Interventions to reduce unplanned hospital admission:

a series of systematic reviews

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Executive summary

Background

Approximately 40% of hospital admissions in England are unplanned admissions (2009/10). Unplanned hospital admissions (UHA) are a problem for health systems internationally as they are costly and disruptive to elective health care, and increase waiting lists. Recent policy in the UK and elsewhere has focused on reducing UHA.

To reduce the burden on elective health care and resource use in the long term, it is therefore important to manage UHA. In order to do this we need to fully understand which interventions are effective in reducing UHA. There have been a small number of community or societal level public health or policy interventions aimed at reducing UHA. These approaches have been variable and generally inconclusive.

Therefore there was a need for a series of comprehensive systematic literature reviews that would identify interventions that address organisation of care and access for the purpose of reducing UHA.

The overall aim of this series of systematic reviews was to evaluate the effectiveness and cost-effectiveness of interventions to reduce UHA. Our primary outcome measures of interest were reduction in risk of unplanned admission or readmission to a secondary care acute hospital, for any speciality or condition. We planned to look at all controlled studies namely randomised trials (RCTs), controlled clinical trials, controlled before and after studies and interrupted time series. If applicable, we planned to look at the cost effectiveness of these interventions.

Key findings

Case management: RCTs found by our searches covered older people, heart failure and COPD patients. Overall case management did not have any effect on UHA although we did find three positive heart failure studies in which the interventions involved specialist care from a cardiologist.

Specialist clinics: RCTs found by our searches covered heart failure, asthma and older people. Overall specialist clinics for heart failure patients, which included clinic appointments and monitoring over a 12 month period reduced UHA. There was no evidence to suggest that specialist clinics reduced UHA in asthma patients or in older people.

Community interventions: A small number of RCTs based on home visits were found by our searches and covered older people, mother and child health and heart disease. Overall,

the evidence is too limited to make definitive conclusions. However, there is a suggestion that visiting acutely at risk populations may result in less UHA e.g. failure to thrive infants, heart failure patients.

Care pathways and guidelines: Care pathway systematic reviews have been conducted across conditions as well as for specific diseases such as gastrointestinal surgery, stroke and asthma. Guidelines have been reviewed similarly across conditions. There is no convincing evidence to make any firm conclusions regarding the effect of these approaches on UHA, although it is important to point out that data are limited for most conditions.

Medication review: RCTs found by our searches covered the older people, heart failure and asthma. There was no evidence of an effect on UHA in older people, and on those with heart failure or asthma carried out by clinical, community or research pharmacists. It is important to note that the evidence was limited to two studies for asthma patients.

Education & self-management: This was a topic covered by recent Cochrane reviews. Our searches found RCTs covering asthma, COPD and heart disease. Cochrane reviews concluded that education with self-management reduced UHA in adults with asthma, and in COPD patients but not in children with asthma. There is weak evidence for the role of education in reducing UHA in heart failure patients.

Exercise & rehabilitation: This was a topic covered by recent Cochrane reviews. Our searches found RCTs covering COPD, heart disease, stroke and older people. Cochrane reviews conclude that pulmonary rehabilitation is a highly effective and safe intervention to reduce UHA in patients who have recently suffered an exacerbation of COPD, exercise-based cardiac rehabilitation for coronary heart disease is effective in reducing UHA in shorter term studies, therapy based rehabilitation targeted towards stroke patients living at home did not appear to improve UHA and there were limited data on the effect of fall prevention interventions for at risk older people. The data that were available suggest they did not influence UHA.

Telemedicine: Telemedicine has been extensively researched in primary studies as well as extensively assessed in systematic reviews and meta-analysis. A recent programme of work called the Healthlines study carried out in the School of Social and Community Medicine at the University of Bristol in collaboration with the Universities of Sheffield and Southampton included a meta-review of home-based telehealth for the management of long term conditions. Whilst the focus of their work was not specifically the reduction of UHA, their final report included relevant systematic reviews or meta-analyses which described the effect of

telehealth on UHA. Telemedicine is implicated in reduced UHA for heart disease, diabetes, hypertension and the older people.

Vaccine programs: We identified a series of Cochrane reviews looking at the effect of influenza vaccinations on a variety of vulnerable patients. A review on asthma patients reported both asthma-related and all cause hospital admissions. No effects on admissions were reported. A review on seasonal influenza vaccination in people aged over 65 years old looked at non-RCTs. The authors concluded that the available evidence is of poor quality and provides no guidance for outcomes including UHA. A review on health workers who work with the elderly showed no effect on UHA.

Hospital at home: This was a topic covered by a recent Cochrane review of hospital at home following early discharge. Readmission rates were significantly increased for older people with a mixture of conditions allocated to hospital at home services.

We found insufficient evidence (a lack of studies) to make any conclusions on the role of finance schemes, emergency department interventions and continuity of care for the reduction of UHA.

Conclusions

This review represents one of the most comprehensive sources of evidence on interventions for unplanned hospital admissions. There was evidence that education/self-management, exercise/rehabilitation and telemedicine in selected patient populations, and specialist heart failure interventions can help reduce unplanned admissions. However, the evidence to date suggests that majority of the remaining interventions included in these reviews do not help reduce unplanned admissions in a wide range of patients. There was insufficient evidence to determine whether home visits, pay by performance schemes, A & E services and continuity of care reduce unplanned admissions.

The results of this review are important for policy makers, clinicians and researchers. Some of the findings may be disappointing but it is important to remember that some of the interventions may have demonstrable impact in other areas, for example case management appears to reduce length of hospital stay. In addition, in many health care economies a number of interventions are introduced across the system. Few research studies include evaluation of system wide approaches, hence the impact of programmes of interventions are rarely reported in the research literature. This highlights the importance of robust evaluation of interventions as they are introduced into health and social care systems.

1. General introduction

Admissions to hospital are an increasing source of pressure on health system resources internationally. In the National Health Service (NHS), changes to commissioning arrangements have increased the focus and drive to reduce hospital admissions.{Purdy 2011} Approximately 35% of hospital admissions in England are unplanned admissions costing 11 billion per annum (2010/11). Unplanned admissions represent 36.7% of hospital admissions in England (5.3 million admissions in 2010/11). {Hospital Episode Statistics} Unplanned hospital admission rates vary between geographical areas from 90 to 139 per 1,000 people. The difference in admission rates between emergency departments is even greater, varying from around 8 per cent to 36 per cent of all hospital emergency attendances. {Wanless 2003} This situation is significant not only because of the unacceptable variation, but also because of the high and rising unit costs of unplanned hospital admission compared to other forms of care, and because of the disruption emergency admissions cause to elective health care, most notably in-patient waiting lists, and to the individuals admitted.

To reduce the burden on elective health care and resource use in the long term, it is therefore important to manage unplanned hospital admissions. In order to do this we need to fully understand which interventions are effective to reduce unplanned hospital admissions. In the NHS there have been community, population and policy level interventions aimed at reducing unplanned hospital admissions but these have had little impact on admission rates. {DOH 2005}

A need was therefore identified for a series of comprehensive systematic literature reviews of the effectiveness of interventions that address the organisation and delivery of care and access to care, with the purpose of reducing unplanned hospital admissions.

2. Methods

This systematic review was carried out across a wide range of electronic databases (Appendix 1, table 1) to identify all studies of interventions used to reduce unplanned hospital admissions.

Inclusion and exclusion criteria

Inclusion criteria were: all controlled studies namely randomised trials (RCTs), controlled clinical trials, controlled before and after studies and interrupted time series, in which one of the outcomes was number of unplanned hospital admissions or readmissions; that were either published in English or had an English abstract; that were carried out in an Organisation for Economic Co-operation and Development (OECD) country. This latter criterion was chosen so that the results could be broadly applicable to the UK and other similar health systems. {OECD 2011}

Unplanned, emergency or unscheduled hospital admissions were defined as 'Admission or readmission with an overnight stay that was not previously planned or scheduled or "elective".

Studies were excluded if unplanned admissions could not be separated from planned or elective admissions using data provided in the paper or by the authors.

Searches

The search strategy (Appendix 1) was designed in OVID Medline using a combination of text words and Medical Subject Headings. Using a set of key papers known to the group, the strategy was further refined to ensure a good balance of sensitivity and specificity. For the rest of the databases search terms were adapted according to the search capabilities of each particular database. Searches were from inception to June 2010. (Appendix 1)

A methodological filter from the Cochrane Effective Practice and Organisation of Care Group (EPOC) was applied, to retrieve study designs considered eligible for the review. {Cochrane EPOC group 2011}

The following websites were searched using the key term of 'hospital admissions':

Agency for Healthcare Research and Quality (AHRQ) http://www.ahrq.gov/, Centre for Reviews and Dissemination (CRD) http://www.york.ac.uk/inst/crd/, EPPI-Centre http://eppi.ioe.ac.uk/EPPIWeb/home.aspx and the King's Fund http://www.kingsfund.org.uk/.

