DETAILED PROJECT DESCRIPTION

Full title of project

Understanding the outcomes of people with cognitive impairment (CI) and/or dementia admitted to the general hospital (GH).

Summary of Research

This project will use systematic review of the research literature and analysis of a unique large admission dataset to examine outcomes for older people with cognitive impairment and dementia admitted as an acute medical emergency. The study sits in phase 0/1 of the MRC 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 that will result from the proposed study is an essential component necessary for the next step in improving the quality of care for people with cognitive impairment in the general hospital.

The study aims to improve understanding of the outcomes of emergency hospital admission in people with cognitive impairment and/or dementia.

The objectives of the study are twofold:-

a) Review of Outcomes: Review of current literature 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.
b) Analysis of Outcomes: To data-link then analyse a unique routine population based healthcare dataset to measure healthcare and economic outcomes following hospital admission of older people with and without cognitive impairment and dementia.

Objective a) Review of Outcomes: Database searches identifying peer reviewed quantitative epidemiology measuring prevalence of cognitive impairment and associations with outcomes and qualitative research identifying a range of outcomes, and plausible improvement interventions will be carried out. Searches will also include "grey" literature covering relevant reports, evaluations and surveys. Screening for duplication and relevance will followed by full text review and assessment for quality. A narrative review of the quantitative and qualitative data will be compiled.

Objective b) Analysis of Outcomes: Older people admitted as medical emergencies in NHS Fife have been routinely screened for cognitive impairment, delirium and dementia using structured instruments since 2011 This unique dataset will be 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 vary between those with and without cognitive impairment, delirium on admissions and/or dementia. The analysis will measure associations between these different patterns of cognitive impairment and important health and social care outcomes, which will inform the design and targeting of interventions and power calculations for future trials and other interventional studies. The results will be combined with the cost analysis to better understand the additional costs of those with cognitive impairment in the general hospital.

Outputs and dissemination: The findings will significantly contribute to our understanding of the outcomes of patients with cognitive impairment in the general hospital and be of interest to academic and NHS audiences. They will be disseminated through a mix of peer-reviewed academic publications and presentations, and a range of tailored outputs targeting lay, policy and professional audiences. The findings will additionally support the development and optimisation of an intervention to improve outcomes for this population in the general hospital.

Background and Rationale

Dementia and cognitive impairment pose a major challenge to health services. Dementia prevalence is most strongly associated with age (Corrada 2008), and has risen sharply with increasing longevity resulting in part from the advances made in reducing vascular mortality in mid 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 the general hospital response to dementia is frequently highlighted. Additionally, the recognition that the measurement of outcomes, rather than just process measures, when aiming to improve quality of care, is deeply rooted in governmental policy.

Dementia is on the policy radar at global level. In Dec 2013 the UK hosted the G8 dementia summit. This concluded with the publication of a declaration setting out agreements reached. Since this event a World dementia council and envoy have been appointed to lead the global dementia action.

The Prime Minister's Dementia Challenge was launched in March 2012. One of its 3 key domains was the "Health and Care" for people with dementia.

The Dementia Challenge follows on from the individual's nation's dementia strategies. In England Objective 8 of the National Dementia Strategy (DH 2009) 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. The Second states one of the key priorities being that people with dementia in hospitals or other institutional settings always being treated with dignity and respect

In 2006 NICE/SCIE (2006) recommend that hospitals review their facilities and service function so that they promote independence and maintain function in people who have a dementia.

In 2013 the Department of health published "Improving care for people with dementia" (DH 2013), once again the general hospital response for people with dementia was highlighted as a priority.

In 2010 the government published the White Paper: Liberating the NHS (DH 2010). This outlined the intention to move the NHS away from focusing on process targets to measuring health outcomes
It stated that "Health outcomes matter to patients and the public. Measuring and publishing information on health outcomes are important for encouraging improvements in quality"
The current NHS Outcomes Framework 2013 to 2014 (DH 2012) sets out the outcomes and corresponding indicators used to hold the NHS Commissioning Board to account for improvements in health outcomes. This sits alongside the Adult Social Care Outcomes Framework 2014 to 2015 (DH 2014) 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 (DOH) estimated that two thirds of hospital beds were occupied by patients aged over 65years, up to one half of whom might have some kind of cognitive impairment, including dementia and delirium (Royal College of Psychiatrists 2005). Poor identification of cognitive impairment, frailty, co-morbidity, and poly-pharmacy 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 (Sampson 2009) which included a specialist clinical assessment for delirium, the prevalence of dementia in the general hospital was found to be 42.4% in patients aged over 70 years but half of these individuals did not have a formal diagnosis. In acute hospital admissions dementia is a common co-morbidity but it is poorly recognised and poorly managed. In a systematic review (Mukadam 2011) prevalence estimates

for people with dementia in a general hospital setting varied from 12.9-63.0% but it was not possible to estimate a pooled prevalence because of very major 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 misclassification risk was high.

Poor outcomes for people with dementia after hospital admission were highlighted by the Alzheimer's Society in 2009 with a staff and carer survey finding that "The majority of people with dementia leave hospital worse than when they arrive" (Alzheimer's Society 2009). Current knowledge concerning the outcomes of this hospital population with cognitive impairment can be divided into three distinct groups i) reports looking at the outcomes of those with dementia, ii) those with delirium and iii) the broader population of those with cognitive impairment. Evidence based documentation of outcomes for people with cognitive impairment in this setting is sparse.

