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Review

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Risk factors for hospital readmissions in elderly patients: a systematic review

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Summary

Population ageing is associated with an increase in hospital admissions. Defining the factors that affect the risk of hospital readmission could identify individuals at high risk and enable targeted interventions to be designed. This aim of this study was to identify the risk factors for hospital readmission in elderly people. A systematic review of the literature published in English or Spanish was performed by electronically searching EMBASE, MEDLINE, CINAHL, SCI and SSCI. Some keywords were aged, elder, readmission, risk, etc. Selection criteria were: prospective cohort studies with suitable statistical analysis such as logistic regression, that explored the relationship between the risk of readmission with clinical, socio-demographic or other factors in elderly patients (aged at least 75 years) admitted to hospital. Studies that fulfilled these criteria were reviewed and data were extracted by two reviewers. We assessed the methodological quality of the studies and prepared a narrative synthesis. We included 12 studies: 11 were selected from 1392 articles identified from the electronic search and one additional reference was selected by manual review. Socio-demographic factors were only explanatory in a few models, while prior admissions and duration of hospital stay were frequently relevant factors in others. Morbidity and functional disability were the most common risk factors. The results demonstrate the need for increased vigilance of elderly patients who are admitted to hospital with specific characteristics that include previous hospital admissions, duration of hospital stay, morbidity and functional disability.

Introduction

The ageing of the population in most countries increases demand on social and health-care services. One of the indicators of this increased consumption of resources is hospital admission.[1,2] The reasons which account for hospital readmission are generally related to health-care factors (such as sub-optimal health and social care), factors related to the patient (social and family environment or treatment adherence), factors related to the disease (such as its natural progression) or a combination of

all of these.[3] While some of these factors may be avoidable, the disease factors cannot always be controlled.[3–5] Specifically defining these factors would help to identify people at higher risk of hospital readmission and to design preventive tailored and effective interventions from hospital stay and discharge to out-patient follow-up.

We were interested in the factors that could affect the risk of readmission in the elderly. After an initial search, we concluded that no systematic review had focused on hospital readmissions among subjects of advanced age and we only found one review that included a broader age range (patients aged $\geqslant$60 years).[6] In light of this gap in our knowledge, we carried out a systematic review to identify the risk factors associated with unplanned hospital readmissions in patients of advanced age ($\geqslant$75 years).

Methods

We report the update of a systematic review originally published in Spanish, in which the search was limited to March 2008.[7] The methods employed in this systematic review were documented in a protocol derived by consensus with geriatric and health technology assessment specialists. The methods were the following:

Information sources and search

The electronic databases searched to identify the relevant studies were: MEDLINE (Ovid; 1950-present), MEDLINE in process (Ovid), EMBASE (EMBASE; 1980-present), CINAHL (EBSCO; 1982-present), Science Citation Index (Web of Science; 1900-present), Social Science Citation Index (Web of Science; 1900-present), Índice Médico Español (1970-present), LILACS (1982-present) and Google Scholar. The original search was carried out in March 2008[7] and updated in January 2010 in all the aforementioned databases, except LILAC and Google Scholar where the original search did not identify any relevant study. A documentalist (B.D.G.) designed the search strategy with the help of specialists in geriatrics and health technology assessment (A.L.R., J.R.V.D., L.G.P.). This strategy combined Medical Subject Headings (MeSH) and text terms such as the following: 'aged/', 'elder', 'geriatrics/', 'logistic', 'old', 'Patient Readmission/', 'readmission', 'rehospitalization', 'risk/'. The strategy was applied without any date or language limits and the reference lists of the articles included were also checked.

Selection, data extraction and quality assessment

The selection of papers and the data extraction and quality assessment of the included studies were performed by one reviewer (L.G.P. or R.L.) and then checked by a second reviewer (L.G.P., J.R.V.D. or A.L.R.). Disagreements between reviewers were resolved by consensus or by consulting a third reviewer.

Data were collated in spreadsheets designed ad hoc and piloted to obtain a standard format for each study. The data extracted were: objective, design, follow-up, recruitment date, setting, inclusion and exclusion criteria, sample, subject's characteristics including average age, percentage of patients >75 years, percentage female, data collecting, outcome, statistical analysis and statistical software, factors included, results including number of readmissions or patients readmitted, significant factors, non-significant factors and authors' conclusions.

Quality was assessed following the CASP checklist for cohort studies (http://www.phru.nhs.uk/pages/phd/CASP.htm) and the analysis of the statistical criteria of logistic regressions based on a methodological paper by Bagley *et al*.[8] Data collated were synthesized by narrative procedures, and the main characteristics and outcomes of each study were displayed in structured tables. The results of models of early readmissions (up to 3 months after the index admission) are reported separately from the results of later readmissions.

Eligibility criteria

The selection criteria were as follows:

Types of studies

Prospective cohort studies that followed elderly patients after hospital admission and that explored the factors related to the risk of readmission by means of suitable statistical analysis, such as logistic regression. We excluded retrospective, cross-sectional and qualitative studies.

Types of participants

Elderly patients (at least 75 years old) admitted to hospital for any medical problem. We excluded studies that focused on patients with specific diseases or conditions (terminal patients, psychiatric patients, heart failure, chronic obstructive pulmonary disease, etc.), and studies where >50% of the patients or the average age was <75 years.