In addition, experts in the field were consulted; reference lists of all included studies and previous systematic reviews were checked for additional relevant publications.

Data collection and analysis

Selection of studies

Two reviewers independently screened each reference title and abstract (if available) for relevance to this review. Where there was disagreement, a third reviewer made the final decision.

For citations that were included from the first round of screening, the full article was obtained. The second round of screening involved one of two reviewers assessing full articles based on the agreed inclusion/exclusion criteria. Only non-English articles reaching the second round were translated in full to English. Exclusions were checked by a third reviewer at this second screen. Data were extracted by one reviewer, into Cochrane Review Manager Software version 5.1 and then checked by a second reviewer. (Appendix 1, Figure 1 PRISMA diagram).

For interventions where there were a number of RCTs available we have not included non-RCTs in the reviews. However, in some areas there were no RCTs identified and therefore other study types have been included. (Appendix 1, Figure 1 PRISMA diagram).

Assessment of risk of bias in included studies

The risk of bias was assessed in each study using the Cochrane risk of bias tool. This is a domain based evaluation, in which critical assessments are made separately for seven domains: sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessors, incomplete outcome data, selective reporting and other sources of bias. Each domain is rated as high, low or of unclear risk of bias. {Higgins 2009}

Data synthesis

Outcome data in the included studies were reported in different formats: total number of unplanned admissions or readmissions and number of patients experiencing (single or multiple) admission or readmission. We attempted to contact authors if data were incomplete or were not in a usable form.

The outcome of number of patients with an admission or readmission was treated as dichotomous and using Review Manager v 5.1, individual risk ratios were calculated. Total numbers of admissions were treated as count data and relative rates calculated. {Higgins 2009} Both risk and relative rates are presented with their 95% confidence intervals (95% CI).

If there were at least three studies in which admissions or readmissions were measured a meta-analysis was performed with a fixed or random effects model depending on the level of between study heterogeneity estimated using the I^2 statistic. {Higgins 2009}

Patient & public involvement

We recruited a patient advisory board in June/July 2010. The first meeting was in September 2010 and through structured discussion we developed a list of their priorities for inclusion in the review. These included interventions or features of interventions to prevent UHA. Recruitment of patients was facilitated by Hildegard Dumper and David Manning from Bristol PCT. An invitation was written and Hildegard contacted a variety of local support groups/specialist clinics. The majority of interested people either contacted David or Alyson Huntley directly by email. A couple of people phoned for more information. Ten people expressed an interest in attending, once a date was set six people confirmed they would attend. On the day, five people attended. Nine of the original ten were happy to have their details kept for future contact and meetings. The remaining person felt she was not suitable for the group.

Main points from patient and public involvement group: these points were taken into consideration when prioritising topics.

- Knew it was essential for me to go into hospital in this case. Happy to stay an extra night for respite from my role as a carer.
- Support from pulmonary nurse every other day for a week/10 days after discharge – invaluable
- Rescue prescription (week's antibiotics/steroids) at home works. Discussion about acceptance about needing to take this type of treatment even though this is preferable to going into hospital (2 people)
- Stressful experience after readmission due to allergic reaction to heart drug – felt 'out of hours' service & NHS Direct were not helpful – "Wait 4 hours or go to A&E". Chaos in A&E on a busy Friday night.

- Day ward was as effective as a hospital admission/overnight stay for blood disorder treatment and preferred by patient.
- Main experience of A&E for acute care (fractures). Main source of support for an older person's clinic which including more appropriate prescriptions.
- Social services adaptations to own home useful to continue normal living.   (2 people)
- Limited information/access to some therapies which have helped e.g. hydrotherapy, acupuncture. GP not really helpful for this.
- Discussion about GPs: continuity of care important, one participant had experience of a different GP nearly every time and had to repeat medical history. Felt there was no specific support for condition.   We discussed specialist GP/clinic would be helpful.
- Emergency doctor/'out of hours' service generally felt not to be useful
- For general illness, first port of call GP. Some participants phone surgery and know/are reassured that their GP will phone back because they know them, and their condition.
- Any symptom that is serious/worrying go to A&E.
- Experience of paramedics – very calming, very reassuring.
- Continuity of care from community nurses can also be an issue and this is particularity important as often they are providing care which involves personal contact e.g. changing a catheter.
- Participants with chronic conditions who have to pay for their prescriptions. (2 people) There was discussion how even though they are aware of the importance of taking medication consistently – financial situation might mean not always taking medication or making decisions on 'I need to take this one but the other is not so important' It was also pointed out that some medication is cheaper over the counter.
- One participant felt that GP was reluctant to prescribe certain medications that were available through a specialist clinic.
- The importance of health professionals in all settings having access to patient's medical records was thought to be important. e.g. in a walk in centre or another GP surgery.
- Family support was discussed. Overall it was felt that it was important that family and friends were kept in the picture, were given information and therefore could be better involved in care and treatment. Whilst generally it was thought this did happen, there were also some not so positive experiences.

- Communication with GP was generally thought to be good in terms of talking about a patient's condition and its treatment. Also true of results of tests, X-rays etc. being explained. Technology has had helped this process as well. Participants agreed this had improved over the years and that this had not always been the case.

We invited the same group of people back in January 2012, to present our findings by group discussion using vignettes from a related qualitative study and posters that we had presented at various conferences. We talked about keeping in contact for future projects and all our participants were happy for us to keep their details. We also discussed the possibility of patients being more involved in the 'mechanics' of conducting systematic reviews e.g. reading & assessing papers Whilst reservations were expressed at this, within this meeting it was acknowledged that some patients were keen to get involved at this level.

3. Results

Overall, 18, 540 references were identified in our searches. 1530 controlled studies were retained after screening titles and abstracts. These were sorted into topic areas according to intervention type e.g. case management, patient education and then subdivided by clinical area e.g. heart failure if appropriate. The topic areas were prioritised on the advice of the advisory group, taking into account the existence of recent high quality systematic reviews, the available evidnece and the relevance to the NHS and the priorities of the patient advisory board.

Priorisation of topic areas

High priority:

- Case management
- Specialist clinics
- Community interventions

Medium priority
- Care pathways & guidelines
- Medication review
- Education & self-management
- Exercise & rehabilitation
- Telemedicine
- Finance schemes
- Emergency department interventions
- Continuity of care

Low priority
- Vaccine programs
- Hospital at home

The high priority topics of case management, specialist clinics and the medium priority topic of medication review have been written up as academic papers.

Struture of report

All the topic areas listed above are included in this report. We have used three levels of presentation:

- *Systematic review with or without meta-analysis.*

  This was used for topics that have either not been reviewed before or there has been many more studies since previous reviews.

- S*ummary of previous review(s) & brief description of new data.*

  This was used for topics that have been reviewed recently and most likely contain all or most of the studies found in this review.

- *Brief description of reviews or studies.*

  This was used for topics or conditions that are low priority or very little evidence i.e. we want to say we found these studies. Brief description of why we are not covering topic in detail.

Mental health interventions

It was agreed by both our working group and advisory group that we would not focus on interventions specifically aimed at patients with mental health problems as these interventions are tailored for mental health and generally not applicable to other conditions. In addition, these interventions have been well-reviewed by mental health specialists.

A.   Case management

Background

Case management can take on a number of forms and tends to be implemented in different ways in different health systems. The NHS has used less intensive approaches than the traditional US model, for example through the use of health visitors or community matrons to support older people and those with long term conditions at home. {Ross 2011}

Definitions

We used the American Case Management Association's definition of case management "Case Management in Hospital/Health Care Systems is a collaborative practice model including patients, nurses, social workers, physicians, other practitioners, caregivers and the community. The case management process encompasses communication and facilitates care along a continuum through effective resource coordination. The goals of case management include the achievement of optimal health, access to care and appropriate utilization of resources, balanced with the patient's right to self-determination." {ACMA 2011}

Case management usually involves the identification of at risk individuals and is therefore dependent on the use of suitable techniques for risk stratification.   The NHS has used less intensive approaches than the traditional US model, for example through the use of health visitors or community matrons to support older people and those with long term conditions at home. {Boaden 2006}

Results

The search found 37 papers describing case management; nine were excluded. Of the 29 included studies, 11 were in the older population, six were on heart failure, four were on COPD and seven covered a range of other conditions such as cancer, diabetes, dementia and stroke.

Older population *(Appendix 2 Table1)*

The search found 14 papers describing RCTs of case management for the older population; three were excluded. Of the 11 included studies, one RCT was published since our initial searches were undertaken. {Boult 2011} All eligible RCTs of case management for the older population had unplanned hospital admissions as a primary outcome.