Outcomes in people with dementia: The systematic review by Mukadam in 2011 identified seven studies reporting outcomes for people with dementia admitted to an acute hospital (Ardern 1993, Erkinjuntti 1986 and 1988, Margiotta 2006, Torian 1992, Wancata 2003, Zekry 2008). 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, and the exception including 2000 patients (Erkinjuntti 1986). The review finds 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 cost of treatment was higher for those with dementia (Mukadam 2011). The current understanding of the health economic impact of dementia is often defined by intervention rather than healthcare setting and estimates for cost of care for those with dementia in the general hospital are sparse, despite some important existing work on Dementia (Knapp 2013)

Outcomes in people with delirium: When looking at the outcomes of patients with delirium in the general hospital, there is substantial evidence which shows that outcomes are poor (Witlox 2010). Delirium is a common condition, known for its acute onset in confusion, fluctuating course and inattention. Delirium affects up to 30 per cent of older hospital patients and people who develop delirium have high mortality, high complication rates and longer hospital stays (BGS/RCP 2006) (NICE 2010). As well as an increase in overall morbidity and mortality (McCusker 2002) delirium increases the length of hospital stay (Stevens LE, 1998). 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 (Witlox 2010). There is also evidence which shows that cognitive function in elderly patients can be significantly worsened following a period of delirium, and may never return to its pre-morbid baseline. (Fann 2007). People with a dementia have a fivefold risk of developing delirium (Faculty of Old Age Psychiatry, Royal College of Psychiatrists 2005). There are estimates from over a decade ago that delirium cost the US health system over $4billion in inpatient costs alone. (Inouye 1994). A study of delirium in elderly patients on general medical units during their initial hospitalisation and 1 year following their discharge, (Leslie 2008) showed that delirium during a hospital stay was associated with higher mean total costs (at least $69,498 vs $47,958) as well as 2.5 times higher costs per day ($461 vs $166). This study concluded that delirium was responsible for between $60,516 and $64,421 additional health costs per year per delirious patient, which translates to $38 billion per year finiancial burden of delirium, with significantly higher figures ($143-$152 billion per year) when the figures was processed using models which accounted for the fact that the data was right censored. In 1986, LevKoff et al estimated that if the length of stay of each delirious patient could be reduced by just one day, the savings to Medicare would amount to $1 - $2 billion dollars annually (Levkoff 1986).

Outcomes in people with cognitive impairment: In a recent randomised control trial of a specialist medical and mental health unit versus standard care for those admitted to hospital with "confusion" (Goldberg 2013) the primary outcome measure used was the number of days at home beyond 90 days after randomisation. 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 examined outcomes for people with co-morbid mental health problems (dementia, delirium, depression) (Bradshaw 2013). 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.

There is little doubt that outcomes for people with cognitive impairment, delirium or dementia admitted to hospital are worse than for those without, and it is likely that these could be improved. Plausible interventions to improve this 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 cognitive impairment in the acute general hospital, and their outcomes. Cognitive impairment may be due to dementia or delirium. Lack of or incorrect identification, frailty, co-morbidity, and poly-pharmacy 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. (Bogardus 2003). The MRC Framework 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 commonly older people admitted to hospital have cognitive impairment and their post-hospital outcomes is sparse due 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.

The proposed research will enable accurate documentation of these outcomes and provide a baseline from which to measure improvement. This documentation will add evidence to be used in future policy development in order to drive these changes.

Evidence explaining why this research is needed now

The study is needed because the experiences and outcomes of patients with cognitive impairment and or dementia in the general hospital are poor. Reporting of healthcare outcomes such as length of stay, mortality and re-admission are difficult to capture in this population due to under diagnosis. This is compounded by the fact that "dementia" per se is rarely recorded as the primary reason for admission, and unreliably recorded as a secondary reason.

There are several areas of weakness in the existing literature. First, the outcomes examined varied very widely between studies. The literature review element of this study will systematically define the range of outcomes used in previous research, and appropriate outcomes based on patient, carer, clinical and policy perspectives. Second, many studies are small with highly variable included and excluded populations making synthesis difficult (Mukadam 2011). Almost all studies required patient or carer consent to participate making them highly selective even before applying inclusion and exclusion criteria. This study uses a dataset with high levels of coverage of an entire geographical older population with an emergency medical admission, with data collected annually on almost 50% more admissions than than the total number 4989 patients included in the 14 studies in the Mukadam 2011 systematic review. Third, not all studies examining outcomes have data on older people admitted to hospital without dementia or delirium, and where such data is available then most studies do not control for potential confounders including co-morbidities (Mukadam 2011). The proposed study will include a wider range of confounders than most previous studies, within the limits of the data available. Fourth, cognitive impairment, delirium and dementia overlap in complex ways in the hospital population, and many studies have focused only on one of these with the risk of misclassification, in part because small sample sizes make it difficult to do subgroup analysis

(Mukadam 2011). This study will be able to better define subgroups and overlaps to examine associations with outcomes.

