Systematic review: interventions intended to reduce admission to hospital of older people

Christine Batty

Aims: *To reduce costly acute hospital admissions of a growing elderly population, a number of complex interventions have been developed, but evidence of the effectiveness of these is inconclusive. What is it about these models that make them effective or ineffective? The aim of this study was to examine the research underpinning these models; analyse treatment components and identify what is and is not effective.*

Method: *Thirteen international studies of complex interventions that reported hospital admission data as an outcome, published between 2000 and 2009, were examined.*

Findings: *What works in reducing admissions is not one, but a combination of components, underpinned by the delivery of interventions by established, integrated health and social care teams.*

Conclusions: *the most effective models in preventing older people being admitted to hospital are provided by established, integrated teams in the patient's home. However, cost effectiveness must be considered if effective interventions are to be delivered to a growing population of older people.*

Key words: ■ community ■ intermediate care ■ interventions ■ older people ■ readmission

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One of the challenges facing health and social care is the rising number of people aged over 65. The World Health Organization predicts that the number of people over 60 will double by 2025 (WHO, 2009), calling for innovative approaches to providing healthcare in an efficient, cost-effective way. Older people are frequently admitted to hospital unnecessarily and many reasons for hospital admission could be successfully treated in the community, (Department of Health (DH), 2006).

AIMS

With the growth of Primary Care worldwide, models have developed to prevent admission to hospital. However, various studies have shown that the effectiveness of these is variable (Elkan et al, 2001; Johri et al, 2003; Beswick et al, 2008). Interventions are complex and publications of studies often lack sufficient detail of interventions for analysis (Elkan et al, 2001; Brand, 2004). The content of publications often leaves the reader asking 'what treatment did the patient receive' and 'how can I replicate that?'

The aim of this research was to determine in more detail what components, or combination of components, make complex interventions effective, and subsequently, to determine what the model for the most effective intervention would look like.

METHODS

Studies were included using the following criteria for selection (see *Table 1*):

- Studies of older people (over 65 years old), normally resident in their own homes
- Studies including older people as a population, so that the results would be relevant to this population. Disease specific studies were excluded
- Studies using an experimental design or project description where a comparison group was used for evaluation
- Interventions which were multi-factorial or complex, with clearly described components
- Interventions which were delivered in community settings, or during the transition from hospital to home
- Studies measuring the effect of the intervention on hospital admission and/or readmission rates.

Criteria were identified prior to searching, to reduce the risk of biased selection of studies, (Moher et al, 1999).

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Table 1.
Criteria for Selection

Selection Criteria	Inclusion criteria	Exclusion criteria
Population	Older people	• Paediatrics • Under 65s • Palliative care • Single diagnosis • Mental health
Interventions	Any multi-professional interventions Nursing and/or therapy Clearly described in the text	• Pharmacological interventions • Interventions delivered by medical staff alone. • Intervention-assessment only no treatment • Cost analysis • Disease specific • Interventions culturally inappropriate for the UK • Insufficient detail of intervention
Setting	• Hospital discharge • Intermediate Care • Community care • Outpatient • Primary care	• Ward/unit based interventions • Interventions that require admission to hospital • Institutional care
Outcomes	• Prevent admission or readmission to hospital • Reduce admissions	• Admission to institutional care • Admission avoidance at the point of care
Study design	All quantitative and qualitative studies Reviews	• Discussion papers, opinion pieces, editorials, letters, commentaries
Paper type	Published since 2000 English language papers	• Published prior to 2000 • Published in languages other than English
Search locations	Databases: CINAHL, BNI, Cochrane, Medline Reference lists of selected publications	

In February 2009, a search was carried out of Medline, CINAHL, British Nursing Index and Cochrane Clinical Trials databases, (2000–2009), using the key word combination: older people/elderly/geriatric or over 65; community/primary care/home/discharge or intermediate care; prevention/avoidance/reduction of hospitalization/rehospitalization/admission/readmission; multidisciplinary/multiprofessional/integrated intervention/care (see *Table 2*). Reference lists from selected publications were examined to identify further publications that met the stated criteria.

Abstracts of all publications were scrutinized against the criteria. Full texts of the publications were obtained and further evaluated for relevance (see quorum diagram *Figure 1*). Relative quality is discussed as each study is evaluated. Studies were not excluded if judged to be of poorer quality than others, because the aim was to analyse the components of interventions and to make comparisons based on these components. The author, owing to limitations in resources, carried out all searches, selection and evaluation. This may have led to some bias in the selection procedure.

RESULTS

Thirteen studies met the inclusion criteria for this review and these are summarized in *Table 3*.

The Cochrane Collaboration's tool for risk of bias was applied for each study (*Table 4*). For comparison of study group a simple risk of admission score was devised:

- Low: normal population over 65
- Medium: Over 65, in receipt of home health or social care and/or with one or more chronic illness
- High: Over 65 discharged from A&E during the study period, i.e. not admitted to a ward
- Very high: admitted to hospital one or more times during the study period.