Types of factors

Clinical, demographic, social or other factors that could affect the risk of readmission.

Types of outcomes

Unplanned hospital readmissions between the index admission and the end of the follow-up period. We accepted as dependent variable in the regression the existence (yes/no) of readmission(s), number of cases of readmission following discharge or days from the index admission until the first readmission.

We selected papers published in English or Spanish without any date limits.

Results

The study selection procedure (Figure 1) identified 1392 references after discarding duplicates, and their titles and abstracts were screened. Of these,

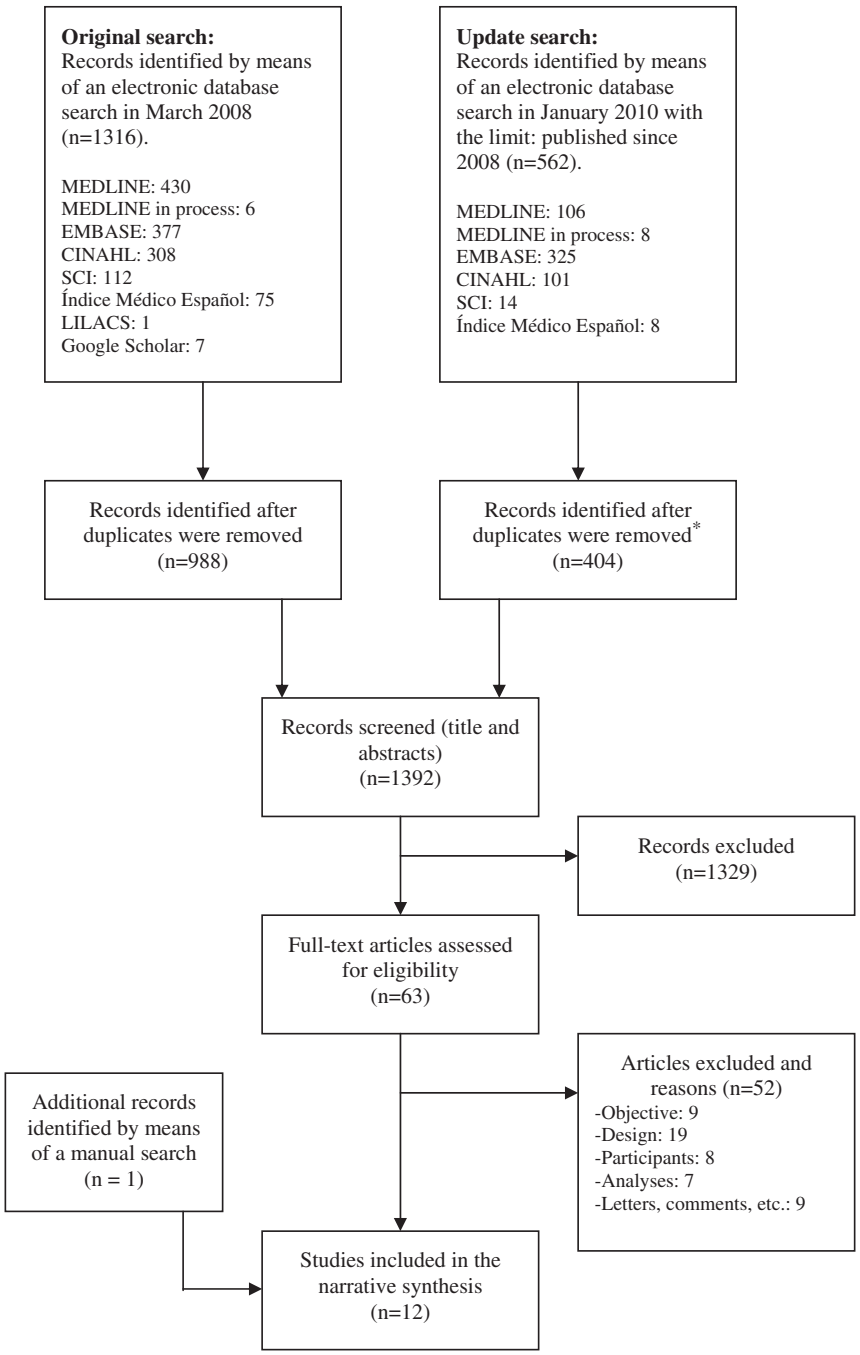

Figure 1. Flow diagram of study selection. Asterisk: records of papers published in 2008 and identified in the original search were also removed.