The relevance of this research is all too apparent when reviewing the catastrophic impact that poor outcomes may have on the lives of individuals, their families, and the health and social care systems. Decline in physical and mental wellbeing in the older population can happen at any time. An admission to the general hospital is often the trigger for an irreversible acceleration in this decline. What happens in general hospitals can have a profound and permanent effect on individuals with a dementia and their families, not only in terms of their inpatient experience, but also their ongoing functioning, relationships, wellbeing, quality of life and the fundamental decisions that are made about their future (Sheehan 2009). The increased understanding that will result from the proposed study is an essential component necessary for the next step in improving the quality of care for people with cognitive impairment in the general hospital.

Aims and objectives

The aim of the study is to improve understanding of the outcomes of hospital admission in people with cognitive impairment and/or dementia. The term cognitive impairment is used here to encompass all individuals with impaired cognitive function at the time of their assessment and includes individuals with dementia, dementia without a formal diagnosis, and/ or delirium. The proposed study is in phase 0/1 of the MRC Framework for the Design and Evaluation of Complex Interventions and aims to systematically develop an understanding of current outcomes in order to support the development of a multi-domain intervention to improve outcomes for people with dementia and cognitive impairment in the general hospital in the future.

The objectives of the study are twofold:-

c) Review of Outcomes: Review of current literature 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.

d) Analysis of Outcomes: To analyse routine population based healthcare data to examine healthcare and economic outcomes following hospital admission of older people with and without cognitive impairment and dementia.

The findings will inform the targeting of future interventions and power calculations for future trials. The results of the population based health data analysis will be combined with the cost analysis to better understand the additional costs for the outcomes of those with cognitive impairment in the general hospital, to explore areas of potential to improve outcomes, and to identify opportunities for cost savings.

Research Plan / Methods

The proposed study is in phase 0/1 of the MRC Framework for Design and Evaluation of Complex Interventions and aims to systematically develop an understanding of current outcomes in order to support the development of a multi-domain intervention to improve outcomes for people with dementia and/or cognitive impairment (CI) in the general hospital (GH) in the future. Methodology for the two study objectives a) and b) is distinct and will run in parallel.

Methods for objective a) Review of Outcomes.

This will involve a systematic literature review and a survey to the Dementia Services Development Centre (DSDC) carers panel. The literature review will search evidence that currently exists in the field of cognitive impairment in the general hospital. It will cover 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, but in the case of dementia, updating the review compiled in 2008 (Mukadam 2011) . The DSDC carers panel survey will ask what are the key relevant outcomes for people with dementia and their carers in the acute hospital setting.

PROSPERO registration will be put in place prior to the start of the literature review

The review of outcomes will seek to answer the following research questions.

- What is the prevalence of cognitive impairment (dementia, undiagnosed dementia and / or delirium) in older people admitted to hospital as emergencies?

- What outcomes have been reported/observed/studied and how have they been measured in the cognitive impairment/dementia/delirium field in the general hospital?

- What are the outcomes that are important to people with cognitive impairment/dementia/delirium and/or their carers in the general hospital. This question will be answered via a combination of information from the literature review and the carers panel survey.

- What are the differences in outcome in the emergency hospital population with and without CI/dementia/delirium?

- What are the associations of cognitive impairment/dementia/delirium with outcomes in observational studies?

The systematic literature review will be carried out using Stirling Systematic Review Methodology. This methodology was developed in order to allow review and quality assessment of all types of research evidence including quantitative, mixed methods and qualitative studies. It therefore results in a systematic search for and fully inclusive review of all types of available research evidence. High levels of confidence in this quality rating are delivered by using well validated internationally adopted quality criteria that are applied to each appropriate category of research evidence during the review process.
The review method adopts the well-established steps of systematic review. Protocol development establishes the search terms and inclusion criteria. Data collection results in the cleaned bibliographic content of the review. Evaluation proceeds by individual review and data gathering from each evidence source. Data is gathered into a pre-programmed online proforma (developed by the School of Applied Social Science, University of Stirling, using google docs). The capture of key information about each text is guided by the key questions forming the basis for the review which have been pre-programmed by the research team. For the quality assessment reviewers use one of nine different predetermined evaluation pathways which differentiate between research designs and methodologies.

The embedded quality criteria are based on Centre for Research and Development (CRD) Report No 4 (CRD 2001), Cochrane Effective Practice and Organisation of Care (EPOC) checklists (Cochrane 2013) and, as appropriate, Critical Appraisal Skills Programme (CASP) assessment criteria (CASP2013). (http://www.sph.nhs.uk/what-we-do/public-health-workforce/resources/critical-appraisals-skills-programme) which all guide quality assessment of different types of research. The use of several sets of assessment criteria allows quality assessment of the full range of quantitative and qualitative research designs. This method avoids privileging the use of any given research design and instead allows consideration of all available evidence. The quality assessment processes evaluate a study or review against criteria which describe the archetype for that research design. This allows for comparisons of quality and therefore persuasive power of reported research within but not across different research designs. Review output is generated in tabulated form with grading of research quality. Reporting, depending on the type of output generated allows narrative and /or collaborative analysis of results.

