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Research and Theory

Reducing hospital bed use by frail older people: results from a systematic review of the literature

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Abstract

Introduction: Numerous studies have been conducted in developed countries to evaluate the impact of interventions designed to reduce hospital admissions or length of stay amongst frail older people. In this study, we have undertaken a systematic review of the recent international literature (2007-present) to help improve our understanding about the impact of these interventions.

Methods: We systematically searched the following databases: PubMed/Medline, PsycINFO, CINAHL, BioMed Central and Kings Fund library. Studies were limited to publications from the period 2007-present and a total of 514 studies were identified.

Results: A total of 48 studies were included for full review consisting of 11 meta-analyses, 9 systematic reviews, 5 structured literature reviews, 8 randomised controlled trials and 15 other studies. We classified interventions into those which aimed to prevent admission, interventions in hospital, and those which aimed to support early discharge.

Conclusions: Reducing unnecessary use of acute hospital beds by older people requires an integrated approach across hospital and community settings. A stronger evidence base has emerged in recent years about a broad range of interventions which may be effective. Local agencies need to work together to implement these interventions to create a sustainable health care system for older people.

Keywords

older people, hospital bed use, admissions avoidance, integrated care, systematic review

Background

There is an emerging consensus about the definition of frailty in older people and its association with increased hospital admissions due to falls, confusion and loss of mobility and with increased length of stay once

admitted to hospital [1]. Furthermore, there appears to be a frailty phenotype associated with unintentional weight loss, self-reported exhaustion, poor physical activity, slow gait speed and weak grip strength [2]. Policy makers are concerned about the impact of ageing populations and in particular on the increased

Table 1. Admission prevention

| Intervention | Author | Type of study (strength of evidence) | Study overview | Impact | Outcomes |
|---|------------------|---|---|--------|--|
| Integrated community teams with care coordination | [3] | Systematic review (M) | Systematic review of interventions intended to reduce admission to hospital of older people. | E | Evidence for reducing hospitalisation rates was equivocal. The most effective was provided by established, integrated teams in the patient's home. The review had some methodological limitations and caution is warranted when interpreting the author's conclusions. |
| | [4] | Systematic review and meta-analysis of randomised controlled trials (H) | 108,838 people; 110 randomised controlled trials - 21 incorporated in meta-analysis Review of randomised controlled trials evaluating 'complex' social and medical interventions that may help maintain independence in older people. | P | There was an overall benefit of complex interventions in helping older people to live at home, explained by reduced nursing home admissions rather than death rates. Hospital admissions and falls were also reduced in intervention groups. Benefits were largely restricted to earlier studies, perhaps reflecting general improvements in health and social care for older people. |
| | [5] | Systematic review and meta-analysis (H) | 89 trials; 97,784 people. Assessment of the effectiveness of community-based complex interventions in preservation of physical function and independence in older people. | P | Risk of hospital admissions (0.94, 0.91–0.97) and falls (0.90, 0.86–0.95) were reduced, and physical function (standardised mean difference –0.08, –0.11 to –0.06) was better in the intervention groups than in other groups. Benefit for any specific type or intensity of intervention was not noted. |
| | [6] ^a | Literature review (M) | Review of randomised controlled trials and observational studies Overview of the effectiveness of different strategies for reducing hospital demand that may be viewed as primarily targeting the hospital sector - increasing capacity and throughput and reducing readmissions - or the <i>non-hospital sector</i> - facilitating early discharge or reducing presentations and admissions to hospital. | P | In regards to the <i>non-hospital sector</i> , potentially the biggest gains in reducing hospital demand will come from improved access to residential care, rehabilitation services and domiciliary support. More widespread use of acute care and advance care planning within residential care facilities and population-based chronic disease management programmes can also assist. |
| | [7] | Randomised controlled trial (USA) (M) | 951 adults ≥65; 474 intervention and 477 usual care Tested the effectiveness of a fully integrated geriatric care management model (GRACE) on improving the quality of care for low-income seniors in primary care. Patients received 2 years of home-based care management by a nurse practitioner and social worker who collaborated with the primary care physician and a geriatrics interdisciplinary team. | E | The cumulative 2-year emergency department visit rate per 1000 was lower in the intervention group (1445 [<i>n</i> = 474] vs. 1748 [<i>n</i> = 477], <i>p</i> = .03) but hospital admission rates per 1000 were not significantly different between groups (700 [<i>n</i> = 474] vs. 740 [<i>n</i> = 477], <i>p</i> = .66). In a predefined group at high risk of hospitalisation (comprising 112 intervention and 114 usual-care patients), ED visit and hospital admission rates were lower for intervention patients in the second year (848 [<i>n</i> = 106] vs. 1314 [<i>n</i> = 105]; <i>p</i> = .03 and 396 [<i>n</i> = 106] vs. 705 [<i>n</i> = 105]; <i>p</i> = .03, respectively). Integrated and home-based geriatric |

