Delayed hospital discharges of older patients: a systematic review on prevalence and costs

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Abstract

Purpose of the study: To determine the prevalence of delayed discharges of elderly inpatients and associated costs.

Design and methods: We searched Medline, Embase, Global Health, CAB Abstracts, Econlit, Web of Knowledge, EBSCO – CINAHL, The Cochrane Library, Health Management Information Consortium, and SCIE – Social Care Online for evidence published between 1990 and 2015 on number of days or proportion of delayed discharges for elderly inpatients in acute hospitals. Descriptive and regression analyses were conducted. Data on proportions of delayed discharges were pooled using a random effects logistic model and the association of relevant factors was assessed. Mean costs of delayed discharge were calculated in USD adjusted for Purchasing Power Parity (PPP).

Results: Of 64 studies included, 52 (81.3%) reported delayed discharges as proportions of total hospital stay and 9 (14.1%) estimated the respective costs for these delays. Proportions of delayed discharges varied widely, from 1.6% to 91.3% with a weighted mean of 22.8%. This variation was also seen in studies from the same country, for example, in the UK they ranged between 1.6% and 60.0%. No factor was found to be significantly associated with delays. The mean costs of delayed discharge also varied widely (between 142 and 31,935 USD PPP adjusted), reflecting the variability in mean days of delay per patient.

Implications: Delayed discharges occur in most countries and the associated costs are significant. However, the variability in prevalence of delayed discharges, and available data on costs limit our knowledge of the full impact of delayed discharges. A standardisation of methods is necessary to allow comparisons to be made, and additional studies are required - preferably by disease area - to determine the post-discharge needs of specific patient groups and the estimated costs of delays.

Keywords: delayed discharge, older people, prevalence, costs

Introduction

Delayed discharges from acute hospitals have been a cause of concern worldwide for the last forty years (Barrette, 1981; Halliday & Grant, 1975), because of the challenge they pose to health and social care systems in terms of provision of services and associated costs, and also because of their impact on patient outcomes. A delayed discharge occurs when a hospital inpatient has been deemed medically fit for discharge but continues to occupy a hospital bed for non-clinical reasons.

The literature identifies older people as the main population at risk of a delayed hospital discharge, especially those with complex health and social needs (Styrborn, 1995; Victor, Healy, Thomas, & Seargeant, 2000). With a rapidly ageing population and an increasing number of people with complex long term conditions such as dementia and stroke, there are concerns about a rise in inappropriate use of acute hospital beds by older patients whose needs would be better attended in facilities with a lower level of care, such as community hospitals, care homes or even their own homes (Glasby, Littlechild, & Pryce, 2004; Victor et al., 2000).

Patients whose discharge was delayed are exposed to iatrogenic complications and adverse events due to their prolonged hospitalisation (Lefevre et al., 1992), such as hospital borne infections, fractures, urinary tract infections, acute renal failure, phlebitis, diarrhoea, drug reactions, confusion and depression (Giraud et al., 1993; Kohli et al., 2000; McFarland, 1995; Tepp & Voitk, 1999). Furthermore, hospitalisation of older people leads to a decline in long-term health and functioning, which may result in further morbidity and disability (Creditor, 1993; Hirsch, Sommers, Olsen, Mullen, & Winograd, 1990; Sager, Franke, et al., 1996; Sager, Rudberg, et al., 1996). Prolonged periods in hospital are also associated with a greater chance of admission to a care home after discharge, or even death (Kozyrskyj, Black, Chateau, & Steinbach, 2005), as well as increased levels of social isolation or dependence (Mayo, Wood-Dauphinee, Gayton, & Scott, 1997). Patients on delayed discharge may also suffer medical setbacks, necessitating further acute treatment (Hinchliffe, 2002). Reducing delayed discharges is therefore of prime importance in improving patient outcomes. Furthermore, the level of care that patients with delayed discharge receive in an acute hospital setting is not appropriate to their needs and can be detrimental to their physical and mental health. From a society perspective, when a patient is occupying a bed for longer than necessary it consumes scarce resources that could be used to benefit other patients, leading to cancellation of elective surgical procedures and longer waiting lists, and blocking emergency admissions (Mohammed, 2001). There is then an opportunity cost associated with beds occupied by delayed discharge patients equal to the health gain arising were these beds used to treat patients requiring acute hospital services (Falcone, 1991). This opportunity cost may also be monetary, with the costs of delayed discharges not being fully reimbursed (Falcone, 1991).

A literature review of studies conducted in the UK before the introduction of the Community Care Act 2003 (Department of Health, 2003) reported that the proportions of discharges which were delayed varied between 8% and 66% depending on the location of the study, the type of participants included, and the methodology used (Glasby et al., 2004). Other reviews have been conducted, aiming: to identify policies for reducing delayed discharges (K Bryan, 2010); to assess the appropriateness of instruments used to assess delayed discharges; to assess the impact of available appropriate facilities for patients at discharge (Norman, 2003); and to assess the effectiveness of planning the acute hospital discharge of patients (Shepperd S, 2013). However, these were either limited to the UK (K Bryan, 2010; Glasby et al., 2004) or did not quantify the number of delayed discharges (Norman, 2003; Shepperd S, 2013), and none have attempted to estimate the economic costs of these delays.

There is, therefore, considerable uncertainty regarding the resources consumed by delayed discharges worldwide and the resulting costs to healthcare systems. In order to address these research gaps, a review of the relevant literature was conducted, with the main objectives being to examine:

- The proportions of delayed discharges of older people worldwide, including synthesising the results of published studies on the proportions of delayed discharges to identify the main factors associated with them;
- The economic impact of delayed discharges on healthcare systems.

Methods

Search strategy

Literature searches were undertaken in Medline, Embase, Global Health, CAB Abstracts, Econlit, Web of Knowledge, EBSCO – CINAHL, The Cochrane Library, Health Management Information Consortium, and SCIE – Social Care Online, without any language restrictions. The selection of electronic databases and the relevant search terms, described in Appendix 1, were developed in conjunction with an information specialist. These searches were last run in February 2015 and were limited to studies published since January 1990. Manual searches were conducted on the reference lists of relevant papers and previous literature reviews.

Study selection criteria

The inclusion criteria used to identify relevant studies were as follows:

- Study populations were inpatients in acute hospitals;
- Mean age of the sample population was 65 years or older;
- Data were reported on either number of days of delayed discharges or proportions of delayed discharges;
- Studies were comparative (randomised controlled trials and non-randomised studies) or observational studies (cross-sectional studies, cohort studies, case-control studies and database studies);
- Journal articles and theses were included.

ENDNOTE X7, Thomson Reuters, was used to manage the references. Duplicates were removed by one reviewer (FL). One reviewer (FL) assessed each abstract to determine whether full text review was needed. Full text of the potentially eligible studies was then retrieved and assessed for final inclusion. A second reviewer (KR) independently assessed a randomly selected sample of 10% of the references (528 references). Any disagreements were solved through discussion between the two reviewers.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed.

Data extraction and risk of bias assessment

Data from each relevant study were recorded in a data extraction pro-forma designed for this analysis. Data extraction for all studies was performed by one reviewer (FL). A second reviewer (KR) also extracted data from relevant studies in the random sample that were reviewed. Any disagreements were solved through discussion between the two reviewers.

The main outcomes analysed were: 1) the proportion of total discharges that were delayed; and 2) the mean cost of delayed discharges per patient. Costs were inflated to 2011 prices, where required, using the World Bank Gross Domestic Product (GDP) deflator for each country (The World Bank). The year 2011 was used because it was the most recent year with deflator data available for all countries included in the review. Costs were then converted into United States Dollars (USD) using the Purchasing Power Parity (PPP) method (The World Bank) which reflects differences in price levels for goods and services across countries.

One reviewer (FL) performed a quality appraisal of each study independently and a second reviewer (KR) assessed the quality of the papers derived from the sample of references reviewed. The quality of randomised controlled trails was assessed using the Jadad scale (Jadad et al., 1996). The quality of cohort, cross-sectional and quasi-experimental studies was assessed using the Newcastle-Ottawa scale (Wells et al.) questionnaire for cohort type studies, on the assumption that this could also be applied to cross-sectional and quasi-experimental studies. Case-control studies were assessed using the case-control questionnaire. Overall quality was defined using previous methodology (Abdul Pari, Simon, Wolstenholme, Geddes, & Goodwin, 2014).

