relatives did not consent, intensive care/cardiac monitoring, transfer to other wards
Wilson 2005[64]	IQCODE used to determine pre-admission cognitive impairment over time prior to admission as risk factors for delirium incidence in multivariate analysis. MMSE to measure impairment at baseline	NR	NR	84.5 (4.2)	31	100	Included: severe physical illness APACHE score of > 8; aged > 75 years Excluded: coma; delirium on admission; insulin-dependent diabetes mellitus; visual/hearing deficits preventing psychometric assessment; discharge or transfer within 48 hours; blood transfusion; too ill to communicate

Study (first author and year)	Assessment tools and diagnostic criteria	Number of cases of cognitive impairment	Prevalence	Age (years), mean (standard deviation)	Male (*n*)	Sample size (*n*)	Inclusion/exclusion criteria
Zekry 2011[105]	MMSE; Short Cognitive Evaluation Battery	48	10.8%	85.3 (6.7)	26	444	Included: patients aged ≥ 75 years admitted to hospital Excluded: those with disorders interfering with psychometric assessment (severe deafness or blindness, or major behavioural problems) and terminal illness
Zuliani 2013[48]	MMSE scores taken to examine association between clinical and demographic factors and cognitive status in both SSD and controls	NR	NR	Mean 80.6	39.9	438	No inclusion criteria reported Excluded: delirium and dementia patients

A&E, accident and emergency; ACE III, Addenbrooke's Cognitive Examination III; APACHE, Acute Physiology and Chronic Health Evaluation; BDRS, Blessed Dementia Rating Scale; CDRS, Clinical Dementia Rating Scale; ED, emergency department; GP, general practitioner; HMSE, Hindi (vernacular) version of MMSE; IQCODE-SF, Informant Questionnaire on Cognitive Decline in the Elderly-Short Form; MacCAT-T, MacArthur assessment tool for treatment; MIS, Memory Impairment Screen; NR, not reported; NS, not significant; PD, Parkinson's disease; QoL-AD, quality of life – Alzheimer's disease; SADS, Schedule for Affective Disorders and Schizophrenia; SBT, Short Blessed Test; SKT, Syndrom Kurztest; SPMSQ, Short Portable Mental Status Questionnaire.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Cognitive spectrum disorder outcomes

TABLE 31 Outcomes for dementia

Study (first author and year)	Control of confounders	Outcomes for dementia
Aminoff 2014[77]	Gender and leucocytosis	**In-hospital mortality** 14.8% (27/183) died in mean time of 19.86 ± 26.9 days; 51.8% (14/27) died in 14 days; 88.8% (24/27) died in 30 days MSSE scale score of non-surviving patients: 7.56 ± 1.71 (high suffering); MSSE score of surviving patients: 3.99 ± 2.10 (low suffering) Significant difference ($p = 0.001$) between groups Multivariate logistic regression showed that high MMSE was a significant risk factor (OR 2.27, 95% CI 1.58 to 3.26; $p < 0.0001$)
Barba 2011[42]	Age, sex, CCI, residential home, main diagnosis at admission, complications during admission	**In-hospital mortality** 3547 (25.9%) people aged > 90 years with dementia died in hospital; 10,151 (74.7%) were discharged alive (adjusted OR 1.13, 95% CI 1.08 to 1.18)
Basic 2009[74]	Age, sex, MBI score, able to do TUG, no infection, no anaemia, no GIT disorder, no stroke	**Length of hospital stay** 36.6% of those with LoS of > 3 days had dementia. 36.5% of those with LoS of ≤ 3 days had dementia. No association explored
Bellelli 2015[55]	Multiple adjustments including age, sex, nursing home residence and hospitalisations prior to current admission, neuroleptics, comorbidity, SBT groups (A, B, C, D)	**In-hospital mortality** OR 1.4, 95% CI 0.7 to 2.74; $p = 0.34$ (NS)
Briggs 2016[81]	None	**Length of hospital stay** The 246 patients with dementia who were also diagnosed with pneumonia had an average LoS of 25.6 days compared with their non-demented counterparts' average LoS of 11.2 days. The average LoS was 31.0 days in the dementia group and 14.1 days in those aged > 65 years without dementia. In total, 26.2% (6300 days) of the total bed-days attributable to the treatment of pneumonia involved care of a patient with dementia **Health/social care costs** Average hospital care cost (case-mix cost) was almost three times more (€13,832) per patient with dementia compared with non-dementia patients (€5404). The costs attributable to patients with dementia accounted for 5% (almost €20M) of the total hospital case-mix budget for the period
de Boissieu 2015[113]	Age and participating centre	**Mortality after discharge** No significant risk factor for dementia and death at 36 months (HR 1.1, 95% CI 0.8 to 1.4; $p = 0.60$)

TABLE 31 Outcomes for dementia (*continued*)

Study (first author and year)	Control of confounders	Outcomes for dementia
Di Iorio 1998[85]	Sex, social condition, living alone, CIRS classes, CIRS score, MMSE, previous hospitalisation, location	**Hospital re-admission** Early re-admission (within first 3 months) associated with cognitive impairment (including dementia) (adjusted OR 1.39, 95% CI 1.06 to 1.83)
Dramé 2008[90]	Age, gender, ADL, malnutrition risk, dementia, delirium	**In-hospital mortality** Adjusted OR 1.6, 95% CI 0.9 to 2.8; $p < 0.11$ (NS)
Dramé 2012[78]	Not specified	**Nursing/care home admission** Multivariate analysis: increased initial MMSE score (1-point increase) significantly reduced risk of nursing home admission (HR 0.97, 95% CI 0.95 to 0.99; $p = 0.03$)
Dramé 2011[115]	Investigating centre	**Nursing/care home admission** One year following acute hospital admission: multivariate analysis/Cox proportional hazards model – dementia is a significant risk factor for institutionalisation (HR 1.9, 95% CI 1.4 to 2.6; $p = 0.001$)
Erkinjuntti 1986[17]	Age	**Length of hospital stay** Dementia group: 45.5 ± 74.4 days, range 1–420 days Non-dementia group: 14.4 ± 28.4 days, range 1–410 days Mean relative risk for longer hospitalisation among dementia group – 2.37, 95% CI 1.7 to 3.51; $\chi^2 = 44.5$; $p < 0.001$) when age held constant **Need for daily nursing** On admission, 56.4% of dementia group and 34.2% of non-dementia group needed at least 3 hours of daily nursing ($p < 0.001$). After treatment of the acute problems, corresponding figures were 35.4% and 12% ($p < 0.001$). After age adjustment, relative risk of need of older daily nursing among dementia group was 2.37 (95% CI 1.92 to 3.51; $\chi^2 = 44.5$; $p < 0.001$), after treatment 3.85 (95% CI being 2.82 to 5.24; $\chi^2 = 78.26$; $p < 0.001$). Effect of age on need for daily care NS ($p = 0.052$ at admission, $p = 0.156$ after treatment)
Erkinjuntti 1988[18]	Age	**Length of hospital stay** Adjusted relative risk of longer hospitalisation (> 90 days) among all the demented patients was 5.45, 95% CI 3.05 to 11.02 ($\chi^2 = 31.5$; $p < 0.001$)
Francis 1992[112]	Not specified	**Mortality after discharge** DRS score strong univariate predictor of mortality (RR 2.39, 95% CI 1.28 to 4.45) Note that when dementia was included in multivariate analysis, delirium was not a long-term predictor of survival

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 31 Outcomes for dementia (*continued*)

Study (first author and year)	Control of confounders	Outcomes for dementia
Golmard 2009[111]	None	**In-hospital mortality** Deceased patients: dementia group: 12/27 (10.8%); non-dementia group 15/27 (13.4%) Survivors: dementia group 99/197 (89.2%); non-dementia group 97/197 (86.6%) ($p = 0.555$, NS)
Inouye 1998[56]	Risk assessment model to evaluate and validate the contribution of functional measures to the ability of five standard burden of illness indices (CCI, APACHE II, disease staging, all patient refined DRGs and a clinician's subjective rating) in predicting 90-day and 2-year mortality among older hospitalised patients	**Mortality after discharge** Dementia group: 25/34 (74%); non-dementia group: 53/170 (31%) (unadjusted RR 3.1, 95% CI 1.9 to 5.0)
Kolbeinsson 1993[97]	None	**Length of hospital stay** Delirious patients stayed longer than non-delirious demented patients (20.2 vs. 16.5 days) **In-hospital mortality** 32% died in delirium group; 8% died in dementia group ($p < 0.01$) **Discharge destination** 6 months beyond study end: no difference between delirium and dementia groups
Marengoni 2008[45]	Age, gender, education	**Discharge destination** Regression model for all separate diseases other than comorbidity showed association of dementia and DSD For rehabilitation, OR 2.3, 95% CI 1.1 to 4.5; for nursing home, OR 3.9, 95% CI 1.4 to 10.9
Marengoni 2011[110]	Logistic regression model used to examine association between in-hospital mortality and dementia. Model 1: logistic regression adjusted for age/gender/education, polypharmacy, CCI, adverse clinical events, vital parameters (blood pressure/heart rate). Model 2: diseases examined separately instead of CCI	**In-hospital mortality** Logistic regression to determine association between dementia and in-hospital mortality; two models: • Model 1 adjusting for age/gender/education/ cognitive impairment; adverse clinical events; vital parameters: OR 2.14, 95% CI 1.02 to 4.49 • Model 2 for independent association of each disease and not cognitive impairment/adverse clinical events: OR 2.64, 95% CI 1.16 to 6.00 Patients with dementia were twice as likely to die as those in the non-dementia group: dementia group 9.40%; non-dementia group 4.90%
Martínez-Velilla 2013[71]	None	**Functional status/ADL** One-year change of BI positively associated with degree of dementia – patients with higher degrees of dementia had a lower BI reduction; and patients with higher initial BI levels lose more

TABLE 31 Outcomes for dementia (*continued*)

Study (first author and year)	Control of confounders	Outcomes for dementia
McCusker 2001[94]	All models were adjusted for age, sex, marital status, education, residence, comorbidity, APS and severity of illness, but not for premorbid IADL	**Nursing/care home admission** Dementia group: at 12-month follow-up, 12/46 (26%) Non-dementia group: at 12-month follow-up, 7/37 (19%) had neither delirium nor dementia Patients with both delirium and dementia were more likely to be admitted to long-term care than those with neither condition (adjusted OR 3.18, 95% CI 1.19 to 8.49) Dementia and admission to long-term care (regression analyses) (OR 1.50, 95% CI 0.50 to 4.51) (NS) However, both adjusted and unadjusted analyses showed that, in comparison with patients with neither delirium nor dementia, the increase in the odds of admission to long-term care was statistically significant among patients with both conditions but not among patients with either delirium or dementia alone **Functional status** At 12 months, the adjusted mean differences in the BI were −16.45 (95% CI −27.42 to −5.50) and −13.89 (95% CI −28.39 to 0.61) for patients with and without dementia, respectively Dementia but not delirium predicted worse IADL scores at follow-up. Unadjusted analyses yielded similar results **Cognitive impairment** The effect of delirium on MMSE scores at follow-up was statistically significant among patients with and without dementia: the adjusted mean difference in MMSE scores between patients with and without delirium was −4.99 (95% CI −7.17 to −2.81) among patients with dementia and −3.36 (95% CI −6.15 to − 0.58) among those without dementia
McCusker 2003[109]	None	**Length of hospital stay** 18.3 days (SD 17.3 days) for whole group of 193 delirious patients. In those with dementia, 18.9 ($n = 136$); those without, 17.5 ($n = 45$) ($p = 0.6$) (NS) **Mortality after discharge** Stratified by dementia status at 12 months' follow-up, number and percentage of deaths: dementia 41/136 (30.2%) vs. non-dementia 15/45 (33.3%) **Functional status/ADL** BI: at enrolment, dementia group, 136 (39 ± 28.5); no dementia, 45 (53.9 ± 29.3) 12 months' follow-up BI score stratified by dementia group: dementia group 92 (59.1 ± 32.9); and 28 (80.9 ± 27.7) for non-dementia group IADL: at enrolment, dementia 136 (5.8 ± 3.4); no dementia 45 (9.9 ± 3.0)

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 31 Outcomes for dementia (*continued*)

Study (first author and year)	Control of confounders	Outcomes for dementia
		12 months' follow-up IADL score stratified by dementia group: dementia 92 (4.2 ± 3.5); no dementia 27 (8.3 ± 3.7) **Cognitive status** Time to cognitive improvement – marked by ≥ 3-point increase in MMSE: 10.8 days (10.1) for entire group At enrolment stratified by dementia status MMSE score: 136 (13.7 ± 7.0); no dementia 45 (19.1 ± 5.7) 12 months stratified by dementia status MMSE score: dementia: 91 (16.7 ± 8.0) vs. no dementia 25 (21.7 ± 5.4)
Orsitto 2005[99]		**Functional status/ADL** Functional status (ADL/IADL) was significantly poorer in those with dementia than in those with MCI or no dementia: • Dementia: ADL 3.1 ± 2.1; IADL 1.5 ± 2.0 • MCI ($n = 35$): ADL 5.1 ± 1.4/IADL 5.2 ± 2.2 ($p = 0.0001$) • No dementia ($n = 71$): ADL 5.5 ± 0.9/IADL 6.4 ± 1.9 ($p = 0.0001$)
Ponzetto 2002[108]	None	**Mortality after discharge** Dementia group: 5 years after discharge 80% died Non-dementia: 5 years after discharge 465/707 (65.8%) died; $p < 0.01$
Sampson 2013[107]	Multivariate Cox proportional hazards model sequentially adjusted for age, gender, APACHE score, CCI and Waterlow (pressure sore risk) score – to establish association between dementia presence and dementia severity and mortality	**Mortality after discharge** After sequential adjustment (age, gender, APACHE II, CCI using multivariate Cox proportional hazards models), dementia patients had mortality risk of 1.56 (95% CI 1.23 to 1.98) ($p < 0.001$); and those with moderately severe/severe dementia (FAST scale), RR 1.81 (95% CI 1.36 to 2.40; $p < 0.001$) Adjusting for all variables but Waterlow score there remained a significant association between dementia and mortality, but when Waterlow score added these HRs were 1.24 (95% CI 0.95 to 1.60); and those with moderately severe/severe dementia (FAST scale) 1.33 (95% CI 0.97 to 1.84) ($p = 0.11$; $p = 0.13$, respectively) (NS)
Sampson 2009[12]	APACHE II and age were identified as confounders in univariate analysis and thus included in final multivariate analysis; other confounders had no significant associations with mortality (i.e. residence, LoS and chronic comorbidity) and function and were thus not included in final model. Final model adjusted for age and APACHE II score	**In-hospital mortality** Mortality risk increased with level of cognitive impairment (24% of those with MMSE 0–15 and 18.1% with dementia died within 14 days) After multivariate analysis, mortality risk still higher in those with cognitive impairment and significantly higher in those with dementia after these adjustments/ considerations (HR 2.09, 95% CI 1.10 to 4.00, $\chi^2 = 31.97$; $p < 0.001$)