Continues

Table 1. (Continued)

| Intervention | Author | Type of study (strength of evidence) | Study overview | Impact | Outcomes |
|------------------|--------|---|---|--------|---|
| Hospital at Home | [8] | Systematic review and meta-analysis (H) | 10 randomised controlled trials; 1327 patients in review; 5 randomised controlled trials; 844 patients in meta-analysis Comparison of the effectiveness of provision of hospital care at home with in-hospital care. | E | care management resulted in improved quality of care and reduced acute care utilisation among a high-risk group. Improvements in health-related quality of life were mixed and physical function outcomes did not differ between groups. No significant difference in mortality at 3 months for patients who received hospital care at home (adjusted hazard ratio [HR] 0.77, 95% confidence interval [CI] 0.54–1.09, $p = 0.15$). However, at 6 months, mortality was significantly lower for these patients (adjusted HR 0.62, 95% CI 0.45–0.87, $p = 0.005$). Admissions to hospital were greater, but not significantly so, for patients receiving hospital care at home (adjusted HR 1.49, 95% CI 0.96–2.33, $p = 0.08$). Patients receiving hospital care at home reported greater satisfaction than those receiving in-patient care. For selected patients, avoiding admission through provision of hospital care at home yielded similar outcomes to in-patient care, at a similar or lower cost. |
| | [9] | Systematic review (H) | 8 studies Evaluation of the effects of patient advocacy case management on service use and healthcare costs for impaired older people or adults with a chronic somatic disease living in the community. | E | In none of the studies was evidence found for clinically relevant increase of service use and costs, whereas in two studies it was reported that patient advocacy case management led to decreased service use and to savings in costs. |
| Case Management | [10] | Controlled before and after analysis of quantitative outcomes data (UK) (L) | 62 Evercare practices; 6960–7695 control practices Assessment of the impact of case management of a high-risk population aged over 65 with history of two or more emergency admissions in preceding 13 months | N | Case management introduced an additional range of services into primary care with no significant impact on rates of emergency admission, emergency bed days or mortality. Authors note that the small number of intervention practices meant that the study had relatively low power to detect changes in outcomes. |
| | [11] | Prospective non-randomised controlled intervention study (UK) (L) | 5 intervention and 30 non-intervention practices Assessment of the impact of case management by advanced practice nurses on unplanned hospital admissions | E | A reduction in unplanned admission rates in the intervention practices appeared to be only in part directly due to nurse case management; most of the reduction did not occur in multiple admitters whom were case managed. |
| | [12] | Comparator Group Study (Australia) (L) | 316 patients in study and 85 in comparator group Evaluation of a new model of care for older people with complex health care | P | Recruited patients displayed a 20.8% reduction in ED presentations, a 27.9% reduction in hospital admissions, and a 19.2% |

Continues

Table 1. (Continued)

| Intervention | Author | Type of study (strength of evidence) | Study overview | Impact | Outcomes |
|---------------------------------|--------|---|--|--------|---|
| | | | needs that aimed to reduce their use of acute hospital services. Older people (over 55 years) with complex health care needs, who had made three or more presentations to a hospital ED in the previous 12 months, or were identified as being at risk of making frequent ED presentations, were recruited to the project. The participants were allocated a 'care facilitator' who provided assistance in identifying and accessing required health care services, as well as education in aspects of self-management. | | reduction in bed-days. In comparison, the patients who declined recruitment displayed a 5.2% increase in ED presentations, a 4.4% reduction in hospital admissions, and a 15.33 increase in in-patient bed-days over a similar timeframe. |
| Targeted preventive home visits | [13] | Randomised controlled trial (The Netherlands) (M) | 151 people; 85 intervention and 66 usual care Evaluated a problem-based multidisciplinary intervention targeting vulnerable older adults at home. In the intervention arm, geriatric nurses visited patients at home for geriatric assessment and management in cooperation with primary care physicians and geriatricians. | P | After 3 months, treatment arms showed significant differences in favour of the new intervention. Functional abilities improved 2.2 points (95% confidence interval [CI], 0.3–4.2) and well-being 5.8 points (95% CI, 0.1–11.4). After 6 months, the favourable effect increased for well-being (9.1; 95% CI, 2.4–15.9), but the effect on functional abilities was no longer significant (1.6; 95% CI, 0.7–3.9). |
| | [14] | Population-based prospective controlled intervention trial in 34 municipalities (Denmark) (L) | 4,034 people Preventive home visits to older home-dwelling people have been part of national policy in Denmark since 1996. Study evaluated whether education of home visitors and GPs was associated with hospital admission rates. | P | No difference was observed in time to first admission between older people living in the intervention municipalities compared with people living in the control municipalities, HR 0.93 (95% CI: 0.85, 1.02, $p = 0.17$). Duration of first hospital stay was the same in the two groups (7.3 days). The mean number of admissions was not associated with intervention. Accepting and receiving home visits was associated with a reduced risk of hospital admission, HR 0.84 (95% CI: 0.76, 0.92), especially among the initially disabled. Hospital admission rates were associated with functional decline patterns. Persons experiencing catastrophic and progressive decline had the highest risk. Persons experiencing reversible functional decline were more often hospitalised in the intervention municipalities, and fewer persons living in the intervention municipalities experienced progressive decline. |
| Home-based exercise | [15] | Systematic review (H) | 6 randomised controlled trials; 987 patients Evaluation of whether home-based exercise interventions improve outcomes for frail older people. Primary | E | A meta-analysis of long-term care admission rates identified a trend towards reduced risk. Inconsistent effects on other primary and secondary outcomes were reported |

Continues

Table 1. (Continued)