Statistical analysis

The proportion of delayed discharges was summarised as a weighted mean, where the weights were proportional to the sample size. A meta-regression was used to estimate the impact of relevant variables on the proportion of delayed hospital discharges. A logistic random effects model was used, in which the proportion of delayed discharges for each study was assumed to vary randomly around an overall mean (Kirkwood & Sterne, 2003). Four factors were examined: mean age of the sample participants, definition of delayed discharge used (i.e. use of Appropriateness Evaluation Protocol (AEP) (Gertman & Restuccia, 1981) versus other definitions), main type of funding of the country's health system (i.e. tax funded versus social or private insurance), and existence of co-payment for inpatients in the country where the study was conducted. We conducted univariate and multivariate logistic regressions. A variable was judged to be significant if $p<0.05$. This analysis was carried out in STATA version 12 (StataCorp. LP, College Station, United States of America).

Results

Figure 1 shows the flow of studies through the review, following PRISMA guidelines. Sixty-four studies were included in this review: one (1.6%) randomised controlled trail; four (6.2%) quasi-experimental studies; one (1.6%) case-control study; 40 (62.5%) cohort studies; 17 (26.5%) cross-sectional studies; and one (1.6%) study using administrative data. Details on the country where the study was conducted, study design, timeframe of the study, wards in which the study was conducted, sample size, number of days of delayed discharges, proportion of delayed discharges, and total costs of delayed discharges are displayed in Appendix 2.

Research on delayed discharges was mainly concentrated in Europe (18 (28.1%) in Great Britain, eight (12.5%) in Spain, seven (10.9%) in Italy and 13 (20.3%) in other countries) and in North America (seven (10.9%) in Canada and four (6.3%) in the USA). Even though in the majority of the countries where research on delayed discharges has been conducted the healthcare services are mainly tax funded, it should be noted that delayed discharges also occur in countries where healthcare services are mainly funded by private insurance (Appendix 4).

Of all the studies, 45 (70.3%) were conducted in a single centre and 18 (28.1%) were multicentre but within the same country (Appendix 4). Thirty studies (46.9%) were conducted in medical wards only and 26 (40.6%) in medical and surgical wards. Three studies (4.7%) were conducted in psychiatric wards and four (6.3%) in surgical wards only.

The majority of the studies (n = 45; 70.3%) were published after 1999. The quality of the studies was assessed for all types of studies except for the study using administrative data (Godden, McCoy, & Pollock, 2009). A table reporting quality assessment of each study is provided in Appendix 3. In general, the quality of the studies included in this review was high with an overall mean quality score of 84.9% (median: 89.0%). Two studies (3.1%) were found to be of low quality, mainly due to the lack of information provided on the assessment and analysis of the outcome of interest, one being published in the form of a clinical and scientific letter to the editor (Hayee & Miell, 2001).

The studies in this review used different criteria, which we grouped into five categories (Table 1), to determine whether a patient was on delayed discharge. Twenty-three studies (35.9%) considered that a patient's discharge was delayed if they remained in hospital after being declared medically fit for discharge, though only five of these studies specified the criteria used for determining medical fitness for discharge (Becchi, Pescetelli, Caiti, & Carulli, 2010; Carey, Sheth, & Braithwaite, 2005; Chin, Sahadevan, Tan, Ho, & Choo, 2001; Foer, Ornstein, Soriano, Kathuria, & Dunn, 2012; Lewis & Glasby, 2006). Thirteen studies (20.3%) determined delays by estimating when patients could be benefiting from a lower level of medical care. Two studies (3.1%) allowed for a specific time period to elapse after the patient was deemed medically fit for discharge (i.e. 24 hours after the patients were declared fit for discharge and 3 days had passed since certain criteria were met) in order for transport to be in place, medication to be ready and necessary preparations for discharge to be completed, before considering the patient to have a delayed discharge. Finally, 22 studies (34.4%)

used the AEP or derivatives, such as the Oxford Bed Study Instrument (Anderson et al., 1988), as a tool to assess the appropriateness of admission and subsequent hospitalisation days.

Proportions of delayed discharges

Table 2 displays information on the proportion of delayed discharges for the whole sample. The weighted mean was 22.8% for the 46 studies reporting both proportion of delayed discharges and sample size, and the arithmetic mean was 29.1% for the 52 studies reporting proportion of delayed discharges, with an interquartile range of 21.8%. The minimum proportion of delayed discharges of 1.6% was observed by Godden (2009) who used administrative English data to look at the trend in delayed discharges during 2006-2007 to assess whether the Community Care Act (Department of Health, 2003) reduced delayed discharges. These data included patients of all ages in any type of ward in the NHS. McClaran (1991) reported the maximum proportion of delayed discharge - 91.3% - in a population of chronic older patients in the Montreal General Hospital, Canada.

The range in the proportions of total discharges that were delayed remained wide even when the studies were aggregated by study type (Figure 2). Observational studies seem to have a higher variation than experimental studies, but the latter are significantly lower in number.

The wide variation in proportions of delayed discharges is also observed within the same country, with a range of 58.4% in the UK, 43.0% in Spain, 49.7% in Italy, 70.3% in Canada, and 56.8% in the Netherlands (Figure 2).

The proportions of delayed discharges in the UK were assessed independently, since it is the country where the most studies have been conducted (14 studies) (Table 3). The proportions of delayed discharges in UK studies conducted varied between 1.6% (Godden et al., 2009) and 60.0% (Tadros, Kelson, Balloo, Tejani, & Al-Taei, 2011) (in a cross-sectional study conducted in an acute hospital in which data was collected for patients aged 65 and over), with an interquartile range of 21.8%. The weighted mean was 23.1%, which is very close to the arithmetic mean of 24.4%.

An analysis of how proportions of delayed discharges vary by type of ward was conducted (Figure 2). A wide variation in proportions of delayed discharges was observed in studies conducted in medical only wards and medical and surgical wards. The variation seemed to be less in surgical only wards and in psychiatric wards, but the number of such studies was much lower than in other types of wards.

The proportions of delayed discharges also varied significantly within studies using similar criteria to determine when a patient was on delayed discharge (Figure 2).

Meta-regression

Seventy-one observations from 50 studies were synthesised, corresponding to a total of 190,593 bed days blocked out of 463,679 hospitalisation days. No factor was found to be significantly associated with the proportion of delayed discharges in either the univariate or the multivariate analysis (Table 4).

Common to all univariate analyses was a considerable degree of variation between studies, reflected in the large standard deviations (SD).

Cost of delayed discharges

Ten studies (15.6%) provided estimates of the costs of delayed discharges, three of which were based on UK populations. The unit costs of delayed discharges were obtained from single hospitals/trusts in five studies, from national reference cost databases in four studies, and in one study no information about sources was given.

The mean cost per delayed discharge was estimated, where possible, and these costs are reported in Table 5. The studies with information on mean costs per delayed discharges (n = 9, 14.1% of the final set) were mostly cohort studies (n = 8), and one was a quasi-experimental study. The mean cost per delayed discharge was USD PPP adjusted 7,020 (median: USD PPP adjusted 2,054), ranging from USD PPP adjusted 482 to USD PPP adjusted 31,935, including only hospitalisation costs.

Studies conducted in Latin America had the lowest mean cost of delayed discharges per patient whereas the study conducted in the United States of America had the highest mean cost, reflecting differences in not only the daily cost of a bed but also the mean duration of delayed discharges.

Discussion

To our knowledge, this is the first review of delayed discharges to pool prevalence estimates of delayed discharges worldwide and to analyse their economic impact. Furthermore, we conducted a meta-regression of potential factors influencing the proportions of delays at an international level.

We found that delayed discharges occur in most countries and have a significant prevalence, even where healthcare services are mainly funded by private insurance, such as in the USA. Although only a small number of studies identified in the review estimated the costs of delayed discharges, these were found to be significant.