ANALYSIS OF STUDIES

Burns et al, 2000

Burns et al (2000) studied the effect of a geriatric evaluation and management (GEM) model. A comprehensive geriatric assessment (CGA) was carried out in the clinic by a well-established, trained multidisciplinary team, who developed individualized care-plans and provided long term, clinic-based management. Patients were randomized to the intervention or control group (49 vs 49), and followed up for two years. Control patients received usual clinic follow-up, details of which were not published. This was a very high-risk of admission group; the patients selected were hospital in-patients. The authors reported

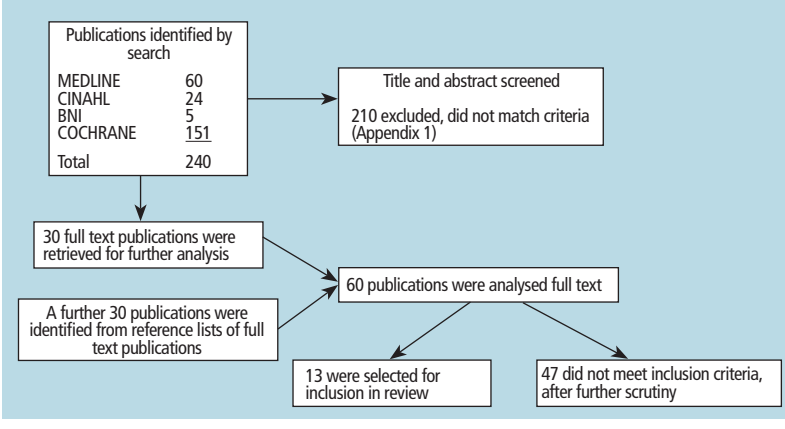
Table 2.
Search strategy – example showing the strategy for Medline only

MEDLINE

1.	MEDLINE; AGED/OR FRAIL ELDERLY/OR "AGED, 80 AND OVER"; 1 818 057 results
2.	MEDLINE; INTERMEDIATE CARE FACILITIES; 563 results
3.	MEDLINE; PRIMARY HEALTH CARE; 38 911 results
4.	MEDLINE; PATIENT ADMISSION; 14 622 results
5.	MEDLINE; readmission.ti,ab; 4517 results
6.	MEDLINE; PATIENT READMISSION/OR HOSPITALIZATION; 59 138 results
7.	MEDLINE; (prevent* OR avoid* OR reduc*).ti,ab; 2 271 187 results
8.	MEDLINE; 2 OR 3; 39 467 results
9.	MEDLINE; 4 OR 5 OR 6; 74 846 results
10.	MEDLINE; 8 AND 9; 772 results
11.	MEDLINE; 1 AND 7; 255 185 results
12.	MEDLINE; 10 AND 11; 88 results
13.	MEDLINE; 12 [Limit to: Publication Year 2000–2009 and (Languages English)]; 66 results
14.	MEDLINE; Duplicate filtered: [12 [Limit to: Publication Year 2000–2009 and (Languages English)]]; 62 results

Cochrane Clinical Trials Register:
(over 65 or elderly or geriatric or older people):ti,ab,kw and (community or primary care or home or intermediate care or discharger):ti,ab,kw and (prevent* or avoid* or reduc*):ti,ab,kw and (admission or readmission or hospitali*ation):ti,ab,kw, from 2000 to 2009

Figure 1. QUORUM Diagram



no statistically significant difference in readmission rates. This study showed low risk of bias in randomization, but outcome assessors were not blinded to study group. Methods of gathering data varied (interviews were conducted in clinics, in the patients home or over the telephone), which may have led to inconsistent reporting and therefore incomparable data. This study highlighted the effect of the cohesive team structure at one clinic base, and the study would benefit from being repeated in other clinic settings to establish external validity.

Hughes et al, 2000

Hughes et al (2000) studied a home-based primary care model (HBPC). Very-high-risk-of-admission patients (i.e. hospitalized patients) were allocated a primary care manager and 24-hour contact was available. The HBPC multi-disciplinary team carried out discharge planning for patients readmitted to hospital; and patients could be transferred to step-down beds if necessary. Control group subjects were 'encouraged to speak to their physicians about aftercare needs' (Hughes et al, 2000), and were able to access any available services apart from the HBPC. Results showed no statistically significant effect on readmission rates. This was a large randomized multi-centre trial and low risk of bias was detected in the sequence generation and, although participants and clinicians were not blinded to allocation, outcome assessors were. Missing outcome data was fully explained, and similar numbers from the intervention and control groups were lost to the study.

Sommers et al, 2000

Sommers et al (2000) studied a model in the United States called 'Senior Care Connections' (SCC) that involved collaboration between primary care physicians, social workers and nurses. The intervention combined clinic visits and home visiting by the multi-disciplinary team who educated and supported patients in managing their own health. Control patients had access to primary care physicians but did not receive the SCC intervention. The large study group (280 patients in the intervention group and 263 in the control group completed the trial) were medium risk of admission. Though the study randomized physicians rather than patients for ethical reasons, it is unclear whether personnel were blinded to allocation. The study reported data for those who completed the study at the end of year two. Numbers lost to follow-up were fully explained, and similar in number between control and intervention groups. Results showed stable readmission rates in the intervention group at the end of year one, compared with a slight increase in the control group. At the end of year two, a statistically significant difference in readmission rates, in favour of the intervention group, was reported.

This was a large multi-centre trial, however differences were noted in the characteristics of participating practices that may affect data comparison.

Landi et al, 2001

Landi et al (2001) carried out a large multi-site study of an integrated home care model in Italy, that had been adopted nationally since a first trial study by Bernabei (1998). A community geriatric evaluation unit (CGEU) provided both the local health services and those of the municipality, in one integrated centre. This model was based on

comprehensive geriatric assessment and case management. This study was of a number of centres and therefore a large cohort, but rather than using a control group, the study was a before and after comparison study. Roland et al (2005) advises caution when using admission rates as an outcome measure. without a control group for comparison, as there is a tendency for a decrease over time. The study group was taken from the normal population and was therefore judged by this review to have a low risk of admission. Landi et al found that hospitalization rates reduced by 18% in the year following the intervention. This was a large multi-site study with good external validity.