TABLE 31 Outcomes for dementia (*continued*)

Study (first author and year)	Control of confounders	Outcomes for dementia
Saravay 2004[114]	Age and functional status on admission	**Length of hospital stay** Factor 1 (delirium, dementia and cognitive impairment measured on admission) highly correlated with factor 2 (eight variables taken from mental and behavioural manifestations and complications) ($r = 0.65$, $p = 0.001$, $n = 75$); and each of these eight factors separately correlated with increasing LoS (factor 1: $r = 0.25$, $p = 0.02$, $n = 85$; factor 2: $r = 0.37$, $p = 0.001$, $n = 83$) Difference in mean LoS by high and low factor scores: 14 days for those differentiated by high and low 1 factor scores ($p < 0.05$); and 10 days for those differentiated by high and low factor 2 scores ($p < 0.01$)
Sonnenblick 2007[106]	Multivariate analysis; confounders not specified	**In-hospital mortality** Dementia group: 40; non-dementia group: 49; NS in multivariate analysis (ORs not reported)
Torian 1992[20]	None	**Length of hospital stay** Dementia group: mean 33.55 (SD 35.03); non-dementia group: mean 17.12 (SD 2.67); $p = 0.001$ Mean number of days in acute care: dementia group, 23.54 (SD 26.82); non-dementia group, 12.83 (SD 9.73); $p = 0.005$ Mean number of days when acute hospital care no longer needed but patient cannot be discharged owing to problems with placement or arranging for home support services: dementia group, 10.01 (SD 17.94); non-dementia group, 4.29 (SD 8.52); $p = 0.029$ Mean LoS for Medicare DRG: dementia group, 7.78 (SD 2.70); non-dementia group, 6.59 (SD 2.65); $p = 0.011$ Mean difference between actual LoS and mean DRG LoS: dementia group, 25.29 (SD 34.46); non-dementia group, 10.53 (SD 12.33); $p = 0.003$ **Health/social care costs** Dementia group: net hospital profit/loss, US$–5910.44 (SD US$–9034.46); non-dementia group: net hospital profit/loss, US$–3331.50 (SD US$7286.06); $p = 0.066$
Wancata 2003[21]	Multiple regression analysis controlled for age, sex, marital status, social class, catchment area, living status, severity of cognitive impairment, duration of somatic illness, number of somatic diagnoses, impaired mobility	**Length of hospital stay** Mean LoS for dementia group with non-cognitive symptoms 30.4 days; mean LoS for those without non-cognitive symptoms 16.9 days Multilogistic regression for all inpatients: LoS predicted by both subtypes of dementia (with, OR 1.75, 95% CI 1.40 to 2.20; $p = 0.014$; and without non-cognitive symptoms, OR 1.27, 95% CI 1.15 to 1.42; $p = 0.020$) Multiple logistic regression for dementia patients: LoS significantly and independently associated with increased cognitive impairment (OR 1.21, 95% CI 1.06 to 1.36; $p = 0.005$); and a higher number of non-cognitive symptoms (OR 1.11, 95% CI 1.05 to 1.17; $p = 0.000$)

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 31 Outcomes for dementia (*continued*)

Study (first author and year)	Control of confounders	Outcomes for dementia
		Nursing/care home admission Dementia patients without non-cognitive symptoms: 21.1% referred; dementia patients with non-cognitive symptoms 47.4% referred Multiple logistic regression for all inpatients showed nursing home admission was significantly associated with presence of dementia (with cognitive symptoms, OR 3.61, 95% CI 1.76 to 7.38; and without non-cognitive symptoms, OR 2.28; 95% CI 1.37 to 3.79; $p = 0.000$ and $p = 0.001$, respectively) Multiple logistic regression for dementia patients: nursing home referrals significantly and independently associated with increased severity of cognitive impairment (OR 2.82, 95% CI 1.10 to 7.19; $p = 0.030$); and a higher number of non-cognitive symptoms (OR 1.38, 95% CI 1.01 to 1.88; $p = 0.041$
Zekry 2011[105]	Multiple Cox proportional hazards models controlled for age, sex, cognitive diagnosis, dementia aetiology and dementia severity	**In-hospital mortality** Dementia group: 7/190 – AD 1/75, mixed dementia 5/82, vascular dementia 1/20 Non-dementia group: 12/206 None of the predictive variables was associated with mortality. MCI, AD and MD were not predictive of short- or long-term mortality Dementia (all aetiologies) not predictive of mortality. The observed vascular dementia effect is probably linked to cardiovascular risk comorbidities: hypertension, stroke and hyperlipidaemia **Mortality after discharge** Introduction of all variables into the full model eliminated the association of moderate and severe dementia

APACHE, Acute Physiology and Chronic Health Evaluation; APS, Acute Physiology Score; CIRS, Cumulative Illness Rating Scale; DRG, diagnosis-related group; DRS, Delirium Rating Scale; FAST, Functional Assessment Staging of Alzheimer's Disease; GIT, gastrointestinal tract; MBI, Modified Barthel Index; NS, not significant; SBT, Short Blessed Test; SD, standard deviation; TUG, Timed Up and Go.

TABLE 32 Outcomes for delirium

Study (first author and year)	Control of confounders	Outcomes for delirium
Adamis 2006[59]	No. Binary logistic regression: forward likelihood ratio for mortality and NHA as outcome, including age, gender, MMSE, CAM, APS, BISEP, ADL and DRS at initial assessment	**Length of hospital stay** Delirium group: 28.6 ± 23.5 (median 21; IQR 35) for prevalent or incident Non-delirium group: 13.8 ± 9.65 [median 10; IQR 8 (no delirium, no impairment]; Mann–Whitney *U*-test 572.5, $p = 0.047$ LoS between delirium, cognitive impairment with no delirium and cognitively intact did not show clear-cut variance Kruskal–Wallis, $p = 0.068$; no difference in LoS between delirium recovery group and non-recovery group **In-hospital mortality** Delirium group: 6/33 (18%); non-delirium group: 3/61 (4.91%); $\chi^2 = 4.35$, $p = 0.037$ **Nursing/care home admission** New care home admission in surviving patients was strongly associated with delirium ($\chi^2 = 10.6$, df = 1; $p = 0.01$) 5.3% with neither cognitive impairment or delirium newly entered care home; 12.8% with cognitive impairment but no delirium entered care home; 40.7% with delirium and cognitive impairment entered care home ($\chi^2 = 11.09$; df = 2, $p = 0.004$) Initial CAM positive (delirium) was a predictor variable for entry into care home (Wald test 7.04, $p = 0.008$)
Adamis 2011[136]	MMSE, APOE, IL-1α, IL-6, LIF and TNF-α levels	**Functional status/ADL** Significant difference in BI score change between prevalent delirium and non-delirious groups (Mann–Whitney *U*-test $p = 0.047$) For non-delirious group, BI score significant increase (Wilcoxon signed-rank test paired $p = 0.001$) By discharge, delirium survivors had significant improvement in BI ($p = 0.005$), and in those who recovered ($p = 0.0001$), but for non-recoverers BI scores did not significantly improve ($p = 0.512$) In multivariate analysis, BI was not significantly affected by delirium

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Adamis 2014[137]	No Note that in generalised estimating equations, model predictor variables included demographic characteristics, severity of illness, dementia presence of absence, APOE 4 allele, CAM status over time, DRS score, cytokines and IGF-1	**Cognitive status** 1. 20% MMSE improvement: i. MMSE 25 or less for 105 patients allows for 20% improvement. 43% showed 20% MMSE improvement. Significant difference between improved vs. non-improved in delirium severity and acute physical illness severity ii. Comparison of improved vs. non-improved showed significant differences in DRS score [Mann–Whitney *U*-test = 484, $p < 0.001$, and delirium status (CAM) ($\chi^2 = 26.4$, df 1, $p = 0.001$)] 2. 3-point MMSE improvement: i. MMSE 27 or less at first assessment ($n = 123$) allows for 3-point improvement. 42% showed MMSE 3-point improvement at next assessment ii. Significant difference between improved vs. non-improved in delirium status at first assessment; delirium severity; lower IGF-1, age/gender (older and female patients predicted greater improvement) 3. Delirium occurence and changing cognitive status: i. 30/55 (65.2%) showing 3-point MMSE improvement had delirium; 53.8% with over 20% MMSE improvement had prevalent delirium ii. For either definition from 142 undertaking second assessment: 38.7% showed cognitive improvement, of which 54.5% had prevalent delirium iii. 96 (67.6%) never developed delirium, of which 24% improved cognitively by either definition
Adamis 2007[130]	No NB a predictive model of mortality using logistic regression and variables examined were gender, age, BI, MMSE, APS, albumin, IFN-γ, IL-6 and delirium status (incident or prevalent)	**In-hospital mortality** Delirium group: 4/164 were from the prevalent delirium group, 2/164 from the incident delirium group Non-delirium group: 8/164 were from the never delirium group No significant association was found between delirium (incident or prevalent) and death (Pearson's chi-squared value = 1.509, $p = 0.219$) **Mortality after discharge** Delirium group: at 6-month follow-up, six of the delirium group (incident and prevalent) had died Non-delirium group: at 6-month follow-up, 15 of the never delirium group had died There was no significant association between either (1) delirium status during hospitalisation (incident or prevalent) (Pearson's chi-squared value = 0.009, df = 1, $p = 0.926$) or (2) delirium severity at first assessment and 6-month mortality Predictive model of mortality: logistic regression of overall mortality showed that delirium was not significantly associated with mortality

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Basic 2009[74]	Multivariate analysis: age, sex, MBI score, able to do TUG, no infection, anaemia, GIT disorder or stroke	**Length of hospital stay** No delirium (logistic regression to show association with short LoS) where MBI treated as dichotomous variable: PE 0.98, SE 0.27, $p = 0.0003$, OR 2.66 (95% CI 1.56 to 4.54)] No delirium for MBI as interval scale: PE 0.92, SE 0.27, $p = 0.0007$, OR 2.52 (95% CI 1.48 to 4.29)
Beauchet 2013[132]	Age, gender, number of drugs taken daily, non-use of home help services, CAM	**Length of hospital stay** Adjusted beta full adjusted 1.82 (95% CI 0.40 to 3.25) $p = 0.012$. Backwards 1.83 (95% CI 0.40 to 3.26) $p = 0.012$
Bellelli 2015[55]	Age, gender (model 1) Age, gender, nursing home residence/ hospitalisation in 6 months prior to hospital admission (model 2) Age, sex, cumulative illness rating scale for comorbidity (model 3) Age, gender, dementia at admission (model 4)	**Length of hospital stay** No significant difference between delirium and non-delirium group ($p = 0.54$) **In-hospital mortality** Delirium group: 2/72 (2%); non-delirium group: 74/2449 (3%) No significant difference ($p = 0.91$) Recorded diagnosis of delirium and in-hospital mortality (univariate analysis): OR 1.0 (95% CI 0.2 to 3.4); $p = 0.9406$ (NS)
Bourdel-Marchasson 2004[68]	Stepwise backward logistic regression: age, sex, previously known cognitive impairment, delirium categories (prevalent, incident, prevalent SSD, incident SSD), dietary intake group, diagnosis (falls/stroke), admission biological data examined separately but not adjusted for	**Nursing/care home admission** Discharged to community: prevalent delirium, 6.8%; incident delirium, 2.9%; prevalent SSD, 18.4%; incident SSD, 10.6%; symptom free, 61.3% Discharged to geriatric institutions: prevalent delirium, 11.1%; incident delirium, 5.1%; prevalent SSD, 26.5%; Incident SSD, 23.1%; symptom free, 34.2% Prevalent delirium (OR 3.19, 95% CI 1.33 to 7.64), SSD (OR 2.72, 95% CI 1.48 to 5.01), incident SSD (OR 4.27, 95% CI 2.17 to 8.39) independent predictors of institutionalisation
Boustani 2010[129]	No	**Length of hospital stay** Cognitive impairment and delirium – mean 9.2 (SD 7.9) days. Cognitive impairment, no delirium – mean 5.9 (SD 4.9) days, $p < 0.001$ **Hospital re-admission** 30-day re-admission: cognitive impairment and delirium, 22.5%. Cognitive impairment, no delirium, 17.8%, $p = 0.50$ **Discharge home** Cognitive impairment and delirium, 24.5%. Cognitive impairment, no delirium, 49.4%. $p < 0.001$ **Survived at 30 days post discharge** Cognitive impairment and delirium, 91.4%. Cognitive impairment, no delirium, 95.8%. $p = 0.09$