The costs to national health services varied between USD 142 and 31,395 (PPP adjusted) per delayed discharge, even in studies conducted in the same country. Differences in countries, time periods, reported mean days of delayed discharge, and patient populations make comparisons between studies difficult. Nonetheless, the within-country variation reported in three studies conducted in the United Kingdom highlights the impact that the variability in populations studied and sources of unit costs used may have on the results. For example, one of the UK studies was conducted in a gastrointestinal general medicine ward (Hendy, Patel, Kordbacheh, Laskar, & Harbord, 2012), reporting 4.4 mean days of delayed discharge, another examined patients in three acute wards (surgical, general medicine and care of the elderly) (Koffman & Hudson, 1996), with mean discharge delays of 20.7 days, whereas the last study was carried out in an old-age psychiatric ward (Hanif & Rathod, 2008), with mean discharge delays of 26.2 days. In terms of sources of unit costs, delayed discharges were valued either using a national cost database (Hendy et al., 2012), the hospital's own costs (Hanif & Rathod, 2008) or left unreported (Koffman & Hudson, 1996).

Consistent with our findings on the costs of delayed discharges, the reported proportion of delayed discharges also varied widely between studies (from 1.6% to 91.3%; weighted mean 22.8%) and within countries (e.g., in the UK they varied from 1.6% to 60.0%; weighted mean 23.1%).

Despite being a long-existing problem, the underlying causes for delayed discharges still persist (K Bryan, 2010; Glasby et al., 2004; Norman, 2003). At an individual level, over-reliance on informal support is observed (Landeiro, Leal, & Gray, 2016) and specific needs of certain patients groups (e.g. mental health issues) remain unaddressed (Lewis & Glasby, 2006). At an organisational level, delays in provision of acute hospital services such as diagnostic tests and interventions are still impacting on delayed discharges (Barisonzo, Wiedermann, Unterhuber, & Wiedermann, 2013; Majeed et al., 2012); lack of assessment and planning for discharge continues to happen (Caminiti et al., 2013; Vieira et al., 2006); and inadequate notice of discharge or consultation with patients and carers (Carey et al., 2005; Foer et al., 2012) is still reported. At a structural level, poor communication between healthcare and social care, and even between acute care and intermediate care (McCoy, Godden, Pollock, & Bianchessi, 2007), and insufficient statutory service provision remains (Karen Bryan, Gage, & Gilbert, 2006; Landeiro et al., 2016). Current evidence from Sweden and Norway suggests that incorporating financial incentives to facilitate transfers between healthcare and social care may reduce delayed discharges. However, even though these measures seem to have reduced the number of days of delayed discharges in Nordic countries (Styrborn & Thorslund, 1993; Unni Alice Dahl, 2014) the same did not happen in the UK reinforcing the idea that local factors play an important role in reducing delayed discharges and that a whole-system approach could yield greater benefits (Glasby et al., 2004; Godfrey & Townsend, 2009; McCoy et al., 2007; NHS England). There is therefore a need for more research into interventions aimed at reducing delayed discharges as well as for comparative studies evaluating the impact of such interventions.

Our study also highlights the impact of methodological differences when explaining the wide variation in the reported estimates of delayed discharges. For example, seasonal fluctuations in hospital admissions can lead to underestimates or overestimates of the proportion of delayed discharges in studies that are conducted for periods shorter than one year. The wider literature also suggests that the proportion of delayed discharges varies depending on the level of seniority and professional background of the healthcare professional evaluating the patient's stay (Glasby et al., 2004; McCulloch, 1997; McDonagh, 2000). Furthermore, proportions of delayed discharges reported in the same country can vary over time as policy measures to tackle this issue are introduced

(Styrborn & Thorslund, 1993), and can also vary in the same time period if, for instance, hospitals are paid on a per diem basis and have different occupancy rates (Paldi, Porath, Friedman, & Mozes, 1995) or if different methodologies and data sources are used (Godden et al., 2009). Another reason for the difference in the proportion of delayed discharges across studies could be the use of different parameters to determine when a patient's discharge is classified as delayed. Some instruments, such as the AEP, are more objective and rigorous in assessing delay but still have limitations when used in isolation, mainly because they do not take into account local circumstances or the availability of alternative resources. They may also introduce bias because they are applied retrospectively, and some such instruments exclude particular patient subgroups like people with mental health problems (Glasby et al., 2004). In addition, although AEP has been adapted to be used in Europe, it is originally from the United States of America and differences may persist between these settings in whether a patient's stay is considered inappropriate. Finally, the AEP instrument was designed in 1981 and has not undergone much revision, although the way in which patients are managed and discharged has altered significantly since then (McDonagh, 2000). Although objective measures to assess inappropriate bed usages are recognised to be superior to subjective decisions, our results do not suggest that the use of the best validated tool (AEP) has a statistically significant impact on the reported proportion of delayed discharges. This may be due to lack of statistical power. We recognise that discrepancies in parameters used to determine when a patient's discharge is delayed will impact upon the estimated proportions of delayed discharge, and we therefore emphasise the need for agreement on a set of internationally recognised parameters to determine when a patient is medically ready for discharge alongside their formal validation. Additionally, we believe that larger studies are needed, with a period of analysis of at least one year to account for seasonal fluctuations. Qualitative studies of the views of patients, families and hospital staff on delayed discharges are needed to better assess these patient's needs, and further assessment is also necessary into the reasons for delay in accessing community services. Furthermore, when determining the impact of delayed discharges, looking at specific diseases and taking into account the pre-admission patient characteristics are key to identify the services likely to be most useful for these patients at discharge, such as rehabilitation for stroke and hip fracture patients.

There are some limitations to this review. The studies included used different methodologies for the analyses of the data, creating challenges when comparing results across studies. Some studies reported delayed discharges only (i.e. days patients spent in hospital after being declared medically fit for discharge) while others reported inappropriate hospital stays. The latter included not only days of delayed discharges but also days spent in hospital before being declared medically fit (i.e. days wasted due to: inappropriate admissions; problems in scheduling operation room, diagnostic tests and procedures and other speciality appointments; and lack of staff available to declare the patient medically fit). As delayed discharges were not separated from inappropriate days prior to being medically fit for discharge, some studies, especially those using AEP and derivatives, may have higher proportions of delayed discharges. Also, in some cases the total length of hospital stay for the sample was not reported and thus it was not possible to determine the proportion of delayed discharges. The number of studies available for the meta-regression was relatively small, which limited the number of factors that could feasibly be explored. Furthermore, sample sizes were small in several studies, which reduced the statistical power to investigate the association between the outcome and possible explanatory factors. It would have been very useful to include other factors that may also be associated with the proportion of delayed discharges, such as level of social support of the patients, level of income, level of dependency in daily living activities prior to hospital admission, or presence of comorbidities. However, such information was not consistently reported across the identified studies. Furthermore, patients in the identified studies came from a variety of ward types ranging from psychiatric to orthopaedic. Even though we explored grouping studies by type of ward of admission, some studies included a variety of wards and did not report the results by ward type. There is, therefore, a significant amount of clinical heterogeneity that may well be impacting on the results of the meta-regression and cannot be fully explored due to limitations on the reported data. We believe it would also be useful to analyse the prevalence of delayed discharges by disease area, since certain patient groups (e.g. hip fractures, or stroke patients) may have specific post-discharge needs, like rehabilitation, which could be impacting on delayed discharges from acute care. It should also be noted that, given the discrepancies, it is not possible to generalise the data on costs of delayed discharges, but it seems clear that these costs are high and that reducing inappropriate stays should be a priority, especially in the light of increasingly overburdened healthcare systems and falling budgets.

In conclusion, we found that delayed discharges are prevalent in most countries and have associated high costs. Further research is needed to determine more reliably the extent of delayed discharges, and more accurate and up-to-date costs for these delays would help in the design of policies to reduce them.