Risk of bias (Appendix 3, figure1)

In these 11 RCTs, the randomisation sequence was nearly always described (n=8), allocation concealment was often not (n=7) (Risk of bias figure 1a). Some studies attempted to blind at the assessment stage (n=4). It is important to point out that in RCTs of service interventions; it is not possible to blind the participants. Most studies described attrition and per protocol or intention to treat analysis (n=7). Selective reporting was not apparent in any of the studies. Any bias specific to included studies is detailed below. (Appendix 3, figure 1a-d)

Case management initiated in hospital or on discharge (n=6)

There were two RCTs describing case management initiated in hospital of which one was an intensive advanced practitioner nurse intervention involving 363 patients (mean age 75yrs) and showed a significant decrease in hospital readmissions compared to usual care at six months (relative rate 0.45 [95% CI 0.29, 0.69]). {Naylor 1999} Overall this study was rated as low risk of bias, although as with all the other included studies, there was no participant blinding.

The other RCT involved a team of specialised geriatric health professionals who were providing case management to 545 older patients (no ages given), and showed no difference in hospital readmissions compared to usual care at 12 months (relative rate 0.99 [95% CI 0.66, 1.49]) {Nikolaus 1999} Overall this study, provided insufficient evidence to assess its risk of bias. It also suggested that the clinicians in the hospital received extra training and this may have influenced outcomes by affecting care in the control group.

There were four RCTs that evaluated case management initiated on discharge from hospital of which three showed no significant difference in unplanned hospital admissions between case management and usual care {Avlund 2002} {Lim 2003} {Melin1992} and one showed a reduction in admissions. {Caplan 2004}   There were no biases in these studies which were likely to negatively influence the outcome of the number of readmissions. However, there are biases that have influenced other outcomes measures e.g. some patients had difficulty answering questions and the use of self- reports by carers. {Avlund 2002} {Caplan 2004} Two of these RCTs expressed unplanned hospital admissions as percentage of patients readmitted with the actual numbers being incalculable.{Avlund 2002} {Melin1992} The third study reported number of people experiencing readmissions over 6 months in a study of case management versus usual care in 645 patients (mean age 77 yrs) (relative risk 0.95 [95% CI   0.72,1.26] p=0.73).{Lim 2003} The remaining study reported no reduction in readmissions at one month but a reduction at 18 months comparing case management with

usual care in 739 people (mean age 82 yrs) discharged from the emergency department, (relative rate 0.76 [95% CI 0.53,1.24]) and 0.76 [95% CI 0.62, 0.93] respectively).{Caplan 2004}

We were able to combine data expressed as relative rates in a meta-analysis (random effects model) from three of these six studies. {Naylor 1999} {Nikolaus 1999} {Caplan 2004} to give an overall relative rate of 0.71 [95% CI 0.49, 1.03], p=0.07). (Appendix 4 figure 1a) Whilst this result suggests a small non-significant reduction in readmissions, it is skewed by the one positive study by Naylor *et al.* Whilst there are insufficient RCTs to justify combining the remaining (two) studies in a sensitivity analysis, if the Naylor data are removed the non-significant effect becomes smaller again (relative rate 0.81 (95% CI 0.65, 1.02), p=0.08).

Whilst enumeration of unplanned hospital readmissions was our outcome of interest, it is important to point out that three of six RCTs significantly reduced length of stay during the study period (see *Economic evaluation*s). {Naylor 1999} {Nikolaus 1999}{Lim 2003} The remaining three did not give these data although one study showed a significant increase in the number of days before first readmission with case management compared to usual care. {Caplan 2004}

Community-based case management (n=5)

There were five RCTs which described case management initiated in the community versus usual care for the reduction of unplanned hospital admissions.{Boult 2011} {Bernabei 1998} {Dalby 2000} {Gagnon 1999} {Vass 2008} Data were expressed as total number and mean number of unplanned admissions. Four of these RCTs showed no advantage of case management over usual care. {Boult 2011} {Bernabei 1998} {Gagnon 1999} {Vass 2008} The first study involved 850 people (mean age 78 yrs) at high risk of using health care services. {Boult 2011} Case management was co-ordinated by guided care nurses with the support of a multi-disciplinary team compared to usual care over 6-8 months with a 12 month follow up (mean number of admissions 0.7±1.06 vs 0.72±1.19 respectively).

142 older people (mean age 79 yrs) identified through a postal screening questionnaire were randomised into either nurse-led case management or usual care for a 14 month period in another study (mean number of admissions were 0.4±0.7 vs. 0.3±0.8 respectively). {Dalby 2000} It is important to note that they did not exclude participants with serious, chronic, debilitating diseases.

In the third study, 427 home dwelling people (mean age 81yrs) were identified via hospital records having been admitted to hospital in the previous year.{Gagnon 1999} Nurse led case

management was compared to usual care over a 10 months period (mean no. of hospital admission 0.5±0.8 vs. 0.4±0.7 respectively). It is important to note that the treatment in the control group depended on whether the participants were known to the community centre and centres used different criteria to assess fragility and needs. The fourth study was randomised at municipal level as opposed to participant level focusing on home dwelling older people over the age of 75yrs.{Vass 2008} Home visitors with extra training provided case management compared to usual care from home visitors over a three year period (RR 0.96 [95% CI 0.93,0.98] respectively).

The remaining one RCT described case management compared with usual care for 200 home dwelling people (mean age 81 yrs) who after an initial assessment were visited every 2 months for one year led by GP and supported by a multi-disciplinary team. This study showed a small non-significant reduction in relative rate of unplanned hospital admissions at 12 months with GP led case management compared with usual care (relative rate 0.71 [95% CI 0.45, 1.07]). {Bernabei 1998} A confounding factor of this study was that all participants were already in the home care system so recruitment was from a selected population.

We were able to combine data in a meta-analysis (fixed effect model) expressed as mean number patients experiencing admissions in a meta-analysis from three of these five studies. {Boult 2011} {Dalby 2000} {Gagnon 1999} to give an overall mean difference of 0.05 [95% CI -0.04, 0.15]), p=0.29. (Appendix 4 figure 1b)

As with the case management initiated in hospital studies, we looked at the outcome measures associated with unplanned hospital admissions in these community based studies. These outcomes were emergency department visits, GP visits, specialist clinic/outpatient visits and to a lesser extent length of stay (n=2 studies). Overall, these outcomes were not improved by case management with the exception of the Bernabei study (GP led case management) in which there was a significant reduction in admissions to the emergency department as well as admissions to nursing homes and non-acute hospitals.{Bernabei 1998} (see *Economic evaluations*).

Economic evaluations *(Appendix 2 Table1)*

Five of the 11 RCTs on the older population presented cost-outcome descriptions (partial evaluations) as opposed to full economic evaluations. {Naylor 1999} {Nikolaus 1999} {Caplan 2004} {Lim 2003} {Bernabei 1998}

The one RCT that showed significantly reduced admissions with case management compared to usual care reported cost data showing the case management intervention significantly reducing costs as well as significantly reducing per patient imputed reimbursements. {Naylor 1999} In addition, this study showed significantly reduced mean length of hospital stay and total number of hospital days between case management and usual care (270 vs. 760 total days, 1.53±3.69 vs. 4.09 ±8.35 respectively).

The remaining four RCTs also reported favourable cost-outcome descriptions for case management compared with usual care in spite of an outcome of no significant effect on hospital admissions. {Nikolaus 1999} {Caplan 2004} {Lim 2003} {Bernabei 1998} However, there was a significant difference in the length of hospital stay between case management and usual care in the Nikolaus study, at 12 months (33.5 days [30.4-36.5] vs. 42.7 days[39.8-45.6] p<0.05) and the Lim study at 6 months (3.0 days [2.1-3.9] vs. 5.2 days [3.8-6.7] p<0.05). There was a significant difference in the number of days until first admission between case management and usual care in Caplan study (382 days SE12 vs. 348 days SE 11, p=0.011). In the Bernabei study, there is a significant reduction in admissions to the emergency department (6 vs.17 hazard ratio 0.64 [0.48,0.85] p<0.025).

Heart failure *(Appendix 2 Table1)*

The search resulted in the identification of six RCTs of case management for heart failure of which all the studies had unplanned hospital admissions as a primary outcome. {Laramee 2003} {Naylor 2004} {Rich 1995} {Stewart 1999} {Inglis 2004} {Peters Klimm 2010}

In these six studies, the randomisation sequence was described in all but one study, {Inglis 2004} but allocation concealment was often not (Risk of bias figure 1b). No studies attempted to blind at the assessment stage. All studies described attrition and per protocol or intention to treat analysis described in the methods. Selective reporting was not apparent in any of the studies.