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Buurman 2011[128]	Multivariate analysis: sex, age and CCI. geriatric conditions with $p < 0.20$ in univariate analysis	**Post-discharge mortality** Prevalent delirium – multivariable HR 1.46 (95% CI 1.02 to 2.09), $p = 0.04$ **Poor outcome (mortality or functional decline)** Multivariate analysis HR 1.52 (95% CI 1.14 to 2.03), $p = 0.01$
Cole 2008[69]	Age, sex, marital status, education, APS, severity of illness, CCI, dementia status	**Hierarchical composite outcome (death, institutionalisation, decline of ≥ 3 MMSE points; decline of ≥ 10 BI points)** SSD-recovery group – based on recovery by 8 weeks At 6 months: • Death or institutionalisation – significant difference ($p < 0.05$) between SSD-non/recovery and no SSD. Adjusted OR 3.1 (95% CI 1.0 to 10.0); • MMSE – significant difference ($p < 0.05$) between SSD-recovery a SSD-non-recovered (adjusted OR 4.1, 95% CI 1.9 to 6.3); and SSD-non-recovered and no SSD. Adjusted OR −4.6 (95% CI −7.3 to −1.7) At 12 months: • MMSE – significant difference ($p < 0.05$) between SSD-recovered and SSD-non-recovered [adjusted OR 4.9 (95% CI 2.7 to 7.2)] and SSD-non-recovered and no SSD [adjusted OR −4.3 (95% CI −6.8 to −1.6)]
Dasgupta 2014[127]	Age, ADL, hypoxia, ARF in relation to outcomes of functional decline, institutionalisation and mortality (poor outcomes)	**Length of hospital stay** Delirium group: median 15.0 days; non-delirium group: median 6.0 days; $p < 0.001$ **In-hospital mortality** Delirium group: 15.2%; non-delirium group: 4.2%; $p < 0.001$ **Mortality after discharge (follow-up)** Delirium group: 1/202 **Nursing/care home admission** Delirium group: 24.2% at discharge, 50/202 at follow-up Non-delirium group: 6.0% at discharge, $p < 0.001$ (using values at discharge) At follow-up: 51% admitted to nursing home (of 97 with poor recovery) **Poor recovery** mDAS median (SD) and poor recovery (functional decline, institutionalisation or death): OR 1.16 (95% CI 1.06 to 1.26) (derivation sample); OR 1.03 (95% CI 0.92 to 1.14) (validation sample)

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
de Boissieu 2015[113]	Multivariable Cox regression adjusting for age and participating centre	**Mortality after discharge** Significant risk factor for mortality at 36 months after adjustment: delirium (HR 1.6, 95% CI 1.1 to 2.3; $p = 0.01$)
Dramé 2008[90]	Age, gender, participating centre	**In-hospital mortality** Delirium linked to survival in univariate analysis (Kaplan–Meier, log-rank test) ($p < 0.001$). For multivariate analysis – Cox proportional hazards regression model/stepwise model, existence of delirium independently predicted mortality: OR 1.7 (95% CI 1.2 to 2.5); $p = 0.006$
Dramé 2011[115]	Investigating centre	**Nursing/care home admission** 20.1% institutionalised in 1 year following hospital admission; of those, 52.6% to a nursing home Bivariable analysis: no significant risk factor for delirium: HR 1.0 (95% CI 0.7 to 1.4); $p = 0.83$
Edlund 2006[60]	No	**Length of hospital stay** Delirium group: 15.4 ± 14.2 days; non-delirium group: 9.5 ± 7.8 days; $p < 0.001$ **In-hospital mortality** Delirium group: 8.8%; non-delirium group: 1.8%; $p < 0.001$ **Mortality within 1 year of admission** Delirium group: 36%; non-delirium group: 20%; $p < 0.001$ **Return to own home at discharge** Delirium group: 68.8%; non-delirium group: 90.6%; $p < 0.001$
Eeles 2010[126]	Age, dementia, placement, illness severity, comorbidity and dependency (for mortality within 5 years)	**Length of hospital stay** Longer for delirium (mean 13.1 days absent delirium and 26.1 days with delirium; $p < 0.001$) Delirium associated with longer hospital admission in first year after index admission: mean 30.3 days (SD 54.3) vs. 17.0 days (SD 36.1); $p = 0.01$ Hospitalisation rates subsequently stabilised in both groups with reduced LoS after 2 years **In-hospital mortality** 35.9% of patients with delirium died during index admission vs. 6.9% without delirium

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
		Cox proportional modelling after adjustment: delirium significantly associated with higher mortality risk: • During index admission: HR 3.5 (95% CI 2.3 to 5.6); $p < 0.0001$ • During first year: HR 3.2 (95% CI 2.1 to 4.8); $p < 0.0001$ • From second to fifth year (follow-up years): HR 2.0 (95% CI 1.3 to 3.2); $p < 0.002$ **Nursing/care home admission** In 5 years post admission, placement higher for delirium group (statistically significant for first 2 years after admission): • Year 1: 40.5 vs. 17.6%; $p = 0.03$ • Year 2: 33 vs. 15.1%; $p = 0.05$
Feldman 1999[125]	No	**Length of hospital stay** Delirium group: 18.2 days (SD 6.2 days); non-delirium group: 7.3 days (SD 5.2 days); $p < 0.001$ **In-hospital mortality** Delirium group: 27.3%; non-delirium group: 2%; $p < 0.005$ **Functional status/ADL** Delirium group: independent 9.1%; mildly dependent 23.1%; completely dependent 18% Non-delirium group: independent 90.9%; mildly dependent 76.9%; completely dependent 76.9% Chi-squared: NS **Cognitive status** No significant difference between delirium and non-delirium groups on cognitive status (classed as no dementia, mild dementia, severe dementia on the MMSE) prior to hospital admission Significant difference in MMSE measured on discharge: • With delirium it was lower: 38.1% (SD 27%) • Without delirium higher: 60.8% (SD 24.4%) ($p < 0.05$) **Complications during hospitalisation** Delirium group: 100%; non-delirium group: 14%; $p < 0.001$

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Fortini 2014[73]	Not specified	**Length of hospital stay** Incident delirium associated with longer LoS ($p = 0.002$) **In-hospital mortality** No statistically significant difference between delirium group and non-delirium group in terms of ORs during hospitalisation (statistics not reported) **Nursing/care home admission** Those with incident or prevalent delirium more likely to be transferred to nursing home or post-acute care settings [18% in delirium group vs. 7% non-delirium group; $p < 0.02$; OR 3.026 IC (25%) 1.304–7.020] than non-delirium group Incident delirium significantly reduced home discharge: $p = 0.01$, OR 0.428
Francis 1990[131]	Analysis of length of hospital stay was performed initially with pairwise correlations or categorical analyses. Simultaneous adjustment for multiple predictors was done with linear regression, with the logarithm of LoS as the dependent variable	**Length of hospital stay** Delirium group: 12.1 days; non-delirium group: 7.2 days; $p < 0.001$ **In-hospital mortality** Delirium group: 8%; non-delirium group: 1%; $p < 0.05$ **6-month mortality** Delirium group: 14.3%; non-delirium group: 10.1%; $p > 0.10$ **Functional status/ADL** No significant differences between the two groups; nearly one-quarter of each reported some increase in dependency **Cognitive status** Delirium group: mean MMSE score – on admission 17.5 (SD 9.3); at discharge 19.4 (SD 8.0); range 6.9 (SD 5.1); at follow-up 24.7 Non-delirium group: mean MMSE score – on admission 25.7 (SD 3.5); at discharge 25.9 (SD 3.2); range 1.9 (SD 1.5); at follow-up 26.7 Discharge to nursing facilities (skilled and intermediate levels of care), personal-care homes and rehabilitation facilities. Delirium group: 16%; non-delirium group: 3.4%; $p < 0.005$

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Francis 1992[112]	Multivariate log regression – confounders not specified	**Mortality after discharge** 2-year mortality 39% for delirium; 23% for controls ($p = 0.03$) (Kaplan–Meier method); univariate predictor of mortality: RR 1.82 (95% CI 1.04 to 3.19). When dementia was included in multivariate analysis, delirium was not a long-term predictor of survival **Functional status/ADL** Delirium strongly associated with loss of independent community living (Katz ADL assessment) Adjusted OR (multivariate analysis) 2.56, 95% CI 1.10 to 5.91 **Cognitive status (11 delirium cases and 81 controls tested)** After adjustment: greater decline in cognitive performance in delirium group ($p = 0.023$)
Gallerani 2013[95]	No	**In-hospital mortality** Delirium group: 7.7%; non-delirium group: 7.5%; $\chi^2 = 0.056$, $p = 0.0427$)
González 2009[124]	Multivariate Cox model adjusting for age, sex, APACHE II score, CCI, SPMSQ score and BI score	**Length of hospital stay** Delirium group: 7.3 (5.9 SD) days; non-delirium group: 5.0 (3.9 SD) days; $p < 0.001$ **In-hospital mortality** Delirium group: 8.5%; non-delirium group: 1.7%; $p < 0.001$ Delirium and mortality (adjusted HR 4.04; 95% CI 2.19 to 7.46) **Mortality after discharge** Delirium group: 17.5%; non-delirium group: 4.0%; $p < 0.001$ **Functional status/ADL** Delirium group: BI 73.8 (24.3 SD); non-delirium group: BI 92.7 (15.1 SD); $p < 0.001$ **3-month mortality** Delirium group 25.9%; non-delirium group 5.8%; $p < 0.001$ Delirium and 3-month mortality: adjusted HR 1.116 (95% CI 1.02 to 1.22). For every 48 hours of delirium, the probability of dying at 3 months increased by 11%

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Hsieh 2015[92]	Association between delirium during early hospitalisation and poor outcomes adjusted for age and REMS Discharge status and association with delirium adjusted for age, REMS, cognitive impairment (MIS ≤ 4 or IQCODE > 3.38). ICU; IQCODE score, MIS score; Rapid Emergency Medicine Score	**Combined outcome of death or unanticipated ICU admission** One episode of delirium was associated with increased odds of unanticipated ICU admission or in-hospital mortality: adjusted OR 8.07 (95% CI 1.91 to 34.14); $p = 0.005$ **Decline in discharge status (defined as discharge to higher level of care, hospice or in-hospital death)** Delirium persisting for all 3 days associated with decline in discharge status even after adjustment for severity of illness and baseline cognitive impairment: OR 4.70 (95% CI 1.41 to 15.63); $p = 0.012$ Delirium within the first 3 days of hospitalisation was not significantly associated with decline in discharge status after adjusting for age, REMS and baseline cognitive impairment: adjusted OR 2.14 (95% CI 0.90 to 5.09); $p = 0.08$ However, this association was significant in patients with delirium that persisted from the ED through hospital day 3 when compared with patients with 0 days of delirium: adjusted OR 4.70 (95% CI 1.41 to 15.63); $p = 0.012$ **Length of hospital stay** Delirium group: median 6 (IQR 4–10) days; non-delirium group: median 5 (IQR 3–7) days; $p = 0.008$ **In-hospital mortality** Delirium group: 8%; non-delirium group: 1%; $p = 0.02$ **Mortality after discharge:** Delirium group: 8%; non-delirium group: 1% **Nursing/care home admission** Delirium group: 34%; non-delirium group: 13% **Clinical deterioration** Delirium group: 16%; non-delirium group: 2%; $p < 0.001$ **Critical care consultation** Delirium group 24%; non-delirium group 6%; $p < 0.001$ **Liver failure during hospitalisation** Delirium group 13%; non-delirium group 14%; $p = 0.89$ (NS) **Unanticipated ICU admission** Delirium group 8%; non-delirium group 1%; $p = 0.02$

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
		Cardiovascular failure during hospitalisation Delirium group 21%; non-delirium group 12%; $p < 0.11$ (NS) **Renal failure** Delirium group 13%; non-delirium group 14%; $p = 0.89$ (NS) **Modified SOFA score** Delirium group: median 1 (IQR 0–4); non-delirium group median 1 (IQR 0–3); $p = 0.51$ (NS)
Inouye 1998[56]	No	**In-hospital mortality** Baseline delirium group: 50%; non-baseline-delirium group: 39% (no other statistics reported)
Jitapunkul 1998[49]	Multivariate logistic regression adjusting for history of acute confusion, systolic blood pressure < 100 mmHg, haematocrit < 30%, platelet count < 100,000 and low CMT score on admission	**In-hospital mortality** Univariate analysis: 7 (25.9%) who died had delirium; 6 (3.7%) who died did not (NS) Note: 7 (26.9%) patients who died had history of acute confusion vs. 8 (4.9%) who did not die. Significant at $p < 0.001$ History of acute confusion: OR 6.3 (95% CI 1.0 to 39.0)
Jitapunkul 1992[96]	No	**Length of hospital stay** No difference between delirious and non-delirious patients (median 20 and 16 days, respectively) (Mann–Whitney *U*-test) **In-hospital mortality** Delirium group: 35%; non-delirium group: 16%; $p < 0.01$ (chi-squared) **Nursing/care home admission** 2/26 delirious patients transferred to long-stay care compared with 3 of 121 non-delirious patients ($p < 0.05$) (calculated for all living cases as denominators, i.e. 26 delirious; 121 non-delirious)
Kolbeinsson 1993[97]	No	**Length of hospital stay** Delirious patients stayed longer than non-delirious demented patients (20.2 vs. 16.5 days) **In-hospital mortality** 32% died in delirium group; 8% in dementia group; $p < 0.01$ **Discharge destination 6 months beyond study end** No difference between delirium and dementia group