Schraeder et al, 2001

Schraeder et al (2001) studied the effect of patient/family assessment, care planning, disease education and health promotion introduced to primary care clinics by registered nurses and case assistants. Eight clinics were randomized to form intervention and control groups, (530 vs 411). No details were published of the method of randomization. Control subjects received usual care. This gave a large cohort for comparison, and data was collected over 24 months giving sufficient time for the intervention team to become embedded. Outcome assessors, blinded to intervention and control, gathered data by telephone and from administrative records. This study showed no statistically significant difference in rates of hospitalization between the groups. This study used several clinics within one region of Illinois and may therefore be limited in external validity.

Phelan et al, 2002

Phelan et al (2002) studied the health enhancement programme, described by Leveille et al (1998), applied in 14 senior centres in Washington, USA. The intervention focused on the meetings between the patient and geriatric nurse where detailed plans were made that targeted risk factors, e.g. Inactivity, smoking, depression. A range of activities was made available at the centre and patients were encouraged participate in their choice of these. Options for exercise at home were also offered. Subjects attended a 7-week course on self-management and health promotion, in addition to individual counselling. Comprehensive geriatric assessment (CGA) was available from the primary care physician. The intervention appeared to follow the original model in its implementation, but this study reported no reduction in readmission rates. Data was compared pre- and post-intervention. The authors collected admission data directly from patients themselves which has been shown in previous studies to be unreliable (Phelan et al (2002) citing Roberts et al (1996) and Wallihan et al (1999)).

Brand et al, 2004

Brand et al 2004 studied a model of transitional care implemented by a chronic disease nurse consultant. This was a very short-term intervention, the patients being seen once in the hospital and followed up once in an out-patient clinic. Patients were given disease management plans that related directly to the condition and did not appear to be individualized. No improvement was seen in readmission rates in comparison with the control group. The cohort studied was a very high-risk group. Allocation was by ward so there was no allocation concealment and no blinding of staff or outcome assessors.

Caplan et al, 2004

Caplan et al (2004) carried out a randomized controlled trial to test the effect of CGA and multi-disciplinary intervention on hospitalization rates. A nurse assessed patients in the emergency department and then visited at home for up to 28 days. Detailed care plans were developed and necessary referrals were made for follow-up interventions. The cohort was large, with 369 in both the intervention and control group, and showed significant reduction in admission rates for the intervention group at one month and at 18 months. Study cohort was very high-risk group for admission.

There was low risk of bias in the randomization of subjects, although nurses were aware of allocation. More control subjects were lost to follow-up than intervention, but outcome data was adjusted for this.

Young et al, 2005

Young et al (2005) studied the effect of intermediate care (IC) services in the UK. A team of nurses, physiotherapists, occupational therapists and social workers delivered the IC in an integrated way. Patients received treatment either in their own homes or in a residential care setting, following their discharge from hospital. Further detail of the elements of the intervention was not explicit in the publication. Data suggests that admission rate for the intervention group was higher over one month, but that the mortality rate was lower than the control group. The control group were recruited prior to the intervention and were compared with a similar group who received the intervention. It was not clear what interventions were available to the control group. This was not randomized and there was no allocation concealment leading to high risk of bias.

Table 3. Summary of Models of Intervention

	Study setting **Number of participants** (Intervention: Control) **Age range** **Risk of admission**	**Components of intervention in study group** **Length of intervention** **Treatment applied to control group**	**Follow-up**	**Readmission Intervention (I) v Control (C)** **P value** **Confidence Interval (CI)**
Burns et al, 2000 USA	Clinic 49/49 >65 Very High	Interdisciplinary team, key worker, GEM intervention Long term Usual clinic care	1 and 2 years	0.2% vs 0.7% (Mean, 1 yr) 0.9% vs 1% (Mean 2 yr) *P*<0.001 CI not published
Hughes et al, 2000 USA	Home plus managed readmissions 981/985 >60 Very high risk	Team trained in intervention, 24 hour on call, home health care. No detail 12 months Usual care	6 and 12 months	49.2% vs 53.4% *P*=0.07 61.2% vs 63.3% *P*=0.35 No statistical difference in admission rate at 6 or 12 months.
Sommers et al, 2000 USA	Clinic and home visits. 280/263 >65 Medium risk	Primary care physician, registered nurse (with geriatric training), social worker. Geriatricians did 9 training sessions for team. Home assessment by nurse or SW included: listening to health concerns, taking vital signs and health history, functional assessment and home safety check. Team discussed results with physician and drafted a risk reduction plan, discussed this with patient and family to set goals, plan treatment and self-management strategies. Telephone contact, home visits, small group sessions or office or hospital visit every 6 weeks. During contacts new problems discussed, checked chronic disease status,, coached patients in self-management, promoted use of community services. 2 year intervention Usual care.	12 and 24 months	At 12 months: I increased from 0.35 to 0.38 (mean number of admissions C decreased from 0.39 to 0.34 At 24 months I 0.36 mean number of admissions C 0.52 *P*< 0.05 95% CI 0.41 to 0.96 (year 2)
Landi et al, 2001 Italy	Home 1204 subjects evaluated pre- and post-intervention >65	Integrated health and social care. Geriatrician, SW, Physio and nurses. CGA by case managers. Model of care similar to Bernabei et al.	1 year	Reduction in admission rate 44% in year pre intervention, 26% post intervention. *P*<0.001
Schraeder, et al 2001 USA	Clinic and home 530/411 >65 Very high	Primary care physicians, registered nurse and case assistant. Patient/family assessments, detailed care planning, coordination of support services. Routine telephone contact to identify changes in condition and adherence to treatment, disease education and health promotion. Also proactive post illness follow-up. Regular team meetings for case discussion. 24-month intervention. Usual care.	12 and 24 months.	I: 26.4% hospitalised in 1st 12 months C: 21.7% I: 25.0% hospitalised in 2nd 12 months C: 22.6% *P*<0.01 95% CI N/S (year 1) 95% CI 1.3 to 2.6 (Year 2)
Phelan et al, 2002 USA	Senior centre based 275 participants compared pre- and post- intervention. (Number represents those who self reported hospitalization data). >65 Medium risk	Health promotion program. Nurse did initial assessment; health, function and risk factors, developed personalised health action plan. Participants encouraged to enrol in exercise class (Lifetime fitness program), Chronic disease self-management course, paired with a health mentor (volunteer senior). Meeting with SW arranged. One-year program (Not all participants were involved for the full year).	12 month follow up	Pre intervention: 63 hospitalised last 12 months. At 1 year follow up: 64 hospitalised.
Brand et al, 2004 Australia	Hospital ward & outpatient clinic 83:83 >65 Very High	Nurse assessment 24hrs prior to D/C, provided patient with action plan, summary to GP, seen in clinic 2 weeks post D/C, review action plan, referrals made. Phone contact between clinics if needed. Short term Usual d/c planning by MDT	3 and 6 months	30/83 vs 30/83 (3 mths) 26/83 vs 21/83 (6 mths) *P*=1 *P*=0.70 95% CI 0.591.40
Caplan et al, 2004 Australia	A&E and home visits 370/369 >75 High	CGA in A&E, specialist nurse assessed at home in 24 hours of D/C, Care plan, MDT meeting, referrals made, input for 4 weeks, then referred on. Up to 28 days Usual care	30 days and 18 months of D/C from Intervention.	42/370 vs 51/369 164/370 vs 201/369 *P*=0.312 95% CI –11.4 to 0.0 (30days) *P*=0.0072 95% CI –17.1to -2.7 (18months)