| Intervention | Author | Type of study (strength of evidence) | Study overview | Impact | Outcomes |
|---|--------|--|--|--------|---|
| | | | outcomes were mobility, quality of life and daily living activities. Secondary outcomes included long-term care admission and hospitalisation. | | in the other studies. There is preliminary evidence that home-based exercise interventions may improve disability in older people with moderate, but not severe, frailty. There is considerable uncertainty regarding effects on important outcomes including quality of life and long-term care admission. |
| Day hospital | [16] | Systematic review - update of Cochrane Review first published 1999 (H) | 13 trials; 3007 patients Examination of the effectiveness of attendance at a medical day hospital for elderly people (usually > 60) in preventing death, disability, and institutionalisation and improving subjective health status. Trials compared day hospital with comprehensive elderly care, domiciliary care or no comprehensive elderly care. | N | When resource use was examined the day hospital group showed trends towards reductions in hospital bed use and placement of survivors in institutional care. Day hospital care appears to be an effective outpatient service for older people but no more effective and possibly more expensive than other forms of comprehensive elderly care. Any conclusions are limited by the relatively small amount of data available, methodological problems and the lack of statistical power resulting from small, heterogeneous trials. |
| Mental health crisis resolution/home treatment services | [17] | Systematic review (H) | Review of the literature which, according to the Oxford Centre of Evidence-Based Medicine guidelines, contains Grade C evidence that crisis resolution/home treatment teams are effective in reducing numbers of admissions to hospitals. | E | The scoping exercise defined three types of home treatment service model: generic home treatment teams; specialist older adults home treatment teams; and intermediate care services. All seemed to be effectively managing crises and reducing admissions. Outcomes such as length of hospital stay and maintenance of community residence were reviewed but evidence was inadequate for drawing conclusions. Review found a lack of evidence for the efficacy of crisis resolution/home treatment teams in supporting older people with mental health problems to remain at home. |
| Multifactorial falls prevention | [18] | Systematic review and meta-analysis (H) | 19 studies Evaluation of the effectiveness of multifactorial assessment and intervention programmes to prevent falls and injuries among older adults recruited to trials in primary care, community or emergency care settings. | N | No differences were found in admissions to hospital, emergency department attendance, death or move to institutional care. Subgroup analyses found no evidence of different effects between interventions in different locations, populations selected for high risk of falls or unselected and multidisciplinary teams including a doctor. Interventions that actively provide treatments may be more effective than those that provide only knowledge and referral. |
| | [19] | | | N | |

Continues

Table 1. (Continued)

| Intervention | Author | Type of study (strength of evidence) | Study overview | Impact | Outcomes |
|-------------------------------|--------|---------------------------------------|--|--------|--|
| Home-based medication reviews | | Randomised controlled trials (UK) (M) | 136 patients in one general practice Home based medication review by a pharmacist in patients aged over 80 years taking four or more medicines and with at least one additional medicines-related risk factor. | | Showed no difference in hospital admissions, care home admissions or deaths at 6 months. |
| Nursing home liaison | [20] | Before and after study (UK) (L) | 1954 admissions Four strategies to reduce hospital admissions were used in 3 nursing homes for a 3-month period: (1) Medical advisory meetings with GPs, (2) Daily telephone advice (Monday–Friday 9 am to 5 pm), (3) Medihome - a health care company that provides nursing for patients who no longer require immediate access to the full range of services provided in an acute hospital but who are not yet ready for final discharge and 4. End of Life Care. The project was extended for another 4 months with 6 nursing homes. | P | Initial results showed that geriatrician input into nursing homes had a significant impact on admissions from nursing homes ($\chi^2(2) = 6.261, p < 0.05$). The second part of the project also showed significant impact on admissions ($\chi^2(2) = 12.552, p < 0.05$). In both parts of the project the length of stay in hospital for the residents was reduced. Limitations: a longer study period including more nursing homes would improve validity in terms of reducing admissions and hospital length of stay findings; impact on mortality not measured; no control group. |

Impact Key: P = Positive N = Negative E = Equivocal.

Strength of Evidence Key: H = High M = Medium L = Low.

^aStudy included in more than one table.

Table 2. Interventions in hospital

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|-----------------------------|------------------|-----------------------|---|--------|--|
| Hospital wide interventions | [21] | Systematic review (H) | 20 articles included out of 1175 Systematic review of the evidence for hospital-wide interventions for older patients. Interventions included multidisciplinary (consultative) teams, nursing care models, structural changes in physical environment and/or changes in site of service delivery. | E | Small or no effects were found on patient-related outcomes such as functional performance, length of stay, discharge destination, resource use and costs compared with usual care. Of nine studies studying length of stay, one (primary nursing model of care) had a significantly shorter length of stay in one of the two experimental sites. One (geriatric ward based) of five studies presenting data on rehospitalisation showed fewer readmissions per patient, at 6-month follow-up. No single best hospital-wide intervention could be identified. The designs are methodologically not sufficiently strict, and the studies too heterogeneously described to allow summary statistics or a Cochrane high-quality evidence rating. |
| | [6] ^a | Literature review | Review of randomised controlled trials and observational studies Overview of the effectiveness of different strategies for reducing hospital demand that may be viewed as primarily targeting the <i>hospital</i> | P | <i>Within the hospital sector</i> , throughput could be substantially improved by outsourcing public hospital clinical services to the private sector, undertaking whole-of-hospital reform of care processes and patient flow that address both access and |