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Lam 2014[70]	For mortality or incident nursing home admission outcome: adjusted for age, sex, comorbidity, severity of illness, and dementia diagnosis	**Length of hospital stay** rSSD group: days, median, IQR 13.0 (95% CI 10.0 to 21.0); non-rSSD group: days, median, IQR 11.0 (95% CI 8.0 to 15.0); $p < 0.001$ **Composite – mortality or incident nursing home admission** Only presence of rSSD at discharge significantly predicted inpatient mortality or incident institutionalisation on discharge (OR 5.27, 95% CI 1.43 to 19.47) **Delirium severity/duration** Participants with rSSD had a slower rate of improvement in delirium severity and cognition than those without rSSD; duration of delirium was significantly longer in participants with rSSD than in those without rSSD Mean daily DRS-R98 severity and CMMSE scores were plotted for the first 5 days (corresponding to median delirium duration of study cohort) of GMU stay. Those who recovered without rSSD had significantly lower DRS-R98 severity on admission to the GMU and subsequently exhibited faster decline in DRS-R98 severity during their GMU stay than their counterparts who recovered with rSSD (both $p < 0.001$). Those who recovered without rSSD had higher MMSE scores on admission, with a subsequent steeper rise in CMMSE during their GMU stay than participants who had rSSD on GMU discharge (both $p < 0.001$) After adjustment for age, sex, and underlying dementia, differences in recovery trajectories of delirium severity and cognitive status were attenuated but remained significant ($p < 0.001$) **Functional status** Those without rSSD had significantly higher MBI at admission and discharge from GMU and had faster rate of improvement in functional status than those with rSSD (MBI increase per day3.8 $\pm$ 6.0 vs. 5.6 $\pm$ 6.3, $p = 0.03$); although the magnitude of functional recovery achieved at discharge from the GMU was similar between participants with and without rSSD (MBI change 18.3 $\pm$ 17.5 vs. 21.0 $\pm$ 19.7; $p = 0.28$)
Lang 2010[79]	Age, gender and inclusion centre	**Length of hospital stay** Multilog regression of predictors of prolonged hospital stay defined by f-DRG adjusted limit Diagnosis of delirium (OR 2.31, 95% CI 1.77 to 2.91)

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Lang 2006[133]	Logistic regression multifactorial model adjusted for sex, age, walking difficulties, fall risk, malnutrition risk, cognitive impairment, delirium status. Age, sex, and centre variables were forced in the model. The effects of the other variables were systematically adjusted for these three factors	**Length of hospital stay** Delirium 18.5% of 862 in lower f-DRG limit; 22.3% of 46 in upper f-DRG limit ($p = 0.02$) Delirium and stay > f-DRG adjusted limit multiple logistic regression [OR 3.3 (95% CI 0.6 to 12.5) (NS)] Delirium not predictive of prolonged hospital stay defined by a 30-day limit and an f-DRG adjusted limit
Lima 2010[123]	Multivariate analysis: age (< 80 vs. ≥ 80 years), delirium, immobility on discharge, five or more diagnoses on discharge, albumin concentration < 3.5 g/dl on admission, and five or more drugs taken on discharge	**Mortality after discharge** Delirium group: 50%; non-delirium group: 33.8%; $p = 0.03$ According to multivariate analysis, delirium was not an independent predictor of post-discharge mortality **Survival following discharge** Prevalent delirium: mean 22.6 ± 18 days ($p = 0.001$). Incident delirium: mean 25.2 ± 19 days ($p = 0.01$) Delirium group: 22.6 ± 18 days; non-delirium group: 13.8 ± 11 days; $p = 0.001$
Martínez-Velilla 2013[71]	Multivariate models adjusted for all covariates found to be at least marginally significant at bivariate analysis	**Mortality after discharge** Bivariate analysis showed risk of death associated only with CIRS-G Delirium group: 51% of delirious patients at follow-up; 39% of SSD patients at follow-up; non-delirium group: 47% **Functional status/ADL** Delirium diagnosis significantly associated with reduced BI at 1 year ($p = 0.022$)
McAvay 2006[63]	Multivariate analyses adjusted for age, marital status, dementia, GDS over 7, any ADL and CCI (for nursing home admission/mortality outcome)	**Length of hospital stay** Delirium at discharge group: 15.4 days; delirium resolved group: 14.3 days; non-delirium group: 7.3 days; F-value = 35.8, $p < 0.001$ **Mortality after discharge within year 1 of follow-up** Delirium resolved group: 25.8%; delirium at discharge group: 37.5%; non-delirium group: 19.8%; $p = 0.03$ **Nursing/care home admission** Delirium resolved group: 45.2%; delirium at discharge group: 79.2%; non-delirium group: 29.4%; $p < 0.001$ **Days of survival** Mean (SE): delirium resolved group: 313.8 (17.8); delirium at discharge group: 234.0 (26.2); non-delirium group: 323.9 (4.8); $p < 0.05$

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
		Days until death or nursing home placement – mean (SE): delirium resolved group: 180.9 (28.2); delirium at discharge group: 80.1 (27.2); non-delirium group: 254.8 (7.7); $p < 0.001$ **Death or nursing home placement:** Delirium resolved group: 67.7%; delirium at discharge group: 83.3%; non-delirium group: 41.5%; $p < 0.001$ Compared with those who were never delirious, patients with delirium at discharge had a multivariable adjusted HR of 2.64 (95% CI 1.60 to 4.35) for nursing home placement or mortality; resolved delirium cases had a HR of 1.53 (95% CI 0.96 to 2.43)
McCusker 2002[26]	Multivariable Cox proportional hazards model Proportional hazards model with the following covariates selected a priori: dementia, comorbidity, clinical severity, APS, admitting service (medicine vs. geriatrics) and demographic variables	**In-hospital mortality** Statistically significant interactions between delirium and comorbidity ($p = 0.01$) and the APS ($p = 0.03$); effect of delirium was stronger among patients with lower scores on these scales **Mortality after discharge** Delirium group: 41.6% at 12-month follow-up; non-delirium group: 14.4% at 12-month follow-up Delirium was independently associated with a twofold increase in mortality during the 12-month follow-up (adjusted HR, 2.11, 95% CI 1.18 to 3.77). Stronger effect on mortality in delirious patients without dementia than those with DSD, and those with neither condition. Dementia therefore had a protective effect on mortality
McCusker 2001[94]	Multivariate analysis: all models were adjusted for age, sex, marital status, education, residence, comorbidity, APS and severity of illness, but not for premorbid IADL	**Mortality after discharge** Delirium group: 93 at 12-month follow-up; non-delirium group: 14 at 12-month follow-up – no other data **Nursing/care home admission at 12-month follow-up** 16% with delirium alone; 19% had neither delirium nor dementia Patients with both delirium and dementia were more likely to be admitted to long-term care than those with neither condition (adjusted OR 3.18, 95% CI 1.19 to 8.49). Increase in the odds of admission to long-term care was statistically significant among patients with both conditions (dementia and delirium/DSD) but not among patients with either delirium or dementia alone **Functional status** Dementia but not delirium predicted worse IADL scores at follow-up. Unadjusted analyses yielded similar results **Cognitive impairment** *There were no significant interactions between study group and time, which indicates that there were no differential changes among the 4 groups between 2 and 12 months*

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
		Finally, the effect of delirium on MMSE scores at follow-up was statistically significant among patients with and without dementia: the adjusted mean difference in MMSE scores between patients with and without delirium was –4.99 (95% CI –7.17 to –2.81) among patients with dementia and –3.36 (95% CI –6.15 to –0.58) among those without dementia
McCusker 2003[109]	Multivariate analysis adjusting for age, gender, education, marital status, residence, dementia, clinical severity, comorbidity, physiological severity, and incident/prevalent delirium	**Length of hospital stay** 18.3 days (17.3) for whole group of 193 delirious patients Dementia 18.9 ($n = 136$); those without 17.5 ($n = 45$) ($p = 0.6$) (NS) **Mortality** Stratified by dementia status at 12 months' follow-up number and % deaths: dementia 30.2% vs. non-dementia 33.3% Stratified by delirium in-hospital course: transient: 26.3%; recovered 30.4%; persistent 32.8% **Functional status/ADL** At 12 months' follow-up BI score stratified by dementia group 92 (4.2 ± 3.5); and 27 (8.3 ± 3.7) for non-dementia group At 12 months follow-up BI score stratified by in-hospital course of delirium: transient delirium BI score 52 (78.56 ± 25.95); recovered 36 (69.17 ± 32.01); persistent 36 (40.17 ± 30.02) [Transient delirium patients had most favourable BI as well as IADL (statistics not reported) outcomes and those with persistent delirium had the worst BI and IADL outcomes] Note: BI scores improved at follow-up compared with time of enrolment. However, mean IADL score deteriorated at follow-up compared with premorbid IADL score In multivariate analysis, compared with recovered delirium, transient delirium patients had significantly worse BI and IADL scores at follow-up; and those with persistent delirium had significantly worse BI and IADL scores at follow-up than recovered patients [i.e. BI of –11.22 (95% CI –20.31 to –2.13); IADL –2.05 (95% CI –3.40 to –0.70) **Cognitive status** Time to cognitive improvement – marked by $\geq$ 3-point increase in MMSE: 10.8 days (10.1) for entire group At 12 months stratified by dementia status MMSE score 91 (16.7 ± 8.0) vs. no dementia 25 (21.7 ± 5.4) At 12 months stratified by delirium in-hospital course: transient: 48 (21.73 ± 4.83); recovered: 35 (20.43 ± 6.27); persistent: 36 (10.14 ± 6.28)

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
		In multivariate analysis, persistent delirium patients had significantly worse MMSE scores at follow-up than patients with recovered delirium (adjusted mean difference for the MMSE of −6.17, 95% CI −8.10 to −4.25)
McCusker 2003[134]	Age, sex, dementia, residence, marital status, admission service, clinical severity, comorbidity, outcome of hospitalisation	**Length of hospital stay** Prevalent delirium was not associated with significantly longer hospital stay following adjustment for covariates. Incident delirium was associated with excess LoS – difference between observed LoS and average LoS for the same disease-related group in similar local hospitals – after diagnosis of 7.78 days (95% CI 3.07 to 12.48 days) In patients with prevalent or incident delirium, mean and median LoS were longer for those with hypoactive symptoms only or hypoactive and hyperactive symptoms than those with hyperactive symptoms only or neither symptom type. This difference remained significant following adjustment Prevalent delirium group: 16.2 ± 13.2 days. Incident delirium group: 20.2 ± 14.2 days Without prevalent delirium group: 12.6 ± 11.8 days Matched controls for incident delirium: 10.7 ± 9.8 days Comparing prevalent delirium to controls: parameter estimate 0.15 (95% CI −0.06 to 0.36) Comparing incident delirium to controls: parameter estimate 0.96 (SD 0.49–1.43)
O'Keeffe 1999[122]	No	**Length of hospital stay** Retarded delirium group: geometric mean 27 (95% CI 7 to 107) days; agitated delirium group: geometric mean 11 (95% CI 2 to 53) days Mixed delirium group: geometric mean 22 (95% CI 6 to 87) days; non-delirium group: geometric mean 16 (95% CI 7 to 34) days; $p < 0.005$ **Mortality** Retarded delirium group: 6 (21%); agitated delirium group: 3 (15%); mixed delirium group: 6 (16%); non-delirium group; NS
O'Keeffe 1997[121]	Age, illness severity, comorbid disease, disability score, dementia	**Length of hospital stay** Delirium group: geometric mean 21 days; non-delirium group: geometric mean 11 days; $p < 0.001$. Delirium (adjusted $t = 3.8$, $p < 0.001$) was only significant predictor of length of hospital stay in multivariate analysis **Mortality** Delirium group: 16%; non-delirium group: 5% (OR 3.4, 95% CI 1.3 to 8.6; adjusted OR 2.6, 95% CI 0.7 to 6.2; NS)

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
		Mortality after discharge Delirium group: 31% at 6 months after discharge; non-delirium group: 15% at 6 months after discharge (OR 2.5, 95% CI 1.3 to 4.7; adjusted OR 1.4, 95% CI 0.7 to 2.8; NS) **Nursing/care home admission** Of patients admitted to hospital from the community who lived to discharge, those with delirium were more likely to be admitted to long-term institutional care within 6 months after discharge than patients without delirium (36% vs. 13%; $p < 0.001$) **Complications of hospitalisation** After adjusting for age, severity of illness, comorbid disease, chronic cognitive impairment, disability score and LoS in hospital delirium was the strongest predictor of developing a hospital-acquired complication (adjusted OR 2.3, 95% CI 1.7 to 5.0) **Functional status** In multiple linear regression, delirium was a significant predictor of change in functional status during hospitalisation (adjusted $t = -3.2$, $p = 0.002$) Of patients admitted from the community who survived to discharge, patients with delirium were more likely to be admitted to long-term institutional care within the 6 months after discharge than those without delirium (36% vs. 13%, $p < 0.001$). Delirium was a significant predictor of admission to institutional care in multivariate analysis
Pendlebury 2015[120]	Age Illness severity (SIRS), premorbid dependency and prior dementia Emergency re-admission rates on follow-up within the first 30 days and thereafter were determined for the whole cohort and by delirium status, without adjustment for other factors	**Mortality after discharge (age adjusted)** OR 4.56, 95% CI 1.71 to 12.17, $p = 0.003$, with excess mortality still evident at 2-year follow-up **Nursing/care home placement (age adjusted)** OR 2.95, 95% CI 1.35 to 6.45, $p = 0.007$ **Hospital re-admission** Patients with delirium had fewer re-admissions within 30 days (OR 0.32, 95% CI 0.09 to 1.1; $p = 0.07$) and in total median, IQR total re-admissions = 0, 0–1 vs. 1, 0–2, $p = 0.01$ (NS) **Discharge with increased care needs (age adjusted)** Increase in dependency among survivors (OR 2.56, 95% CI 1.37 to 4.76; $p = 0.003$) **LoS (age adjusted)** Delirium was associated with stay > 7 days (OR 2.82, 95% CI 1.68 to 4.75; $p < 0.0001$)