Table 1 Main characteristics of the studies included

Study	Country	Inclusion criteria: patients' age (years)	N1/N2	Women (%)	Age: years (mean ± SD)	Follow-up	Readmission rate[a] (%)
Alarcón *et al.*[9]	Spain	Patients admitted in a geriatric unit	353/?	66.3	81.8 ± 7.2	6 mo	Not reported
Anpalahan and Gibson[10]	Australia	⩾75	116/110	68.2	82.5–84.1	3 mo	40.9?
Bellelli *et al.*[11]	Italy	⩾65	1323/1072	71.8	76.6 ± 10.5 (range 65–99)	12 mo	38.2
Cornette *et al.*[12]	Belgium	⩾70	596/585–552	57.2	80.0 ± 6.15 (range 70–101)	1 mo 2–3 mo	10.7 12.4
Fethke *et al.*[13]	USA	⩾70	101/85	61.4	77.52 ± 5.33 (range 70–92)	6 wk 6 mo 12 mo	21.2 40.0 51.8
Kwok *et al.*[14]	Hong Kong	⩾70	1204/1204	66.3	79.4 ± 6.5	1 mo 6 mo	18.0 37.8
Lanièce *et al.*[15]	France	⩾75	1306/944	65.0	84	1 mo	14.2
Lotus *et al.*[16]	Taiwan	⩾65	239/216	45.8	76.26 ± 7.37	1 mo	23.6
Mast *et al.*[17]	USA	>60	173/140	71.6	74.32 ± 8.94	3 mo 3–6 mo 6–18 mo	25.5 16.0 39.3
Morrissey *et al.*[18]	Ireland	⩾65	522/487	54.6	76.0 ± 7.3	12 mo	40.7
Narain *et al.*[19]	USA	⩾70	396/366	3.3	76.9 ± 0.34	6 mo	43.9
Zanocchi *et al.*[20]	Italy	⩾75	839/839?	49.5	80.6 ± 6.3	15 d 16–90 d 90 d	2.9 9.9? 12.8

[a]Readmission rate: Percentage of patients readmitted to hospital during follow-up.
?: Not clear; d: days; mo: months; N1: Sample size at recruitment; N2: Sample size included in regression; SD: Standard deviation; wk: weeks.

63 articles were retrieved for full review, and 52 of them were excluded for different reasons (Figure 1). Subsequently, 11 studies were selected from the electronic search. Review of the list of references and the manual review yielded a further additional reference. Accordingly, 12 studies were finally included in the systematic review.[9–20]

The papers describe prospective observational studies of cohorts of patients (cf. Table 1). The objective was to determine which factors affected the risk of hospital readmission by means of multivariate regressions, although some studies also had other objectives. One study developed a Cox regression,[20] while the other 11 studies performed logistic regressions. The dependent variable was a dichotomic variable: 1 if the patient is readmitted and 0 if the patient is not readmitted to hospital after discharge. Two papers also studied the risk of more than a given number of cases of readmission during follow-up.[14,20] Follow-up periods ranged from 15 days to 18 months, and more than one follow-up period was analysed in 5 studies.[12–14,17,20] According to these studies, 10–25% of the patients were readmitted the first 3 months after discharge, and 40–50% of the patients were readmitted between the 6th and 12th month after hospital discharge.

Methodological quality

The studies' quality was assessed by means of the Critical Appraisal Skills Programme (CASP) tool for cohort studies (Table 2) and the assessment of some statistical criteria for logistic regressions as suggested by Bagley *et al.*[8] (Table 3) While the research question was generally stated clearly and the method was suitable, the selection of patients was not clear in all cases. In addition, the outcome was not always accurately measured as most of the studies measured readmission to the same hospital but not to any hospital; risk factors were not always identified and included in the regression analysis. Results were sufficiently reliable only in two studies.[15,18] The main limitation of the quality of these studies was the lack of a satisfactory description of the methods.

Table 2 Quality assessment of the studies included according to the CASP tool for cohort studies[a]

References	1. Clearly focused question	2. Suitable method	3. Cohort selection	5. Outcome accurately measured	6.A. Confounding factors identified	6.B. Confounding factors included	7.A. Complete follow-up (%)	7.B. Sufficiently long follow-up	10. Reliable results	11. Application to local population	12. Results fit with other evidence
Alarcón *et al.*[9]	Yes	Yes	NC	NC	NC	NC	NC	Yes	No	Yes	Yes
Anpalahan and Gibson[10]	Yes	Yes	NC	Yes	Yes	NC	95	Yes	No	Yes	Yes
Bellelli *et al.*[11]	Yes	Yes	Yes	NC	Yes	Yes	81	Yes	NC	NC	Yes
Cornette *et al.* [12]	Yes	Yes	Yes	Yes	Yes	Yes	93	NC	NC	Yes	Yes
Fethke *et al.*[13]	Yes	Yes	Yes	Yes	Yes	NC	84	Yes	NC	Yes	Yes
Kwok *et al.*[14]	Yes	Yes	Yes	Yes	Yes	NC	100	Yes	NC	NC	Yes
Lanièce *et al.*[15]	Yes	Yes	Yes	Yes	Yes	Yes	72	Yes	Yes	Yes	Yes
Lotus *et al.*[16]	Yes	Yes	NC	NC	Yes	NC	90	NC	No	NC	Yes
Mast *et al.*[17]	Yes	Yes	Yes	NC	Yes	NC	81	Yes	NC	Yes	Yes
Morrissey *et al.*[18]	Yes	Yes	Yes	Yes	Yes	Yes	93	Yes	Yes	Yes	Yes
Narain *et al.*[19]	Yes	Yes	Yes	NC	NC	NC	92	Yes	No	NC	Yes
Zanocchi *et al.*[20]	Yes	Yes	NC	NC	Yes	Yes	NC	Yes	NC	Yes	Yes

[a]Question 4 (Exposure accurately measured) is not applicable because there is only one cohort and the exposure is not being evaluated. Questions 8 and 9 (Results and Precision of estimations) are addressed more extensively in Tables 4 and 5.
NC: Not clear.