Continues

Table 2. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|----------------------------|--------|---|--|--------|---|
| | | | sector - increasing capacity and throughput and reducing. | | exit block, separating acute from elective beds and services, increasing rates of day-only or short stay admissions and curtailing ineffective or marginally effective clinical interventions. |
| | [22] | Quasi-randomised, controlled trial (USA) (L) | 122 intervention and 95 usual care Evaluation of a hospitalist-run acute care for the elderly service comprising: selected hospitalist attendings; daily interdisciplinary rounds; standardised geriatric assessment; clinical focus on mitigating harm and discharge planning; novel in-patient geriatrics curriculum. | N | Hospitalist acute care for the elderly patients had significantly greater recognition of abnormal functional status (65% vs. 32%, $p < 0.0001$), and abnormal cognitive status (57% vs. 36%, $p = 0.02$), and greater use of 'Do Not Attempt Resuscitation' orders (39% vs. 26%, $p = 0.04$). Hospitalist acute care for the elderly patients and usual care patients had similar mean lengths of stay in days (3.4 ± 2.7 vs. 3.1 ± 2.7 , $p = 0.52$), mean charges ($\$24,617 \pm \$15,828$ vs. $\$21,488 \pm \$13,407$, $p = 0.12$), and 30-day readmission rates (12% vs. 10%, $p = 0.50$). |
| Geriatric assessment units | [23] | Systematic review and meta-analysis of controlled studies (H) | 11 studies; 5 randomised; 4 non-randomised and 2 case control Comparison of care in an Acute Geriatric Unit with care in conventional hospital units of patients aged 65 years and over with an acute medical illness. | P | Overall analysis of all the studies showed that those admitted to an acute geriatric unit had a statistically significant reduction in hospital length of stay (mean difference -1.01 days; 95% CI, -1.66 to -0.36) and hospital care costs (mean difference of -330 US dollars; 95% CI, -540 to -120) compared to the elderly hospitalised in conventional units. |
| | [24] | Literature review (M) | Review of published data from Spanish hospitals in which comparisons had been made between the mean length of stay in patients admitted to acute geriatric units and (1) those admitted to other medical departments in the hospital; (2) with the standard average stay in the corresponding autonomous region. | P | The mean length of stay in the acute geriatric unit was 8–19% shorter than that of similar patients in other medical departments. In one hospital, the reduction in the mean length of stay was 21% in patients older than 80 years. In three of the four hospitals where comparisons with the standard average stay in the corresponding autonomous region were performed, the mean length of stay in the acute geriatric unit showed reductions of 7–9%. |
| | [25] | Systematic review and meta-analysis (USA) (H) | Examination of how geriatric evaluation and management units are organised and the effectiveness of admissions. Outcome parameters were mortality, institutionalisation, functional decline, readmission and length of stay at different follow-up points. | E | Geriatric evaluation and management units are organised in a heterogeneous way and the included studies gave no thorough description of comprehensive geriatric assessment. Involvement of a multidisciplinary team was a key element in all geriatric evaluation and management units. The individual trials showed that admission to a geriatric evaluation and management unit has one or more favourable effects on the outcomes of interest, with two significant effects in the meta-analysis: less functional decline at discharge from the geriatric evaluation and management unit (RR = 0.87, 95% confidence interval (CI) = 0.77–0.99; $p = .04$) and a lower rate of institutionalisation 1 year after discharge |

Continues

Table 2. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|------------------------------------|-------------------|---|--|--------|---|
| | | | | | (RR = 0.78, CI = 0.66–0.92; $p = .003$). For the other outcomes in the meta-analysis, a geriatric evaluation and management unit did not induce significantly different outcomes from usual care. |
| | [26] | Randomised controlled trial (USA) (M) | 1,632 patients Comparison of care delivered via Acute Care for Elders Units (offer enhanced care for older adults in specially designed hospital units delivered by interdisciplinary teams, which can include geriatricians, advanced practice nurses, social workers, pharmacists and physical therapists) with usual care. | P | Length-of-stay was significantly shorter (6.7 days per patient vs. 7.3 days per patient) among those receiving care in the Acute Care for Elders Unit compared to usual care. This difference produced lower total in-patient costs per patient (\$9,477 vs. \$10,451) while maintaining patients' functional abilities and not increasing hospital readmission rates. The study was completed more than a decade ago but the authors present several reasons as to why the findings are even more relevant today. |
| Comprehensive geriatric assessment | [27] | Meta-analysis of randomised controlled trials (H) | 22 randomised controlled trials; 10,315 patients in 6 countries Determination of whether in-patient comprehensive geriatric assessment for frail older adults (≥ 65) admitted to hospital as an emergency is more effective than routine or general medical care in hospital. | P | Patients who underwent comprehensive geriatric assessment were more likely to be alive and in their own homes at the end of scheduled follow-up (odds ratio 1.16 (95% CI 1.05–1.28; $p = 0.003$; numbers needed to treat 33) at a median follow-up of 12 months versus 1.25 (1.11–1.42; $p < 0.001$; numbers needed to treat = 17) at a median follow-up of 6 months) compared with patients who received general medical care. In addition, patients were less likely to be living in residential care (0.78.0.69 to 0.88; $p < 0.001$) and were more likely to experience improved cognition (standardised mean difference 0.08, 0.01 to 0.15; $p = 0.02$) in the comprehensive geriatric assessment group. These effects of acute geriatric medicine programmes are consistently shown in trials of geriatric wards but are not replicated in trials of geriatric consultation teams on general wards. These benefits might be cost effective. |
| | [28] | Before and after cohort study (UK) (L) | 95 patients; 46 pre- and 49 post-intervention Evaluation of a novel service model for comprehensive geriatric assessment screening of older acute medical inpatients linked to geriatric intervention. | P | Comprehensive geriatric assessment of acute medical inpatients leading to early geriatric intervention (ward-based case management, appropriate transfer to geriatric wards), improved clinical effectiveness and general hospital performance. Over twice as many patients were transferred to elderly care, with mean time from admission to transfer falling from 10 to 3 days. Readmission rates and referral rates to intermediate care did not differ. Mean length of stay fell by 4 days post-OPAL. |
| Orthogeriatric care | [29] ^a | Systematic review and meta-analysis of randomised | 17 randomised controlled trials; 4780 patients Review of the evidence for impact of | P | Compared with those in control groups, weighted mean length of hospital stay after randomisation was shorter in patients |