Three out of six of the included RCTs showed no differences between case management and usual care on unplanned hospital admissions. The study by Peters-Klimm actually shows a slight advantage to the control group. The three positive trials are Naylor, Rich, and Stewart. The Naylor study showed a relative rate of 0.55 (95% confidence intervals 0.37, 0.81) in favour of transition case management by an advanced practitioner nurse at 12 months. The Rich *et al* study showed a relative rate of 0.45 (95% confidence intervals 0.25, 0.70) at 3 months in favour of transition case management co-ordinated by a specialist nurse for heart failure patients. Only 6 month follow up data from Stewart are included as these

were the only acute heart failure related readmissions data reported (relative rate 0.58 [95% confidence intervals 0.37, 0.88]). The intervention in this study was a specialist case management nurse on discharge. All three transition case management studies could be expressed as relative rates and so were combined in a meta-analysis (relative rate 0.61 [95% confidence intervals 0.44, 0.83] p=0.002) (Appendix 4, figure 1c).

COPD (*Appendix 2 Table1)*

The search resulted in the identification of 4 RCTs of case management for COPD, one classified as transition case management, one as community-based case management and two recruiting both on discharge and in the community.{Egan 2002} {Hermiz 2002} {Smith 1999} {Sridhar 2008}

In these four studies the randomisation sequence was described in all, although allocation concealment was not described in any of them (Risk of bias figure 1c). No studies attempted to blind at the assessment stage. Two of the studies described appropriate analysis to allow for attrition {Hermiz 2002} {Smith 1999} but the other two were unclear in their methods.{Egan 2002} {Sridhar 2008} Selective reporting was not apparent in any of the studies.

None of the four RCTs showed any effect on unplanned hospital admissions or readmissions compared to usual care, and all of them expressed the outcome in different formats.

Other conditions *(Appendix 2 Table 1)*

Case management RCTs were found on each of the following subjects: Elderly cancer patients (n=1), general medical patients (n=1), dementia (n=2), homeless people (n=1), stroke (n=1) & post myocardial infarction (n=1). {Andersen 2000} {Latour 2006} {Sadowski 2009} {Young 2003} {Bellantonio 2008} {Johansson 2001}{Shelton 2001}

In these seven studies, the randomisation sequence was described in all the studies but one by Shelton *et al* (Risk of bias figure 1d). However allocation concealment was only described in two studies. {Andersen 2000} {Sadowski 2009} No studies attempted to blind at the assessment stage. All of the studies described appropriate analysis to allow for attrition except Shelton *et al*. Selective reporting was not apparent in any of the studies.

Four of these studies showed no significant benefit of case management over usual care for the reduction of number of unplanned hospital admissions. Johansson *et al* reported a benefit of case management for elderly cancer patients aged over 70 years (relative rate

>70yrs 0.37 (0.07, 0.86). In Sadowski et *al* there was an effect of social/health case management over usual care for homeless people but in both these studies it was difficult to substantiate the results because of the way the data were presented (relative rate 0.58 [95% confidence intervals 0.51, 0.68]). Shelton *et al* report that there was no difference in the total number of hospitalisations in intervention and control groups, although the number of people in the intervention experiencing an admission was lower.

Previous reviews

We found three relevant systematic reviews on older and elderly patients. {Beswick 2008}{Batty 2010} {Lupari 2011} The first is a systematic review and meta-analysis of complex interventions aimed at improving physical function and independent living in elderly people and it included unplanned hospital admissions as one of its outcomes.{Beswick 2008} This review included many different types of community based interventions including case management, education, rehabilitation and exercise. The authors calculated in a meta-analysis of fall prevention and community-based care interventions a risk-ratio of unplanned hospital admissions of 0.94 (95% CI 0.91-0.97). Nine of the studies included in this review were in the earlier systematic review, two did not fit their inclusion criteria and one has been published since. The second review was narrative and looked at complex, multifactorial interventions based in the community intended to reduce hospital admissions in older people. {Batty 2010} The authors did not perform a meta-analysis on the data but sought to unpick the interventions to determine effective components of the interventions. They concluded that well-established, integrated health and social care teams, working with people in their own homes were more successful in preventing hospital admissions and unnecessary readmissions than usual care. The most recent review on case management for older people was also a narrative paper incorporating both non-randomised studies and qualitative studies focusing on highlighting the important issues for nursing practice as well as policy and service provision {Lupari 2011} They concluded that whilst the qualitative evidence suggests case management has a positive impact on patients, the quantitative data did not support a reduction in unplanned hospital admissions

There is a pre-existing Cochrane review on clinical service organisation for heart failure. {Taylor 2005} This review included a wide range of inpatient, outpatient & community based interventions, excluding purely pharmaceutical or educational based interventions. Readmissions were one of its primary outcomes. They included eight RCTs of case management excluding two more RCTs that were education based and one further RCT which include visiting a specialist clinic. In this review the authors state that there is weak evidence that case management interventions may be associated with reduction in

admissions with heart failure but that the effective components of case management are unclear. They highlight the results of one high quality trial {Stewart 1999}, that case management may reduce the frequency of unplanned hospital admissions, citing mean all-cause, rather than heart failure, readmissions per month (0.14 (95% CI 0.1, 0.18) vs. 0.34 (95% CI 0.19, 0.49, p=0.03) at 6 months and this effect was maintained at 18 months (0.15 [95% CI 0.11, 0.19) vs. 0.37 (95% CI 0.19, 0.5), p=0.053).Three of our included studies were not in the Cochrane review. Naylor 2004 describes transition case management and so did not fit the inclusion criteria. Inglis 2004 was not included as its participants had atrial fibrillation and Peters-Klimm 2010 was published after the Cochrane review.

Lemmens *et a*l published a systematic review and meta-analysis of integrated use of disease management interventions in asthma and COPD. {Lemmens 2009} All four of the included RCTs were included in this previous review which included case management interventions, using the Effective Practice of Care (EPOC) Cochrane group definition and reported all outcomes. Thirty-six controlled studies were included and 19 RCTs of COPD or COPD and asthma patients of which only two RCTs were classified as describing case management interventions. The authors reported that there was a statistically significant reduction of the probability of at least one hospital admission among patients receiving multiple interventions compared to usual care.

Since the commencement of this review, there have been a number of other relevant reviews published.{Challis 2010} {Goodman 2010}However, none have been as comprehensive, nor have any focused on RCTs or conducted a meta-analysis of included studies. Two research studies on the use of case management in chronic conditions have conducted literature reviews as part of the study methodology. Challis *et al* used previous reviews plus citation tracking to identify studies but again identified no relevant RCTs. Goodman *et al* conducted a systematic review to investigate the types and impact of the contribution of the nurses as case managers in different models of chronic disease management. They cite two non RCTs and conclude that 'There is little conclusive evidence that nurse case managers (advanced practice nurses or community matrons) have been able to reduce emergency admissions or shorten the length of hospital stay.

Summary

This systematic review does not provide evidence to support that the use of case management in addition to usual care leads to a reduction of unplanned hospital admissions in a broad range of patient groups and long-term conditions.

The majority of the 29 studies showed no significant benefit in terms of reduction of unplanned hospital admissions with case management compared with usual care. However, there were seven studies that showed an effect of case management. In heart failure patients, meta-analysis of the transition case management studies showed a beneficial effect. These effects may be due to specialist as opposed to generic case management of heart failure patients. The four studies that showed a benefit of case management and also presented cost data showed that there appeared to be a cost saving associated with the intervention.

There was no evidence to suggest that these studies had a high risk of bias, most were rated at moderate risk. Studies of case management may be very difficult to be blinded from the recipient's perspective. However, is important to point out that many studies lacked information on the potential impact of risk of bias on interpretation of the study findings

B.   Specialist clinics

Background

The objective of a specialist clinic is to utilise optimal management of disease protocols focusing on best possible treatment of the condition, education of patient and family or carer about the signs and symptoms of worsening disease and medication compliance. In the UK, specialist clinics have been set up in both primary and secondary care settings, which may utilise nurses to provide specialist nurse led clinics or multidisciplinary care teams including doctors (GPs or hospital specialists), specialist nurses, dieticians, physiotherapists, pharmacists, psychiatrists and counsellors to help manage long term conditions.

Definition

A specialist clinic provides advanced diagnostic or treatment services for diseases/conditions. Specialist clinics have been set up in both primary and secondary care settings, which may utilise nurses to provide specialist nurse led clinics or multidisciplinary care teams to help manage long term conditions.   In some countries hospital specialists provide outreach services in the primary care setting whereas others utilise short stay observational wards or units in the hospital and outpatient settings.

The objective of a specialist clinic is to utilise optimal management of disease protocols focusing on optimal treatment of the condition, education of patient and family or carer about the signs and symptoms of worsening disease and medication compliance.

The clinic models identified for this review were conducted in outpatient clinics, primary care based or day hospitals or clinics within a community setting. There were a variety of different health professionals conducting the interventions such as specialist nurse-led, combination of doctors (GPs or hospital specialists) and specialist nurses and multidisciplinary teams including dieticians, physiotherapists, pharmacists, psychiatrists and counsellors.