Table 3. Cont.

Coleman et al, 2006 USA	Ward/home/phone contact 379/371 >65 Very high	Transition coach (APN with intervention training) assessed on ward, personal health record introduced, HV arranged (48-72 hours post D/C), phoned/visited weekly, medication assessment, focus on self care training. Structured intervention. 28 days post D/C Usual care	30, 90, 180 days	8,3% vs 11.9% 16.7% vs 22.5% 25.6% vs 30.7% *P*=0.48 95% CI 0.2 to 0.96(30 days) *P*=0.04 95% CI 0.25 to 0.72 (90 days) *P*=0.28 95% CI 0.36 to 0.92 l (180days)
Young et al, 2005 UK	Home or short term care home placement 848/800 High	Interdisciplinary Intermediate Care rehabilitation model, joint health and social care. Nurses varying grades, occupational therapists, physiotherapists, care assistants, dietician, access to community psychiatric nurses. Assessed by each discipline and a care plan developed. Input up to 6 weeks. Usual care	3, 6 and 12 months	I readmissions: 3 months 0.26 (per patient) 6 months 0.44 12 months 0.98 C readmissions: 3months 0.28 6 months 0.41 12 months 0.81 95%CI 3.1 to 13.0
Stott et al, 2006 UK	Home visits 56/28 >65 High risk	Nurse, physiotherapist, occupational therapist, rehabilitation assistants, specialist in geriatric medicine. Individualized home rehab programme, medication review, liaison with other support services including referral to other services such as day hospital, community allied health professionals, Social workers etc. An average of 19hours additional rehab over a mean of 19 domiciliary visits. Usual care.	12 months	I: 64% (36/56) readmitted C: 75% (21/28) *P*< 0.001 95% CI 0.34 to 1.46
Keating et al, 2008 UK	Home visiting and hospital in reach. Intervention practice population 3650 Control practice 11,700 >65 High*	Community Matron and SW based in SS, access to SS electronic record. 'Unique Care' model. Letter, phone call or home visit from GP to complete risk assessment tool. High-risk patients info collated from both health and Social Care record so that patients could be prioritised. Patients then case managed, individual care plans anticipating potential needs to avoid crises. Weekly meeting of team with GP. Hospital in reach for practice patients admitted to hosp to facilitate D/C. (Early warning system set up with hospitals) Pilot 22 weeks Usual care	During the project period	Intervention group 50% fewer admissions compared with prior to intervention. Control 12% reduction in admission. No *P* value or CI given
Peleg et al, 2008 Israel	Clinic care Study clinic year before and after intervention >65 High risk	Geriatrician in liaison with clinic physicians (GP equivalent), trained clinic staff in falls prevention, polypharmacy, and use of benzodiazepines in elderly. Health promotion and disease prevention were emphasised. Early detection of colorectal and breast cancer. Social worker and dietician, nurse working together. Medical staff available by telephone for some patients. Clinic and hospital staff communication.	1 year	Reduction in hospitalization rate of 29.3% for the study clinic from the year prior to the study. For study year 10.3 hospitalizations per 1000 for control region, compared with 10.7 per 1000 for study clinic. *P*< 0.01 No CI given

KEY TO ABBREVIATIONS

Risk of admission: Low: normal population over 65. Medium: Over 65, in receipt of home health or social care and/or with one chronic illness. High: Over 65 discharged from A&E, i.e. not admitted to a ward. Very High: admitted to hospital during preceding 12 months. High* Keating et al (2008) used the Castlefields EARLI questionnaire to assess risk of admission. Key Worker: this term is used where one member of the intervention team assumes a coordination of care role.