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Figures and Tables

Figure 1: PRISMA flow chart

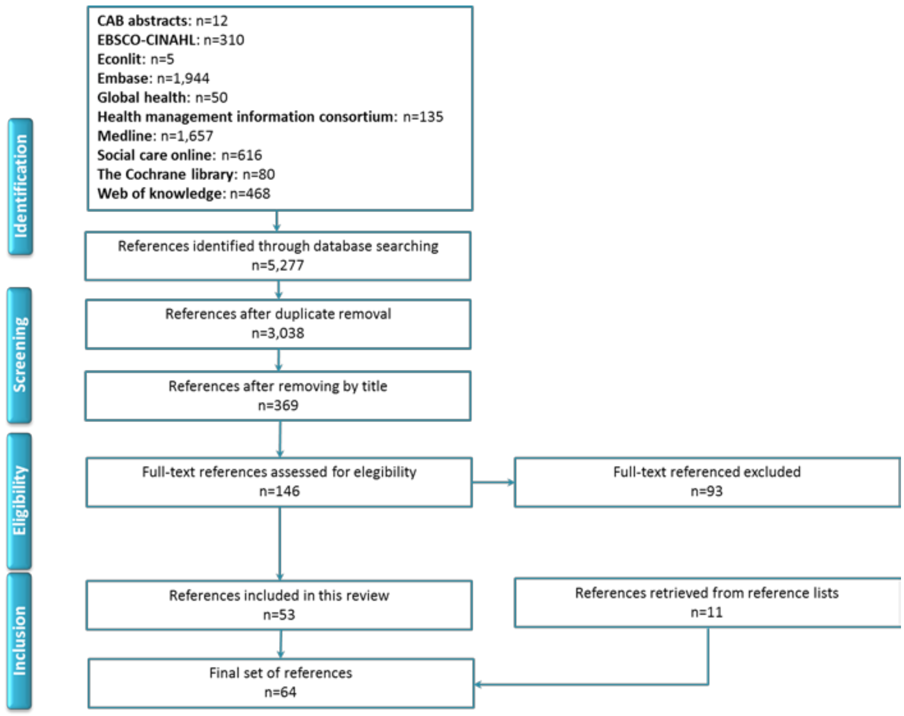
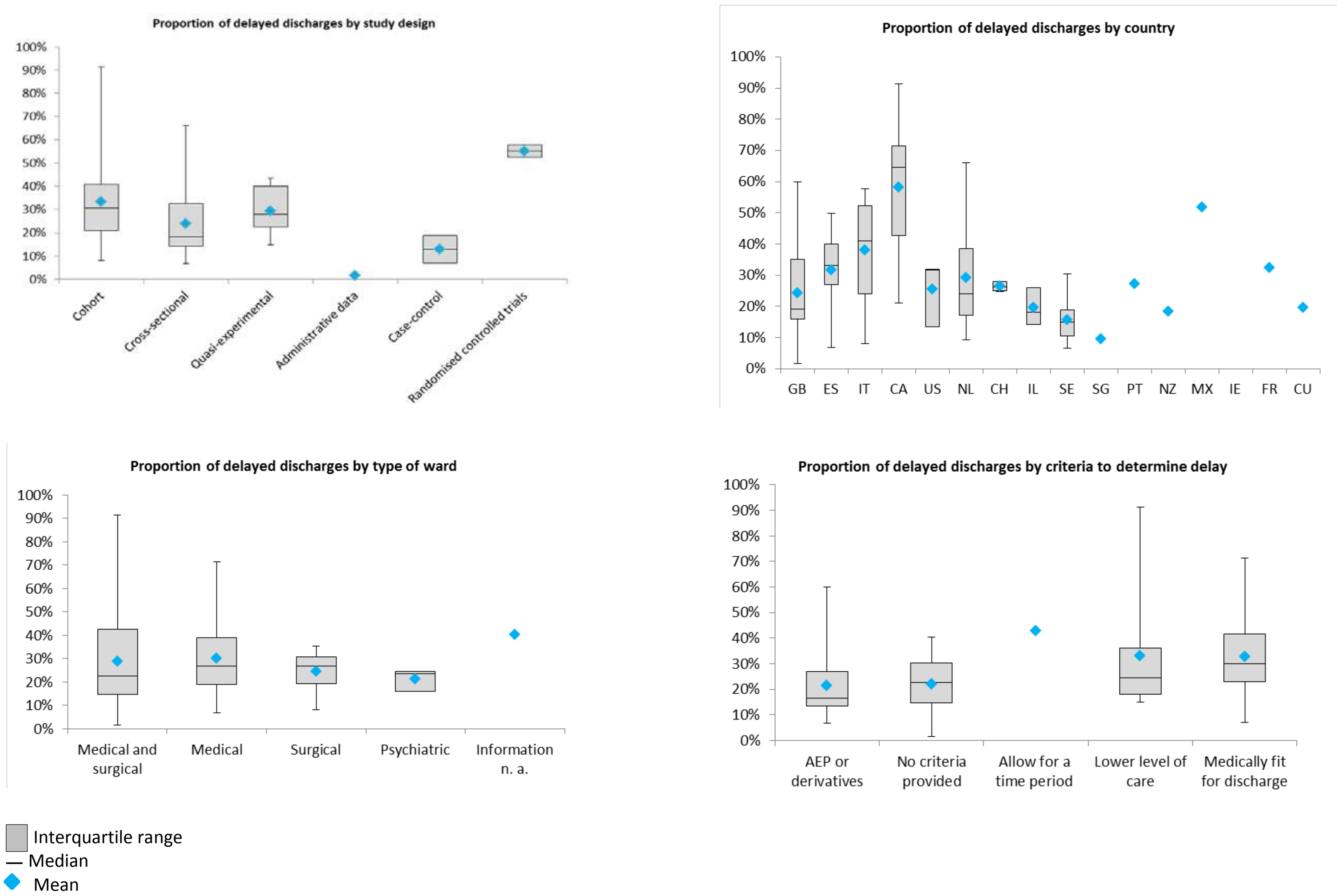


Figure 2: Proportions of delayed discharges by type of study, country, type of ward, and criteria used to determine delayed discharges



Country code: CA– Canada; CH– Switzerland; CU– Cuba; ES– Spain; FR– France; GB– United Kingdom; IE– Ireland; IL– Israel; IT– Italy; MX– Mexico; NL– The Netherlands; NZ– New Zealand; PT– Portugal; SE– Sweden; SG– Singapore; US– United States of America

Table 1: Criteria used to determine delayed discharges

Parameters	Study (year of publication)
Remained in hospital after being declared medically fit for discharge	Becchi (2010); Benson (2006); Bryan (2006); Carey (2005); Chin (2001); De Bey (2004); Edirimanne (2010); Epstein (2001); Falcone (1991); Foer(2012); Gallagher (2008); Hanif (2008); Hendy (2012); Lewis (2006); Lenzi (2014); Mendoza-Giraldo (2012); Meschi (2004); Mohamed (2001); Panayiotou (1995); Panero (2013); Rockwood (1990); Styrborn (1993); Tadros (2011)
Patients could benefit from lower level of care	Chen (2012); Costa (2012); De Coster (2005); Fillit (1993); Hermans (1995); Ingold (2000); Koffman (1996); Koffman (1996); McClaren (1991); Merom (1998); Namdaran (1992); Van Straten (1997); Victor (1990)
Allow for a minimum time period between medically fit and actual discharge date	Jasinarachchi (2009); Mayo (1997)
No criteria provided	Brown (2010); Godden (2009); Hayee (2001), Styrborn (1995)
AEP or derivatives	Barisonzo (2013); Bianco (2006); Caminiti (2013); Choppard (1998); DeCoster (1997); Fenn (2000); Kossovsky (2002); Majeed (2012); Monteis Catot (2007); Mould-Quevedo (2009); Moya-Ruiz (2002); Paillé-Ricolleau (2008); Paldi (1995); Panis (2002); Rodríguez-Vera (2003); Sáez(2004); San Román (2009); Suárez-García (2001); Vieira (2006); Villalta (2004); Vuadens (1996); Zambrana-García (2001)

Table 2: Summary statistics of the proportions of delayed discharges for the whole sample

	Summary statistics
Minimum	1.6%
25th percentile	17.1%
Arithmetic mean (n)	**29.1% (52)***
Weighted mean (n)	**22.8% (46)****
75th percentile	38.9%
Maximum	91.3%

* Ten studies had more than one observation
** Seven studies had more than one observation

Table 3: Summary statistics for the proportion of delayed discharges for studies conducted in the UK

	Summary statistics
Minimum	1.6%
25th percentile	16.2%
Arithmetic mean (n)	**24.4% (14)***
Weighted mean (n)	**23.1% (12)***
75th percentile	31.1%
Maximum	60.0%

