SYSTEMATIC REVIEWS

A systematic literature review of factors affecting outcome in older medical patients admitted to hospital

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Abstract

Introduction: the ACME*plus* project aims to devise a standardised system for measuring case-mix and outcome in older patients admitted to hospitals in different parts of Europe for primarily 'medical' (i.e. not surgical or psychiatric) reasons. As a first step in this project, a systematic review was carried out to identify factors which had a significant influence on outcome in such patients.
Methods: the systematic search used Medline 1966–2000, Cinahl 1982–2000, Web of Science 1981–2000, reference lists of relevant papers and a hand search of *Age and Ageing* 1974–2000. A six-category grading system was devised to classify the 313 identified papers with regard to their relevance to the ACME*plus* project, study design and power. The analysis of the 14 'category 1' papers is presented.
Results: the main areas of assessment of case-mix were function, cognition, depression, illness severity, nutrition, social elements, aspects of diagnosis and demographic details. Statistically significant predictors, for the four outcome measures, listed below were:

i. For length of stay: functional status score, illness severity, cognitive score, poor nutrition, comorbidity score, diagnosis or presenting illness, polypharmacy, age and gender.
ii. For mortality: functional status score, illness severity, cognitive score, comorbidity score, diagnosis or presenting illness, polypharmacy, age and gender.
iii. For discharge destination: functional status score, cognitive score, diagnosis or presenting illness and age.
iv. For readmission rate: functional status score, illness severity, co-morbidity, polypharmacy, diagnosis or presenting illness and age.

Conclusions: factors affecting outcome in older medical patients are complex. When looking at outcomes of hospital admission in older people it is important not just to look at routinely available statistics such as age, gender and diagnosis but also to take into account multifaceted aspects such as functional status and cognitive function.

Keywords: *systematic review, outcome assessment (health care), aged (80 years and over), prospective studies, length of stay, elderly, prognosis, hospital admission*

Introduction

ACME*plus* [http://www.abdn.ac.uk/acmeplus] is a European-wide research project, which focuses on patients aged 65 years and over who have recently been admitted to hospital for 'medical' (as distinct from surgical or psychiatric) reasons. The aim is to devise a standardised system for measuring case-mix (case-mix can be defined as patient-based, disease-based and other factors that can affect outcome, including the type and severity of physical/mental problems,

and new or pre-existing disability; case-mix classification systems attempt to divide groups of patients into different sub-groups, which are homogenous in the sense that they have similar outcomes, or require similar amounts of resources) and outcome so that health workers in a given unit can compare their performance with similar units elsewhere in Europe. When comparing outcomes in older medical patients it is of particular importance to adjust for case-mix due to the wide range in diagnoses, severity of illness, co-morbidities and functional abilities found within this age group.

A necessary first step in the process of identifying possible case-mix items was to carry out a systematic review of previous studies of recently hospitalised older patients which had examined the relationship between various admission factors and hospital outcome. The results of that systematic review are described here.

Methods

The main objective was to identify previous studies, which investigated elements of case-mix and outcome assessment in older people (≥60 years of age) admitted from the community to the acute care setting (mainly into general medical specialties).

Electronic databases were searched using a systematic search strategy, Medline 1966–2000, Cinahl 1982–2000, Web of Science 1981–2000. Reference lists of identified papers were checked for other relevant papers, which may not have been found, on the initial search. A hand search of *Age and Ageing* 1974–2000 was also undertaken as it was felt that this publication was likely to yield the most relevant studies for our purposes. The Aberdeen University library catalogue was also searched to identify books relevant to case mix and geriatric textbooks which might refer to case-mix studies.

Because of the prior experience and research work [1, 2] of the ACME*plus* partners we already knew of many of the potential case-mix domains, which were likely to be of relevance in the search. These included:

i. Information about the patient prior to admission: socio-economic status, functional status (both physical and cognitive) and diagnosis.
ii. Information at the time of new diagnosis, new disabilities, co-morbidity.
iii. Fixed patient factors such as age and gender.
iv. Administrative details, such as ward type and local discharge arrangements.

Similarly, we knew that the main measures of outcome used in previous studies were mortality, length of stay, discharge destination and readmission rates. This knowledge enabled us to define a suitable search strategy. [Full details of the search strategy are detailed in supplementary data available at http://www.ageing.oupjournals.org].