CGA: comprehensive geriatric assessment by consultant led team
CM: case management
D/C: discharge
CI: confidence interval
DN: district nurse
APN: advanced practice nurse
SW: social worker
GEM: geriatric evaluation and management

Study name in bold indicates intervention resulting in statistical significant reduction in admission rate.

Table 4.
Risk of bias summary

	Adequate sequence generation	Allocation concealment	Blinding (subjective outcomes)	Blinding (mortality)	Incomplete outcome data	Free from selective reporting	Free of other bias
Burns et al, 2000	Yes	?	Yes	Yes	Yes	Yes	?
Hughes et al, 2000	Yes	Yes	No	?	Yes	Yes	Yes
Sommers et al, 2000	Yes	?	?	?	Yes	Yes	Yes
Landi et al, 2001	No	No	No	No	Yes	Yes	Yes
Schraeder et al, 2001	No	No	No	No	Yes	Yes	Yes
Phelan et al, 2002	No	No	No	No	?	?	?
Brand et al, 2004	No	No	No	No	Yes	Yes	No
Caplan et al, 2004	Yes	No	No	No	Yes	Yes	Yes
Coleman et al, 2004	Yes	No	?	?	Yes	Yes	No
Young et al, 2005	No	No	No	No	Yes	Yes	?
Stott et al, 2006	No	No	No	?	Yes	Yes	?
Keating et al, 2008	No	?	?	?	Yes	Yes	?
Peleg et al, 2008	No	No	No	No	Yes	Yes	?

Coleman et al, 2006

Coleman et al (2006) developed a model of transitional care that focused on encouraging patients and carers to take a proactive role in their care. The subjects were those over 65 who had been admitted to hospital (very high risk of admission), and were randomly assigned to either intervention or control groups, (379 vs 371). Randomization showed low risk of bias, but allocation was not concealed. This intervention significantly reduced re-hospitalization rates at 30, 90 and 180 days. Similar numbers in both groups were lost due to mortality or drop out before the end of the study period.

This study did not give detail of what interventions, if any, were applied to control subjects.

Stott et al, 2006

Stott et al (2006) studied a model that combined CGA with home-based rehabilitation, carried out by a nurse, a physiotherapist, an occupational therapist and rehabilitation assistants. The team worked closely together to devise individualized rehabilitation programs, medication management and coordination of support services. Subjects were randomized to intervention or control groups (56 intervention, 28 control). At 12 months follow-up, the intervention group showed slight reduction in readmission rates. However, the control group was half the size of the intervention group, so sensitivity was lessened. Subjects were assigned according to GP areas where the intervention was or was not available, which may have led to differences between the comparison groups. This was a small study with therefore limited external validity.

Keating et al, 2008

Keating et al (2008) studied an integrated model in the UK, in which a GP led team included a social worker and a community matron. The team identified patients over 65 at risk of hospital admission for case management over the study period. The team also planned discharge and home follow up for patients from the practice admitted to hospital. Although it is unclear from the published data how many patients were actively managed, the study reports a reduction in admission rates for the intervention practice. This study compared subject from different GP practices and it is unclear whether these had similar characteristics. The publication gave little detail of how admission data was generated. This was a short-term (2 week) pilot study with no follow-up data reported.

Peleg et al, 2008

Peleg et al (2008) studied a multi-dimensional intervention that combined CGA, integrated and transitional care with disease prevention and health promotion. Liaison with the local hospital promoted reduced length of stay and reduction of waiting time for elective and out patient procedures. This intervention showed significant reduction in hospitalization rates over twelve months. This study evaluated the intervention by comparing data pre- and post- study. Data was presented using hospitalization rates per thousand patients, but it is unclear how many patients received the intervention. The study group had higher rate of hospitalizations compared with the comparison group so there was a potential for risk of bias in the data.

Table 5.
Intervention components

Intervention component	Effective interventions							Nil effect/Negative interventions					
	Somers 2000	Landi 2001	Caplan 2004	Coleman 2004	Stott 2006	Keating 2008	Peleg 2008	Burns 2000	Hughes 2000	Schraeder 2001	Phelan 2002	Brand 2004	Young 2005
Sructured intervention	x	x	x	x	x	x	x	x		x	x	x	
Team training in intervention	x	x		x			x		x				
Comprehensive geriatric assessment		x	x		x	x	x	x					
Multi-disciplinary collaboration	x	x	x		x	x	x	x					x
Individualized care plan	x	x	x	x	x	x	x			x	x	x	
Patient education	x			x			x	x		x	x	x	
Patient self-management	x			x			x			x	x	x	
Treatment in hospital prior to discharge	x		x	x									x
Post-discharge treatment only		x					x	x	x	x			
Treated in clinic setting		x					x	x		x	x	x	x
Home treatment	x	x	x	x	x		x			x	x		
Long-term intervention >3 months		x			x			x	x	x	x		
Short-term intervention <3 months	x		x	x			x						x
Intervention for <1 month												x	
On call service									x			x	
Medications management	x			x	x		x			x		x	

DISCUSSION

Seven of the studies showed a statistically significant decrease in hospitalization rate; Sommers et al, 2000; Landi et al, 2001; Caplan et al, 2004; Coleman et al, 2006; Stott et al, 2006; Keating et al, 2008; and Peleg et al, 2008.

Six showed a negative or nil effect; Burns et al, 2000; Hughes et al, 2000; Schraeder et al, 2001; Phelan et al, 2002; Brand et al, 2004; and Young et al, 2005. All these studies were of complex interventions applied to varying subjects ranging from very high risk of admission to low risk.