* One study had two observations

Table 4: Univariate and multivariate random effects logistic models

	Number of observations	Univariate odds ratio (95% CI)	Multivariate odds ratio (95% CI)
Mean age of participants	45	0.99 (0.95-1.02)	0.71 (0.38-1.32)
Between-study SD		0.92	-
AIC		2,700	-
BIC		2,705	-
Criteria used to determine delayed discharge	71		
Other criteria	36	1.00	1.00
AEP or derivative	35	1.22 (0.74-2.01)	0.85 (0.46-1.58)
Between-study SD		0.88	-
AIC		4,076	-
BIC		4,083	-
Existence of co-payment	71		
No co-payment	45	1.00	1.00
Co-payment	26	0.89 (0.53-1.49)	1.01 (0.55-1.84)
Between-study SD		0.89	-
AIC		4,077	-
BIC		4,084	-
Funding of health system	71		
Tax funded	49	1.00	1.00
Social/private insurance	22	0.70 (0.41-1.19)	0.60 (0.33-1.10)
Between-study SD		0.88	-
AIC		4,075	-
BIC		4,082	-
Number of observations in the multivariate model			45
Between-study SD		-	0.86
AIC		-	2,703
BIC		-	2,714
Wald χ^2			3.65 (p=0.456)

SD: Standard deviation; AIC: Akaike's Information Criterion; BIC: Bayesian Information Criterion

Table 5: Mean cost per delayed discharge, USD PPP adjusted 2011

Author, Year	Country	Mean days of delayed discharges per patient with a delayed discharge	Source of cost (unit)	Daily cost of a bed (USD PPP adjusted)	Mean cost per delayed discharge (USD PPP adjusted)
Sáez (2004)	Cuba	3.4	Own hospital/trust costs (hospitalisation day)	142	482
Mould-Quevedo (2009)	Mexico	2.2	Own hospital/trust costs (hospitalisation day)	374	823
Chin (2001)	Singapore	4.6	Own hospital/trust costs (hospitalisation day)	322	1,561
Hendy (2012)	UK	4.4	National reference costs (excess bed day)	372	1,647
Styrborn (1995)	Sweden	12.7	National reference costs	254	2,054
Epstein (2001)	Israel	10.6	Own hospital/trust costs (hospitalisation day)	433	4,569
Koffman (1996)	UK	20.7	Unknown	445	9,199
Hanif (2008)	UK	26.1	Own hospital/trust costs (hospitalisation day)	417	10,908
Foer (2012)	USA	17.0	National reference costs	1,879	31,935
Mean		11.3			7,020
Median		10.6			2,054
Interquartile range		12.6			7,638
Mean absolute deviation		6.9			6,885

Delayed hospital discharges of older patients: a systematic review on prevalence and costs

Appendices

Appendix 1: Search syntax used in systematic review

Table A.1.1: MEDLINE, EMBASE, GLOBAL HEALTH, CAB Abstracts, ECONLIT

Searches	Search terms
1	(delay* adj3 discharg*).mp.
2	"block* bed*".mp.
3	"bed* block*".mp.
4	"prolong* hospital* stay*".mp.
5	("prolong* stay*" adj3 hospital*).mp.
6	"prolong* hospitali*".mp.
7	"protract* hospital* stay*".mp.
8	("protract* stay*" adj3 hospital*).mp.
9	"protract* hospitali*".mp.
10	"inappropriat* hospital* stay*".mp.
11	("inappropriat* stay*" adj3 hospital*).mp.
12	"inappropriat* hospitali*".mp.
13	"nonmedical stay*".mp.
14	"social stay*".mp.
15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14
16	exp Aged/
17	elder*.mp.
18	geriatric*.mp.
19	"older patient*".mp.
20	"older adult*".mp.
21	"older people*".mp.
22	"older person*".mp.
23	"older individual*".mp.
24	"old age".mp.
25	16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24
26	15 and 25
27	limit 26 to yr="1990 -Current"

mp=abstract, title, original title, broad terms, heading words

Table A.1.2: WEB OF KNOWLEDGE

Searches	Search terms
1	Topic=((delay* NEAR/3 discharg*))
2	Topic=("block* bed*")
3	Topic=("bed* block*")
4	Topic=("prolong* hospital* stay*")
5	Topic=(("prolong* stay* NEAR/3 hospital*))
6	Topic=("prolong* hospitali*")
7	Topic=("protract* hospital* stay*")
8	Topic=("protract* stay*" NEAR/3 hospital*")
9	Topic=("protract* hospitali*")
10	Topic=("inappropriate* hospital* stay*")
11	Topic=("inappropriate* stay*" NEAR/3 hospital*")
12	Topic=("inappropriate* hospitali*")
13	Topic=("nonmedical stay*")
14	Topic=("social stay*")
15	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #12 OR #13 OR #14
16	Topic=(elder*)
17	Topic=(geriatric*)
18	Topic=("older patient*")
19	Topic=("older adult*")
20	Topic=("older people*")
22	Topic=("older person*")
23	Topic=("older individual*")
24	Topic=("old* age*")
25	#16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24
26	#10 AND #18

Table A.1.3: EBSCO – CINAHL

Searches	Search terms
1	delay* N3 discharg*
2	“block* bed*”
3	"bed* block*"
4	"prolong* hospital* stay*"
5	"prolong* stay*" N3 hospital*
6	"prolong* hospitali*"
7	"protract* hospital* stay*"
8	"protract* stay*" N3 hospital*
9	"protract* hospitali*"
10	"inappropriat* hospital* stay*"
11	"inappropriat* stay*" N3 hospital*
12	"inappropriat* hospitali*"
13	"nonmedical stay*"
14	"social stay*"
15	S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14
16	(MH “Aged+”)
17	elder*
18	geriatric*
19	"older patient*"
20	"older adult*"
21	"older people*"
22	"older person*"
23	"older individual*"
24	"old age"
25	S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24
26	S15 and S25
27	Published Date from 19900101-20111231

Table A.1.4: THE COCHRANE LIBRARY

Searches	Search terms
1	delay* NEAR/3 discharg*
2	block* NEXT bed*
3	bed* NEXT block*
4	prolong* NEXT hospital* NEXT stay*
5	prolong* NEXT stay* NEAR/3 hospital*
6	prolong* NEXT hospitali*
7	protract* NEXT hospital* NEXT stay*
8	protract* NEXT stay* NEAR/3 hospital*
9	protract* NEXT hospitali*
10	inappropriat* NEXT hospital* NEXT stay*
11	inappropriat* NEXT stay* NEAR/3 hospital*
12	inappropriat* NEXT hospitali*
13	nonmedical NEXT stay*
14	social NEXT stay*
15	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14)
16	MeSH descriptor Aged explode all trees
17	elder*
18	geriatric*
19	older NEXT patient*
20	older NEXT adult*
21	older NEXT people*
22	older NEXT person*
23	older NEXT individual*
24	"old age"
25	(#16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24)
26	(#15 AND #25)
27	(#26) from 1990 to 2012

Table A.1.5: HEALTH MANAGEMENT INFORMATION CONSORTIUM

Searches	Search terms
1	(delay* adj3 discharg*).mp.
2	"block* bed*".mp.
3	"bed* block*".mp.
4	"prolong* hospital* stay*".mp.
5	("prolong* stay*" adj3 hospital*).mp.
6	"prolong* hospitali*".mp.
7	"protract* hospital* stay*".mp.
8	("protract* stay*" adj3 hospital*).mp.
9	"protract* hospitali*".mp.
10	"inappropriat* hospital* stay*".mp.
11	("inappropriat* stay*" adj3 hospital*).mp.
12	"inappropriat* hospitali*".mp.
13	"nonmedical stay*".mp.
14	"social stay*".mp.
15	delayed discharge/ or blocked beds/
16	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15
17	exp older people/
18	elder*.mp.
19	geriatric*.mp.
20	"older patient*".mp.
21	"older adult*".mp.
22	"older people*".mp.
23	"older person*".mp.
24	"older individual*".mp.
25	"old age".mp.
26	17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27	16 and 26
28	limit 27 to yr="1990 -Current"