Table 3 Quality of logistic regressions

References	Events per variable	Linear gradient for continuous variables	Test for interactions	Co-linearity	Validation	Statistically significant (factors)	Statistical significance (model)	Goodness-of-fit measures	Selection of predictor variables	Coding of variables	Fitting procedure
Alarcón *et al.*[9]	?/?	NR	NR	NR	NA	*P*, CI[b]	NR	NR	NR	NR	Forward stepwise
Anpalahan and Gibson[10]	(19 + 26)/?	NR	NR	NR	NA	*P*, CI[b]	NR	Overall correct classification	NR	Partially reported	Stepwise
Bellelli *et al.*[11]	409/?	NR	NR	NR	NA	*P*, CI[b]	NR	NR	NR	NR	Stepwise
Cornette *et al.*[12]	64/11 = 5.82 (1 mo) 74/7 = 10.57 (2–3 mo)	NR	NR	NR	NA	CI[b]	NR	NR	Yes[c]	Partially reported	Backward stepwise
Fethke *et al.*[13]	41/10 = 4.1 (12 mo later)	NR	NR	NR	NA	*P*	Chi^2	NR	Informal	Yes	NR
Kwok *et al.*[14]	455/20? = 22.75	NR	NR	NR	NA	*P*, CI[b]	NR	NR	NR	Yes	NR
Lanièce *et al.*[15]	~140/8 = 17.5	NR	Yes	NR	NA	*P*, CI[b]	NR	Hosmer and Lemeshow test	Yes[c]	Yes	Descending stepwise
Lotus *et al.*[16]	51/8 = 6.375	NR	NR	NR	NA	*P*, CI	NR	NR	Yes[c]	Yes	NR
Mast *et al.*[17]	55/8 = 6.875	NR	NR	NR	NA	*P*, CI	Chi^2	Overall correct classification	NR	Partially reported	NR
Morrissey *et al.*[18]	198/11 = 18	NR	Yes	NR	Yes	*P*, CI	NR	Hosmer and Lemeshow test	Yes[c]	Yes	Backward stepwise
Narain *et al.*[19]	174/? =?	NR	NR	NR	NA	*P*[b]	NR	NR	NR	NR	Stepwise
Zanocchi *et al.*[20,a]	107/~30 = 3.56	NR	NR	NR	NA	*P*, CI[b]	NR	NR	NR	Partially reported	Forward stepwise

[a]Zanocchi *et al.*[20] did not perform a logistic regression but rather a Cox regression, although the criteria are useful for the assessment of the quality.
[b]Data reported only for significant variables.
[c]Significant variables in previous analyses.
?: Not reported or not clear; CI: Confidence interval; NA: Not applicable (the authors did not try to predict); NR: Not reported; mo: months; *P*: *P*-value; Yes: Yes, it was done.

Outcomes of the studies included: significant factors

The significant factors included in the models are shown in Tables 4 and 5. Table 4 describes the models whose dependent variable was readmission within 3 months after discharge.

One study assessed readmission in the 2 weeks after hospital discharge[20] and four studies assessed readmission 1 month after discharge,[12,14–16] both of which can be considered as early and avoidable readmissions according to the literature.[5] Early readmissions are more often explained by the existence of admission prior to the index admission[12,14,15] and by a longer hospital stay during the index admission.[12,14,20] Morbidity, different diseases according to four different studies, is also a group of factors affecting readmission (Table 4).[12,14,15,20] Functional disability was also relevant to explain the risk of hospital readmission in two studies.[14,15] The highest quality paper that studied the risk of readmission at 1 month was the study published by Làniece *et al*.[15] This study identified the following significant risk factors: admission in the previous 3 months, poor overall condition, dependence on feeding and pressure sores. On the other hand, a sight disorder was a protective factor. Only one study found a social characteristic to be relevant, highlighting the importance of dependence on social services, although this study was not of high quality and also focused on the needs of caregivers.[16]

Seven models (in five studies)[10,12,13,17,20] were designed to explain the risk of readmission between 1 and 3 months after discharge (Table 4). Sociodemographic factors were relevant in four studies. Widowhood,[13] convalescence in a nursing home[20] or having a medium–high level of education[20] were significant risk factors in a few studies. In one study, women appeared to be a protective factor,[13] although this variable was not significant in the remaining studies. Reaching an age of $\geqslant 92$ years was also a significant factor in one study to explain the risk of two or more readmissions in 90 days.[20] Previous admissions,[12] the number of days in hospital,[20] and morbidity[10,12,13,20] also appeared to be relevant. The Charlson Index was included in one set of models by Zanocchi *et al*. and having an index of two or more became a significant risk factor.[20] Functional disability was also a relevant factor to explain the risk of hospital readmission in two studies at 3 months.[12,17] Moreover, two studies highlighted the relevance of psychological problems.[10,20] On the other hand, feeling satisfied with life was a protective factor in one study,[13] although when these authors included income in the models, this variable was not significant and did not alter the results.[13]