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
		After adjustment for SIRS, dementia and pre-admission dependency: increased care needs (OR 2.45, 95% CI 1.28 to 4.70; $p = 0.007$), new placement (OR 2.86, 95% CI 1.24 to 6.63; $p = 0.010$) and death during admission (OR 3.15, 95% CI 1.11 to 8.90; $p = 0.003$) Increased mortality from delirium was maintained throughout 2-year follow-up ($p = 0.016$) Although delirium was not a significant risk factor for death following discharge after adjustment for confounders Delirium at index admission were no more likely than non-delirious patients to be re-admitted within 30 days (3/81 vs. 22/202, OR 0.32, 95% CI 0.09 to 1.1; $p = 0.07$)
Praditsuwan 2013[119]	Adjusted for age > 80 years, severe illness, infection, malignancy, prerenal azothaemia and delirium	**Length of hospital stay** Delirium group: median 10 days, range 3.61 days; non-delirium group: median 8 days, range 2–38 days; $p = 0.001$ Delirium remained a strong predictor for 3-month mortality in multivariate analysis [adjusted OR 3.33 (95% CI 1.45 to 7.62); $p = 0.004$] Delirium was a predictor for in-hospital mortality in multivariate analysis [adjusted OR 7.34 (95% CI 1.51 to 35.69); $p = 0.014$]
Rockwood 1989[83]	No	**Length of hospital stay** 'Confused' group: 20 days; non-confused group: 14 days; NS, $p = 0.11$ **Functional status/ADL** No significant difference **Change in residence at discharge** No significant difference between confused and non-confused groups
Silva 2009[118]	Multivariate analysis adjusting for delirium, neoplastic disease, admission albumin levels, admission creatinine levels, history of heart failure, immobility and aged	**Mortality** Overall mortality was 16.4% Multivariate logistic regression: OR for delirium 4.13 (95% CI 2.65 to 6.44; $p < 0.001$)
Thomas 1988[135]	No	**Length of hospital stay** Delirium group: 21.6 ± 23.7 days; non-delirium group: 10.6 ± 10.1 days; $p < 0.0002$

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
Martínez-Velilla 2013[116]	Albumin levels, CIRS-G, BI for mortality; CIRS-G and initial BI for functional status	**Mortality after discharge** 30-day risk of death (follow-up): delirium not significantly associated with mortality (after adjustment) **Functional status/ADL** Delirious patients had significantly lower BI than in SSD and non-delirious patients (54.2; 57.9 and 76.4, respectively) Similarly, LI lower in delirious patients than in those with SSD and non-delirious patients: statistically significant linear trend for BI and LI ($p = 0.001$ and $p = 0.008$, respectively) Adjusting for CIRS-G and initial BI, delirium diagnosis related to lower BI at 30 days ($p = 0.019$), showing significant linear gradient ($p = 0.005$). Reduction of BI in delirium patients significantly greater than in non-delirious patients; reduction in BI in SSD patients not statistically different from that of delirious patients or without **Persistent delirium at follow-up** Bivariate analysis showed it is associated with previous delirium episodes ($p = 0.001$); degree of malnutrition, BI and LI, the degree of dementia ($p = 0.001$), the DRS-R 98 and CIRS-G
Wakefield 2002[66]	No Only for risk factors associated with acute confusion	**Length of hospital stay** Acute confusion patients had average 13 days; non-acute confusion patients 8 days Using non-parametric one-way analysis of median LoS used because distribution skewed towards short LoS, LoS not statistically significantly different between the two groups (excludes deaths); $p > 0.50$ **In-hospital mortality** 25% of cases died; 0% of controls died **Functional status/ADL** Subjects who developed acute confusion worsened from mean ADL score of 2.5 at admission to 3.3. at discharge (NS); control patients did not show any real difference before admission and discharge **Discharge disposition** Acute confusion patients more likely to be discharged to another hospital or nursing home than controls (Fisher's exact test, $p < 0.0005$)

TABLE 32 Outcomes for delirium (*continued*)

Study (first author and year)	Control of confounders	Outcomes for delirium
White 2005[117]	No	**In-hospital mortality** Delirium group: 37%; non-delirium group: 6%; $p < 0.001$ Strong inverse relationship between plasma esterase activity on admission and in-hospital mortality **Mortality after discharge** 11% delirious died; 2% non-delirious died (chi-squared; $p = 0.007$) within 1 month of discharge

APACHE, Acute Physiology and Chronic Health Evaluation; APS, Acute Physiology Score; ARF, acute renal failure; BISEP, Burden of Illness Score for Elderly Persons; CIRS-G, Cumulative Illness Rating Scale in Geriatrics; DRG, diagnosis-related group; DRS, Delirium Rating Scale; DRS-R98, Delirium Rating Scale; Revised-98; ED, emergency department; f-DRG, French Diagnosis-Related Group; GDS, Global Deterioration Score; GIT, gastrointestinal tract; GMU, general medical unit; IFN-γ, interferon gamma; IGF-1, insulin-like growth factor 1; MBI, Modified Barthel Index; LI, Lawton Index; IQR, interquartile range; MIS, Memory Impairment Screen; NHA, nursing home admission; NS, not significant; SD, standard deviation; SE, standard error; SIRS, systemic inflammatory response syndrome; SPMSQ, Short Portable Mental Status Questionnaire; TUG, Timed Up and Go.

TABLE 33 Outcomes for cognitive impairment

Study (first author and year)	Control of confounders	Outcomes for cognitive impairment
Beauchet 2013[144]	No	**Length of hospital stay** Prevalence of male gender higher in high LoS group (> 13 days) vs. intermediate LoS group ($p = 0.002$) More with HoF in long LoS group than in intermediate LoS group ($p = 0.001$) and low LoS group ($p = 0.001$). Male patients with MMSE score of < 20 who fell under age 85 years formed end node with the greatest relative risk of long hospital stay (relative risk 14.3; $p = 0.001$) Those with no HoF but had cognitive impairment, polypharmacy, and no social isolation had significantly higher relative risk of long LoS (relative risk 8.5; $p = .009$). Combination of HoF, male gender, cognitive impairment, and age < 85 years identified ED patients with highest risk of LoS
Bickel 2006[98]	Relationships between gender, MCI, education level, age, discharge diagnosis, morbidity and number of medications prescribed were analysed using logistic regression models	**Cognitive status** MMSE score of 28–30 considered severely cognitively impaired/SISCO score of 34–47 reported for MCI Positive predictive value for cognitive impairment 3.5 months after discharge: 61%; among those with multidomain MCI 82.9% cognitively impaired following discharge; (47.5%) of single-domain MCI cognitively impaired at discharge MCI 5.7 (95% CI 3.9 to 8.4) 61.0% p.p. (predictive value)

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 33 Outcomes for cognitive impairment (*continued*)

Study (first author and year)	Control of confounders	Outcomes for cognitive impairment
		Amnestic MCI single domain 3.4 (95% CI 1.8 to 6.4) 47.8% p.p. Amnestic MCI multiple domain 16.4 (95% CI 8.4 to 31.2) 81.5% p.p. Non-amnestic MCI multiple domain 100.0% p.p. Non-amnestic MCI single domain 3.3 (95% CI 2.0 to 5.6) 47.2% p.p.
Conde-Martel 2012[143]	Global multivariate Cox regression analysis performed including variables CCI, categorised SPMSQ, age, gender	**Probability of survival at 1, 2, 3 and 5 years** For normal SPMSQ score for all patients: 77%, 55%, 50% and 32%. Probability of survival at 1, 2, 3 and 5 years for abnormal SPMSQ score for all patients: 42%, 23%, 15% and 11% [HR 2.13 (95% CI 1.19 to 3.80); $p = 0.011$] Probability of survival at 1, 2, 3 and 5 years for normal SPMSQ score for surviving discharged patients: 77%, 55%, 50%, 32% and 23%. Probability of survival at 1, 2, 3 and 5 years for abnormal SPMSQ score for surviving discharged patients: 46%, 26%, 17%, 13%. HR 1.96 (95% CI 1.09 to 3.52); $p = 0.023$ Probability of survival at 1, 2, 3 and 5 years for normal MMSE score for all patients: 88%, 44%, 35% and 25%. Probability of survival at 1, 2, 3 and 5 years for abnormal MMSE score: 42%, 31%, 25% and 14%. HR 1.83 (95% CI 0.94 to 3.57); $p = 0.077$ Probability of survival at 1, 2, 3 and 5 years for normal MMSE score for surviving discharged patients: 86%, 44%, 38%, 25%. Probability of survival at 1, 2, 3 and 5 years for abnormal MMSE score for surviving discharged patients: 46%, 33%, 27%, 15%. HR 1.70 (95% CI 0.86 to 3.36); $p = 0.13$
Di Iorio 1999[84]	Comorbidity, ADL and living alone	**Length of hospital stay** MMSE independently associated with LoS in multiple linear regression ($p = 0.03$) Controlled for comorbidity, ADL and living alone as these were univariate predictors of LoS
Di Iorio 1998[85]	Sex, social condition, living alone, CIRS classes, CIRS score, MMSE, previous hospitalisation, centre	**Hospital re-admission** Multivariate analysis: early re-admission (within first 3 months) associated with cognitive impairment: OR 1.39 (95% CI 1.06 to 1.83)
Dinescu 2012[102]	Living situation prior to hospitalisation, functional independence (measured using ADL scales), number of prescription medications at admission, LoS, discharge deposition, advancement in home-health-aid services at discharge	**Patient–clinical team discharge disposition disagreement** Patient–clinical team discharge disposition agreement: 46.2% with cognitive impairment present, 53.2% with cognitive impairment absent. Disagreement: 50% with cognitive impairment present, 50% with cognitive impairment absent

TABLE 33 Outcomes for cognitive impairment (*continued*)

Study (first author and year)	Control of confounders	Outcomes for cognitive impairment
Espallargues 2008[138]	Multivariate analysis included: gender, ward, assessment status, Geriatric Giants, BI, Katzman, main system affected at admission, difficulty answering and centre	**Length of hospital stay** Cognitive status (Katzman) and LoS: bivariate regression analysis showed amount of variation R^2 in LoS as 1.2%; $p < 0.05$ **In-hospital mortality** Amount of variance (R^2) by bivariate analysis: 10.8% ($R^2 > 5\%$ in bivariate regression analysis) Variance explored with both bivariate and multivariate analysis; with significance: $p < 0.05$; $p < 0.05$, respectively **Composite outcome (in-hospital mortality or in month following discharge)** Amount of variance (R^2) by bivariate analysis: 11.9% ($R^2 > 5\%$ in bivariate regression analysis) Variance explored with multivariate analysis; with significance: $p < 0.05$ **Hospital re-admission** Refers to re-admission within 1 month of discharge: amount of variance (R^2) by bivariate analysis: 1.0%; NS **Discharge status** Refer to discharge to same residence from which admitted Amount of variance (R^2) by bivariate analysis: 8.7% ($R^2 > 5\%$ in bivariate regression analysis) Discharge status: refer to discharge to different residence; included still in hospital at 90 days Amount of variance (R^2) by bivariate analysis: 6.6% ($R^2 > 5\%$ in bivariate regression analysis) Variance in in-hospital mortality explored with multivariate analysis; with significance ($p < 0.05$)
Fields 1986[139]	No	**Length of hospital stay** Patients with cognitive impairment spent an average of 29.4 ± 42.7 days in hospital awaiting placement, so only 6.0 ± 18.0 days represented their stay for illness alone Regardless of complications, LoS was longer for cognitive impairment group (28.4 vs. 8.5 days, $p < 0.05$, no complications; 46.4 vs. 26.6 days, $p > 0.05$, with complications) Cognitive impairment group: 35.4 ± 46.2 days; non-cognitive impairment group: 11.8 ± 14.7 days; $p < 0.05$ **In-hospital mortality** Cognitive impairment group: 17%; non cognitive impairment group: 5%; $\chi^2 = 3.79$, $p = 0.05$

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 33 Outcomes for cognitive impairment (*continued*)

Study (first author and year)	Control of confounders	Outcomes for cognitive impairment
		Mortality 3 months post discharge Cognitive impairment group: 13.0%; non-cognitive impairment group: 9.3% **Nursing/care home admission** Cognitive impairment group: 16%; non-cognitive impairment group: 1% **Home assistance** Cognitive impairment group: 31.6%; non-cognitive impairment group: 1.1% **Hospice admission** Cognitive impairment group: 0; non-cognitive impairment group: 3%
Forti 2014[145]	Multivariate analyses included adjustment for two sets of variables: • Model 1: multimorbidity; sociodemographic, disability; depressive symptoms • Model 2: sociodemographic plus illness severity on admission and cancer or cerebrovascular disease as main diagnostic category at discharge	**Length of hospital stay** 56.4% patients had LoS > 8 days; LoS borderline association with pre-admission cognitive impairment ($p = 0.073$) Unfavourable discharge (death plus any other ward discharge disposition other than return home) 69.4% unfavourable discharge: significantly associated with cognitive impairment ($p < 0.001$) According to Cohen's kappa, cognitive impairment had statistically significant association with weight loss but had clinically poor agreement ($\kappa = 0.134$; $p = 0.003$); poor mobility ($\kappa = 0.306$; $p < 0.001$); low serum albumen ($\kappa = 0.190$; $p < 0.001$)
Freedberg 2008[104]	HR adjusted for age, sex, marital status, nursing home residency status, modified CCI score and admission diagnosis	**In-hospital mortality rate (deaths per person-year)** Cognitive impairment group: 0.083; non-cognitive impairment group: 0.055; HR 3.99 (95% CI 0.42 to 37.90); $p = 0.229$ **Mortality rate after discharge (deaths per person-year)** Cognitive impairment group: 0.284; non-cognitive impairment group: 0.147; HR 2.35 (95% CI 1.15 to 4.78); $p = 0.019$ **Cumulative mortality rate (deaths per person-year)** Cognitive impairment group: 0.367; non-cognitive impairment group: 0.202; HR 2.46 (95% CI 1.26 to 4.82); $p = 0.009$