The aim of this review was to establish what components contribute to the effectiveness of an intervention so a list of intervention components was plotted against the list of studies, in table form, to see if a pattern emerged (*Table 5*).

One of the features of successful interventions (in terms of reduction in readmission rates) was that the intervention was clearly structured and defined, with the team meeting regularly for case discussion and collaboration. Established teams appeared to be more successful, with reduction in readmission rates becoming greater over time as the team and the intervention became more embedded (Sommers et al, 2000; Schraeder et al, 2001). Hughes et al (2000) noted that different centres had significant changes in structure or staffing during their study. This may have led to differences in results from different centres, however reporting was collective so potential benefits at individual sites may not have been revealed. Control subjects could access other available services and were 'encouraged' to do so, which may have resulted in them accessing other effective intervention components. Burns et al (2000) combined a structured intervention and MDT collaboration, however patients were seen in clinic and not at home. Assessing patients in the home appears to improve the success of the intervention. Time between clinic and telephone follow-up was several months so any benefits of clinic intervention may have been lost. More regular follow-up may be needed to result in lasting health benefits.

There was no record of home assessment in the model applied by Brand et al (2004), which may have been a vital component in ensuring problem identification was thorough. The short-term nature of this intervention may also have contributed to its ineffectiveness. Individualising care plans featured in all successful interventions.

The model of care applied by Schraeder et al (2001) was aligned to a medical rather than the

rehabilitative approach and lacked MDT collaboration. This may have resulted in medical treatment being applied to deteriorating health resulting in referral and admission. Phelan et al (2002) and Schraeder et al (2001) applied structured interventions, individualised care plans, but lacked MDT collaboration, which may have impacted on their effectiveness. Phelan et al collected admission data directly from patients themselves, which has been shown in previous studies to be unreliable, (Phelan et al, 2002 citing Roberts et al, 1996 and Wallihan et al, 1999). To fully evaluate the effect of this intervention on readmission rates, it would be useful for more reliable data, for example from insurers, to be available, as it was in Leveille et al's (1998) study.

Keating et al (2008) reported a decrease in readmission rates but an analysis of their publication revealed little significant detail of the intervention and risk of bias was very hard to assess. For the purposes of comparison, this study adds little to what is already known.

Coleman et al's (2006) model of transitional care recognises the patient and carer as central to the transition. By supporting and empowering these, Coleman et al, succeeded in reducing admissions. The authors claim that by devising a care plan to address reasons for the initial hospital admission, patients are guided to understand and plan for future deterioration.

LIMITATIONS

The author was unable to search grey literature or to collaborate with other experts in this field due to time restraints and would recommend that this be done for future research.

Analysis of interventions was based on the publications of selected studies. In some instances the intervention may have been better described than in others. This may have led to some components, that were in fact present within treatments, but that were not explicit, being inadvertently omitted from the analysis. Further research is required to explore each intervention in greater depth, either by contacting the authors and/or examining full text research papers. Authors may edit out details when presenting their research, owing to publishing limitations, thus omitting detail required by this study.

This study only considered admission rate as an outcome measure. Clearly these models of intervention have greater value in terms of functional improvement, quality of life and perceived wellness of patients. Further study is needed to include other outcome measures.

CONCLUSIONS

The findings of this study would seem to indicate that the most effective models in preventing older people being admitted to hospital are provided by established, integrated teams in the patient's home. Such models persistently incorporate elements of comprehensive geriatric assessment; care planning, disease management and health promotion. There is some evidence to suggest that prior to discharge, an approach that provides continuity of care during the transition (hospital to home) increases effective prevention of readmission. Multi-disciplinary teams that are trained and/or experienced in delivering a clearly defined model of intervention appear to have more successful outcomes.

This review recommends that a more in-depth analysis be carried out to substantiate conclusions drawn and to include the other outcome measures previously mentioned. Treatment models that are designed to reduce hospitalization need also to be effective in improving quality of life and independence. Cost effectiveness also must be considered if interventions shown to be effective, are to be delivered to a growing population of older people. This would provide the evidence to underpin future development of intermediate care services, primary care of the elderly and those with chronic illness. IJTR

Conflict of interest: none

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KEY POINTS

- Complex interventions can only be analyzed if their components and method of delivery are clearly defined.
- Well established, integrated health and social care teams, working with people in their own homes, are more successful in preventing hospital admission.
- Older people who are supported and empowered to manage their own health are less likely to be readmitted unnecessarily.
- Further study of complex interventions is required to measure their affect on other outcome measures and also to ensure cost-effectiveness.

COMMENTARIES

The management of the continuity of care is a fundamental issue, especially because of increasing number of elderly with complex care needs. Such complex care needs require the contribution of several providers and personnel, and is often provided in different settings. A good level of integration is needed between these actors, and a lack of coordination can frequently lead to unnecessary hospital admissions. These admissions could be successfully treated in the community through a variety of interventions.

This article reviews a several different sets of interventions aiming to reduce the costly acute hospital admissions of the elderly, trying to identify features which make them effective or ineffective, and providing suggestions for preventing readmission to hospital. The methods were clearly stated, and research was carried out finally focusing on 13 articles, dating from 2000 to 2009.

The findings show what pattern of features makes complex interventions effec-

tive and, subsequently what the most effective intervention model would look like. The presence of multidisciplinary teams, which are trained and/or experienced in delivering clearly structured interventions, especially in the patient's home, seems to be a successful model preventing older people from readmission to hospital. Comprehensive geriatric assessment, care planning, disease management and health promotion could be incorporated into this model.