Table 5 shows the statistically significant factors in the models whose dependent variable was readmission 3 months after the index admission. These models produced similar results to those mentioned previously for some characteristics. While being female was a protective factor, widowhood was a risk factor according to one study.[13] In addition, living in a home for the elderly,[14] having little family support[14] or being single[18] were significant factors in some studies. Indeed, living in a home for elderly and poor family support were risk factors for three or more readmissions in 6 months.[14] Admission in previous months was again a significant factor.[13,14,18] However, the number of day in hospital was not significant in these models for late readmissions. On the other hand, one factor that became significant in two models was the number of drugs prescribed.[9,18] Moreover, morbidity was again a heterogeneous group of significant factors,[11,14,18,19] while functional capacity was not a significant factor in the models that included this variable.[11,14,17] Among the neuro-psychological variables, mental problems were identified as a risk factor for readmission in two studies, such as occurrence of delirium[11] or depression,[17] while satisfaction with life[13] and confusion at admission[18] were protective factors for readmission a year after discharge in another two studies. The latter is the result of the only validated model included in this systematic review which was built to predict the risk of readmissions 12 months after discharge.[18] In this model, the factor with the highest odds ratio (OR) was having a history of cancer (OR = 3.238), whereas other predictive variables were active endocrine disease (OR = 2.075) or a history of hypertension (OR = 2.297).[18]

Discussion

According to the evidence found in this systematic review, there are several factors that could be related to the risk of hospital readmission in elderly people (aged $\geqslant 75$ years): a previous hospital admission (prior to index admission), the duration of the hospital stay (a longer stay means a higher risk of readmission in the short term), their morbidity/comorbidity and functional disability. Just as the systematic review by Campbell *et al*.,[6] we found that age or sex do not seem to determine the results in contrast to other factors such as patients' functional abilities. In order to ascertain more precisely which factors affect those patients aged $\geqslant 75$ years, we carried out this review.

Table 4 Significant risk factors of hospital readmission in the 3 months after discharge, according to logistic regressions included in the systematic review

References	Socio-demographic characteristics	Healthcare	Morbidity	Functional capacity	Neuro-psychological characteristics	Other factors
Anpalahan and Gibson[10]						
3 months	n.s.	n.s.	CIRS cardiac OR = 1.59* (1.04–2.4) CIRS hepatic OR = 21.3* (4.9–47.7) CIRS vascular OR = 1.84* (1.03–3.2)	n.s.	CIRS psychiatric OR = 6.21* (1.03–36.8)	Urinary incontinence OR = 8.94*** (2.4–33.4)
Cornette *et al.*[12]						
1 month	n.s.	Admission in previous 3 months OR = 2.21 (1.24–3.87) >30–33 days in hospital OR = 2.79 (1.31–5.67)	Respiratory system OR = 3.49 (1.88–6.42) Genito-urinary system OR = 5.91 (2.24–14.54)	n.s.	n.s.	NI
2–3 months	n.s.	Admission in previous 3 months OR = 2.28 (1.35–3.82)	Circulatory system OR = 1.98 (1.17–3.34)	IADL-Lawton Scale OR = 0.85 [c] (0.76–0.96)	n.s.	NI
Fethke *et al.*[13]						
6 weeks	Woman[a] Coef: –1.539* Widow Coef: 1.342 $P < 0.10$	n.s.	Severity[b] Coef: 0.7*	NI	Satisfaction with life-LSI[a,d] Coef: − 0.152*	NI
Kwok *et al.*[14]						
1 month	n.s.	Admission in previous 6 months RR = 2.5*** (1.7–3.5) 5–8 days in hospital RR = 1.7* (1.1–2.4)	Problem not resolved assessed by nurse RR = 1.7* (1.1–2.5)	ADL-Barthel Index: score 15–19 RR = 1.8** (1.1–2.7)	n.s.	NI
Lanièce *et al.*[15]						
1 month	n.s.	Admission in previous 3 months OR = 1.6* (1.1–2.5)	Poor overall condition OR = 2.01*** (1.3–3.0) Sight disorder[a] OR = 0.5** (0.3–0.8)	Became dependent on feeding (ADL-Katz scale): OR = 1.9** (1.2–2.9)	NI	Pressure sores OR = 2.05* (1.0–3.9)

(continued)

Table 4 Continued

References	Socio-demographic characteristics	Healthcare	Morbidity	Functional capacity	Neuro-psychological characteristics	Other factors
Lotus *et al.*[16]						
1 month	Needs for social services, patients not totally dependent OR = 9.03** (2.32–35.16) No need for social services, patients not totally dependent[a] OR = 0.08** (0.014–0.41)	n.s.	NI	NI	Caregivers need a support group OR = 5.33* (1.47–19.34)	NI
Mast *et al.*[17]						
3 months	n.s.	NI	n.s.	ADL-FIM[c] OR = 0.899*** (0.844–0.959)	n.s.	NI
Zanocchi *et al.*[20]						
15 days	n.s.	Days hospital RR = 5.5** (1.9–16.1)	Cancer RR = 2.9* (1.2–7.5)	n.s.	n.s.	n.s.
16–90 days	Medium-high education level RR = 1.8** (1.1–3.6)	Days hospital RR = 3.2** (1.5–7.3)	Charlson Index $\geqslant$ 2 RR = 1.8* (1.1–3.6)	n.s.	Dementia RR = 1.8* (1.3–5.5)	n.s.
90 days	Medium-high education level RR = 1.4* (1.0–1.6) Nursing home for convalescence RR = 1.9* (1.1–3.3)	Days hospital RR = 3.3*** (1.8–6.5)	Charlson Index $\geqslant$ 2 RR = 1.7* (1.1–2.6)	n.s.	n.s.	n.s.
$\geqslant$2 readmissions in 90 days	Age $\geqslant$ 92 years RR = 3.3* (1.1–9.8)	n.s.	Charlson Index $\geqslant$2 RR = 2.7* (1.1–6.1)	n.s.	n.s.	n.s.