A six category grading scale [detailed in the supplementary data] was used to classify identified papers, (by S.C. and D.G.S.), in order of their importance to the project. The first 30 papers were dually graded to check for inter-rater reliability and were graded the same. Either S.C. or D.G.S. graded other studies individually, but where either was unsure of the category the other was consulted and a consensus reached.

By definition, category 1 studies were of most relevance to our study. These were studies of a population 60 years of age and older, assessed with a standard measure reflecting case-mix and or outcome, admitted to a general medical facility. The studies were then dually (S.C., D.G.S. and W.P.) graded for quality using the methodology checklist for cohort studies produced by the Scottish Intercollegiate Guidelines Network (SIGN) [3]. To ensure that the quality of the statistical methods used in each paper were appropriately assessed, an independent statistician was consulted.

As the studies are heterogeneous we have not attempted to synthesize the results, but present the case-mix measures in each study which have a statistically significant effect on outcome.

Results

Fourteen studies (Table 1) were classified category 1 from 313 identified publications from the systematic search. These were all prospective cohort studies carried out in acute general medical or geriatric facilities. The sample sizes ranged from 150 to 823 patients. The majority of studies (11) [1, 2, 4–12], assessed patients within the first week of admission, and a further study [13] assessed patients 'after medical stabilisation', which was likely to be in the first week. Two studies [14, 15] gave no report of the time of assessment. Half of the studies (seven) [1, 2, 5, 8, 10, 13, 15] followed patients only until discharge from hospital with others undertaking a follow-up period after hospital discharge varying from one month to two years.

SIGN reports that in regard to cohort studies 'Because of the potential complexity and subtleties of the design of this type of study, there are comparatively few criteria that automatically rule out the use of a study as evidence' [3]. There is more of a need to have confidence that aspects of a good study design are present. The appropriateness of the statistical methods used in the 14 studies on the whole were appropriate, although there were some concerns about the overuse of statistical methods with small sample sizes in some studies [4, 8]. [Further information of the appropriateness of the statistical methods is detailed in the supplementary data.]

The main areas of assessment of case-mix were function, (carried out in all studies), cognitive function (13), depression (5), illness severity (4) and nutrition (2). [Please see supplementary data for details of the standardised assessment instruments used.] All studies included some social elements (e.g. education, social support, living location and income), aspects of diagnosis (e.g. number of medications, comorbidity and diagnosis) and demographic details such as age, gender and marital status. Table 2 details the case-mix variables, which were used, and whether they were significant predictors for the four main outcome measures employed. For the level of significance we have chosen to show all the analyses, which have a P value of <0.05. However, some studies may have a higher level of significance. The more detailed statistical analysis for each study can be found on the ACME*plus* website [http://www.abdn.ac.uk/acmeplus].

Table 1. Category one study descriptions

Reference	Country	Year	Study design	Study period	Clinical setting	Sample size	Follow up period	Assessment time from time of admission
Alarcon T et al. [4]	Spain	1999	Prospective cohort	10 months	Acute geriatric ward	353	6 months	Within 48 hours
Bertozzi B et al. [5]	Italy	1996	Prospective cohort	November 1993–October 1994	Geriatric evaluation and rehabilitation unit	295	Until hospital discharge	Day 3
Covinsky KE et al. [6]	USA	1997	Prospective cohort	March–July 1990 & November 1990–March 1992	General medical service of a teaching hospital	823	1 year	Within 48 hours
Di Iorio A et al. [14]	Italy	1998	Prospective cohort	March and April 1996	Acute geriatric care units in 4 city hospitals	379	6 months	Not reported
Di Iorio A et al. [15]	Italy	1999	Prospective cohort	March and April 1996	Acute geriatric care units in 4 city hospitals	402	Until hospital discharge	Not reported
Dunstan EJ et al. [1]	UK	1996	Prospective cohort	1993	Acute geriatric care units in 2 centres	400	Until hospital discharge or 90 days in hospital	Within 1st week
Findlay P et al. [2]	UK	2000	Prospective cohort	March–July 1997	Department of medicine for the elderly	227	Until hospital discharge or 90 days in hospital	Within 1st week
Gutierrez Rodriguez J et al. [7]	Spain	1999	Prospective cohort	December 1995–December 1996	Acute unit in a geriatric department	150	1 month	Within 48 hours
Incalzi RA et al. [8]	Italy	1997	Prospective cohort (Comparative retrospective cohort)	November 1992–June 1994	Medical and geriatric wards in an acute care hospital	370 (500)	Until hospital discharge	On admission
Inouye SK et al. [9]	USA	1998	Prospective cohort (Comparative prospective cohort)	November 1989–June 1990	General medical service of a teaching hospital	207 (318)	2 years	Within 48 hours
Maguire PA et al. [10]	Northern Ireland	1986	Prospective cohort	14 weeks in 1983	Geriatric medical unit	350	Until hospital discharge	Mean = 4.6 days
Narain P et al. [11]	USA	1988	Prospective cohort	July 1985–June 1986	Acute geriatric unit	396	6 months	Within 2 days
Perlado F et al. [12]	Spain	1999	Prospective cohort	Not documented	70 acute geriatric medicine beds	221	Not documented	Within 3 days
Rock BD et al. [13]	USA	1996	Prospective cohort	January 1993–May 1993	Urban medical teaching hospital	250	Until hospital discharge	After medical stabilisation