Continuity of care

Some evidence suggests that continuity of care during the transition period (from hospital to home), planned before the discharge, could increase effectiveness of treatments. According to these findings, the black box of effectiveness of community delivered interventions in preventing hospital admissions of the elderly, has been opened, with scientific criteria providing useful synthesis of primary data. This contribution could enforce the role of primary health care for the elderly. In fact, long term care, together with individual prevention activities, first contact with patient, and chronic disease management, can be seen as main target of primary health care.

> "Some evidence suggests that continuity of care during transition period (hospital to home) planned before the discharge could increase effectiveness of treatments."

In addition, evidence reported in this article is coherent with the main features of primary health care: accessibility, longitudinality, comprehensiveness and coordination of care.

Conclusions

In perspective this paper provides also the opportunity for the scientific community of improving research focusing on other outcomes that can be achieved through this model of integrated care for the elderly apart from hospitalizations. Further cost effective analysis might represent another useful issue rising from this interesting study.

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No-one wishes to deny elderly people admission or readmission to hospital for potentially life-saving treatment. However, hospitalization is in itself a risky business. About 850 000 medical errors occur in NHS hospitals every year, resulting in 40 000 deaths, and it is noted that adverse events are more common in the elderly (Aylin et al, 2004). In addition, all health care professionals dealing with older people will be aware of several occasions where hospital admission has robbed individuals of their independence. Older people often have well formulated routines, and those with cognitive impairment are particularly susceptible to losing fragile coping strategies as a result of participating in the highly structured nature of ward routines. The limited ability to mobilize in hospital, and a restriction of personal space can in some cases render patients effectively bed-bound – a dangerous side-effect of hospitalization, as bed-bound individuals lose muscle strength at a rate of 2–5% per day (Harper and Lyles, 1988).

Addressing concerns

In-patient Intermediate Care units go some way to addressing these concerns, by encouraging residents to take their own medication where deemed safe, to dress and sit out as they would do at home, and to ensure regular mobilization. However, there can be no doubt that avoidance of readmission to either hospital or an Intermediate Care unit is the best strategy, when the individual can remain at home.

> "Hospitalization is in itself a risky business."

Batty addresses exactly this issue in the systematic review. Older people are an extremely heterogeneous group and it is not unexpected that there is some contradiction between studies as to the effectiveness of certain intervention components – 1000 older people in one study may be very different from 1000 in the next. Multidisciplinary teams also differ greatly and the drive and enthusiasm of the individuals involved may well be as important as the service setup. It is also of no surprise that the most effective interventions are those where members of different disciplines collaborate and work together to achieve a common goal – this is very much in keeping with standard geriatric medicine practice.

Unfortunately, multidisciplinary interventions such as those included here are costly to set up and maintain, and in the current turbulent financial situation, a strong body of evidence is needed to justify such services. In addition to the necessity of further work looking at alternative outcome measures as recommended, there must surely also be a case for work looking at 'case selection' i.e. who are those most at risk of readmission, and who are those most likely to benefit from the allocation of precious resources?

Conclusions

Batty is very careful to assess for bias amongst the studies included in the review. High standards of care of older people is often driven by enthusiasts, and when positive results are reported it is important to keep in mind that trial settings are often unrepresentative of the realities of day-to-day health and social care settings. It was reassuring to read however that established teams seemed to be more successful, with fewer readmissions recorded as the team matured in confidence and experience.

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The provision of hospital beds uses a massive volume of financial expenditure. There are large costs in the infrastructure of hospital based care such as information technology, buildings and equipment. Hospital workers are particularly expensive to train, recruit, manage and monitor for quality. Using the National Health Service in the UK as an example, we see in 2006/07 that £45,436 million was allocated to operating hospitals; this is £750 for every man, woman and child in the UK. In 2000/01 the figure was £28,699 million or £486 per capita (Office of Health Statistics, 2008).

Hospital dangers

Hospitals are also dangerous places with increased risks of morbidity and mortality from acquiring an infection, falling and medication errors. These events are themselves costly by prolonging hospital stay and requiring extra treatment (Plowman et al, 2001; Graves et al, 2003). Individuals who are readmitted may develop worse health and so not return home, and may die in hospital away from friends and family.

Benefits of preventing readmission

By preventing re-admission to hospital there will be economic savings, as well as the potential for gains in duration and quality of life among a high risk group of individuals. The extra costs of effective interventions that reduce risks of re-admission might be completely compensated by the cost savings, and, health benefits may accrue. If this 'win win' outcome can be demonstrated, then high level decision makers should be motivated to make positive investments in effective programmes. Indeed, it would be unethical not to invest in a programme that reduces cost and increases health benefits.

Cost vs. health benefits

Cutting-edge health technologies can increase health benefits, but cost is often increased too. In this situation, decision makers must make a judgement about whether the extra cost is worth the extra benefit, and organizations such as the National Institute for Clinical Excellence adjudicate on these difficult resource allocation decisions (Rawlins and Culyer, 2004). Making decisions to invest in programmes that save costs and increase health are easy, and impediments to these decisions should be removed.

> "Hospitals are also dangerous places with increased risks of morbidity and mortality from acquiring an infection, falling and medication errors."

What features matter?

This article contributes by asking what features of community delivered interventions matter. The role of good teamwork and clear communication seem to be important, to get good outcomes; this point was also made by Atul Gawande in his excellent book '*The Checklist Manifesto: How to Get Things Right*'. He gives health and non-health examples of how checklists, teamwork, planning and good communication reduce mistakes and compensate for human ineptitude that arises in complex situations like healthcare delivery.