[a]Protective factor.
[b]Severity: Index developed by authors (Fethke *et al.*[13]).
[c]The higher the score, the lower the limitation: OR<1 means limitations increase the risk of readmission.
[d]The higher the score, the greater the satisfaction: the negative coefficient means being satisfied with life helps to prevent readmissions.
*Factor included and significant between 0.01< $P \leqslant$ 0.05. **Factor included and significant between 0.001< $P \leqslant$ 0.01. ***Factor included and significant at $P \leqslant$ 0.001.
95% Confidence intervals within parenthesis (Fethke *et al.*[13] did not report the confidence intervals; Cornette *et al.* [12] did not report the *P*-values).
ADL: Activities of daily living; Coef.: Estimated coefficient; CIRS: Cumulative illness rating scale; FIM: Functional Independence Measure; IADL: Instrumental activities of daily living; LSI: Life Satisfaction Index; n.s.: Factor/s included in the model but non-significant; NI: Factor not included in the model; OR: Odds ratio; RR: Relative risk.

Table 5 Significant risk factors of hospital readmissions after the first three months after discharge, according to the logistic regressions included in the systematic review

References	Socio-demographic characteristics	Healthcare	Morbidity	Functional capacity	Neuro-psychological characteristics	Other factors
Alarcón *et al.*[9]						
6 months	NR	>5 drugs OR = 2.53** (1.88–3.31)	NR	NR	NR	NR
Bellelli *et al.*[11]						
12 months	n.s.	n.s.	Charlson Index 2–3 OR = 2.0*** (1.5–2.7) Charlson Index ⩾4 OR = 2.2*** (1.5–3.1)	n.s.	Occurrence of delirium OR = 1.6* (1.1–2.4)	n.s.
Fethke *et al.*[13]						
6 months	Woman[a] Coef: −0.859 $P < 0.10$ Widow Coef.: 1.224 P?	n.s.	n.s	NI	n.s.	NI
12 months	Widow Coef: 1.745*	Admission in previous 24 months Coef: 1.213*	n.s	NI	Satisfaction with life-LSI[a,b] Coef:-0.193**	NI
Kwok *et al.*[14]						
6 months	n.s.	Admission in previous 6 months RR = 3.1** (1.4–6.9)	n.s	n.s.	n.s.	NI
⩾3 readmissions in 6 months	Living in home for elderly (subsidized) RR = 2.2* (1.0–4.8) Living in home for elderly (private) RR = 3.7** (1.6–8.5) Poor familial support according to patient RR = 2.7* (1.2–6.1)	Admission in previous 6 months RR = 3.5*** (2.0–6.0)	Problem not resolved as assessed by nurse RR = 2.0* (1.1–3.9)	n.s.	n.s.	NI
Mast *et al.*[17]						
3–6 months	n.s.	NI	n.s	n.s.	Depression-GDS OR = 3.549** (1.360–9.263)	NI
6–18 months	n.s.	NI	n.s	n.s.	n.s.	NI
Morrissey *et al.*[18]						
12 months	Single OR = 2.195* (0.979–4.919)	>4 drugs OR = 1.757* (0.999–3.090) ⩾1 admission in previous year OR = 2.693*** (1.692–4.288) Nicorandil prescribed[a] OR = 0.36** (0.182–0.711)	History of cancer OR = 3.238** (1.303–8.05) Active endocrine disease OR = 2.075* (1.158–3.716)	NI	Confused on admission[a] OR = 0.359* (0.159–0.808)	Former cigarette smoker OR = 1.742* (1.055–2.877) History of hypertension OR = 2.297** (1.278–4.130)

(continued)

Table 5 Continued

References	Socio-demographic characteristics	Healthcare	Morbidity	Functional capacity	Neuro-psychological characteristics	Other factors
Narain *et al.*[19]						
6 months	Children as caregivers**	NR	Cardiac and neurological diseases***	NR	NR	NR

[a]Protective factor.
[b]The greater the LSI, the greater the satisfaction: the negative coefficient means satisfaction with life helps to prevent readmissions.
*Factor included and significant between $0.01 < P \leqslant 0.05$; **Factor included and significant between $0.001 < P \leqslant 0.01$; ***Factor included and significant at $P \leqslant 0.001$.
95% Confidence intervals within parenthesis (Fethke *et al.*[13] did not report the confidence intervals; Narain *et al.*[19] did not report the *P*-values).
Coef.: Estimated coefficient; GDS: Geriatric Depression Scale; LSI: Life Satisfaction Index; n.s.: Factor/s included in the model but non-significant; NI: Factor not included in the model; NR: Not reported (Alarcón *et al.*[9] and Narain *et al.*[19] only reported the factors that were significant); OR: Odds ratio; RR: Relative risk.