Continues

Table 2. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|--------------|-------------------|--|--|--------|--|
| | | controlled trials (UK) (H) | in-patient rehabilitation specifically designed for geriatric patients. | | allocated to orthopaedic rehabilitation (24.6 vs. 28.9 days). Insufficient data are available for defining characteristics and cost effectiveness of successful programmes. |
| | [30] | Controlled trial (based on assignment by convenience) (USA) (L) | 171 patients; 94 intervention; 77 usual care Evaluation of the effect of an in-patient geriatric consultation team on length of stay, functional status, mortality, new nursing home admission and hospital readmission in people (≥ 65) with hip fracture.. | N | Found no significant difference in mean length of stay. After 6 weeks, 4 months and 12 months no between-group differences could be documented for mortality, new nursing home admission or readmission rate. Detected no functional benefits of an in-patient geriatric consultation team intervention in people with hip fracture. |
| | [31] | Prospective quasi-experimental randomised intervention study (Spain) (L) | 506 patients Study of the effects of the management of hip fracture patients in an acute orthogeriatric unit shared between the departments of Orthopaedic Surgery and Geriatrics compared with the usual hospital care. | P | Among the orthogeriatric unit patients group it was more frequent to receive rehabilitation in the acute setting, to be able to walk at discharge and to be referred to a geriatric rehabilitation unit (all with $p < 0.05$). The orthogeriatric unit patients also received geriatric assessment and were operated on earlier ($p < 0.001$). The length of stay in the acute ward was 34% shorter in the orthogeriatric unit patients (mean 12.48 ± 5 vs. 18.9 ± 8.6 days, $p < .001$) (median 12 [9–14] vs. 17 [13–23] days, $p < .001$). The whole hospital length of stay, including the days spent in the geriatric rehabilitation units, was 11% shorter in the OGU patients (mean 21.16 ± 14.7 vs. 23.9 ± 13.8 days, $p < 0.05$) (median 14 [10–31] vs. 20 [14–30] days, $p < .001$). |
| | [32] | Cohort study with case controls (USA) (L) | 163 patients; 91 intervention; 72 historical controls The hip fracture service is an interdisciplinary, geriatrician-led programme instituted to improve the care of frail elderly people who present to the hospital with acute hip fracture. The hip fracture service pilot project used existing hospital personnel and facilities and initiated new practices, including set protocols, pre-printed orders and standardised assessments, to achieve and evaluate patient triage and care and hospital cost savings. | P | Analysis demonstrated better outcomes in terms of length of stay (6.1 ± 2.4 days for standard care, 4.6 ± 1.1 days for the hip fracture service; $p < .001$) and time to surgery (< 24 hours after admission in 22.2% of standard care patients vs. 50.5% of hip fracture service patients; $p < .001$). The findings suggest that care with set protocols overseen by a trained lead physician may improve the quality and cost effectiveness of managing elderly patients with hip fracture. Limitations: an observational study with historical controls, data are limited to the acute hospital setting and the preliminary nature of this study made it impossible to distinguish which new elements - care protocols or dedicated attending physician or geriatric physician-provided the critical effect on quality and financial metrics. |
| | [33] ^a | Systematic review (H) | 52 systematic reviews, randomised controlled trials or observational studies Review of numerous medical and surgical interventions on surgical | E | Authors present information relating to the effectiveness and safety of the numerous interventions including coordinated multidisciplinary approaches for in-patient rehabilitation of older people. |

Continues

Table 2. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|------------------------------------|-------------------|---|--|--------|--|
| Mental health liaison | [34] | Narrative review (M) | <p>outcome and prevention of complications in people with hip fracture including the effects of rehabilitation interventions and programmes.</p> <p>13 papers</p> <p>Review of joint geriatric/psychiatric wards as a potential solution to improving care of older patients with both psychiatric and medical illnesses in acute hospitals.</p> | E | <p>Two systematic reviews comparing coordinated multidisciplinary approaches for in-patient rehabilitation of older people versus usual orthopaedic care found no significant difference in mortality.</p> <p>These wards share common characteristics and there is an evidence that they may reduce the length of stay and be cost-effective, but there are no high-quality randomised controlled trials. This is a narrative rather than a systematic review because the limited number of studies address different aspects of care in different patient populations and authors did not consider it meaningful to attempt to combine results.</p> |
| General rehabilitation in hospital | [35] | Prospective controlled trial with blinded outcome evaluation (Australia). (L) | Evaluation of the effect of a structured, multi-component, early rehabilitation programme on functional status, delirium, and discharge outcomes of older acute medical inpatients. | N | The intervention group had greater improvement in functional status than the control group, with a median modified barthel index improvement of 8.5 versus 3.5 points ($p = .03$). In the intervention group, there was a reduction in delirium (19.4% vs. 35.5%, $p = .04$) and a trend to reduced falls (4.8% vs. 11.3%, $p = .19$). Length of stay, timed up-and-go, discharge destination and readmissions did not differ between the groups. Authors state that ‘study was underpowered or secondary outcomes such as delirium, falls and length of stay’. |
| | [29] ^a | Systematic review and meta-analysis of randomised controlled trials (H) | <p>17 randomised controlled trials; 4780 patients</p> <p>Review of trials addressing whether in-patient rehabilitation specifically designed for geriatric patients improves outcomes related to function, admission to nursing homes and mortality.</p> | N | <p>Compared with those in control groups, weighted mean length of hospital stay after randomisation was longer in patients allocated to general geriatric rehabilitation (24.5 vs. 15.1 days) and shorter in patients allocated to orthopaedic rehabilitation (24.6 vs. 28.9 days). Insufficient data are available for defining characteristics and cost effectiveness of successful programmes</p> |
| Exercise | [36] | Systematic review & meta-analysis (Cochrane) (H) | <p>3138 articles screened; 7 randomised controlled trials and 2 controlled trials included</p> <p>Review of the effect of exercise interventions for acutely hospitalised older medical patients on functional status, adverse events and hospital outcomes.</p> | E | <p>The effect of exercise on functional outcome measures is unclear. Pooled analysis of multidisciplinary interventions that included exercise indicated a small significant increase in the proportion of patients discharged to home (Relative Risk 1.08, 95% CI 1.03–1.14 and Numbers Needed to Treat 16, 95% CI 11–43) and a small but important reduction in acute hospital length of stay (weighted mean difference, –1.08 days, 95% CI –1.93 to –0.22) and total hospital costs (weighted mean difference, –US\$278.65, 95% CI –491.85 to –65.44) compared to usual care</p> <p>Pooled analysis of <i>exercise intervention trials</i> found no effect on the proportion of patients discharged to home or acute hospital length of stay.</p> |