Step 1: Protocol development: search terms, pre-determined questions for data collection and on-line pro-forma refinement.
A written literature review protocol will be developed and circulated to the larger research team then approved by the advisory board. An initial list of search terms and/or strings will be refined following preliminary searches to test the balance between sensitivity (finding every relevant study but with the potential for huge numbers of irrelevant studies) versus specificity (higher ratio of relevant to non-relevant but with the potential to miss some). Search terms will be refined early in the project in consultation with the stakeholders but are likely to include (dementia + hospital) and (cognitive impairment + hospital) linked in turn with a range of key words aimed at identifying an appropriate range of literature, such as care, delirium, geriatr*, older people, outcome. .
The on-line proforma will be refined and tested for purpose independently by two independent researchers based in SASS University of Stirling using 5 randomly chosen pieces of evidence pertaining to the field. Further modification of the proforma will take place in cases of large intra user variability or reported lack of clarity in use.

Step 2: Identification of relevant literature

Items included at this stage of the review will meet the following criteria: they will describe research or review other published studies on CI in the GH conducted in the UK and abroad; they will be published in English (for reasons of cost); and they will have been first published on or after 1 January 1990. The main focus will be on identifying peer-reviewed research, though we will also expect to conduct web-searches for government and local authority reports based on good quality research and "grey" literature covering relevant reports, evaluations and surveys.

The databases to be searched will include the following:

CINAHL, PsycINFO, Health Source: Nursing / Academic Edition, and EconLit (via EBSCO Host)
ASSIA, Social Services Abstracts, and Sociological Abstracts (via ProQuest)
IngentaConnect
Social Care online
Web of Science, Medline and BIOSIS (via Web of Knowledge)
Cochrane Library
Campbell library

Together, we have found through experience that these enable excellent coverage of scientific peer-reviewed literature. In addition to the database searches, we will conduct web-based searches for 'grey' literature, with a view to identifying robust evaluation reports that contribute good evidence.

Additionally the search strategy will include lateral searching, including contacting experts particularly to identify work in progress, and also reviewing reference lists of items identified in the initial searches.
The searches will produce full bibliographic details of each item: at this stage of the work, large numbers of references are normally found (in thousands). All will be downloaded into a RefWorks database for management, and to ensure that all the steps in the process can be tracked.

Step 3: Ensuring relevance of items

Following the download of references, the following steps will be taken:

- Duplicates eliminated
- Items screened for relevance on the basis of title
- Items screened for relevance on the basis of title and abstract
- Relevant items obtained for review of full text
- Decisions about the relevance of items will be taken by the research fellow and ER against clear criteria including topic relevance, focus on outcomes, research base of references.

Step 4: review of full text items and assessment of quality

Following the assessments of relevance, a selective reading and quality assessment of full text literature will be undertaken. Each item will be read and evaluated on line by the Research Fellow. The evaluation will include full summary of the key findings of the work, data about the nature of the study, the key conclusions and recommendations. Each review will require the reader to answer specific questions about the implications of the work for assessing outcomes for people with CI in the GH which will be pre-programmed into the online proforma. To ensure consistency of evaluation and judgements about the quality of evidence, a second member of the team will read and evaluate a sample of the retrieved items, and any identified disagreements will be discussed among the research team. The second independent reviewer will assess 20 per cent of the studies included: we have found in previous work that this is sufficient to ensure consistency, and therefore propose it as a means of keeping costs down. These will be identified randomly, but will also include any studies for which the first reader requires a second opinion. The process will be kept under review for consistency; if serious disagreements appear, a third reader will look at the item; if there are multiple disagreements, the whole sampling will be reviewed and team consultation will reconsider the approach.

Step 5: Review of data and development of conclusions

Whilst we expect the analysis to be predominantly descriptive, we will conduct formal meta-analysis where this is appropriate. Heterogeneity will be examined by calculation of the I-squared value and test for heterogeneity, along with examination of within study variance. If I-squared is > 50% indicating important heterogeneity, then no meta-analysis will be carried out. If heterogeneity appears to be relatively minor, then standard meta-analysis will be carried out with decision on fixed or random effects based on Akaike's Information Criterion (AIC).

The descriptive analysis of the literature will use qualitative analysis methodology. The proforma will be set up to produce descriptive data on the content of included studies, such as the PICO data, as the reading of items proceeds. In addition, we will conduct a thematic analysis of the key findings of the studies using open coding, which will allow an in-depth qualitative understanding of their contributions to be developed. The qualitative analysis will be carried out by the Research Fellow in consultation with other team members, and checking and validation processes will include independent reading to test out thematic codes.

The Research Fellow will write up the key conclusions from the reviews, collating the findings, quantifying and qualitatively analysing research evidence results informing the question of outcomes for people with CI in the general hospital.

The main outputs of the review of outcomes will be:

1. A report of the outcomes that have been suggested in the literature to be most important to people with dementia and their carers in the general hospital
2. An updated systematic review and collaborative analysis of the prevalence and outcomes of people with dementia in the general hospital. This will be an update and expansion of previous work (Mukadam 2011).
3. A systematic review and collaborative analysis of the prevalence and outcomes of people with delirium in the general hospital. This will draw on some work published previously (Siddiqi 2006) but will update and expand on the general hospital.
4. A narrative systematic review of the prevalence of the spectrum of cognitive disorders and their outcomes in the general hospital compared to the population without cognitive impairment. Where possible a collaborative subgroup analysis will be reported. (for example this may be possible in the specialist setting of an acute geriatric medicine ward).
5. A searchable database of the output of the review process that can be used to inform the development of a protocol to evaluate a future complex intervention.