Table 2. Studies showing significant relationships ($P \leq 0.05$) between predictor variables and four main outcomes

Outcome → Predictor ↓	Length of stay Significant	Length of stay NS	Mortality Significant	Mortality NS	Discharge destination Significant	Discharge destination NS	Readmission Significant	Readmission NS
Function								
Barthel Index	1*, 2*, 4, 12*		1*, 2*, 4		1*, 2*	4		4
Hearing (whisper)				9				
Katz IADL	5, 13, 14		6, 8		6		14	
Lawton-Brody IADL	5, 11, 15	13	9, 11		11			11, 14
Near vision (Jaeger)				9				
FDS		4	4		4			4
Stand & walking speed	15						14	
Test of gait & balance	15							
Tinetti scale	5						14	
Illness severity								
Apache II			6, 9			6		
CCS			6, 9			6		
CIRS	15							
Cognition								
AMTS	1*, 2*, 10, 12*		1*, 2*		1*, 2*			
CAM	11			9	11			
Kahn scale of mental state	5, 15		11					11
MMSE			8, 9		11			14
mBDRS				9				
MDS		4		4		4		4
SPMSQ		4, 13		4	4			4
Depression								
Geriatric depression scale		5, 15	9					14
Nutrition								
Prognostic nutritional index	5							
Nutritional status score				8				
Aspects of Diagnosis								
Co-morbidity	5, 15	4	6, 8	4		4	15	4
Poly-pharmacy	11	4, 5	4	11		4, 11	4	11
Diagnosis or presenting illness	1, 2, 10, 11, 12	4, 5, 13, 15	1, 11	4, 8, 9**	1, 2	4, 11	11	4
Demographic factors								
Age	10, 11	1, 2, 4, 5, 12, 13, 15		1, 2, 4, 6, 8, 9, 11	1, 6, 11	2, 4	14	4, 11
Gender	1	2, 4, 5, 10, 12, 15	6	1, 2, 4, 9		1, 2, 4, 6		4, 14

NS = Not significant.
*These studies do not use the whole scales but do use selected items from these scales.
**Disease staging scale used which is a diagnosis based system.
NB. Although study number 7 uses a number of the measures above, the OUTCOME used is 'Risk of Functional Impairment After Discharge', therefore it does not appear in this table.

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The measures of outcome used were length of stay (nine) [1, 2, 4, 5, 10–13, 15] mortality (seven) [1, 2, 4, 8, 9, 11], discharge destination (five) [1, 2, 4, 6, 11], readmission (three) [4, 11, 14], function after discharge (one) [7], cost of hospitalisation (one) [6]. Nearly all studies which measured functional status found a significant relationship with length of stay [1, 2, 4, 5, 11, 13–15], mortality [1, 2, 4, 6, 8, 9, 11] and discharge destination [1, 2, 4, 6, 11]. However, of the three studies [4, 7, 14] which looked at the relationship between function and readmission, only one [14] found a significant relationship. Only four studies [6, 9, 14, 15] used measures of illness severity to predict outcome. These showed a significant relationship with length of stay [15], mortality [6, 9] and readmission [11], but not with discharge destination [6].