Results

Forty seven RCTs were found of which 26 were included. Of the included studies, there were 10 heart failure RCTs, 6 older people RCTs, 5 asthma RCTs and 5 RCTs of other conditions (stroke (1), COPD (1), coronary heart disease (2)).

Heart failure (appendix 2, table 2)

The studies were assessed according to their duration of follow up and across follow up periods for the intensity of the follow up appointments and if the intervention began prior to hospital discharge. {Atienza 2004} {Blue 2001} {Bruggink 2007} {Capmolla 2002} {Doughty 2002} {Ekman 1998} {Jaarsma 2008} {Kasper 2002} {McDonald 2001 & 2002} {Wierzchowiecki 2006}

3 month follow up

One study had a follow up period of three months.{McDonald 2001& 2002}The intervention utilised both a cardiologist and a specialist nurse and began with education before hospital discharge, with clinic attendance at 2 and 6 weeks post discharge and weekly telephone monitoring throughout the 3 month period. They found that no patients in either the intervention or control groups had an unplanned readmission within 30 days of discharge. After three months there was a significant reduction in the number of unplanned admissions (risk ratio 0.08 95% CI 0.01 to 0.62 rate ratio 0.08 95% CI 0.01 to 0.65).

6 month follow up

There were three studies with a follow up period of six months. Kasper et al utilised a GP, specialist nurse and a cardiologist with monthly clinic visits and occasional home vists and regular telephone contact for the full 6 month follow up period.{Kasper 2002} Ekman *et al* was a specialist nurse-led intervention with clinic visits beginning one week postdischarge and subsequenct visits tailored to the patients needs with regular telephone contact.{Ekman1998} Wierzchowiec *et al* utilised a cardiologist and specialist nurse along with a physiotherapist and a psycologist with clinic visits beginning two weeks post discharge with follow ups at one, three and six months. {Wierzchowiecki 2006} There was a non-significant reduction in the number of patients with an admission (Appendix 4, Figure 2a) (pooled risk ratio 0.83 95% CI 0.65 to 1.07).

12 month follow up

Five studies had a follow up period of 12 months. {Capmolla 2002} {Blue 2001} {Atienza 2004} {Doughty 2002} {Bruggink 2007} Two studies were of high quality with no bias detected other than performance bias. {Blue 2001}{Atienza 2004}   The remaining three studies did not provide enough detail on how allocation was concealed to allow the assessment of selection bias {Capomolla 2002} {Doughty 2002}{Bruggink 2007} with Capomolla *et al* also not providing details on how the random sequence was generated. Other bias was also found in two of these studies with Bruggink *et al* at high risk of selection

bias with only 1 in 3 eligible patients recruited into the study and Doughty *et al* utilising cluster randomisation.

Atienza *et al* used a GP, specialist nurse and cardiologist; the intervention began with patient education before discharge with alternating clinic and GP appointments every 3 months with continuous telemonitoring. Blue *et al* was a specialist nurse-led home based intervention who were attached to a specialist clinic with telemonitoring. Capomolla *et al* utilised a large multidisciplinary team consisting of cardiologist, specialist nurse, physiotherapist, dietician, psychologist and a social assistant in a day hospital setting. The intervention included planned appointments and open access to the day hospital with telemonitoring however the frequency of contacts was not provided. This was the only study to utilise both one on one and group education sessions. Bruggink *et al* used a heart failure physician, specialist nurse and a dietician and had an intensive follow up with clinic visits at 1, 3, 5 and 7 weeks and 3, 6, 9 and 12 months post discharge. Doughty *et al* included a GP, cardiologist and specialist nurse with the fist clinic review occurring two weeks post discharge with one visit every six weeks alternating between GP and specialist clinic. The initial education session was on an individual basis with group education thereafter. Overall these studies showed a 49% reduction (Appendix 4, Figure 2b) in the risk and a 65% reduction in the rate of unplanned hospital admissions (pooled risk ratio 0.51 95%CI 0.41 to 0.63) pooled rate ratio 0.35 (95%CI 0.17 to 0.75).

Capomolla *et al* utilised a day hospital which was a different setting to the other studies included. They also included the youngest group of patients mean (SD) age 56 (8) years compared to 70(10) years Bruggink *et al*, 72.5(7.6) years Doughty *et al*, 75.6 (7.5) years Blue *et al* and median (range) 69 (61-74) years Atienza *et al.* Because of this a sensitivity analysis was conducted to see if any difference was obtained by removing this study from the meta-analyses. There was small increase in the pooled risk ratio to 0.56 (95%CI 0.45 to 0.71) and in the pooled rate ratio to 0.52 (95% CI 0.37 to 0.74) however a significant reduction in unplanned admissions still remained for both outcomes.

18 month follow up

The remaining study had a follow up period of 18 months and looked at the effects of a basic and more intensive intervention against usual care. {Jaarsma 2008} The basic and intensive interventions differed in the number of clinic visits and care providers with the basic intervention being specialist nurse led with four clinic visits with the cardiologist and 9 with the nurse. The intensive intervention had more clinic visits with the nurse (18), with an additional home nurse visitation (2) and multidisciplinary advice sessions (2). The

intervention continued for the whole of the 18 month follow up period. Both the number of patients with an admission and the total number of admissions were provided. There was no evidence of an effect of either the basic or intensive interventions versus the control or for the two intervention groups combined against the control for either risk ratio or rate ratio.

Intensity of follow up visits

In an attempt to establish whether the intensity of the follow up visits were more important than the length of time over which the follow up occurred studies were grouped according to the intensity of their follow up visits (Fig 4). Intensive follow up was defined as those studies with follow up visits once per month or 6 weeks for the duration of their follow up period (n=3, pooled risk ratio 0.96 (95% CI 0.78,1.17 Appendix 4, figure 2c). {Doughty 2002}{Jaarsma 2008}{Kasper 2002} Decreasing intensity were those studies who began with follow up visits every week or once every 2 weeks for the first 2 months following hospital discharge and were then reduced to once every 3 months thereafter (3 studies). {Blue 2001} {Bruggink 2007} {McDonald 2001} Those studies classed as decreasing intensity of follow up showed a significant 58% reduction in unplanned hospital admissions (pooled risk ratio 0.42 95% CI 0.27, 0.65 Appendix 4 Figure 2d). Tailored visits were those studies which provided follow up to suit the individual patients but no further detail was provided (n=2, pooled risk ratio 0.52 (0.14,1.95) Appendix 4, figure 2e).{Capomola 2002}{Ekman 1998} Regular visits were those studies which followed up all patients once every 2-3 months (n=3 studies, Pooled risk ratio 0.75 (0.45,1.23) Appendix 4, figure f). {Atienza 2004} {Jaarsma 2008} {Wierchowiecki 2006} No significant reduction in unplanned admissions were seen for those studies with intensive, tailored or regular follow up of patients throughout the follow up periods.

Inpatient interventions

There were three RCTs which began before the patient was discharged from hospital. {Atienza 2004} {Jaarsma 2008} {McDonald 2001} Two of these three studies showed a significant reduction in unplanned admissions.{Atienza 2004} {McDonald 2001} The remaining study having possible contamination of the control group which would minimising the effect of the intervention. The pooled risk ratio for the three studies was 0.47 (95% CI 0.17, 1.29 Appendix 4, figure f), removing the study with contamination bias led to a significant reduction in unplanned admissions (risk ratio 0.26 95% CI 0.07, 0.92) however both remaining studies had small sample sizes (Appendix 4, figure g).

Risk of bias (Appendix 3, figure 1a)

Overall, the included studies had a moderate risk of bias. There was a lack of detail provided by some studies assessment of bias in areas especially the method of allocation concealment.{Bruggink 2007} {Capomolla 2002} {Mcdonald 2001}, {Wierchowiecki 2006}   It was not possible to blind participants in this type of intervention and this question was therefore rated as high risk in all cases, although some studies did blind the assessors. {Blue 2001} {Bruggink 2007} {Jaarsma 2008} {Kasper 2002} {McDonald 2001} All of the studies used the intention to treat analysis and no reporting or attrition biases were detected in any of the studies. Other sources of bias were found in four studies two of which did not include all eligible patients which is suggestive of a selection bias and in two studies there was possible contamination of the usual care group. {Atienza 2004} {Bruggink 2007} {Jaarsma 2008} {Kasper 2002}

Older population (Appendix 2, table 2)

The studies varied between management and follow up in geriatric evaluation and management clinics in outpatients settings (Toseland 1996} {Englehardt 1996} {Burns 1995} and primary care based chronic care clinics {Coleman 1999} {Scott 2004}) with Tulloch and Fletcher focussing on questionnaires with follow up in Geriatric clinics. {Burns 1995} {Coleman 1999} {Englehardt 1996} {Fletcher 2004} {Scott 2004} {Toseland 1996} {Tulloch 1979} The majority of studies followed up patients over a period of 2 years with Burns *et al* 1 year and Fletcher *et al* over 3 years the only exceptions. The clinic visits varied with one study scheduling appointments for once per month (Scott), one every 3-4 months(Coleman), one did not have any set scheduled appointments (Burns) and the remaining studies did not provide details of scheduling beyond saying routine follow up. {Fletcher 2004} {Toseland 1996} {Englehardt 1996} {Tulloch 1979}

A meta-analysis of the studies was not possible due to the difference in the makeup of the studies follow up time and method of outcome reporting.