Table A.1.6: Social Care online

Search terms
((freetext="delay* discharg*") OR (freetext="block* bed*") OR (freetext="bed* block*") OR (freetext="prolong* hospital* stay*") OR (freetext="prolong* stay*") OR (freetext="prolong* hospitali*") OR (freetext="protract* hospital* stay*") OR (freetext="protract* stay*") OR (freetext="protract* hospitali*") OR (freetext="inappropriat* hospital* stay*") OR (freetext="inappropriat* stay*") OR (freetext="inappropriat* hospitali*") OR (freetext="nonmedical stay*) OR (freetext="social stay*)) **AND** ((freetext="elder*") OR (freetext="geriatric*") OR (freetext="older patient*") OR (freetext="older adult*") OR (freetext="older person*") OR (freetext="older individual*") OR (freetext="old age")) **AND** publicationdate>1989

Appendix 2: References included in the systematic review

Table A.2.1: Description of the studies included in the systematic review

First author (Publication year)	Country code	Study design	Time frame	Wards	Sample size: number of patients (hospitalisation days)	Days of delayed discharges	Proportion of delayed discharges	Total cost of delayed discharges (USD 2011)
Barisonzo (2013)	IT	CS	3 days in September 2010	Medical	n.a. (373)	164	44.0%	n.a.
Becchi (2010)	IT	CO	October 2007 - September 2008	Medical	1,330 (2,584)	1,058	40.9%	n.a.
Benson (2006)	GB	CS	1 weekday in December 2003	Surgical	75 (509)	179	35.2%	n.a.
Bianco (2006)	IT	CS	April - July 2004	Medical and surgical	529 (529)	209	39.5%	n.a.
Brown (2010)	GB	CO	3 months	Medical	51 (n.a.)	65	n.a.	n.a.
Bryan (2006)	GB	CO	2 separate weeks between April 2011 and March 2002	Medical and surgical	125 (n.a.)	4,029	n.a.	n.a.
Caminiti (2013)	IT	RCT	12 months assessed on an index day	Medical	Intervention group: n.a. (1,688) Control group: n.a. (1,810)	Intervention group: 885 Control group: 1,046	Intervention group: 52.4% Control group: 57.8%	n.a.
Carey (2005)	US	CO	25 September - 1 November 2002	Medical	151 (2,762)	373	13.5%	n.a.
Chen (2012)	CA	CO	3 Fiscal years 2007/8 - 2009/10	Medical and surgical	Traumatic brain injury: 2,555 (n.a.) Non-traumatic brain injury: 6,556 (n.a.)	Traumatic brain injury: 58,473 Non-traumatic brain injury: 134,886	n.a.	n.a.
Chin (2001)	SG	CO	December 1996 - March 1997	Medical	172 (2,427)	233	9.6%	53,007
Chopard (1998)	CH	CO	November 1994 - February 1995	Medical	500 (5,665)	1,584	28.0%	n.a.

First author (Publication year)	Country code	Study design	Time frame	Wards	Sample size: number of patients (hospitalisation days)	Days of delayed discharges	Proportion of delayed discharges	Total cost of delayed discharges (USD 2011)
Costa (2012)	CA	CO	April 2009 - March 2011	Medical and surgical	17,111 (n.a.)	294,198	n.a.	n.a.
De Bey (2004)	NL	CO	July 2001 - June 2002	Medical	123 (2,706)	1,107	40.9%	n.a.
De Coster (2005)	CA	CO	1998/9	Medical and surgical	39 (3,381)	2,188	64.7%	n.a.
DeCoster (1997)	CA	CO	1 year between 1993/4	Medical	2,322 (25,215)	179,951	71.4%	n.a.
Edirimanne (2010)	NZ	CO	6 months in 2006	Surgical	150 (729)	135	18.4%	n.a.
Epstein (2001)	IL	CO	1994 - 1996	Medical and surgical	5,235 (n.a.)	10,403	n.a.	4,955,268
Falcone (1991)	US	CO	May 1989	Medical and surgical	3,111 (n.a.)	51,954	n.a.	n.a.
Fenn (2000)	GB	CO	25 days in June and July 1994	Medical and surgical	542 (3,393)	1,441	42.5%	n.a.
Fillit (1993)	US	CO	April 1987 - June 1988	Medical	233 (6,291)	1,992	31.7%	n.a.
Foer (2012)	US	CO	2007	Medical and surgical	17 (428)	136	31.8%	255,484
Gallagher (2008)	IE	CO	2 years	Medical and surgical	1,240 (n.a.)	2,436	n.a.	n.a.
Godden (2009)	GB	AD	1 year between 2006/7	Medical and surgical	n.a. (n.a.)	n.a.	1.6%	n.a.
Hanif (2008)	GB	CO	October - December 2005	Psychiatric	50 (2,997)	706	23.6%	330,297
Hayee (2001)	GB	CO	4 months	n.a.	317 (3,653)	1,477	40.4%	n.a.
Hendy (2012)	GB	CO	7 weeks starting on 12/10/2010	Medical	83 (888)	239	26.9%	99,721

First author (Publication year)	Country code	Study design	Time frame	Wards	Sample size: number of patients (hospitalisation days)	Days of delayed discharges	Proportion of delayed discharges	Total cost of delayed discharges (USD 2011)
Hermans (1995)	NL	CO	1992	Medical	232 (16,740)	3,348	20.0%	n.a.
Ingold (2000)	CH	CO	July 1995 - February 1996	Medical	196 (2,098)	550	26.2%	n.a.
Jasinarachchi (2009)	GB	CO	February 2007	Medical	158 (n.a.)	682	n.a.	n.a.
Koffman (1996)	GB	CS	15 June 1994	Psychiatric	1,510 (1,510)	368	24.4%	n.a.
Koffman (1996)	GB	CO	8 weeks	Medical and surgical	118 (n.a.)	331	n.a.	165,068
Kossovsky (2002)	CH	QE	December 1994 - February 1995 18 November 1996 - 14 February 1997	Medical	1994/5: 500 (5,665) 1996/7: 498 (6,095)	1994/5: 1,586 1996/7: 1,512	1994/5: 28.0% 1996/7: 24.8%	n.a.
Lenzi (2014)	IT	CS	First day of an index period of 15 consecutive days between 30 April and 31 May 2011	Medical and surgical	6,325 (6,325)	510	8.1% (3.1%: general surgery; 6.4%: geriatrics; 6.1%: internal medicine; 9.6%: orthopaedics; 15.2%: long-term/rehabilitation)	n.a.
Lewis (2006)	GB	CS	12 September - 18 September 2004	Psychiatric	n.a. (14,788)	2,366	16.0%	n.a.
Majeed (2012)	GB	CO	January - April 2010	Surgical	99 (1,408)	271	19.3%	n.a.
Mayo (1997)	CA	CO	1991	Medical	2,232 (60,279)	25,668	42.6%	n.a.
McClaran (1991)	CA	CO	31 July 1987 - 31 July 1989	Medical and surgical	115 (101,585)	92,705	91.3%	n.a.
Mendoza-Giraldo (2012)	ES	CO	February 2008 - January 2009	Medical	170 (n.a.)	1,603	n.a.	n.a.

First author (Publication year)	Country code	Study design	Time frame	Wards	Sample size: number of patients (hospitalisation days)	Days of delayed discharges	Proportion of delayed discharges	Total cost of delayed discharges (USD 2011)
Merom (1998)	IL	CS	1 day in the end of November 1995 and 1 day in the end of February 1996	Medical	1,003 (1,003)	182	18.1%	n.a.
Meschi (2004)	IT	CO	July 2001 - June 2002	Medical and surgical	591 (n.a.)	6,106	n.a.	n.a.
Mohammed (2001)	GB	CO	September - November 1998	Surgical	621 (3,159)	255	8.1%	n.a.
Monteis Catot (2007)	ES	QE	15 days pre-intervention + 9 intervention days between October - November 2003 + 15 days post-intervention	Medical and surgical	Intervention group: n.a. (1,594) Control group: n.a. (1,495)	Intervention group: 619 Control group: 651	Intervention group: 40.0% Control group: 43.5%	n.a.
Mould-Quevedo (2009)	MX	CO	2004	Medical and surgical	724 (3,891)	198	51.9%	45,719
Moya-Ruiz (2002)	ES	QE	21 days distributed fortnightly between October 1997 - July 1998	Medical and surgical	Intervention group: n.a. (305 pre-intervention; 314 during intervention; 199 post-intervention) Control group: n.a. (176 pre-intervention; 150 during intervention; 108 post-intervention)	Intervention group: 124 pre- intervention; 111 during intervention; 74 post- intervention Control group: 54 pre-intervention; 44 during intervention; 36 post-intervention	Intervention group: 40.7% pre-intervention; 35.3% during intervention; 37.2% post-intervention Control group: 30.7% pre-intervention; 29.3% during intervention; 33.3% after intervention	n.a.
Namdaran (1992)´	GB	CS	1 - 7 November 1988 and 1 - 7 August 1990	Medical and surgical	First week: 1,170 (1,170) Second week: 1,171 (1,171)	First week: 224 Second week: 214	First week: 19.1% Second week 18.2%	n.a.
Paillé-Ricolleau (2008)	FR	CS	1 day in Spring 2006	Medical and surgical	219 (219)	71	32.4%	n.a.
Paldi (1995)	IL	CS	1 hospitalization day chosen randomly	Medical	Hospital A: 147 (147)	Hospital A: 35	Hospital A: 26.1%	n.a.