Age was a relevant factor in only two models,[13,20] perhaps because of the narrow age range of the subjects, and the interaction between age and comorbidity. There may be no difference between the risk of readmission in a 75- and an 85-year-old, and the differences between such age groups might be because of morbidity. In other studies, socio-economic factors affected the rate of readmission, with higher rates of readmission for people at lower socio-economic levels.[3,21] This fact could not be demonstrated here because only one study included income and it proved irrelevant.[13] Similarly, despite the fact that the effect of the social network on health-care use and well-being seems to be demonstrated,[22] the variables related to the existence of a social network are expressed in such different ways in the included studies that it is not possible to draw any conclusion regarding their effects on admission. We can only hypothesize that loneliness or the need for support could be predictive factors for readmissions in the elderly.

Two factors related to health-care services appear to be significant, such as previous admission[12–15,18] and the length of the hospital stay.[12,14,20] It is well-documented in the literature that previous admission, especially non-programmed and emergency admissions, is a very important risk factor.[23,24] On the other hand, in the three studies that included hospital stay as a factor, it was concluded that the longer the stay the greater the risk of readmission in the short term,[12,14,20] although this contrasts with the results of other studies.[25] Considering that patients with longer stays could be patients in a worse state of health and with a chronic disease, the risk could be due to the severity or the case–mix on admission.

The follow-up period of patients is a relevant issue and a meta-analysis suggests that early readmission is related to prior readmission.[23] There is some agreement that readmission could be prevented during the month following discharge,[26,27] as early readmission could be the expression of deficient healthcare during the previous admission.[4,27] The results of this review do not enable us to conclude which factors are relevant over each period, although the number of days in hospital was only significant in short-term models.[12,14,20]

Although, there were different studies that concluded that suffering from a specific disease affects the risk of readmission, unfortunately they did not agree on any disease in particular.[10–12,15,18–20] The Charlson Index was found to be relevant in two of the three studies that used it[11,20] and the limitation in daily activities was relevant in four out of seven studies.[12,14,15,17] Consequently, we suggest the use of the Charlson Index and a validated questionnaire

about daily activities (such as the Barthel Index or the Katz Index) to assess patients' condition upon admission.

Some limitations of this review result from the quality of the studies included. Besides the paucity of studies that explore the risk of readmission in the elderly, the synthesis was not straightforward because of the variety of factors analysed and the tools used to measure each characteristic. Also Campbell *et al.*[6] in their systematic review, found that most studies used a variety of tools to assess the case–mix in relation to several outcomes. Moreover, this synthesis was also hindered by the different follow-up periods and definitions of readmission, the different contexts and healthcare systems studied, and the failure to define the interventions received by the patients in the hospital of recruitment (likely to be an important determinant of the risk of readmission). Since, we only included prospective studies, high-quality retrospective studies might have been overlooked. The age limit established ($\geqslant$75 years) became an issue given the lack of studies with this inclusion criteria and selecting studies based on average age could be an artificial criterion. Other limitations are those common to systematic reviews, such as publication bias or language bias, although we have tried to make every effort to systematically identify the relevant literature.

The results are important for clinical practice because they show the need to pay particular attention to elderly patients with specific characteristics such as prior admissions, morbidity (that could be measured using the Charlson Index) and functional disability; and considering that a longer stay could be determinant for a new hospital admission in the short term. Accordingly, it would be advisable: (i) to implement interventions, in collaboration with primary care, to follow patients with a higher risk of readmission after discharge;[28] and (ii) to collate patients data and to make the effort to ascertain the reasons for readmission in the local setting. Consequently, it is also pertinent to make some recommendations for future research: (i) to pay attention to deaths, the use of emergency services and readmissions to other hospitals, because not controlling these events could lead to underestimating cases of readmission and introduction of bias; (ii) to describe the outcome, such as emergency or programmed readmission, early or late readmissions and frequency of admissions; (iii) to describe the interventions received by patients during their stay and follow-up; (iv) to describe and improve the statistical analysis; and (v) ideally, to develop a consensus list of the reasons for admission.

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References

1. Creditor MC. Hazards of Hospitalization of the Elderly. *Ann Intern Med* 1993; **118**:219–23.
2. Roland M, Dusheiko M, Gravelle H, Parker S. Follow up of people aged 65 and over with a history of emergency admissions: analysis of routine admission data. *BMJ* 2005; **330**:289–92.
3. Lyratzopoulos G, Havely D, Gemmell I, Cook GA. Factors influencing emergency medical readmission risk in a UK district general hospital: A prospective study. *BMC Emerg Med* 2005; **5**:1.
4. Benbassat J, Taragin M. Hospital readmissions as a measure of quality of health care — Advantages and limitations. *Arch Intern Med* 2000; **160**:1074–81.
5. Dobrzanska L. Readmissions — an evaluation of reasons for unplanned readmissions of older people: a United Kingdom and international studies literature review. *Quality in Ageing* 2004; **5**:20–8.
6. Campbell SE, Seymour DG, Primrose WR. ACMEPLUS Project. A systematic literature review of factors affecting outcome in older medical patients admitted to hospital. *Age Ageing* 2004; **33**:110–5.
7. García Pérez L, Linertová R, Lorenzo Riera A, Vázquez Díaz JR, Duque González B, López Hijazo A, *et al.* Factores predictivos e intervenciones efectivas para la reducción del riesgo de reingreso hospitalario en pacientes de edad avanzada. Plan de Calidad para el Sistema Nacional de Salud del Ministerio de Sanidad y Política Social. Servicio de Evaluación del Servicio Canario de la Salud; 2009. Informes de Evaluación de Tecnologías Sanitarias: SESCS N° 2007/20.
8. Bagley SC, White H, Golomb BA. Logistic regression in the medical literature: standards for use and reporting, with particular attention to one medical domain. *J Clin Epidemiol* 2001; **54**:979–85.