Two studies demonstrated a reduction in unplanned admissions from their interventions Scott 2004 risk ratio 0.59 (95% CI 0.43, 0.82) and Fletcher 2004 risk ratio 0.92 (95% CI 0.90, 0.95). Scott 2004 was a co-operative health care clinic model in primary care which focused on group education of all conditions or diseases of patients on a monthly basis with GP consultation.   Whilst Fletcher 2004 compared targeted versus universal questionnaires followed by specialist clinic vs usual primary care. However the remaining five studies reported no difference in unplanned admissions. {Coleman 1999} {Englehardt 1996} {Burns 1995} {Toseland 1997} {Tulloch 1979}. Risk of bias (appendix 3, figure 2b)

<u>Asthma (Appendix 2, Table 2)</u>

Pilotto *et al* described a RCT of asthma clinics in general practice for adults which was randomised at practice level. {Pilotto 2004} A total of three clinic visits were arranged for review and instruction of inhaler techniques education on types and use of medication and smoking cessation with action plans. The follow up period was three months but there were wide variation in the data giving a relative rate of RR 4.50 (95% CI 0.98, 20.57)

In a RCT by Salisbury *et al*, young people aged 12-14 years were randomised to either tailored school nurse asthma clinic sessions with education and treatment changes as required or usual care which was a nurse led clinic in general practice. {Salisbury 2002} Follow up time was 3 months and there was only one readmission in the usual care group versus none in the intervention group.

Harish *et al* described a RCT of an intervention of a paediatric asthma centre with education and asthma assessments with emergency action plans and allergen testing and telephone follow up compared with usual care over 12 months.{Harish 2001} No effect on unplanned hospital admissions was seen (relative rate 1.02 (95% CI0.57, 1.82).

In a RCT by Mayo *et al*, adult patients were randomised to either outpatient chest clinic with medication tailored to each patient and with education sessions or the usual routine clinic. {Mayo 1990} The frequency of visits was tailored to patient preference and asthma activity. Over an eight month follow period, there were 19 admissions in the intervention group and 70 in the usual care group.

Heard *et al* described a RCT comparing asthma clinic in general practice for adults and children with standard treatment (no details were given) over 6 months. {Heard 1999} 3 asthma clinic sessions included education of management strategies and written management plans followed by consultation with the GP. Results were expressed as an odds ratio and showed non-significant reduced odds in favour of the intervention (OR 3.1 (95% 0.05-1.75).

Risk of bias is reported in Appendix 3 (Figure 2c)

<u>Other conditions (Appendix 2, Table 2)</u>

Risk of bias (appendix 3, figure 2d)

In a study by Welin *et al,* patients were either randomised to a stroke outpatient clinic or usual care with GP.{Welin 2010} The intervention group involved an assessment of health

and advice or information offered as well as drug therapy assessed with follow up at 1,3 and 4 years. Access to other health professionals could be obtained. There was no significant difference in the number of unplanned hospital admissions reported at 12 months between the intervention and control groups (30 (37%) vs. 35(43%) p=0.37).

Soler et *al* described a RCT of monthly group education sessions in a specialised clinic for patients and families with COPD compared with conventional management. {Soler 2006} In spite of being a randomised study, results were presented per study group before and after study period and the authors described no differences in the conventional management group and a 73% reduction in hospital admission from baseline in intervention group.

In a RCT by Campbell *et al,* coronary heart disease patients were randomised to patient education with review of symptoms in secondary prevention clinics in general practice or usual care from GP with a follow up of up to 6 months. {Campbell 1998}The odds ratio for requiring hospital admission for the intervention group was 0.64 (95% CI 0.48, 0.86 p=0.003).

Murphy *et al* described a RCT of patient education tailored goal setting and action plans compared to usual care for coronary heart disease patients.{Murphy 2009} Patients were followed up every 4 months.   After the study follow up period unplanned hospital admissions in the intervention group were 25.8% (107/415) compared to the usual care group 34% (148/435).

Previous reviews

a.   Interventions including specialist clinics – across all disease areas

A review of evidence for interventions to reduce unplanned hospital admissions (Ham C 2006) found limited evidence to suggest that specialist clinics reduced hospitalisations with one review and one trial finding no effect on unplanned hospital admissions and one trial finding no impact on days in hospital. They also found inconsistent evidence about the effect of hospital clinics before and after discharge on unplanned hospital admissions and length of stay in hospital.   With one review and two trials suggesting hospital clinics could reduce hospital admissions but one review and one additional trial finding no effect. Another review suggested they reduced days in hospital but 2 additional trials showed no effect.

The review by Ham 2006 also looked at the effects of group visiting to specialist clinics where education sessions took place within a group setting in primary care. They found

limited evidence about the effect on hospitalisation. Two trials suggested group visits reduced unplanned admissions while one trial found no effect on days in hospital.

b. Disease specific systematic reviews which include specialist clinic interventions

There were 4 systematic reviews of interventions for heart failure. Two of which did not show any benefit from clinic based interventions. The first looked at case management, clinic settings, multidisciplinary teams and day hospitals. {Taylor 2005} They concluded that from the very scant evidence available i.e. two studies both of which are likely to have lacked sufficient statistical power, there is almost no evidence of any benefit from clinic interventions. The second looked at home-based, telephone, televideo or physiological monitoring and specialist clinic interventions. {Holland 2005} They identified 3 RCTs of specialist clinics with no significant benefits reported. The remaining 2 reviews which included a larger number of randomised control trials concluded that there was a benefit associated with heart failure clinics. {Gustafsson 2004} {McAlister 2004} Gustafsson concluded that treatment in specialised HF clinics using nurse intervention reduces readmission frequencies and improve quality of care for HF patients. Furthermore, the clinics do not appear to increase costs and the optimal design of the clinics and the range of services provided are yet unresolved. Whilst McAllister 2004 found that multidisciplinary management strategies for patients with HF were associated with a 27% reduction in HF hospitalization rates (NNT 11) and a 43% reduction in total number of HF hospitalizations. Those strategies that incorporate specialized follow-up by a multidisciplinary team or in a multidisciplinary HF clinic also reduce all-cause mortality by approximately one-quarter (NNT 17) and all-cause hospitalizations by one-fifth (NNT 10).

A systematic review of asthma clinics in primary care settings identified only 1 randomised control trial which showed a benefit in regards to the a reduction in the number of patients who experienced waking at night due to asthma. {Jones 2002} There was also a rise in peak flow meter prescriptions, but the benefits of this to the patients are not clear.

Summary

The majority of the evidence from RCT's is related to heart failure clinics with limited evidence available for other disease/conditions. Specialist clinics in heart failure showed a reduction in unplanned admissions at 12 months (pooled risk ratio [RR] for 5 studies 0.51 (95% CI 0.33 to 0.76); absolute risk reduction (ARR) 16 per 100 (95% CI 12 to 20). Studies with initial frequent (weekly/fortnightly) appointments that reduced in frequency over the

study duration demonstrated a 58% reduction in unplanned admissions (pooled RR for 3 studies 0.42 (95% CI 0.27 to 0.65); ARR 14 per 100 (95% CI 7 to 20). Clinics conducted on a monthly basis throughout, tailored to the individual patients or were once every 3 months did not show an effect. Two of seven identified studies in the older population showed some benefit. The five studies on asthma are on the whole of poor quality and show inconsistent findings.

Specialist clinics for patients with heart failure can reduce the risk of unplanned admissions; these were most effective when there was a high intensity of clinic appointments close to the time of discharge which then reduced over the follow up period. The limited evidence available suggests that asthma clinics have no effect on unplanned admissions with a possible leaning towards favouring usual care.

C.   Community interventions

Background

In this section, we included RCTs of community interventions which were not case management nor involved attendance at a specialist clinic and were not predominantly education or exercise and rehabilitation based. Some of the RCTs included specialist care. The majority of them involved home visits.