First author (Publication year)	Country code	Study design	Time frame	Wards	Sample size: number of patients (hospitalisation days)	Days of delayed discharges	Proportion of delayed discharges	Total cost of delayed discharges (USD 2011)
			between August and September 1992		Hospital B: 150 (150)	Hospital B: 20	Hospital B: 14.2%	
Panayiotou (1995)	GB	CO	April 1993 - March 1994	Medical	15 (2,182)	360	16.5%	n.a.
Panero (2013)	IT	CO	September 2008 - February 2009	Medical	450 (7,069)	1,699	24.0%	n.a.
Panis (2002)	NL	CS	143 index days selected between October 1998 - April 1999 and August 1999 - February 2000	Medical and surgical	Surgery: 408 (1,991); internal medicine: 176 (899); obstetrics and gynaecology: 480 (1,167); neurology: 314 (966); neurosurgery: 150 (496)	Surgery: 265; internal medicine: 127; obstetrics and gynaecology: 107; neurology: 623; neurosurgery: 105	Surgery: 26.7%; internal medicine: 14.1%; obstetrics and gynaecology: 9.2%; neurology: 66.0; neurosurgery: 21.2%	n.a.
Rockwood (1990)	CA	CO	October 1986 - 31 March 1987	Medical	80 (1,362)	286	21.0%	n.a.
Rodríguez-Vera (2003)	ES	CS	27 February 2002	Medical	59 (n.a.)	n.a.	33.0%	n.a.
Sáez (2004)	CU	CO	January - June 2001	Medical	100 (870)	170	19.5%	7,717
San Román (2009)	ES	CO	2004	Medical	202 (909)	222	27.0%	n.a.
Styrborn (1995)	SE	QE	3 months in Autumn 1991	Medical and surgical	Intervention group: 180 (1,728) Control group B: 166 (1,743) Control group C: 190 (2,071)	Intervention group: 255 Control group B: 395 Control group C: 629	Intervention group: 14.8% Control group B: 22.7% Control group C: 30.4%	7,319,116
Styrborn (1993)	SE	CS	One day in each year: 1989, 1990, 1991, 1992 (March and September)	Medical and surgical	1989: 3,964 (3,964) 1990: 3,959 (3,959) 1991: 3,512 (3,512) March 1992: 1,752 (1,752) September 1992: 1,491 (1,491)	1989: 3,964 1990: 3,959 1991: 3,512 March 1992: 1,752 September 1992: 1,491	1989: 15.4% 1990: 15.0% 1991: 13.9% March 1992: 7.0% September 1992: 6.6%	4,068,727
Suárez-García (2001)	ES	CO	October 1994 - March 1996	Medical and surgical	367 (6,220)	3,103	49.9%	n.a.

First author (Publication year)	Country code	Study design	Time frame	Wards	Sample size: number of patients (hospitalisation days)	Days of delayed discharges	Proportion of delayed discharges	Total cost of delayed discharges (USD 2011)
Tadros (2011)	GB	CS	1 day	Medical and surgical	96 (n.a.)	n.a.	60.0%	n.a.
Van Straten (1997)	NL	CO	November 1992 - January 1994	Medical	154 (4,316)	1,554	36.0%	n.a.
Victor (1990)	GB	CS	1 day in May 1988	Medical and surgical	287 (287)	43	15.0%	n.a.
Vieira (2006)	PT	CS	13 March 2003	Medical	22 (22)	6	27.3%	n.a.
Villalta (2004)	ES	CC	6 months in 2001	Medical	Cases: 352 (1,317) Controls: 203 (1,268)	Cases: 87 Controls: 247	Cases: 6.9% Controls: 18.7%	n.a.
Vuadens (1996)	CH	CO	5 months	Medical	118 (2,047)	513	25.1%	n.a.
Zambrana-García (2001)	ES	CS	1998	Medical	n.a. (1,046)	176	16.8%	n.a.

Country code: CA– Canada; CH– Switzerland; CU– Cuba; ES– Spain; FR– France; GB– United Kingdom; IE– Ireland; IL– Israel; IT– Italy; MX– Mexico; NL– The Netherlands; NZ– New Zealand; PT– Portugal; SE– Sweden; SG– Singapore; US– United States of America
Study design: AD– Study using administrative data; CC– Case-control study; CO– Cohort study; CS– Cross-sectional study; QE– Quasi-experimental study; RCT– Randomised controlled trial

Appendix 3: Quality assessment of each reference included in the systematic review

The quality of randomised controlled trails was assessed using the Jadad scale. A maximum of 5 points could be awarded, with a score of three or more indicating “good” quality. The quality of cohort, cross-sectional and quasi-experimental studies was assessed using the Newcastle-Ottawa scale questionnaires. For ease of understanding, an equal weight was assumed for all items. Studies were classified as “poor” (fulfilled <50% of applicable quality criteria); “fair” (fulfilled between 50% and 80% of applicable quality criteria) and “good” quality (fulfilled >80% of quality criteria).

Table A.3.1: Summary of quality rating for each paper included in the systematic review

First author (Publication year)	Study design	Scale	Selection	Comparability	Outcome	Total Score	%
Barisonzo (2013)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Becchi (2010)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Benson (2006)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Bianco (2006)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Brown (2010)	Cohort study	NOS	★★★	★★	★★★	8/9	89%
Bryan (2006)	Cohort study	NOS	★★★		★★★	6/9	67%
Caminiti (2013)	Randomised controlled trial	Jadad	2	2		4/5	80%
Carey (2005)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Chen (2012)	Cohort study	NOS	★★★	★★	★★★	8/9	89%
Chin (2001)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Chopard (1998)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Costa (2012)	Cohort study	NOS	★★★	★★	★★★	8/9	89%
De Bey (2004)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
De Coster (2005)	Cohort study	NOS	★★		★★★	5/9	56%

First author (Publication year)	Study design	Scale	Selection	Comparability	Outcome	Total Score	%
De Coster (1997)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Edirimanne (2010)	Cohort study	NOS	★★★	★★	★★★	8/9	89%
Epstein (2001)	Cohort study	NOS	★★★	★★	★★★	8/9	89%
Falcone (1991)	Cohort study	NOS	★★★	★★	★★	7/9	78%
Fenn (2000)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Fillit (1993)	Cohort study	NOS	★★★	★★	★★	7/9	78%
Foer (2012)	Cohort study	NOS	★★		★★★	5/9	56%
Gallagher (2008)	Cohort study	NOS	★★		★★	4/9	44%
Godden (2009)	Study using administrative data	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Hanif (2008)	Cohort study	NOS	★★★★		★★★	7/9	78%
Hayee (2001)	Cohort study	NOS	★	★	★★	4/9	44%
Hendy (2012)	Cohort study	NOS	★★★★	★	★★★	8/9	89%
Hermans (1995)	Cohort study	NOS	★★★	★★	★★★	8/9	89%
Ingold (2000)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Jasinarachchi (2009)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Koffman (1996)	Cross-sectional study	NOS	★★★	★★	★★	7/9	78%
Koffman (1996)	Cohort study	NOS	★★★★		★★	6/9	67%
Kossovsky (2002)	Quasi-experimental study	NOS	★★★★	★★	★★★	9/9	100%
Lenzi (2014)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Lewis (2006)	Cross-sectional study	NOS	★★★		★★	5/9	56%
Majeed (2012)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%