Methods for objective b) Analysis of Outcomes

This will involve the analysis of a record linked routine clinical dataset from NHS Fife, Scotland. The dataset contains assessment information from the Older Persons Acute Assessment (OPAA) and will be used to stratify cohorts with and without cognitive impairment (with or without dementia and/ or delirium) and then perform analysis of their healthcare and economic outcomes.

Setting and participants

The Fife region of Scotland is a diverse rural and urban area with a population in 2012 of 366,220, with somewhat higher than average levels of morbidity and deprivation than the rest of Scotland. Like other areas of the UK, Fife has an ageing population and the proportion of the population aged 75 and over is projected to be 13% by 2030, having risen from 6.6% in 1991 8.1% in 2011, and particularly large increases in those aged 85 and over who now compose 2.3% of the population. Healthcare (primary and secondary) is provided by NHS Fife Health Board. There has been a 76% rise in emergency admissions of people aged 65 and over in Fife over the last 10 years. From January 2011 all emergency admissions in NHS Fife are directed through the Victoria Hospital Kirkcaldy. The Victoria Hospital is a District general hospital with approximately 640 staffed beds and has a full range of healthcare specialties. Medical and surgical emergency admissions are unselected and access the hospital via the acute admissions units. The configuration of service provision (especially for those over 65 years) is in line with the majority of district general hospitals within the UK. Routine hospital data therefore collected in this location will be generalizable to the majority of the older population admitted to acute hospitals within the UK.

Datasets to be used

Since 2011, the majority of people aged 65 years and over admitted as an emergency to an NHS Fife hospital have undergone an Older Persons Acute Assessment (OPAA). By design, individuals with a predicted length of stay less than 24hrs, a poor prognosis or acute illness requiring critical care intervention did not generally undergo an OPAA. The assessment includes assessment of functional and cognitive ability, screen for delirium, and documentation of their socio-environmental situation. Assessment includes use of the Abbreviated Mental test (AMT) (Qureshi & Hodkinson, 1972) plus

the Confusion Assessment Method (CAM) (Inouye 1990) a brief delirium measure, as well as documentation of the presence of a pre-admission diagnosis of dementia (although under-recording is an issue, community diagnosis of dementia in Scotland is known to be significantly more complete than in England compared to epidemiological expectations) (Alzheimers Society 2012). Development of the process of acute assessment was undertaken by the NHS Fife Dementia Co-ordinating group between 2009 and 2011 with pilot funding obtained from the Joint Improvement Team, Scottish Government.

The OPAA data is collected by trained specialist nurses during the first 24 hours of admission and recorded in the NHS Fife electronic patient administration system (PAS) for NHS use during the admission. By design, OPAA is not carried out for very brief admissions for assessment to rule out the presence of serious disease like myocardial infarction or for admissions for palliative care or where rapid death is expected. The hospital uses the unique NHS Scotland Community Health Index (CHI) number as the patient identifier, allowing linkage to other NHS Scotland dataset via the Health Informatics Centre (HIC), part of the Farr Institute, University of Dundee. HIC Standard Operating Procedures have been reviewed by the NHS Tayside Rsearch Ethics Service and research use is done with the consent of the NHS Fife Caldicott Guardian, based on researcher access only to anonymised data held in a secure safe haven that does not permit data export. Almost all emergency admissions in the over-65s in NHS Fife come via the Acute Medicine Admissions Unit (AMAU) with smaller numbers via surgery and orthopaedics, and we have carried out an initial descriptive analysis of OPAA data for AMAU admissions in 2012. 6532 (79.9%) of 8283 emergency admissions in the over-65s via AMAU in 2012 had either a full OPAA (68.4%) or a brief nurse assessment (BNA 10.5%) both of which include a delirium and dementia assessment (the total number of patients included in the 14 studies in the Mukadam 2011 systematic review was 4989). As expected, those not receiving a OPAA were more likely to have a very brief admission and were somewhat younger than those with an assessment (77.0 years vs 80.8 years for OPAA and 78.9 for brief nurse assessment). Using this data we will define a cohorts of admissions in people aged 65 or older who have:

- Cognitive impairment on admission defined as having an abbreviated mental test (AMT) (Hodkinson 1972) score of 7 or less on admission (in the 2012 AMAU preliminary analysis [applies to all bracketed numbers that follow], 1106 (16.9% of those with a OPAA or BNA) had cognitive impairment on admission).
- Full syndromic delirium on admission defined as those who are positive on the Confusion Assessment Method score (CAM+) (Inouye 1990) (388 (5.9%)
- Any delirium on admission defined as CAM+ve or clinical assessment suggestive of delirium (1587 (24.3%)
- Diagnosed dementia defined as pre-admission diagnosis recorded or receipt of any licenced drug for the treatment of dementia in the community (cholinesterase inhibitors or memantine included in chapter 4.11 of the British National Formulary) (539 (8.3%)). Dementia diagnosis in NHS Fife is done in specialist memory clinics who are responsible for initiating drugs to treat dementia, which are then prescribed by GPs.