Results (Appendix 2, table 3)

We identified 13 RCTs (14 papers) of community interventions that did not fit into our other topic areas. Three were excluded (one was a reanalysis of included paper, one not available through the British library, one with no useable data)

We have included ten RCTs, three on the older people, four on post natal health and three on heart patients. {Benatar 2003} {Boulvain 2004} {Carroll 2007} {Dunn 1994} {Garasen 2007 & 2008} {Mason 2007} {Raynor 1999} {Sainz Bueno 2005} {Sinclair 2005} {York 1997}

Risk of bias (Appendix 3, figure 3)

The risk of bias analysis generally showed poor reporting on risk of bias issues although there was no positive evidence that these studies were at high risk of bias. In addition to this, the type of intervention means that the patients or participants cannot be blinded. It is important to point that in one study, home visits were the control group in comparison with a telemedicine intervention. {Benatar 2003}

Previous reviews

There were no relevant previous reviews identified, in part due to the range of interventions and conditions in this topic

Older population *(Appendix 2, table 3)*

In brief, the three RCTs of older people were all distinct care interventions. Dunn 1994 provided just one home visit following discharge from hospital and unsurprisingly did not influence subsequent unplanned admission in comparison with usual care (RR 0.96 [0.73,1.27] p=0.78)

The study by Mason *et al* 2007 investigated an active paramedic intervention and did show some effect on unplanned hospital admissions at 28 days (RR 0.87 [0.81, 0.94] p<0.001). The final RCT (Garåsen 2007 & 2008) compared community hospital care with general

hospital care on unplanned hospital admissions showing a very small effect at 6 months (RR 0.54 [0.31,0.96]) p=0.04 but no effect by 12 months 0.88 [0.70, 1.10] p=0.25).

Post-natal *(Appendix 2 table 3)*

The four post natal RCTs included one study of mothers and their failure to thrive babies, one study of high-risk childbearing women diagnosed with diabetes or hypertension in pregnancy and two studies of low risk mother and baby populations. The failure to thrive intervention provided expert intensive care compared with usual care over a period of 12 months and produced an increased protective effect against unplanned admissions compared with no intervention (RR 0.43 [95% CI 0.18, 0.99] p=0.05). {Raynor 1999}

In a RCT by York *et al*, of high-risk childbearing women: women diagnosed with diabetes or hypertension in pregnancy were either discharged routinely from the hospital or discharged early using a model of clinical nurse specialist transitional follow-up care. During pregnancy, the intervention group had significantly fewer rehospitalisations than the control group. {York 1997}

One of the low risk mother and baby RCTs compared home based (minimum hospital stay) versus hospital based postnatal care and reported both mother and infant hospital readmissions within1 month and 2-6 months of birth. There were no significant differences between the groups at either time point except for a significant effect in favour of hospital based care on infant readmissions at 2-6 months (RR 3.0 [1.23, 7.52] p=0.02). {Boulvain 2004} The second RCT of low risk mothers and babies compared home visits in first 48hrs, a visit to practice and phone calls up to 6 months with usual care; reporting unplanned hospital admissions at 6mths for the mother and infant. {Sainz Bueno 2005} No differences were seen between the groups.

Heart patients *(Appendix 2 table 3)*

There were three RCTs involving heart patients. One study was a comparative study comparing telemedicine with home visits for congestive heart failure patients. Unplanned hospital admissions were measured at 3, 6 and 12 months (intervention duration 3 months) and telemedicine significantly reduced admissions in comparison with home visits at all-time points.{Benatar 2003} Another RCT compared home visits over 6-8 weeks with usual care for patients discharged with suspected myocardial infarction (MI), showing a small advantage of home visits reducing unplanned hospital admissions compared to usual care at 100 days post discharge (RR 0.68 (95% CI 0.47-0.98) p<0.05). {Sinclair 2005} The third RCT included MI and post coronary artery bypass patients in which the intervention was a

home visit within 72 hours followed by telephone calls for up to 3 months. {Carroll 2007} Unplanned hospital admissions (secondary outcome) were measured at 3, 6 & 12 months and were overall not significantly different to usual care except for at 6 months when a small effect in favour of the home visit and calls was seen (RR 0.21[0.05, 0.97] p=0.05).

Summary

Overall, the evidence for community interventions based on home visits is too limited to make definitive conclusions. However, there is a suggestion that visiting acutely at risk populations e.g. fairly to thrive babies, heart failure patients may result in fewer unplanned hospital admissions.

D.   Care pathways and guidelines

Background

Clinical or critical care pathways are a systematic approach to guide health care professionals in managing a specific clinical problem. They are defined by the European Pathway Association as: 'care pathways are a methodology for the mutual decision making and organization of care for a well-defined group of patients during a well-defined period'. The pathways require an explicit statement of the goals and key elements of care based on evidence, best practice and patient expectations; the facilitation of the communication, coordination of roles, and sequencing the activities of the multidisciplinary care team, patients and their relatives; the documentation, monitoring and evaluation of variances and outcomes; and the identification of the appropriate resources. Their aim is to promote effectiveness and thereby improve quality, reduce the unintended variations in care, reduce resource utilization, improve patient education and improve quality of care. For pathways to be effective a multidisciplinary team needs to be involved in the development and continual evaluation to ensure acceptance by clinicians.

Practice guidelines can be defined as systematically developed strategies that assist practitioner and patient decisions about appropriate healthcare for specific clinical circumstances. Considerations of validity, reliability, reproducibility, clinical applicability, clinical flexibility, clarity, multidisciplinary process, evidentiary review and documentation are necessary to develop good clinical practice guidelines. Effective guidelines may promote access to better care as well as decrease medical costs. They aim to promote effectiveness and thereby improve quality.

Results

Thirteen RCT's were identified of which four were excluded. Nine RCTs were included (Appendix 2 table 4) of which six described care pathways (community acquired pneumonia [CAP], asthma (n=2), heart disease (n=3), and three described guideline studies (CAP, asthma, COPD).

Previous reviews

There have been several reviews looking at the use of care pathways and guidelines. Systematic reviews have been conducted across disease/conditions {Rotter 2010} and {Allen 2009}, and for disease specific pathways such as gastrointestinal surgery {Lemmens 2008} Stroke {Kwan 2004} and asthma {Banasiak 2004}. Guidelines have also been reviewed similarly across disease/conditions. {Bahtsevani 2004}.

Care Pathways – any condition

Rotter *et al* was a systematic literature review of the effects of clinical pathways on professional practice, patient outcomes, length of stay and hospital costs. They included 27 studies 19 of which were RCT's and one of the patient outcomes was readmission to hospital within 6 months for all causes which included 4 RCT's and 1 controlled clinical trial. Only 1 of the 4 RCT's was identified for inclusion within this report due to the distinction between all cause admissions and unplanned admissions and these could not be separated in the remaining 3 RCT's. This report includes an additional 4 RCT's not included in the review 1 of which was excluded {Mitchell 2005} another is a duplicate publication {Palmer 2000} and 2 were published after the reviews searches were conducted {Murphy 2009}, {Panella 2009}. The 5 included studies did not demonstrate a significant reduction in unplanned hospital admissions with a pooled odds ratio of 0.6 (95%CI 0.32, 1.13). The authors concluded that critical pathways are associated with reduced in-hospital complications and improved documentation without negatively impacting on the length of stay and hospital costs.

Allen *et al* was a systematic review of integrated care pathways to identify the circumstances in which they are effective, for whom and in which contexts. They included 7 RCT's all of these are excluded from this report 2 planned and unplanned admissions could not be separated, 4 RCT's did not provide hospital admission/readmissions data and the remaining study could not be found. This report contains 6 RCT's 3 of which were excluded from the review. {Mitchell 2005} {Palmer 2000} {Philbin 2000} and an additional 2 were published after the search was conducted {Murphy 2009} {Panella 2009}. The review was narrative and only four of the included studies reported hospital admission and whilst the intervention groups showed lower readmissions the difference was not significant. The authors concluded that integrated care pathways are most effective where patient care trajectories are predictable. They were also most effective at bringing about behavioural changes where there are identified deficiencies in services.

Care pathways – disease specific

Kwan *et al* conducted a systematic review of in-hospital care pathways for stroke in which one of the secondary outcomes was readmission to hospital. Include 15 studies 3 of which were RCT's. However only 1 RCT provided data on readmission or emergency department attendance which demonstrated a significant reduction (OR 0.15 95% CI 0.04, 0.59). However the two outcomes of readmission and emergency department attendance could not be separated and so the study was excluded from this report. The authors concluded that the uses of stroke care pathways were associated with positive and negative effects and that there was insufficient evidence to justify the routine implementation of care pathways for acute stroke management or stroke rehabilitation.

Lemmens *et al* conducted a systematic review to evaluate the effectiveness of clinical pathways for gastrointestinal surgery. A total of 23 studies were included within this review however none of these were RCT's. They found that the implementation of clinical pathways did not lead to a change in morbidity, mortality or the number of readmissions compared to conventional care. However they concluded that they can be regarded as a safe and effective method of decreasing the length of stay.