First author (Publication year)	Study design	Scale	Selection	Comparability	Outcome	Total Score	%
Mayo (1997)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
McClaran (1991)	Cohort study	NOS	★★★		★★★	6/9	67%
Mendoza-Giraldo (2012)	Cohort study	NOS	★★★	★★	★★★	8/9	89%
Merom (1998)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Meschi (2004)	Cohort study	NOS	★★★		★★★	6/9	67%
Mohammed (2001)	Cohort study	NOS	★★★★	★	★★★	8/9	89%
Monteis Catot (2007)	Quasi-experimental study	NOS	★★★★		★★★	7/9	78%
Mould-Quevedo (2009)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Moya-Ruiz (2002)	Quasi-experimental study	NOS	★★★	★★	★★★	8/9	89%
Namdaran (1992)	Cross-sectional study	NOS	★★★		★★★	6/6	67%
Paillé-Ricolleau (2008)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Paldi (1995)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Panayiotou (1995)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Panero (2013)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Panis (2002)	Cross-sectional study	NOS	★★★		★★★	6/9	67%
Rockwood (1990)	Cohort study	NOS	★★★★	★★	★★	8/9	89%
Rodríguez-Vera (2003)	Cross-sectional study	NOS	★★★		★★★	6/9	67%
Sáez (2004)	Cohort study	NOS	★★★★		★★★	7/9	78%
San Román (2009)	Cohort study	NOS	★★★★	★★	★★	8/9	89%
Styrborn (1995)	Quasi-experimental study	NOS	★★★★	★★	★★	8/9	89%
Styrborn (1993)	Cross-sectional study	NOS	★★★		★★★	6/9	67%

First author (Publication year)	Study design	Scale	Selection	Comparability	Outcome	Total Score	%
Suárez-García (2001)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Tadros (2011)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Van Straten (1997)	Cohort study	NOS	★★★★	★★	★★★	9/9	100%
Victor (1990)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
Vieira (2006)	Cross-sectional study	NOS	★★★		★★★	6/6	83%
Villalta (2004)	Case control study	NOS	★★★	★★	★★★	8/9	89%
Vuadens (1996)	Cohort study	NOS	★★★	★★	★★★	8/9	89%
Zambrana-García (2001)	Cross-sectional study	NOS	★★★	★★	★★★	8/9	89%
						Average	**84.1%**

NOS: Newcastle-Ottawa scale
Jadad: Jadad scale
Good quality Fair quality Poor quality

Appendix 4: Details of factors included in the meta-regression

Table A.4.1: Factors included in the meta-regression by study

First author (Publication year)	Mean age of the sample participants	Criteria used to determine delayed discharge	Main type of funding of the country's health system	Existence of co-payment in the country of the study
Barisonzo (2013)	<75	AEP or derivative	Tax funded	Co-payment
Becchi (2010)	≥75	Other	Tax funded	Co-payment
Benson (2006)	≥75	Other	Tax funded	No co-payment
Bianco (2006)	≥75	AEP or derivative	Tax funded	Co-payment
Brown (2010)	≥75	Other	Tax funded	No co-payment
Bryan (2006)	n.a.	Other	Tax funded	No co-payment
Caminiti (2013)	≥75	AEP or derivative	Tax funded	Co-payment
Carey (2005)	n.a.	Other	Social or private insurance	Co-payment
Chen (2012)	n.a.	Other	Tax funded	No co-payment
Chin (2001)	≥75	Other	Social or private insurance	Co-payment
Chopard (1998)	<75	AEP or derivative	Social or privte insurance	Co-payment
Costa (2012)	≥75	Other	Tax funded	No co-payment
De Bey (2004)	≥75	Other	Social or private insurance	No co-payment
De Coster (2005)	≥75	Other	Tax funded	No co-payment
De Coster (1997)	n.a.	AEP or derivative	Tax funded	No co-payment
Edirimanne (2010)	<75	Other	Tax funded	No co-payment
Epstein (2001)	<75	Other	Social or private insurance	No co-payment
Falcone (1991)	≥75	Other	Social or private insurance	Co-payment

First author (Publication year)	Mean age of the sample participants	Criteria used to determine delayed discharge	Main type of funding of the country's health system	Existence of co-payment in the country of the study
Fenn (2000)	n.a.	Other	Social or private insurance	No co-payment
Fillit (1993)	≥75	Other	Social or private insurance	Co-payment
Foer (2012)	<75	Other	Social or private insurance	Co-payment
Gallagher (2008)	≥75	Other	Tax funded	Co-payment
Godden (2009)	n.a.	Other	Tax funded	No co-payment
Hanif (2008)	≥75	Other	Tax funded	No co-payment
Hayee (2001)	n.a.	Other	Tax funded	No co-payment
Hendy (2012)	<75	Other	Tax funded	No co-payment
Hermans (1995)	<75	Other	Social or private insurance	No co-payment
Ingold (2000)	≥75	Other	Social or private insurance	Co-payment
Jasinarachchi (2009)	≥75	Other	Tax funded	No co-payment
Koffman (1996)	≥75	Other	Tax funded	No co-payment
Koffman (1996)	n.a.	Other	Tax funded	No co-payment
Kossovsky (2002)	<75	AEP or derivative	Social or private insurance	No co-payment
Lenzi (2014)	<75	Other	Tax funded	Co-payment
Lewis (2006)	n.a.	Other	Tax funded	No co-payment
Majeed (2012)	n.a.	AEP or derivative	Tax funded	No co-payment
Mayo (1997)	<75	Other	Tax funded	No co-payment
McClaran (1991)	<75	Other	Tax funded	No co-payment
Mendoza-Giraldo (2012)	≥75	Other	Tax funded	Co-payment
Merom (1998)	<75	Other	No co-payment	Social or private insurance
Meschi (2004)	≥75	Other	Tax funded	Co-payment

First author (Publication year)	Mean age of the sample participants	Criteria used to determine delayed discharge	Main type of funding of the country's health system	Existence of co-payment in the country of the study
Mohammed (2001)	n.a.	Other	Tax funded	No co-payment
Monteis Catot (2007)	<75	AEP or derivative	Tax funded	No co-payment
Mould-Quevedo (2009)	≥75	AEP or derivative	Social or private insurance	No co-payment
Moya-Ruiz (2002)	n.a.	AEP or derivative	Tax funded	No co-payment
Namdaran (1992)	n.a.	Other	Tax funded	No co-payment
Paillé-Ricolleau (2008)	<75	AEP or derivative	Social or private insurance	Co-payment
Paldi (1995)	<75	AEP or derivative	Tax funded	No co-payment
Panayiotou (1995)	n.a.	Other	Tax funded	No co-payment
Panero (2013)	≥75	Other	Tax funded	Co-payment
Panis (2002)	n.a.	AEP or derivative	Social or private insurance	No co-payment
Rockwood (1990)	≥75	Other	Tax funded	No co-payment
Rodríguez-Vera (2003)	<75	AEP or derivative	Tax funded	No co-payment
Sáez (2004)	<75	AEP or derivative	Tax funded	No co-payment
San Román (2009)	<75	AEP or derivative	Tax funded	No co-payment
Styrborn (1995)	≥75	Other	Tax funded	Co-payment
Styrborn (1993)	n.a.	Other	Tax funded	Co-payment
Suárez-García (2001)	<75	AEP or derivative	Tax funded	No co-payment
Tadros (2011)	n.a.	Other	Tax funded	No co-payment
Van Straten (1997)	<75	Other	Social or private insurance	No co-payment
Victor (1990)	n.a.	Other	Tax funded	No co-payment
Vieira (2006)	<75	AEP or derivative	Tax funded	Co-payment
Villalta (2004)	≥75	AEP or derivative	Tax funded	No co-payment

First author (Publication year)	Mean age of the sample participants	Criteria used to determine delayed discharge	Main type of funding of the country's health system	Existence of co-payment in the country of the study
Vuadens (1996)	<75	AEP or derivative	Social or private insurance	Co-payment
Zambrana-García (2001)	n.a.	AEP or derivative	Tax funded	No co-payment

Appendix 5: List of references identified in the systematic review

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