The OPAA dataset will be linked to the Scottish Morbidity Records 01 (SMR01) dataset (acute hospital admissions, broadly equivalent to HES in England), General Register Office (GRO) for Scotland mortality data, the master Community Health Index (CHI) dataset, and the patient-level community dispensed prescribing dataset held by HIC.

- SMR01 data will be used to measure several key outcomes (in-hospital mortality, length of stay during index admission, discharge destination, readmission within 30 and 90 days of discharge), and to calculate the Charlson Index (Charlson 1987)for case-mix adjustment of analyses relating to hospital resource use and mortality.
- GRO data will be used to measure mortality within 30 and 90 days of admission
- CHI data will be used to obtain patient characteristics including age, sex, social deprivation (postcode-assigned Scottish Index of Multiple Deprivation score, assigned to sectors with an average of 750 individuals which is more fine grained than possible elsewhere in the UK),

rurality/remoteness (postcode assigned Scottish Executive Urban-Rural Classification), and nursing home residence.

- Community dispensed prescribing data will be used to create an alternative multimorbidity score or marker of multimorbidity for case-mix adjustment (Brilleman 2012) which is broader than just hospital admissions, and to measure initiation of sedative or psychotropic drugs around the time of admission, including antipsychotics, hypnotics, anxiolytics, and antidepressants. (Guthrie 2010) Additionally a count of regularly prescribed medication will be used to gauge the extent of polypharmacy

Outcomes

The primary outcome will be whether or not an individual is living at home 30 days after discharge, calculated for all admissions and for all discharges (since some people admitted do not survive to be discharged) (Beswick 2008). Other outcomes examined will be in-hospital mortality, mortality within 30 and within 90 days of admission, length of stay, discharge destination (home, care home), new care home admission at discharge or within 30 and within 90 days of discharge, and readmission within 30 and within 90 days of discharge.

Based on pilot data for the year of 2012, there were 8,283 admissions of whom around 80% had a OPAA recorded. Of those assessed approximately 75% would be living in the community at 30 days and 60% at 90 days giving approximately 5000 and 4000 events for survival modelling. With 80% power this would allow detection of Hazard Ratios of the order of 1.15 or above. For the outcomes of mortality in the year of 2012 these were 15% 30-day mortality and 20% 90-day mortality allowing detection of HRs of 1.25 or greater. Hence there is more than enough power for the major outcomes in this cohort. The data to be analysed for the study will include that from 2012 and 2013 hence ensuring adequate power for meaningful analysis.

Analysis methods

The study will define a cohort of patients aged 65 or over admitted to hospital with CI and without CI and so time to event models will be utilised. Initially the cohort will be described by means and standard deviations for continuous variables and percentages and denominators for categorical variables. The distribution of continuous variables will be assessed and transformations applied where necessary. Total hospital stay over one year following an index admission will be tabulated by no CI, CI, delirium, and dementia and combinations as these may overlap.

The incidence of the primary outcome of living at home within 30 days of discharge (Yes, No) will be described for the index admission and for those discharged form hospital separately.

Analysis of time to living at home (30 days) will be initially assessed with Kaplan-Meier plots and log-rank tests for associations. Variables considered will be age, sex, deprivation (SIMD), markers of co-morbidity such as Charlson index, individual morbidities based on SMR and / or prescriptions as well as number of prescriptions.

Cognitive Impairment, Delirium and dementia will also be included as binary predictors.

Multiple regression modelling will then be implemented with Cox proportional hazards models. Variable selection will be based on Akaike's Information Criterion (AIC) for best fit. The discriminative index or c-statistic will be estimated as a measure of predictive ability.

The assumptions of proportional hazards and assessment of the functional form will be carried out using Schonfeld residuals and diagnostic plots.

For time to living at home there is the potential for competing risks, in particular the competing risk of death which could occur prior to living at home. Assessment of competing risks will utilise cumulative incidence functions and the Fine and Gray model. As not all admissions will have a OPAA completed we will assume that those with no OPAA also have no Cognitive Impairment. This could potentially introduce some bias so propensity scores will be constructed for the propensity to have a OPAA completed (Yes, No) and the propensity score will be utilised in the regression analyses to reduce this potential bias. The proportion with completed OPAA was approximately 80% in 2012

% and hence any bias is likely to be small. Analyses will be carried out in SAS (v9.3). These analyses will be repeated for the outcomes of readmission, and care home admission

Cohort analysis from the index admission will examine how a range of outcomes vary between those without CI, and those with diagnosed dementia and/or delirium before and after adjustment for age, sex, demography and reason for admission.

Economic analysis will use service costs to examine the differences between the subgroups in relation to the outcome variables identified above.

Economic Analysis

The results of the outcomes analysis will be used to model the service costs in order to quantify differences between the subgroups.

Care will be taken in modelling healthcare costs to ensure that the cost data satisfies 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 (Gregori et al. 2011). There are four main violations of the standard OLS assumptions which can be particularly problematic in analysing health care costs: skewness; heteroscedasticity; censoring; and zero costs. We describe each of these issues below in relation to this study and the economic analysis that will be performed.