Continues

Table 2. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|--------------------------|--------|--|---|--------|---|
| Nutrition in hospital | [37] | Randomised blinded placebo controlled trial (UK) (M) | 445 patients ≥ 65 years Study of the impact of oral nutritional supplements during acute illness and recovery on a number of specified outcomes including non-elective hospital readmissions in older patients. | N | Authors conclude that here is 'silver' level evidence (www.cochranemsk.org) that multidisciplinary intervention that includes exercise may increase the proportion of patients discharged to home and reduce length and cost of hospital stay for acutely hospitalised older medical patients. Oral nutritional supplements during acute illness and recovery reduced non-elective hospital readmissions in older patients but did not reduce mortality, morbidity, disability, length of hospital stay or discharge destination. |
| Computerised care record | [38] | Before and After Study (USA) (L) | 11 community hospitals Study of the impact of the introduction of the acute care for the elderly Tracker (computer-generated checklist of all older patients in a facility that takes information from multiple areas of the electronic medical record to identify the older patients' risk factors for functional decline and poor outcomes) into hospitals with no geriatricians on staff. | N | There were significant improvements in urinary catheter and physical therapy referrals but no significant changes in the other outcomes. There was no change in the length of stay or in the rate of hospital readmission within 30 days. |

Table 3. Interventions supporting discharge

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|--------------------|--------|---------------------------------|--|--------|---|
| Discharge planning | [39] | Randomised controlled trial (M) | 126 patients - 65 intervention and 61 control To determine the effectiveness of nutritional supplementation on rehabilitation outcomes following hip fracture surgery | P | Hospital length of stay was reduced and there were nutritional improvements in the intervention group. |
| | [40] | Systematic review (H) | 21 randomised controlled trials; 7234 patients To determine the effectiveness of discharge planning from hospital to home. | P | Hospital length of stay and readmissions to hospital were significantly reduced for patients allocated to discharge planning (mean difference length of stay -0.91 , 95% CI -1.55 to -0.27 , 10 trials; readmission rates RR 0.85, 95% CI 0.74–0.97, 11 trials) The evidence suggests that a structured discharge plan tailored to the individual patient probably brings about small reductions in hospital length of stay and readmission rates for older people admitted to hospital with a medical condition. The impact of discharge planning on mortality, health outcomes and cost remains uncertain. |
| | [41] | Literature review (M) | Examination of the available evidence concerning hospital discharge practices for frail older people and their family caregivers and what practices were most beneficial for this group. | P | The current evidence indicates that hospital discharge planning for frail older people can be improved if interventions address family inclusion and education, communication between health care workers and family, interdisciplinary |

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Table 3. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|--------------------------------|--------|--|--|--------|---|
| | | | | | communication and on-going support after discharge. Interventions should commence well before discharge. The research shows there is a direct correlation between the quality of discharge planning and readmission to hospital. No mention of cost-effectiveness or economic evaluations. |
| | [42] | Systematic meta-review (H) | 15 reviews Synthesis of the evidence presented in the literature on the effectiveness of interventions aimed to reduce post-discharge problems in adults discharged home from an acute general care hospital. | E | Although a statistical significant effect was occasionally found, most review authors reached no firm conclusions that the discharge interventions they studied were effective. We found limited evidence that some interventions may improve knowledge of patients, may help in keeping patients at home or may reduce readmissions to hospital. Interventions that combine discharge planning and discharge support tend to lead to the greatest effects. There is little evidence that discharge interventions have an impact on length of stay, discharge destination or dependency at discharge. |
| | [43] | Quasi-experimental pre-post study design (USA) (L) | 237 patients pre intervention; 185 intervention Study of the feasibility and effectiveness of a discharge planning intervention to facilitate the transition of older adults from three hospitals back to their homes. The intervention toolkit had five core elements: admission form with geriatric cues, facsimile to the primary care provider, interdisciplinary worksheet to identify barriers to discharge, pharmacist–physician collaborative medication reconciliation and pre-discharge planning appointments. | P | The proportion of patients with high quality transitions home increased from 68% to 89% (odds ratio (OR) =3.49, 95% confidence interval (CI) =2.06–5.92). Return to the emergency department within 3 days of discharge was lower in the intervention period (10% vs. 3%, OR=0.25, 95% CI=0.10–0.62). At 30 days, there was a lower rate of readmission (22% s. 14%, OR=0.59, 95% CI=0.34–0.97) and fewer visits to the emergency department (21% vs. 14%, OR=0.61, 95% CI=0.36–1.03) (P=.06). This intervention appears to have improved care without post hospital follow-up care, which has been a core component in most prior studies. |
| Integrated information systems | [44] | Literature review (Australia) (M) | Review of literature relating to multi-professional communication between health and social care professionals within transitional care for older people, with particular attention on outcomes, enabling contextual factors and constraints to be identified. | P | Specified discharge worker roles, multi-professional care coordination teams, and information technology systems promote better service satisfaction and subjective quality of life for older people when compared with standard hospital discharge. Improved multiprofessional communication reduces rates of re-admission and length of stay indicating greater cost effectiveness and efficiency for the health and social care systems. Systems of care emphasising information exchange, education and negotiation |