TABLE 33 Outcomes for cognitive impairment (*continued*)

Study (first author and year)	Control of confounders	Outcomes for cognitive impairment
Furlanetto 2003[86]	Multivariate analysis controlled for age and physical severity	**Length of hospital stay** Mean LoS for all inpatients: 13.3 (SD 12) days Mean LoS for inpatients without psychiatric comorbidity: 12.1 (SD 9.9) days In multivariate analysis cognitive impairment group had increased LoS ($F = 17.8$, $p < 0.01$) In multivariate analysis excluding deaths during hospitalisation cognitive impairment group had increased LoS ($F = 26.2$, $p < 0.01$)
Helvik 2014[147]	Logistic regression model controlled for age, gender, municipality, death within a year, any falls in 12 months before hospitalisation, impaired instrumental functioning and comorbidity	**Nursing/care home admission** Cognitive impairment group: mean MMSE score 21.6; non-cognitive impairment group: mean MMSE score 24.6; $p < 0.01$
Inouye 2006[141]	Multivariate analyses controlling for age, ADL score, APACHE II	**Mortality after discharge** RCD independently predictive of 1-year mortality; adjusted OR of 1.82 (95% CI 1.03 to 3.20) (compared with non-impaired group) **Cognitive status** 39% patients showed RCD Multivariable analysis showed three factors predictive of RCD after adjusting for baseline MMSE: higher educational level, pre-admission functional impairment and higher illness severity At 1 year, further improvement in MMSE score occurred in 41% patients with RCD
Joray 2004[148]	Multivariate Cox proportional hazard regression analyses adjusted for nursing home admission, living situation, income, education, 'fall' as admitting diagnosis and level of IADL, hospital re-admission, depressive symptoms and comorbidity, death, comorbidity and IADL	**Nursing/care home admission** At 6-month follow-up: • Undetected cognitive impairment – adjusted HR 1.6 (95% CI 0.60 to 3.72); $p = 0.383$ • Detected cognitive impairment – adjusted HR 3.85 (95% CI 1.66 to 8.94); $p = 0.002$
Lorén Guerrero 2011[44]	Bivariate analysis controlled for SPMSQ and BI	**Length of hospital stay** Bivariate analysis between SPMSQ normal, deficient and severe cognitive deficit and LoS ($p < 0.05$) Normal had mean LoS 12.65 days (SD 5.9); deficient 11.2 (SD 4.74); severe 21.32 (SD 16.13) Patients with severe intellectual deficit show longer LoS – on average 9 days longer than 'normal' cognitive status

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 33 Outcomes for cognitive impairment (*continued*)

Study (first author and year)	Control of confounders	Outcomes for cognitive impairment
Marengoni 2008[45]	Age, gender and education adjusted ORs from logistic regression model testing combined effect of cognitive impairment, physical dependence and multimorbidity on allocation to a rehabilitation unit vs. home	**Discharge destination to nursing home or rehabilitation unit (or home)** Multivariate model tested combined effect of MMSE, functional dependence and multimorbidity on being discharged to rehabilitation unit Cognitive impairment and multimorbidity determined admission to rehabilitation unit but only in functionally impaired patients (OR 16.7, 95% CI 4.9 to 56.6; p <0.01)
Marengoni 2004[146]	Multivariate logistic regression models included sociodemographic factors, MMSE at admission, GerDS score (depressive scores at admission), comorbidity (GIC)	**Functional status/ADL** Multivariate logistic regression with two models In both age groups, poor cognitive status associated with functional disability In model containing only patients with MMSE scores of > 16 and controls for depressive scores: • 65–74 years: OR 0.9, 95% CI 0.8 to 0.9; $p < 0.01$ • ≥ 75 years: OR 0.8, 95% CI 0.8 to 0.9; $p < 0.001$ With MMSE score of > 16, having more depressive symptoms was related to disability in both age groups (i.e. 65–74 and ≥ 75 years) Adjusting for age, gender, education and LoS: low MMSE (< 24 points) and high GerDS (> 10 points) were associated with functional disability (OR 3.0, 95% CI 1.5 to 6.0; $p < 0.01$) and OR 2.7, 95% CI 1.0 to 2.5; $p < 0.05$ In oldest old, low MMSE, high GerDS and high GIC associated with functional impairment Logistic regression model combining effect of cognition, depression, and cognition and comorbidity, on functional disability showed cognitive impairment major predictor of functional disability in both age groups. MMSE and GerDS showed an additive association with disability, especially in younger patients; comorbidity predictor in functional status only in oldest old who were cognitively impaired
Marengoni 2013[140]	Based on model 2 multilogistic regression, education, diseases potentially related to death (cerebrovascular disease, chronic pulmonary diseases, heart failure, atrial fibrillation in addition to functional status, age, gender, adverse events, malignancy and chronic renal failure)	**In-hospital mortality** Statistically significant association between cognition and in-hospital mortality Mortality after multiadjustment: OR 3.1, 95% CI 1.12 to 8.64 Increased severity of cognitive impairment associated with higher odds of in-hospital mortality as follows multiadjustment: • Questionable impairment (score 5–9): OR 2.2, 95% CI 0.66 to 7.71 • Moderate impairment (score 10–19): OR 2.7, 95% CI 1.00 to 7.96 • Severe impairment (score > 20): OR 4.2, 95% CI 1.29 to 13.78

TABLE 33 Outcomes for cognitive impairment (*continued*)

Study (first author and year)	Control of confounders	Outcomes for cognitive impairment

		After stratification of adverse clinical events, impaired cognition associated with mortality only in patients with at least one event during hospital stay:
		
		• At least one adverse clinical event –
		  ○ Questionable impairment OR 8.8, 95% CI 0.94 to 82.84; impaired OR 1.68, 95% CI 1.68 to 104.24
		• No adverse clinical event –
		  ○ Questionable impairment OR 0.59, 95% CI 0.09 to 3.63; impaired OR 0.60, 95% CI 0.14 to 2.48
		
		Mortality after discharge
		
		Multivariate log regression showed: no significant associations after multiadjustment (OR 1.1, 95% CI 0.48 to 2.35)
		
		No significant association between increasing severity of cognitive impairment with 3-month mortality

Orsitto 2005[99]	No	**Functional status/ADL** Functional status (ADL/IADL) was significantly poorer in those with dementia than those with MCI or no dementia Dementia: ADL 3.1 ± 2.1; IADL 1.5 ± 2.0; MCI (35): ADL 5.1 ± 1.4/IADL 5.2 ± 2.2 ($p = 0.0001$); no dementia (71): ADL 5.5 ± 0.9/IADL 6.4 ± 1.9 ($p = 0.0001$)
Pedone 2005[54]	Not specified	**Functional status/ADL** CIA was a risk factor for functional decline (OR 2.4, 95% CI 1.7 to 3.5; $p < 0.001$) independent of age, gender, comorbidity, polypharmacy and disability on admission. Cognitive decline occurred in 3.7% of the sample and was strongly associated with an increased risk for functional decline (OR 16.0, 95% CI 10.8 to 23.6; $p < 0.001$)
Ponzetto 2002[108]	No	**Mortality after discharge** 81.2% of those with ≥ 5 errors in SPMSQ were dead at 5-year follow-up; $\chi^2 = 38.728$, $p < 0.0001$
Sampson 2009[12]	APACHE and age; other confounders excluded from multivariate analysis as had no associations in univariate analysis	**In-hospital mortality** Mortality risk increased with level of cognitive impairment even after adjustment in model below; and final model adjusting for all factors Adjusted Cox proportional hazard model for in hospital death with cognitive impairment and dementia (adjusting for age and APACHE II, which showed significant associations with death in univariate analysis): MMSE 24–30 HR 1; MMSE 16–23 HR 1.34 (95% CI 0.60 to 3.15); MMSE 0–15, HR 2.62 (95% CI 1.28 to 5.39); $\chi^2 = 34.14$; $p < 0.001$

continued

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 33 Outcomes for cognitive impairment (*continued*)

Study (first author and year)	Control of confounders	Outcomes for cognitive impairment
Saravay 2004[114]	Age and functional impairment in analysis of covariance	**Length of hospital stay** Factor 1 (delirium, dementia and cognitive impairment measured on admission) highly correlated with factor 2 (eight variables taken from mental and behavioural manifestations and complications) ($r = 0.65$, $p = 0.001$, $n = 75$); and each of these eight factors separately correlated with increasing LoS (factor 1: $r = 0.25$, $p = 0.02$, $n = 85$; factor 2: $r = 0.37$, $p = 0.001$, $n = 83$) Difference in mean LoS by high and low factor scores: 14 days for those differentiated by high and low 1 factor scores ($p < 0.05$), and 10 days for those differentiated by high and low factor 2 scores ($p < 0.01$)
Torisson 2012[142]	Bivariate Cox proportional hazards regressions adjusted for age and sex where applicable For the multivariable analysis, a stepwise approach was carried out, using a backwards method with $p > 0.051$ as the threshold for removal. Starting the stepwise model with all variables or only the ones with a bivariate p-value of < 0.25 resulted in the same final model. Exclusion of categorical variables with small cells (neurocognitive disorder) did not affect the final model	**Mortality after discharge** At 12 months, 63/200 patients were deceased: 14% with no abnormal tests, 37% with one abnormal test, 39% with two abnormal tests One abnormal cognitive test vs. zero: multivariate model HR 2.86 (95% CI 1.28 to 6.39); $p = 0.001$ Two abnormal cognitive tests vs. zero: multivariate model HR 3.39 (95% CI 1.54 to 7.45); $p = 0.002$
Zekry 2011[105]	Multiple Cox models controlled for age, sex, cognitive diagnosis, dementia aetiology and dementia severity	**In-hospital mortality** Cognitive impairment group: 6.3%; non-cognitive impairment group: 5.8% **Mortality after discharge** Cognitive impairment group: 1 year: 20.8%; 5 years: 56.2% Non-cognitive impairment group: 1 year: 18.9%; 5 years: 55.8%

APACHE, Acute Physiology and Chronic Health Evaluation; CIA, cognitive impairment on admission; CIRS, Cumulative Illness Rating Scale; ED, emergency department; GerDS, Geriatric Depression Scale; GIC, Greenfield Index of Disease Severity; HoF, history of falls; NS, not significant; SD, standard deviation; SPMSQ, Short Portable Mental Status Questionnaire.

TABLE 34 Outcomes for DSD

Study (first author and year)	Control of confounders	Outcomes for DSD
McCusker 2001[94]	All models were adjusted for age, sex, marital status, education, residence, comorbidity, APS and severity of illness, but not for premorbid IADL	**Nursing/care home admission** At 12-month follow-up: 47/121 (39%) **Mortality after discharge** Delirium group: 93 at 12-month follow-up; non-delirium group: 14 at 12-month follow-up – no other data **Nursing/care home admission at 12-month follow-up** 16% with delirium alone; 19% had neither delirium nor dementia Patients with both delirium and dementia were more likely to be admitted to long-term care than those with neither condition (adjusted OR 3.18, 95% CI 1.19 to 8.49). Increase in the odds of admission to long-term care was statistically significant among patients with dementia and delirium or DSD but not among patients with delirium or dementia alone **Functional status** Dementia but not delirium predicted worse IADL scores at follow-up. Unadjusted analyses yielded similar results **Cognitive impairment** *Over time, patients with both delirium and dementia had the worst MMSE scores and those with neither condition had the best scores* *At enrolment, patients with delirium only had worse MMSE scores than those with dementia only, but patients with delirium only showed more improvement at follow-up than those with dementia only* *After adjustment for covariates, all 4 study groups showed small but statistically significant declines in MMSE scores from 2 to 6 and 12 months* *There were no significant interactions between study group and time, which indicates that there were no differential changes among the 4 groups between 2 and 12 months* *The effect of delirium on MMSE scores at follow-up was statistically significant among patients with and without dementia*
Lang 2010[79]	Age, gender and inclusion centre	**Length of hospital stay** Multiple logistic regression: no delirium OR 1; delirium OR 2.31, 95% CI 1.77 to 2.91; $p < 0.01$

APS, Acute Physiology Score.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Appendix 4 Supplementary quantitative analysis