Skewness	This is likely to be an issue in our study, with small numbers of patients experiencing very high service costs, skewing the distribution.
Heteroscedasticity	This may be an issue in our study, with patients within sub-groups experiencing different levels of variation in their service costs.
Censoring	This will be of some concern in our study. While date of death will be known so survival time will not be censored, censorship due to death will need to be accounted for.
Zero costs	All patients in our study will have at least an index admission, and so there will not be a mass of patients with zero costs. We will still need to be aware of potential skewing of the distribution with numbers of patients with relatively low costs.

A number of recent reviews have provided detailed assessment of the range of cost modelling methods available (Gregori et al. 2011, Mihaylova et al. 2011, Jones 2010, Mandelblatt et al. 1997). While 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 policymakers (Mihaylova et al. 2011). Mihaylova et al also provides practical guidance to analysts attempting to analyse multivariate cost models. We anticipate that the cohort used in this study falls in the 'amber orbit', where our data succumbs only to 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 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.

The strategy for analysing the costs in this study will include:

- Producing detailed descriptives of cost distributions by key characteristics, and analysis of the distributions;
- Testing (where possible) of the key assumptions outlined above for the study data;
- Estimation of multivariate cost models that are robust to violations of the standard OLS assumptions;

- Estimation and reporting of alternative specifications of the models for robustness, checking for sensitivity of the findings and estimates to model specification.

Service cost data drawn from the NHS Scotland "Scottish Health Service Costs" publication will be matched into the dataset in order to allow modelling of the costs of different patterns of intervention. Multivariate modelling of total costs will use Generalised Linear Models (GLM) with appropriate distributional assumptions drawn from the data (e.g. log link with gamma errors). Hazard modelling will be used to model service costs incurred through time. The specifications of these cost models will be informed by the model specification used in the outcomes analysis. The analysis will report estimated costs of the different cohorts; and estimate the magnitude of cost differences between sub-groups. Patient-level cost data from the Patient Level Information Costing (PLIC) methodology provided by NHS Scotland's Information Services Division (ISD) will be used. This incorporates direct costs by speciality for both admission and length of stay; estimates for high cost items, and an overhead allocation. These costs are then applied to the individual patient records held in SMR01 admissions data to provide detailed patient-level costs for the economic analysis. The SMR01 records currently contained in the data linkage and accessible through the safe haven will provide sufficient detail to permit the use of the PLICS methodology.

Robustness checking will involve estimating alternative model specifications, alternative distributional assumptions, and estimates using sub-groups in order to test the sensitivity of the model estimates to these methodological choices.

The analysis will measure associations between CI/dementia/delirium and important health social care outcomes. The results of the health data analysis will be combined with the cost analysis to better understand the additional costs for the outcomes of those with CI., Together the results will inform the targeting of future interventions and power calculations.

Dissemination and projected outputs

Output:-
This project will aim to understand current outcomes related to admissions to the general hospital for people with cognitive impairment including those with dementia and delirium. This will be done via analysis of current routine hospital data and a review of current peer review and grey literature and will have active PPI involvement so that those outcomes most important to people with dementia in this situation will be apparent.

There are two types of output. Firstly, the findings are of interest in themselves, both in terms of academic understanding and in terms of helping policymakers, clinicians and managers understand the significance of these outcomes. As described above, the outputs will be a mix of peer-reviewed academic publications and presentations, and a range of tailored outputs targeting lay, policy and professional audiences.

Secondly, the findings will support the development and optimisation of an intervention to improve the outcomes for patients with cognitive impairment in the general hospital.

The list of planned outputs in chronological order is:

- Report from the carer panel survey to be published in dementia news format such as "Dementia Today"

- Pulse surveys X 3. Snapshots of research findings to be disseminated for comment using the mailing distributed by Dementia Services Development Centre

- NIHR progress reports at 6 monthly intervals.

- Journal articles. Peer review academic journal articles will be published on both strands of the research: review of outcomes and analysis of outcomes.

- Public report of the project findings, (including a guide as to the weight of evidence supporting the finding), to be produced in PDF format and made available for download from the Dementia Services Development Centre website. For example http://dementia.stir.ac.uk/system/files/filedepot/12/good_practice_in_the_design_of_homes_and_living_spaces_for_people_living_with_dementia_and_sight_loss_final.pdf

- NIHR full project report. This will be available on the NIHR website and published in the NIHR journal series.

We will disseminate the knowledge gained from this research to the following audiences:

ACADEMICS:

As a minimum, we envisage peer-reviewed publications and presentations on: literature review of outcomes of those with cognitive impairment/ dementia in the general hospital; and quantification of current healthcare and economic outcomes for patients with cognitive impairment in the general hospital using routine hospital data The full project report will be available on the NIHR website and published in the NIHR journal series.

PATIENTS AND THE PUBLIC:
In addition to the report from the carers panel, the pulse surveys and the public report of the project, we will work with the Dementia Services Development Centre and the University press offices as we

publish findings, to ensure that they are appropriately and attractively distributed to newspapers, websites and patient organisations.

COMMISSIONERS AND POLICY MAKERS:
The public report of the project findings will be freely available for download from the DSDC website. The full NIHR project report will include an executive summary. We will create a set of Powerpoint slides aimed at NHS managers for dissemination, and offer a UK wide policy and NHS focused workshop. The applicants will additionally use their own networks to disseminate the findings.