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Table 3. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|-----------------------------|--------|---|--|--------|---|
| Nurse-led transitional care | [45] | Before and after (USA) (L) | Study of the effectiveness of a nurse practitioner-led transitional care programme for hospitalised homebound people. | N | <p>between stakeholders facilitate communication in transitional care contexts for older adults.</p> <p>The small number of studies and small sample sizes in studies evaluating enabling factors and barriers are limitations.</p> <p>The programme improved communication between home-based primary care providers and in-patient providers of all disciplines and facilitated the timely and accurate transfer of critical patient information.</p> <p>The intervention failed to decrease significantly hospital length of stay and readmission rate.</p> |
| Intermediate care | [46] | Randomised controlled trial (Norway) (M) | 142 patients; 72 intervention and 70 general hospital care Study of the efficacy of intermediate care at a community hospital compared to standard prolonged care at a general hospital. | P | <p>Intermediate care at a community hospital significantly decreased the number of readmissions for the same disease to general hospital (14 patients vs. 25, $p = 0.03$), and a significantly higher number of patients (18 vs. 7; $p = 0.02$) were independent of community care after 26 weeks of follow-up.</p> <p>There was no significant increase in mortality or number of days in institutions.</p> |
| | [47] | Systematic review of randomised controlled trials (H) | 73 randomised controlled trials Discussion of the randomised controlled trial evidence for various intermediate care service models from the perspectives of clinical, service and economic outcomes. | E | <p>The evidence base remains patchy but suggests that the hospital-at-home approach is currently the best randomised controlled trial supported intermediate care service model. It is a condition-flexible service (e.g., Chronic Obstructive Pulmonary Disease), post-fractured hip, frail older people, stroke); is intermediate care-function flexible (admission avoidance, early discharge, palliative care); and is an excellent foundation for other integrated care services.</p> <p>New national guidance has been produced that is attempting to refocus intermediate care on its intended target group of frail older people, and not to specifically exclude older people with mental health problems.</p> |
| Community rehabilitation | [48] | Observational cohort study (UK) (L) | 394 patients Study of the impact of targeted early rehabilitation at home after total hip and knee joint replacement. | P | <p>Targeted early rehabilitation at home after total hip and knee joint replacement resulted in reduced hospital stay for both procedures (from 14 to 8.17 days for total hip replacement and from 12 to 8.21 days for total knee replacement) without an increase in complication rates. It also generated significant savings to the Trust without an increase in readmission rates. A multidisciplinary team working in close collaboration is the key to success of such a scheme.</p> <p>Authors acknowledge that there was a</p> |

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Table 3. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|----------------------------------|-------------------|---|--|--------|---|
| Early discharge hospital at home | [49] | Meta-analysis (H) | 13 trials; 2498 patients (usually female) Examination of the effects of multidisciplinary rehabilitation, in either in-patient or ambulatory care settings, for older patients with hip fracture. Multidisciplinary rehabilitation was provided primarily in an in-patient setting in 11 trials. | E | targeted selection of patients suitable to be included in the scheme but that well defined selection criteria and the fact that rehabilitation begins at pre-operative assessment should have prevented a bias towards suitability-included factors that would lead to a shorter length of stay. Pooled results showed no statistically significant difference between intervention and control groups for poor outcome, mortality or hospital readmission. Overall, the evidence indicates that multidisciplinary rehabilitation is not harmful. The trial comparing primarily home-based multidisciplinary rehabilitation with usual in-patient care found marginally improved function and a clinically significantly lower burden for carers in the intervention group. Participants of this group had shorter hospital stays, but longer periods of rehabilitation. While there was a tendency to a better overall result in patients receiving multidisciplinary in-patient rehabilitation, these results were not statistically significant. |
| | [33] ^a | Systematic review (H) | 52 systematic reviews, randomised controlled trials or observational studies Review of numerous medical and surgical interventions on surgical outcome and prevention of complications in people with hip fracture including the effects of rehabilitation interventions and programmes. | E | Authors present information relating to the effectiveness and safety of the numerous interventions including early supported discharge followed by home-based rehabilitation. Authors found one systematic review and two subsequent randomised controlled trials comparing early supported discharge versus control. All three randomised controlled trials emphasised the careful selection of people for early supported discharge and home-based rehabilitation. These were generally people who were the least disabled and who had suitable and supportive home environments. Thus the application of these findings to other people with hip fracture is questionable |
| | [6] ^a | Literature review (M) | Review of randomised controlled trials and observational studies Overview of the effectiveness of different strategies for reducing hospital demand that may be viewed as primarily targeting the non-hospital sector - <i>facilitating early discharge</i> or reducing presentations and admissions to hospital. | P | In regards to the <i>non-hospital sector</i> , potentially the biggest gains in reducing hospital demand will come from improved access to residential care, rehabilitation services and domiciliary support as patients awaiting such services currently account for 70% of acute hospital bed-days. |
| | [50] | Systematic review and meta-analysis (H) | 26 trials ($n = 3967$); 21 trials eligible for meta-analysis and 13 contributed data ($n = 1899$) Determination of the effectiveness and cost of managing patients with early discharge | N | Readmission rates were significantly increased for elderly patients with a mix of conditions allocated to hospital at home (adjusted HR 1.57; 95% CI 1.10–2.24; $n = 705$). For patients recovering |

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Table 3. (Continued)

| Intervention | Author | Type of study | Study overview | Impact | Outcomes |
|--------------|--------|---------------|--|--------|---|
| | | | hospital at home compared with in-patient hospital care. | | from a stroke and elderly patients with a mix of conditions significantly fewer people allocated to hospital at home were in residential care at follow-up (RR 0.63; 95% CI 0.40–0.98; $n = 4$ trials; RR 0.69, 95% CI 0.48–0.99; $n = 3$ trials). Patients reported increased satisfaction with early discharge hospital at home. There was insufficient evidence of a difference for readmission between groups in trials recruiting patients recovering from surgery. Evidence on cost savings was mixed. This review provides insufficient objective evidence of economic benefit or improved health outcomes for early discharge hospital at home services. |

numbers of frail older people in creating rising demand for acute hospital beds. There is therefore a strong interest in identifying interventions which are effective in reducing avoidable hospital admissions and in reducing the length of stay amongst frail older people.