TABLE 35 Descriptive statistics showing mortality

Participants	Mortality, OR (95% CI)			
	30 days	90 days	1 year	2 years
All patients ($n = 6724$)	10.5 (9.8 to 11.3)	23.6 (22.6 to 24.7)	30.8 (29.7 to 31.9)	40.3 (39.1 to 41.4)
No CSD ($n = 4344$)	8.8 (8.0 to 9.7)	19.7 (18.6 to 20.9)	25.8 (24.5 to 27.1)	33.5 (32.1 to 34.9)
CSD ($n = 2380$)	14.4 (13.0 to 15.9)	30.7 (28.9 to 32.6)	40.0 (38.0 to 42.0)	52.6 (50.6 to 54.6)
Delirium alone ($n = 1065$)	14.3 (12.3 to 16.5)	30.7 (28.0 to 33.5)	37.2 (34.3 to 40.1)	48.0 (45.0 to 51.0)
Known dementia alone ($n = 522$)	12.6 (10.0 to 15.7)	28.7 (25.0 to 32.7)	42.5 (38.3 to 46.8)	55.4 (51.1 to 59.6)
DSD ($n = 508$)	14.4 (11.6 to 17.7)	33.9 (29.9 to 38.1)	43.9 (39.6 to 48.2)	58.9 (54.6 to 63.1)
Unspecified cognitive impairment ($n = 285$)	12.3 (9.0 to 16.6)	28.8 (23.9 to 34.3)	39.3 (33.8 to 45.1)	53.3 (47.5 to 59.0)

TABLE 36 Sensitivity analysis: OR estimates of the logistic regression model for living at home at 30 days from discharge

Model variable	Adjusted + ADL model, OR (95% CI)
CSD	
Delirium alone vs. no CSD	0.53 (0.41 to 0.70)
Known dementia alone vs. no CSD	0.44 (0.31 to 0.63)
Delirium and known dementia vs. no CSD	0.27 (0.20 to 0.38)
Unspecified cognitive impairment vs. no CSD	0.62 (0.41 to 0.94)
Age: per 5-year increase	0.82 (0.76 to 0.88)
CCI score	
1 vs. 0	0.93 (0.70 to 1.24)
2–5 vs. 0	1.02 (0.79 to 1.32)
≥ 6 vs. 0	0.36 (0.25 to 0.52)
ADL score[a]	
Persistently low ADL score vs. persistently high ADL score	0.38 (0.29 to 0.57)
Changed ADL score vs. persistently high ADL score	0.58 (0.45 to 0.75)

a 28.6% of ADL scores are missing; only 3978 out of 5570 patients included in the ADL analysis.
Note
Adjusted for demographics, comorbidity variables and functional status for complete-case ADL.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 37 Hazard ratios of the Cox proportional hazards model

Model variable	HR (95% CI)		
	Unadjusted model	Adjusted model	Adjusted + ADL
CSD group			
Delirium alone vs. no CSD	1.61(1.46 to 1.78)	1.38 (1.25 to 1.53)	1.19 (1.07 to 1.33)
Known dementia alone vs. no CSD	1.89 (1.67 to 2.15)	1.45 (1.27 to 1.66)	1.22 (1.05 to 1.40)
Delirium and known dementia vs. no CSD	2.08 (1.84 to 2.36)	1.51 (1.31 to 1.73)	1.25 (1.08 to 1.43)
Unspecified cognitive impairment vs. no CSD	1.79 (1.52 to 2.12)	1.28 (1.08 to 1.52)	1.12 (0.94 to 1.33)
Sex: men vs. women	1.17 (1.09 to 1.27)	1.22(1.13 to 1.31)	1.26 (1.17 to 1.37)
Age: per 5-year increase	1.25 (1.22 to 1.28)	1.23 (1.20 to 1.26)	1.19 (1.16 to 1.22)
Residence: care home vs. private home	2.83 (2.53 to 3.16)	2.16 (1.91 to 2.45)	1.84 (1.60 to 1.08)
SIMD			
1 vs. 5 (least deprived)	1.10 (0.96 to 1.26)	1.14 (0.99 to 1.30)	1.12 (0.98 to 1.29)
2 vs. 5 (least deprived)	1.18 (1.04 to 1.34)	1.17 (1.03 to 1.32)	1.17 (1.03 to 1.33)
3 vs. 5 (least deprived)	1.16 (1.02 to 1.32)	1.11 (0.97 to 1.26)	1.11 (0.97 to 1.26)
4 vs. 5 (least deprived)	1.12 (0.98 to 1.30)	1.07 (0.93 to 1.23)	1.06 (0.92 to 1.22)
CCI score			
1 vs. 0	1.18 (1.05 to 1.34)	1.31 (1.15 to 1.49)	1.31 (1.15 to 1.48)
2–5 vs. 0	1.74 (1.56 to 1.94)	1.75 (1.57 to 1.96)	1.73 (1.54 to 1.94)
≥ 6 vs. 0	5.82 (5.12 to 6.61)	6.86 (6.02 to 7.83)	6.68 (5.85 to 7.62)
Number of drugs prescribed in previous 84 days			
1–5 vs. 0	0.91 (0.76 to 1.09)	1.10 (0.91 to 1.32)	1.09 (0.90 to 1.31)
5–10 vs. 0	1.10 (0.92 to 1.30)	1.19 (0.99 to 1.41)	1.17 (0.98 to 1.39)
≥ 11 vs. 0	1.18 (0.99 to 1.41)	1.19 (0.99 to 1.42)	1.14 (0.95 to 1.36)
ADL group			
Persistently low ADL score vs. persistently high ADL score	2.73 (2.47 to 3.01)		1.84 (1.63 to 2.09)
Changed pre ADL score vs. persistently high ADL score	1.62 (1.42 to 1.86)		1.43 (1.26 to 1.63)

Note
Unadjusted, adjusted for demographics, comorbidity variables (adjusted model) and ADL functional status (adjusted plus ADL).

TABLE 38 Sensitivity analysis for the HR estimates

Model variable	HR (95% CI)				
	≤ 30 days	31–90 days	91–180 days	181 days to 1 year	1–2 years
CSD group					
Delirium alone vs. no CSD	1.30 (1.12 to 1.51)			1.02 (0.77 to 1.36)	1.14 (0.90 to 1.45)
Known dementia alone vs. no CSD	0.79 (0.60 to 1.02)		1.43 (1.17 to 1.74)		
Delirium and known dementia vs. no CSD	1.00 (0.80 to 1.25)		1.39 (1.16 to 1.67)		
Unspecified cognitive impairment vs. no CSD	0.97 (0.77 to 1.23)			1.30 (1.01 to 1.68)	
Sex: male vs. female	1.34 (1.23 to 1.46)				
Age: per 5-year increase	1.03 (0.97 to 1.10)	1.20 (1.16 to 1.24)			
Residence: care home vs. private home	2.25 (1.72 to 2.93)	1.70 (1.44 to 2.01)			
CCI score					
1 vs. 0	1.31 (1.14 to 1.51)				
2–5 vs. 0	1.65 (1.46 to 1.87)				
≥ 6 vs. 0	6.61 (5.28 to 8.27)	8.81 (6.94 to 11.18)	6.31 (4.96 to 8.01)		3.77 (2.63 to 5.42)
ADL group					
Persistently low ADL score vs. persistently high ADL score	2.77 (2.11 to 3.64)	1.84 (1.59 to 2.13)			
Changed ADL score vs. persistently high ADL score	2.31 (1.81 to 2.96)	1.38 (1.21 to 1.56)			

Note
Adjusted for demographics, comorbidity variables and ADL functional status to account for missing ADL scores.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 39 Hazard ratios of the Fine and Gray[189] proportional subdistribution hazard model

Model variable	HR (95% CI)		
	Unadjusted model	Adjusted model	Adjusted + ADL
CSDs			
Delirium alone vs. no CSD	1.25 (1.10 to 1.41)	1.40 (1.23 to 1.59)	1.22 (1.06 to 1.40)
Known dementia alone vs. no CSD	1.07 (0.95 to 1.22)	1.28 (1.12 to 1.47)	1.34 (1.17 to 1.53)
Delirium and known dementia vs. no CSD	1.19 (1.02 to 1.39)	1.12 (0.95 to 1.31)	1.08 (0.92 to 1.27)
Unspecified cognitive impairment vs. no CSD	1.03 (0.96 to 1.09)	1.06 (0.99 to 1.13)	1.07 (0.99 to 1.14)
Sex: male vs. female	1.07 (1.05 to 1.10)	1.09 (1.07 to 1.11)	1.08 (1.06 to 1.10)
Age: per 5-year increase	0.76 (0.68 to 0.86)	0.61 (0.53 to 0.70)	0.59 (0.51 to 0.68)
Residence: care home vs. private home	1.14 (1.02 to 1.27)	1.10 (0.99 to 1.23)	1.10 (0.98 to 1.23)
SIMD			
1 vs. 5 (least deprived)	1.13 (1.02 to 1.26)	1.09 (0.98 to 1.22)	1.09 (0.98 to 1.21)
2 vs. 5 (least deprived)	1.00 (0.90 to 1.12)	0.98 (0.88 to 1.10)	0.98 (0.88 to 1.09)
3 vs. 5 (least deprived)	1.03 (0.91 to 1.16)	1.00 (0.89 to 1.13)	0.99 (0.88 to 1.12)
4 vs. 5 (least deprived)	1.21 (1.10 to 1.33)	1.18 (1.07 to 1.30)	1.18 (1.08 to 1.30)
CCI score			
1 vs. 0	1.56 (1.44 to 1.70)	1.42 (1.30 to 1.55)	1.42 (1.30 to 1.55)
2–5 vs. 0	2.04 (1.77 to 2.36)	1.95 (1.68 to 2.26)	1.94 (1.67 to 2.25)
≥ 6 vs. 0	1.17 (0.99 to 1.38)	1.11 (0.94 to 1.31)	1.11 (0.93 to 1.31)
Number of drugs prescribed in previous 84 days			
1–5 vs. 0	1.47 (1.25 to 1.73)	1.29 (1.10 to 1.52)	1.29 (1.09 to 1.52)
5–10 vs. 0	1.86 (1.58 to 2.19)	1.57 (1.33 to 1.85)	1.55 (1.31 to 1.83)
≥ 11 vs. 0	1.22 (1.10 to 1.36)		1.19 (1.04 to 1.36)
ADL score			
Persistently low ADL score vs. persistently high ADL score	1.21 (1.12 to 1.34)		1.15 (1.04 to 1.27)
Changed ADL score vs. persistently high ADL score	1.25 (1.10 to 1.41)	1.40 (1.23 to 1.59)	1.22 (1.06 to 1.40)

Note
Unadjusted, adjusted for demographics, comorbidity variables (adjusted model) and ADL functional status (adjusted plus ADL).

TABLE 40 Sensitivity analysis: HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to re-admission under the competing risk of death

	HR (95% CI)			
Model variable	**Up to 30 days**	**31 days to 90 days**	**91 days to 1 year**	**1 year to 2 years**
CSD groups				
Delirium alone vs. no CSD	1.18 (1.06 to 1.32)			
Known dementia alone vs. no CSD	1.21 (1.04 to 1.41)			
Delirium and known dementia vs. no CSD	0.98 (0.77 to 1.23)		1.37 (1.14 to 1.66)	
Unspecified cognitive impairment vs. no CSD	1.06 (0.90 to 1.25)			
Sex: male vs. female	1.14 (1.05 to 1.25)			0.87 (0.73 to 1.03)
Age: per 5-year increase	1.02 (0.98 to 1.07)	1.09 (1.06 to 1.12)		
Residence: care home vs. private home	0.76 (0.62 to 0.93)		0.43 (0.34 to 0.56)	
CCI score				
1 vs. 0	1.20 (1.07 to 1.34)			
2–5 vs. 0	1.28 (1.12 to 1.47)		1.44 (1.27 to 1.63)	
≥ 6 vs. 0	2.27 (1.86 to 2.76)		1.39 (1.01 to 1.90)	0.78 (0.48 to 1.27)
Number of drugs prescribed in previous 84 days				
1–5 vs. 0	1.20 (0.96 to 1.49)			
5–10 vs. 0	1.35 (1.10 to 1.67)			
≥ 11 vs. 0	1.65 (1.33 to 2.05)			
ADL group				
Persistently low ADL score vs. persistently high ADL score	1.22(1.04 to 1.43)		1.47 (1.24 to 1.76)	0.92 (0.71 to 1.18)
Changed ADL score vs. persistently high ADL score	1.18 (1.08 to 1.29)			

Note
Adjusted for demographics, comorbidity variables and functional status for complete-case ADL.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

TABLE 41 Sensitivity analysis: HR estimates of the Fine and Gray[189] non-proportional subdistribution hazard model for time to death without re-admission

Model variable	HR (95% CI)			
	≤ 30 days	31–90 days	91 days to 1 year	1–2 years
CSD groups				
Delirium alone vs. no CSD	0.98 (0.70 to 1.37)			1.59 (0.86 to 2.92)
Known dementia alone vs. no CSD	0.86 (0.53 to 1.38)		1.47 (0.96 to 2.25)	
Delirium and known dementia vs. no CSD	1.17 (0.85 to 1.60)			
Unspecified cognitive impairment vs. no CSD	1.28 (0.82 to 1.98)			0.63 (0.15 to 2.62)
Sex: male vs. female	1.68 (1.19 to 2.38)		1.21 (0.94 to 1.56)	
Age: per 5-year increase	0.99 (0.90 to 1.10)		1.37 (1.21 to 1.55)	1.05 (0.88 to 1.25)
Residence: care home vs. private home	3.51 (2.55 to 4.84)		5.49 (3.77 to 8.01)	
CCI score				
1 vs. 0	0.85 (0.62 to 1.17)			
2–5 vs. 0	1.06 (0.82 to 1.37)			
≥ 6 vs. 0	6.05 (4.10 to 8.79)		1.76 (0.95 to 3.29)	
ADL group				
Persistently low ADL score vs. persistently high ADL score	2.66 (1.88 to 3.77)		1.27 (0.85 to 1.91)	
Changed pre ADL score vs. persistently high ADL score	1.15 (0.85 to 1.54)			

Note
Adjusted for demographics, comorbidity variables and functional status for complete-case ADL.