HEALTH CARE PROFESSIONALS:
We will offer seminars and workshops to NHS professionals, communicate with professionals via professional networks (e.g. British Geriatrics Society) and make summaries of the research available to health professionals in academic publications in the professional press.

Plan of investigation and timetable

Month of project	**Management**	**Objective a) Review of Outcomes**	**Objective b) Analysis of Outcomes**	**Objective b) Health-economic analysis of outcomes**	**PPI activity**	**Reporting / Dissemination**
M1	Steering committee meeting	Prospero registration	Caldicott Guardian approval			
M2						
M3	Steering committee/ advisory group meeting	Definition of search terms and parameters			Carer panel survey and report	
M4			Cleaned OPAA dataset and start of data analysis			
M5	Steering committee meeting					
M6					Pulse Survey, DSDC mailing	NIHR Progress report
M7	Steering committee meeting			Start of economic data analysis		
M8						
M9	Steering committee meeting					
M10						
M11	Steering committee meeting					
M12	Advisory group meeting	Conclusion of review and quality assessment				NIHR Progress report
M13	Steering committee meeting				Pulse Survey, DSDC mailing	Start writing NIHR Final Report
M14						
M15	Steering committee meeting					

M16						
M17	Steering committee meeting					
M18		Draft of review report	Conclude main data analysis	Conclude main health economic data analysis	Pulse Survey, DSDC mailing	NIHR Progress report
M19	Steering committee meeting					
M20		Conclusion of reporting	Conclusion of reporting	Conclusion of reporting		
M21	Steering committee meeting	Submission of article for publication	Submission of article for publication	Submission of article for publication		
M22						
M23	Steering committee/ advisory group meeting				Public project report and publication on DSDC website	
M24						NIHR Final report

Project management

All members of the research team from both the University of Stirling and the University of Dundee will form the project Steering committee (SC). The SC will be co-ordinated by ER. The SC will meet 8 weekly via Skype and face to face for alternate meetings.

The researchers involved in the quantitative data analysis (objective b) from the UoS (AR) and UoD (PD, BG, RF(D)) will meet via skype 2 weekly. Access to the dataset will be provided via the safehaven in Dundee and will be made accessible for AR in Stirling.

An advisory group (AG) for the project will be appointed. This will be chaired by Prof Gordon Wilcock, currently Emeritus Professor of Clinical Geratology at the University of Oxford and an independent expert in this clinical field. The AG will include 2 independent lay members, the project lead ER, a member with remit for data governance, a member with remit for ethical overview and a member of NHS management. This group will meet on a minimum of three occasions (within the first 3 months with the findings from the survey from the carers panel, at one year for a project update from the steering committee, and within the last 2 months), but frequency will be determined by the AG itself.

Approval by ethics committees

The Health Informatics Centre (HIC) (Dundee) Standard Operating Procedures have been reviewed by the NHS Tayside Research Ethics Service and research use is done with the consent of the NHS Fife Caldicott Guardian, based on researcher access only to anonymised data held in a secure safe haven that does not permit data export. Caldicott guardianship is in place for upload from NHS Fife of data to safe haven at HIC and pilot data analysis. Caldicott guardianship will be obtained for the data analysis.

Patient and Public Involvement

A carer representative will be employed as a member of the research team. She has direct experience of the acute hospital being a former carer for someone with dementia and has been involved in the NHS Fife development and implementation of the older persons acute assessment (OPAA) since the outset of the project in 2007. She continues to be an active member of NHS Fife health board dementia co-ordinating group who meet regularly to review service delivery and development. The Older Persons Acute Assessment (OPAA) continues to be at the centre of this service delivery. The carer representative will attend research steering committee meetings, be a member of the research advisory group, be the first port of call for advice regarding PPI and help with project dissemination.

The Dementia Services Development Centre (DSDC) Carers' Panel and the Alzheimer's Society Research Network will be involved in the project. They will be consulted during the first 3 months of the project and asked what they feel are the key relevant outcomes for people with dementia and their carers in the acute hospital setting. The findings of this consultation will be written up as a report and published in a Dementia News type of journal..

The DSDC carers panel and the Alzheimer's Society Research Network will also be involved in the final 4 months of the project in the drafting of a public summary of the project and helping with its dissemination. This public report of the project findings will include a guide as to the weight of evidence supporting the findings, will be produced in PDF format and be made available for download from the Dementia Services Development Centre website. For example http://dementia.stir.ac.uk/system/files/filedepot/12/good_practice_in_the_design_of_homes_and_living_spaces_for_people_living_with_dementia_and_sight_loss_final.pdf

PPI representatives involved in the survey or production of the report will be acknowledged for their participation line with INVOLVE guidance.

Throughout the duration of the project a regular pulse survey will be sent out with the DSDC mailing asking for initial reactions to project findings as they become available. These responses will be fed back to the research team and discussed at steering committee meetings.

In addition to the involvement of the Dementia Services Development Centre (DSDC), University of Stirling, the Alzheimer's Society will be an external PPI partner in the project and help to bring about extensive meaningful public engagement throughout the project.