9. Alarcon T, Barcena A, Gonzalez-Montalvo JI, Penalosa C, Salgado A. Factors predictive of outcome on admission to an acute geriatric ward. *Age Ageing* 1999; **28**:429–32.
10. Anpalahan M, Gibson SJ. Geriatric syndromes as predictors of adverse outcomes of hospitalization. *Intern Med J* 2008; **38**:16–23.
11. Bellelli G, Magnifico F, Trabucchi M. Outcomes at 12 months in a population of elderly patients discharged from a rehabilitation unit. *J Am Med Dir Assoc* 2008; **9**:55–64.
12. Comette P, D'Hoore W, Malhomme B, Van Pee D, Meert P, Swine C. Differential risk factors for early and later hospital readmission of older patients. *Aging Clin Exp Res* 2005; **17**:322–8.
13. Fethke CC, Smith IM, Johnson N. "Risk" factors affecting readmission of the elderly into the health care system. *Med Care* 1986; **24**:429–37.
14. Kwok T, Lau E, Woo J, Luk JK, Wong E, Sham A, Lee SH. Hospital readmission among older medical patients in Hong Kong. *J R Coll Physicians Lond* 1999; **33**:153–6.
15. Lanièce I, Couturier P, Dramé M, Gavazzi G, Lehman S, Jolly D, Voisin T, Lang PO, Jovenin N, Gauvain JB, Novella JL, Saint-Jean O, Blanchard F. Incidence and main factors associated with early unplanned hospital readmission among French medical inpatients aged 75 and over admitted through emergency units. *Age Ageing* 2008; **37**:416–22.
16. Lotus SYI, Chen M-C, Lee H-C. Caregiver's needs as predictors of hospital readmission for the elderly in Taiwan. *Soc Sci Med* 2004; **58**:1395–403.
17. Mast BT, Azar AR, MacNeill SE, Lichtenberg PA. Depression and activities of daily living predict rehospitalization within 6 months of discharge from geriatric rehabilitation. *Rehabil Psychol* 2004; **49**:219–23.
18. Morrissey EFR, McElnay JC, Scott M, McConnell BJ. Influence of drugs, demographics and medical history on hospital readmission of elderly patients: A predictive model. *Clin Drug Investig* 2003; **23**:119–28.
19. Narain P, Rubenstein LZ, Wieland GD, Rosbrook B, Strome LS, Pietruszka F, *et al.* Predictors of immediate and 6-month outcomes in hospitalized elderly patients. The importance of functional status. *J Am Geriatr Soc* 1988; **36**:775–83.
20. Zanocchi M, Maero B, Martinelli E, Cerrato F, Corsinovi L, Gonella M, *et al.* Early re-hospitalization of elderly people discharged from a geriatric ward. *Aging Clin Exp Res* 2006; **18**:63–9.
21. Arbaje AI, Wolff J, Yu Q, Powe NR, Anderson GF, Boult CE. Post-Discharge Environmental and Socioeconomic Factors and the Likelihood of Early Hospital Readmission among Community-Dwelling Medicare Beneficiaries. *Gerontologist* 2008; **48**:495–504.
22. Rodríguez-Artalejo F, Guallar-Castillón P, Herrera MC, Otero CM, Chiva MO, Ochoa CC, *et al.* Social network as a predictor of hospital readmission and mortality among older patients with heart failure. *J Card Fail* 2006; **12**:621–7.
23. Ashton CM, Del Junco DJ, Souchek J, Wray NP, Mansyur CL. The association between the quality of inpatient care and early readmission. A meta-analysis of the evidence. *Med Care* 1997; **35**:1044–59.
24. Implementing the Evercare Programme. Interim report. *February 2004*. [www.natpact.nhs.uk/cms/186.php] Accessed 12 February 2011.
25. Westert G, Lagoe R, Keskimäki I, Leyland AH, Murphy M. An international study of hospital readmissions and related utilization in Europe and the USA. *Health Policy* 2002; **61**:269–78.
26. Frankl SE, Breeling JL, Goldman L. Preventability of emergent hospital readmission. *Am J Med* 1991; **90**:667–74.
27. Sibbritt DW. Validation of a 28 day interval between discharge and readmission for emergency readmission rates. *J Qual Clin Pract* 1995; **15**:211–20.
28. Linertová R, García-Pérez L, Vázquez-Díaz JR, Lorenzo-Riera A, Sarría-Santamera A. Interventions to reduce hospital readmissions in the elderly: in-hospital or home care. A systematic review. *J Eval Clin Pract* 2010; [Epub ahead of print].