The relationship between patient cognition and outcome was explored in 12 studies [1, 2, 4, 5, 8–15]. The majority showed a significant relationship between cognition and length of stay [1, 2, 5, 10–12, 15]. Five studies found a significant relationship with mortality [1, 2, 8, 9, 11] and four studies with discharge destination [1, 2, 4, 11]. However, of the three studies [4, 11, 14], which explored readmission as an outcome, none found a significant relationship with cognition.

In the four studies [5, 9, 14, 15] that measured depression there were no significant associations with two of the outcomes measured, length of stay [5, 15] and readmission [14]. However, a significant relationship was found between depression and mortality [9].

One study [5] did find an association between nutritional status and length of stay but another study [8] did not find any significance with mortality. However, different nutritional scores were used.

For various aspects of diagnosis (co-morbidity, diagnosis or presenting illness and poly-pharmacy), a significant relationship was found with length of stay [1, 2, 5, 10–12, 15], mortality [1, 4, 6, 8, 11] discharge destination [1, 2] and readmission [4, 11, 15]. However, length of stay was not found to be significantly related to diagnosis in four studies [4, 5, 13, 15].

Most of the studies explored the relationship between outcome and age and gender. However, as Table 2 shows, the majority of the studies found no significant relationships.

Discussion

Published comparisons of hospital performance are usually based on a small number of outcome measures, namely length of stay, in-hospital mortality and readmission rates. Attempts can be made to refine these comparisons by making adjustments using routinely available data such as age, gender and diagnosis. However, our systematic review has shown that these variables are not strongly correlated with outcome in older medical patients, and so their potential as 'risk adjusters' is limited.

On the other hand, our review showed that measures of physical function and cognitive status were consistently found to be correlated with length of stay and mortality in studies of older medical patients. Physical function was an especially good predictor of mortality, with all studies

investigating such a relationship finding a significant correlation present. Studies showed conflicting results in relation to a statistical relationship between aspects of diagnosis and mortality. Illness severity was reported as significantly related with mortality but only two studies investigated this association.

The factors related to discharge destination show a similar pattern, with physical function and cognitive status prevailing as factors most strongly affecting the discharge destination of older patients. However, in contrast to the outcomes of length of stay and mortality, age was significantly related to discharge destination in the limited number of studies reporting this variable.

The pattern of factors affecting the outcome of readmission to hospital in older adults was rather different from that of length of stay, mortality or discharge destination. No one factor emerged as particularly important, but as few studies investigated readmission to hospital the evidence was somewhat limited.

It can be seen therefore, that when looking at the outcomes length of stay, mortality and discharge destination, the dominant factors affecting these outcomes in older patients are functional and cognitive status. Hospital managers therefore need to be aware that when measuring standards of care in older patients it is important to take into account the complex, yet often subtle factors, which affect older people when admitted to hospital. Outcomes cannot be accurately compared between hospitals caring for older patients unless these factors are taken into consideration, even though they are not readily available from routine data.

Although we can see clear influences on outcome from the systematic review, caution still has to be taken in interpreting the results. Prospective cohort studies use a large range of statistical methods. Unlike systematic reviews of randomised controlled trials a meta-analysis of the statistical data cannot be performed because of differences in the way the studies have been carried out and the varied statistical analysis used. Therefore, the authors would advise that interested readers look at the ACME*plus* website where detailed statistical reports of the individual papers are given. However, this systematic review of factors affecting outcome in patients admitted to medical hospital beds has highlighted that it is not the routinely available pieces of information, e.g. gender, diagnosis, age, which determine outcome. Indeed, if hospitals caring for older patients are to be accurately compared, whether it be to broaden patient choice or to improve clinical practice, then the factors which affect outcome most strongly are functional status and cognitive function. Methods of incorporating such key descriptors into routine clinical practice should now be actively pursued.

Key points
- When comparing outcomes in older medical patients it is particularly important to adjust for case-mix due to the wide range in diagnoses, severity of illness, co-morbidities and functional abilities found within this age group.

- Identified studies use a variety of tools to assess case-mix in relation to a range of outcomes.
- Routinely collected patient information, e.g. age, gender, diagnosis does not determine outcome, but measures of function and cognition are strongly related to length of stay, discharge destination and mortality.
- Methods of incorporating key descriptors, e.g. function and cognition, into routine clinical practice should be actively pursued.

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