TABLE 42 Sensitivity analysis: RR estimates of the generalised gamma regression model for LoS

Model variable	Adjusted + ADL, RR (95% CI)
CSD group	
Delirium alone vs. no CSD	1.47 (1.35 to 1.61)
Known dementia alone vs. no CSD	1.53 (1.36 to 1.73)
Delirium and known dementia vs. no CSD	2.21 (1.98 to 2.47)
Unspecified cognitive impairment vs. no CSD	1.41 (1.23 to 1.62)
Sex: male vs. female	1.00 (0.94 to 1.07)
Age: per 5-year increase	1.07 (1.05 to 1.09)
Residence: care home vs. private home	0.31 (0.28 to 0.35)
SIMD	
1 vs. 5 (least deprived)	0.87 (0.78 to 0.97)
2 vs. 5 (least deprived)	0.99 (0.89 to 1.09)
3 vs. 5 (least deprived)	0.91 (0.83 to 1.01)
4 vs. 5 (least deprived)	1.01 (0.90 to 1.13)
CCI: 1-unit increase	1.06 (1.05 to 1.08)
Number of drugs prescribed in previous 84 days: 5-drug increase	0.86 (0.83 to 0.89)
ADL group	
Persistently low ADL score vs. persistently high ADL score	2.96 (2.70 to 3.24)
Changed pre ADL score vs. persistently high ADL score	2.99 (2.78 to 3.22)

Note
Adjusted for complete-case ADL functional status.

Appendix 5 Supplementary table from the economic analysis

TABLE 43 Survival model estimates from the joint model

Variable	Coefficient	Standard error
CSD: delirium and dementia	0.216**	0.082
Condition		
Delirium alone	0.236***	0.060
Dementia alone	0.255**	0.079
Unspecified cognitive impairment	0.200*	0.100
Female	−0.253***	0.043
Age group (years)		
70–74	0.237**	0.090
75–79	0.453***	0.086
80–84	0.584***	0.085
≥ 85	0.940***	0.083
Admitted from a care home	0.770***	0.073
CCI score		
1	0.315***	0.068
2–5	0.611***	0.060
≥ 6	1.982***	0.074
ADL score		
Changed	−0.202**	0.061
High	−0.706***	0.069
Missing	−0.567***	0.068
SIMD		
2	0.066	0.061
3	−0.035	0.063
4	−0.056	0.071
5 (least deprived)	−0.103	0.073
Cons	−4.210***	0.019

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Appendix 6 Online questionnaire

Important outcomes from hospital admission

Survey background

Survey exploring outcomes that are important to people with dementia or confusion who have experienced a hospital admission

Thank you for your interest in our research.

This research, lead by the University of Stirling, is part of a National Institute for Health Research funded project which aims to investigate what outcomes are most important to people following a hospital admission.

In order to take part in this research you should be:

1. A person who has experienced dementia or confusion, AND been admitted to hospital within the past two years.

2. OR someone who provides support to a person who has/is experiencing dementia or confusion AND has had an admission to hospital within the past two years.

NB. The hospital admission must have occurred **whilst** the person was living with dementia or confusion as it is the experience of

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

being in hospital whilst living with one of these conditions that we are most interested in.

Consent

Responses to this survey will be kept anonymous. However, by completing it you are agreeing to your replies being used in our analysis, including anonymised quotations from your responses. If you are not happy with this then please **do not** complete the survey.

You can find more information about the survey and the research here

Introduction

Before you start

This is a brief survey and should not take more than 10 -15 minutes of your time, please do not feel that you have to spend any more time on it than that.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Survey version

Are you the person who has experienced a hospital admission in the last two years (during which you had confusion,dementia, cognitive impairment and/or delirium)? *

Required

- Yes
- No

Living with dementia questions

General questions about you

Your gender * *Required*

- ○ Female
- ○ Male
- ○ Transgender
- ○ Prefer not to say

Your age * *Required*

- ○ 55 or younger
- ○ 56-65
- ○ 66-75
- ○ 76-85
- ○ 86-95
- ○ older than 95

Your country of residence * *Required*

More info

- ○ Scotland
- ○ England
- ○ Wales
- ○ Northern Ireland
- ○ Other

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

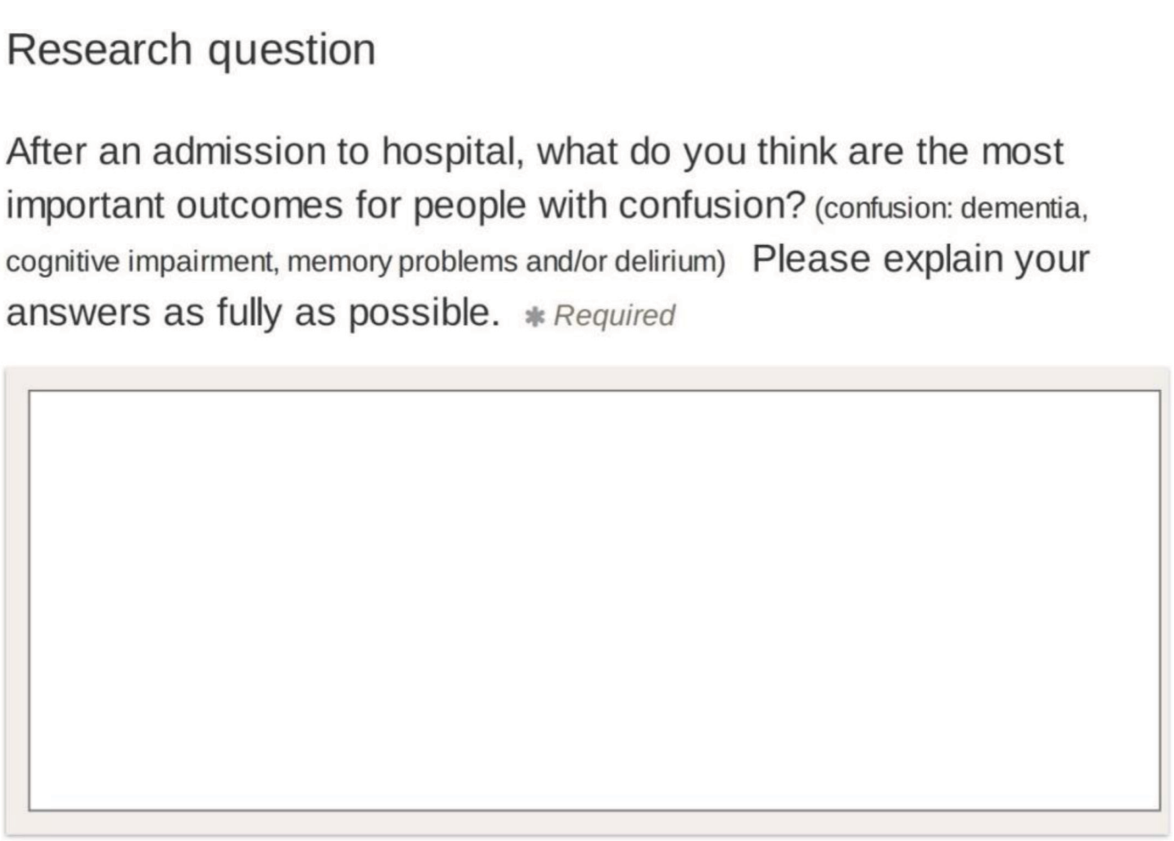
If you selected Other, please specify:

What is your living situation?
(Select all that apply) * Required

- [ ] I live on my own
- [ ] I live with my spouse/partner
- [ ] I live with another member of my family
- [ ] I live with a carer
- [ ] I have carers who visit daily
- [ ] I live in a care/nursing home
- [ ] Other

If you selected Other, please specify:

Please specify the family relationship



© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Supporter

Introduction

This version of the survey is intended to gather the views of families and friends of people who have experienced a hospital admission in the past two years (during which they had confusion, dementia, cognitive impairment, memory problems and/or delirium)

Questions about the supporter

General questions about you

Your gender * *Required*

- Female
- Male
- Transgender
- Prefer not to say

Your age * *Required*

- Younger than 18
- 18-25
- 26-35
- 36-45
- 46-55
- 56-65
- 66-75
- 76-85
- 86-95
- older than 95

Your country of residence * *Required*

More info

- Scotland

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

- England
- Wales
- Northern Ireland
- Other

If you selected Other, please specify:

What is your relationship to the person you support? * *Required*

- spouse/partner
- sibling
- child
- grandchild
- other family member
- friend
- paid carer
- Other

If you selected Other, please specify:

How often do you provide support to this person? * *Required*

- daily

- weekly
- monthly
- every couple of months
- every now and then

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Supporter survey: about the person

Questions about the person you support

What gender is the person you support? * *Required*

- ○ Female
- ○ Male
- ○ Transgender
- ○ Prefer not to say

How old is the person you support? * *Required*

- ○ 55 or younger
- ○ 56-65
- ○ 66-75
- ○ 76-85
- ○ 86-95
- ○ older than 95

What is the living situation of the person you support? (Select all that apply) * *Required*

- ☐ the person lives on their own
- ☐ the person lives with their spouse/partner
- ☐ the person lives with another member of their family
- ☐ the person lives with a carer
- ☐ the person has carers who visit daily
- ☐ the person lives in a care/nursing home

☐ Other

If you selected Other, please specify:

Please specify the family relationship

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Supporter survey: research question

After an admission to hospital, what do you think are the most important outcomes for people with confusion? (confusion: dementia, cognitive impairment, memory problems and/or delirium) Please explain your answers as fully as possible. * *Required*

After the admission to hospital of someone living with confusion (confusion: dementia, cognitive impairment, memory problems and/or delirium) what do you think are the most important outcomes to their **family and friends**? Please explain your answers as fully as possible. * *Required*

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Thank You

Thank you very much for completing our survey, we are very grateful for the time that you have taken to share your experiences with us. Please feel free to share it if you think you know anyone else who would be interested in taking part.

If you want to learn more about the research and/or be kept up to date with the project you can do this here.

Appendix 7 Online recruitment for the questionnaire

Postings were made on social media (Twitter and Facebook) through the Dementia Services Development Centre accounts to recruit respondents to the questionnaire and raise awareness of the study by asking people to share the information.

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Appendix 8 Sample participant responses

TABLE 44 Sample participant responses

Question	Response example 1	Response example 2
Sex of PwC	Female	Female
Age of PwC (years)	86–95	86–95
Country	Scotland	Scotland
Living situation of PwC	Lives with spouse/partner	Lives on their own, carers visits daily, lives in a care/nursing home
Sex of carer	Female	Female
Age of carer (years)	46–55	56–65
Relationship of carer	Child	Child
Support frequency of carer	Monthly	Weekly
Carer opinion. After an admission to hospital, what do you think are the most important outcomes for people with confusion? (Confusion: dementia, cognitive impairment, memory problems and/or delirium.) Please explain your answers as fully as possible	To try and ensure they are restored to their pre-admission baseline wherever possible. To ensure that they have the right support that gives them a good QoL	*Come out well not on more drugs and able to move quickly back to as normal a life as possible. In my experience hospital has been used to manage medication or avoid further damage i.e. Broken arm not really needed hospital. But mum came out on antipsychotics, was in for weeks as there was no community care (though I could have covered most of it but wasn't asked) and she was discharged without me being informed. They left a message on the wrong phone number and never mentioned it when I was in. We were traumatised by how she was treated, she was ignored and had no pain treatment at all, despite screaming in pain. I wrote to complain, the person who wrote back never said sorry but said my complaint had upset the staff!*
After the admission to hospital of someone living with confusion (confusion: dementia, cognitive impairment, memory problems and/or delirium) what do you think are the most important outcomes to their family and friends? Please explain your answers as fully as possible	To ensure that the person they care for is supported to achieve their pre-admission baseline or discuss new outcomes for the person that ensure if there are changes then the person still can have a good QoL. To listen to person, family and friends to ensure they know what that baseline looks like	*As above plus to be kept informed and treated as part of the team. Why on earth didn't get ask what I could do to help or at least make sure someone knew she was being discharged. She had no key so I eventually found her in a waiting area in her nightie, no water, shaking and frightened. The irony was she'd been a nurse for 45 years. What system does this to human beings, what has happened to the nurses and doctors that they can't see the person?*

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Appendix 9 Patient and public involvement across the study

Marion Latimer, a lay researcher, was a member of the project team from the outset and provided patient and public involvement oversight to the project team.

Development of patient/carer survey

Marion Latimer provided input and guidance when developing the online survey, and took the survey directly to members of the public at care homes and dementia cafes in the local area for feedback.

A version of the survey was produced and distributed to an expert panel from the Alzheimer's Society, consisting of people with dementia. On the basis of their feedback, we made amendments to some of the questions and to the introduction of the survey.

As part of the online survey, we asked the respondent if they would like to be kept informed of the findings from the project. We collected these data outside the survey and a total of 32 respondents have requested an update.

Reporting from the findings

Overviews of findings from the project were delivered at the annual Dementia and Ageing Research Group (DARG) conferences,[221] which address a mixed audience of members of the public, professional caregivers, academics and policy-makers. This involved updates on all four aspects of the study and, at the same time, overviews of the study and a description of the study cohort was published on the DSDC website.[224]

On the back of the publication of the article in BMC Medicine,[184] a blog was published on the DSDC website for the general public on the findings, and advertised in the DSDC newsletter.[225]

© Queen's Printer and Controller of HMSO 2021. This work was produced by Reynish *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

EME
HS&DR
HTA
PGfAR
PHR

Part of the NIHR Journals Library
www.journalslibrary.nihr.ac.uk

This report presents independent research funded by the National Institute for Health Research (NIHR). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care

Published by the NIHR Journals Library