In this study, we have undertaken a systematic review of the recent international literature (2007-present) to help improve our understanding about the interventions which appear to work and those which have been less successful in reducing hospital bed use.

Method

We systematically searched the following databases: PubMed / Medline, PsycINFO, CINAHL, BioMed Central and Kings Fund library using the following search filters; older people/frail older people/elderly people/geriatrics and hospital admission rates/hospital length of stay/hospital bed use/early supported discharge/admission avoidance/intermediate care. Studies were limited to publications from the period 2007-present. A total of 514 studies were identified. Following a review of study abstracts, we excluded those which did not include older people or frail older people as the main target population, studies which only included older people with specific long-term conditions and studies of lower quality, for example, single case studies, audit studies and those which did not include a comparison population.

Results

A total of 48 studies were included for full review consisting of 11 meta-analyses, 9 systematic reviews, 5 structured literature reviews, 8 randomised controlled trials and 15 other studies (6 before and after studies,

6 non-randomised controlled trials, 1 comparator group study, 1 cohort study with case controls and 1 observational cohort study). With only 1 exception [3], evidence from meta-analyses and systematic reviews was classified as high, from literature reviews and randomised controlled trials as medium and that from 'other' studies as low.

We assessed the impact of the studies based on the reported findings as follows: Positive - statistically significant positive impact on hospital admissions/readmissions and/or length of stay; Equivocal - some positive but not statistically significant impact; Negative - no impact. We classified interventions into those which aimed to prevent admission (Table 1) interventions in hospital (Table 2), and those which aimed to support early discharge (Table 3).

We found evidence for the effectiveness of care coordination, preventive health checks and care home liaison in the prevention of admission to hospital. Within the hospital setting, there was an evidence for the effectiveness of geriatric assessment units and orthogeriatric units targeting frail older people in reducing the length of stay. For services which linked hospital- and community-based care, including discharge planning, information sharing and rehabilitation services provided in the person's home, there was an evidence of effectiveness in reducing length of stay and preventing readmission to hospital.

There were a series of interventions where there was no evidence of impact on hospital bed use. These included multi-factorial falls prevention services, day hospital services, medication reviews, exercise programmes in the community, nutritional enhancement in hospital and nurse-led transitional care units.

Discussion

Our search for peer-reviewed publications about interventions for reducing hospital bed use by frail older people published since 2007 revealed a large number of studies. There may be further studies which were not captured by our search terms. As the majority of studies we identified were secondary reviews, our study covers a substantial body of evidence from peer-reviewed research on this topic.

We have found that the evidence base has strengthened for many interventions in hospital and community settings. These include: targeted preventive health checks, care coordination for frail older people, when embedded within integrated health and social care teams, hospital geriatric assessment and orthogeriatric units, community-based rehabilitation services and better integration of acute and post-acute care through discharge planning and joined up information systems.

We have found no evidence to support multi-factorial falls prevention services, community-based medicines reviews, day hospital services, exercise interventions in hospital and nurse-led transitional care, but there were fewer studies of these interventions. It may be that with further development, some of these interventions may prove effective. Studies of association have shown that falls [51], polypharmacy [52], poor nutrition [53–55] and lack of exercise [56] are all associated with increased hospital bed use in older people, so interventions targeted on these areas have the potential to reduce hospital bed use.

Despite huge expectations, telehealth and telecare have not been shown to be effective in the randomised trials. In a recently published randomised trial of telehealth [57] (the Whole Systems Demonstrator telehealth trial), compared with usual care, telehealth was not more effective and did not improve quality of life or psychological outcomes for patients with chronic obstructive pulmonary disease, diabetes or heart failure over 12 months [58]. Reassuringly, no deleterious effects on the service users were noted with the telehealth. Similarly, a cluster randomised trial comparing telecare (as implemented in the Whole Systems

Demonstrator trial) with usual care did not show significant reductions in service use over 12 months [59].

Other factors associated with increased bed use include advanced old age [60,61], poor grip strength [62,63], other markers of frailty [64,65], atypical disease presentation [66], multiple co-morbidities [67,68], depression [69,70], cognitive impairment [71–74], poor functional status [75–77], development of pressure sores [78], low socio-economic status [79], lack of family support [80], loneliness [81] and living in a care home [82,83]. These underlying risks are inter-related, which may explain why many of the effective interventions identified in our study were multifaceted.

Effective interventions had common features including anticipatory care targeting older people at risk of adverse outcomes in all settings and well-integrated multidisciplinary practice and inter-agency working. We conclude that services should be developed as a whole system including preventive care, acute hospital care and community care. A shared information system should be created to support patient flow through the system.

Conclusion

Reducing unnecessary use of acute hospital beds by older people requires an integrated approach across hospital and community settings. A stronger evidence base has emerged in recent years about a broad range of interventions which may be effective. Local agencies need to work together to implement these interventions to create a sustainable health care system for older people.

Reviewers

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