Addressing a problem early, in the patient's home, before the consequences spiral out of control also seem to be important, as does motivating and empowering patients. These make sense to us; and some recent research done in Australia (Courtney et al, 2009) showed that for older adults the prescription of an individualized programme of exercise strategies, and nurse-conducted home visits and telephone follow-ups, reduced emergency re-admissions from 47% to 22%, with this reduction being statistically significant.

Conclusions

The next step for researchers might be to make the full economic argument for the adoption of these potentially valuable interventions, and disseminate the results in high quality journals. This work would compare the change in cost with the change to health benefits, measured by quality adjusted life years (QALYs). To achieve this cost-effectiveness modelling studies might be done.

This flexible method has real advantages over the use of economic evaluation alongside clinical trials, for which one data source is used to construct the economic argument. Modelling studies could compare the 13 interventions reviewed, side by side, which is something that could never be achieved in one clinical trial. Randomized controlled trials are often based on strict criteria, which mean it is difficult to generalize the results. Modelling studies can synthesise evidence and data from multiple sources and so describe outcomes that are likely to occur after the endpoint of a trial. Of course, the analyst must be skilled in handling heterogeneity across patient groups, time periods and settings, and uncertainty, when they draw their conclusions.

> "The next step for researchers might be to make the full economic argument for the adoption of these potentially valuable interventions."

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Older people are the largest consumers of healthcare resources in the West, and a significant part of the cost stems from hospitalization (Peleg et al, 2008). Finding alternatives to hospital admission is a key driver of UK health and social care policy, but there is inconsistent evidence on their benefits. Inter-disciplinary programmes aimed at decreasing admission/readmission rates, mainly for older people, are based on the assumption that improved standards of care will reduce (re)admissions, lead to optimal use of resources and lower costs (Peleg et al, 2008). However evidence is inconsistent and many methodological problems make studies difficult to compare, as Batty's systematic review found.

Readmission rates and factors

About one-third of all readmissions occur within a month of discharge (Benbassat and Taragin, 2000) and rates, which are particularly high for those over 75 years, have 'consistently shown a rising annual trend', from 10% in 1998/9, to 14% in 2006/7, (Zerdevas and Dobson, 2008: 5). Conversely, length of stay for readmissions in the 75+ age group has decreased from 15.94 days in 1998/9, to 13.89 days in 2006/7 (Zerdevas and Dobson, 2008).

Many older people, their families (and perhaps their occupational therapists) may support the commonly held assumption that readmission reflects poor quality care in the original admission, including too early discharge, but data on global (all-cause) readmissions appear to be a poor measure of quality (Benbassat and Taragin, 2000). It is extremely difficult to disentangle the many contributing factors either in general, or for particular patient groups. Although readmissions are more frequent in the over-75s, chronological age is not a good prognostic indicator per se; frailty and progression of chronic diseases are more closely linked with poor health outcomes (Benbassat and Taragin, 2000; Gonseth et al, 2004; Morgan, 2009).

Zerdevas and Dobson (2008) looked at individual indicators of readmission (age, gender, diagnosis, method of admission of the original hospital stay, operation, geography and socio-economic status) and found that none of them fully explain the rising trend. Contrary to expectations, their review found extremely small correlations: 'providing no evidence for the hypothesis that decreases in the length of stay have led to a higher rate of (avoidable) readmissions' (Zerdevas and Donson, 2008: 7). They suggest that some readmissions reflect poor care, but many do not. A review of studies published between 1991–1998 found a wide range, 9–48%, of readmissions judged to be preventable (Benbassat and Taragin, 2000). Mayhew (2009: 269) draws attention to the 'complex interplay between patient characteristics, referral behaviour by medical professionals and other factors'.

> "Rates, which are particularly high for those over 75 years, have 'consistently shown a rising annual trend'..."

There are many different models of intervention, but it is unclear what specific contribution each of a programme's elements, including the method of delivery, makes to the final outcome. Nor is the effect of specific diseases on outcome clear (Peleg et al, 2008) or what specific type of intervention is best suited to each type of patient (Gonseth et al, 2004). Common components include: an individualized care plan; patient/carer education and support (to increase adherence to treatment and/or self-efficacy); telephone follow-up; home visits; home-based rehabilitation; and inter-disciplinary working to ensure continuity of care (Stuck et al, 2002; Gonseth et al, 2004; Peleg et al, 2008; Windle et al, 2010; Batty, 2010). However it can be seen from Batty's review just how diverse the programmes are, and how difficult it is to identify which components are most effective, who will benefit the most, and the appropriate intensity and duration of intervention.

Gonseth et al's meta-analysis (2004) outlines the many potential sources of bias within studies, and the difficulties of comparing different age groups, settings, interventions, intensity, duration, and outcome measures. Many studies also omit to control for confounding factors, such as co-morbidity, or adequately to describe 'standard care'. Nor do they explore the service user or carer's perceptions of intervention. Length of intervention is often surprisingly short considering the complex and long-term needs of the patient groups at which most programmes are aimed.

Conclusions

If readmission rates are a poor indicator of quality care and tell us little about improvements in quality of life, what else could be used? Beswick et al's meta-analysis (2008) identified outcomes such as autonomy, independent decision making, and improved self-efficacy. Attainment of personal goals, such as ability to go out alone or to carry out an enjoyable activity, could be outcome measures although they are obviously subjective and not amenable to cost-effective analysis.

Despite the lack of clear evidence in most systematic reviews and meta-analysis, the National Evaluation of Partnerships for Older People Projects (2010) clearly advocates for multi-agency and multi-disciplinary working to develop services for older people. The emphasis is on moving beyond maintenance of function towards improvement of independence, quality of life, health promotion and involvement of older people in the design and implementation of services (Ryburn et al, 2009).

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