Banasiak *et al* conducted an integrative review of inpatient asthma clinical pathways for children. The review had 4 primary outcomes one of which was the effect on readmission rates. 5 studies were included with only 1 study being an RCT. Only four of these 5 studies included data on readmission rates however no significant difference was found. The authors concluded that inpatient paediatric clinical pathways are effective in reducing the length of stay for asthma hospitalisations and that this contributes to a reducing in costs.

Guidelines

Bahtsevani *et al* aimed to investigate whether evidence-based clinical practice in health care improved outcomes for patients, personnel and/or organisations. They included 8 studies however none of these were RCT's and only 2 reported admission rates. One of which implemented guidelines for children with bronchiolitis which showed significant changes in yearly admission rates and the second implemented guidelines for the care of children with gastroenteritis which showed a non-significant decrease in admission rates. The authors concluded that the use of evidence-based guidelines can improve outcomes in relation to organisations in the sense of decreased admission rates, length of stay and less resource utilisation which reduces costs as well as improving outcomes for patients and personnel. This report includes 3 RCT's of guidelines interventions two of which were published since this review.

More recent studies

Care pathways (Appendix 2 Table 4)

Two studies of care pathways for heart disease have been published since the previous reviews of Allen and Rotter. Murphy *et al* 2009 used practice and patient care pathways delivered by GP's and practice nurses. There was a significant 24% reduction in admissions for cardiac causes (RR 0.76 95% CI 0.61, 0.93). This study differed from the other studies included in this area as patients were given a GP appointment every 4 months for 18 months. Panella *et al* 2009 utilised a multidisciplinary team in secondary care. They reported a reduction in unscheduled readmissions however this just failed to reach significance (7.9% intervention vs 13.9% control p=0.053).

The remaining 4 studies of care pathways all reported non-significant reductions unplanned admissions.

Guidelines (Appendix 2 Table 4)

There were 3 RCT's which utilised guidelines as an intervention and assessed the effects on unplanned admissions. One was for community acquired pneumonia (CAP) {Fine 2003}, one utilised guidelines for asthma {Premaratne 1999} and the remaining study looked at guidelines for COPD. {Tinelli 2003} All three studies reported non-significant reductions in the number of unplanned admissions.

Summary

There is no convincing evidence to make any conclusions on the effect of pathways and guidelines on hospital admissions although it is important to point out that data are limited for most conditions.

E. Medication review

Background

Medication related problems are thought to cause between 10 - 30% of all hospital admissions in older people. {Col 1990} {Hohl 2001} {Passarelli 2005} {Grymonpre 1988} These are commonly caused by avoidable adverse reactions, interactions and poor adherence. Adverse reactions to medicines are implicated in 5-17% of hospital admissions. {DOH 2005} Non-compliance with prescribed medicine can cause unnecessary ill health, premature death and significant avoidable cost to the NHS. {RPSGB 1997} {RCP 1997} Estimates of non-compliance among the elderly vary from 21% to 55%[8] with approximately 11% of admissions attributable to non-compliance. {Col 1990}

Pharmacists have the responsibility for ensuring the safe, effective and rational use of medicines and over recent years, strategic plans for health care have increasingly taken this into account.{Williams 2002} {Gillespie 2009a} {Scullin 2007} Many medication errors occur on admission to hospital due to discrepancies in the patients' medication lists.{Lisby 2010} Reviews of patient's medication on admission have uncovered such errors in up to 70% of hospitalised patients.{Andersen 2003} {Lau 2000} Medication errors are also frequent during transition between acute and post-acute care, partly due to incomplete discharge instructions. {Crotty 2004}

A medication review has been defined as: 'A structured, critical examination of a patient's medicines with the objective of reaching an agreement with the patient about treatment, optimising the impact of medicines, minimising the number of medication-related problems and reducing waste. {Task Force on Medicines Partnership 2002} We conducted a systematic review to examine the effectiveness of medication reviews on reducing unplanned hospital admissions.

Results (Appendix 2, table 5)

We identified 44 RCTs that examined medication reviews conducted by pharmacists. After review of the full papers against the inclusion criteria a total of 25 studies were included, conducted in 9 countries (n = 11) UK, (n = 6) Europe, (n = 4) America, (n = 2) Australia and (n = 2) Canada. The studies covered the following areas: 16 studies of older people {Gillespie 2009a} {Scullin2007} {Lisby 2010} {Sellors 2003} {Bond 2000} {Holland 2005} {Krska 2001} {Lenagan 2007} {Lipton 1994} {McMullin 1999} {Nauton 2003} {Nazareth 2001} {Spinewine 2007} {Taylor 2003} {Zermansky 2001} {Zermansky 2006} 7 studies of heart failure {Bouvy 2003} {Holland 2007} {Lopez 2006} {Murray 2007} {Stewart 1998} {Varma

1999} {Bond 2007} and 2 studies of asthma.{Charrois 2006} {Herborg 2001} All studies were analysed within their disease or condition and a) by pharmacist type (clinical or community) and b) across pharmacist type by the duration of the study.

Risk of bias (appendix 3, figure 4)

The intervention in the 25 RCT's involved a pharmacist conducting medication reviews, with some including education of patient or carer. The education provided addressed issues of compliance and increasing knowledge of their disease or conditions and awareness of medications.   They were conducted in an inpatient setting, when the pharmacist recommendations were provided to the physician in charge of the patients care, and in community settings conducted in either the pharmacy when a patient went to refill their prescription, in the GP surgery or nursing home or in the patients home. In these communities- based programs the pharmacist provided recommendations to the GP for action (table 2). In some of the inpatient interventions the pharmacists followed the patients following discharge whereas others ended on discharge from hospital.

Results

Older people RCTs

Seven of these studies used a clinical pharmacist {Gillespie 2009a} {Scullin 2007} {Lisby 2010} {Lipton 1994} {McMullin 1999} {Nazareth 2001} {Spinewine2007}, nine used community pharmacists.{Sellors 2003} {Bond 2000} {Holland 2005} {Krska 2001} {Lenaghan 2007} {Nauton 2003} {Taylor 2003} { Zermansky 2001} {Zermansky 2006}

Of the seven studies which utilised a clinical pharmacist beginning once patients had been admitted to hospital, four ended at discharge {Scullin 2007} {Lisby 2010} {McMullin 1999} {Spinewine 2007} whilst three continued following discharge.{Gillespie 2009a}{Lipton 1994} {Nazareth 2001} The post discharge follow up consisted of a telephone call at two months to ensure adequate home management of medications,{Gillespie 2009a} or regular follow up appointments at 1 and 2-4 weeks, 2 and 3 months post discharge.{Lipton 1994}   The remaining study {Nazareth 2001} used a combination of clinical pharmacists for patients discharge planning from hospital with transfer of information to the GP and community pharmacist of patients choice following discharge and home based follow up with the community pharmacist 7-14 days following discharge with further visits arrange at the pharmacist's discretion.   There was no effect on the number of unplanned admissions across all clinical pharmacist interventions (seven studies pooled RR 0.97 95% CI 0.88, 1.07) or when separated by inpatient only (four studies pooled RR 0.91 95%CI 0.79, 1.06),

Inpatient with follow up (three studies pooled RR 1.01 95% CI 0.89, 1.15). (Appendix 4 figure 3a)

Nine studies utilised community pharmacists for providing medication reviews.{Sellors 2003} {Bond 2000} {Krska 2001} {Lenagan 2007} {Naunton 2003} {Taylor 2003} Zermansky 2001} {Zermansky 2006} In Zermansky *et al* the pharmacists used GP medical records to conduct a clinical medication review with a written preformed provided to the GP. Sellors *et al* conducted a structured medication review in the physician's office and then provided the physician with their recommendations. Follow up visits were made with the physician at 3 and 5 months and with the patient at 1 and 3 months following this initial visit. In Lenaghan *et al* a copy of the patients medication and medical history was provided to the pharmacist who arranged a home visit with the patient and carer for education and removal of out of date drugs. An additional visit was arranged for 6-8 weeks later. In Bond *et al* the pharmacist provided monthly protocol checks when the patients refilled prescriptions with reviews at either 3, 6 or 12 months with the GP depending on clinical need. In Holland *et al* the pharmacists used home visits to assess the patient's ability to self-medicate and drug adherence. They provided education, removed out of date drugs, reported possible drug reactions or interactions to the GP and reported the need for a compliance aid to the local pharmacist. Krska *et al* completed detailed profiles for each patient using medical notes and practice computer records. Following a home visit a pharmaceutical care plan was drawn up with copies provided to the GP for agreement. Naunton *et al* performed a medication review in the patients home to educate patients, optimise medication management, improve compliance and detect drug related problems. The pharmacist then contacted the patients GP to discuss any urgent issues. Taylor *et al* reviewed medical records for medication related problems and conducted chart reviews. They provided comprehensive individualised patient education that included a brief review of disease important lifestyle modifications and basic drug information. Therapeutic recommendations were communicated to physicians. In Zermansky 2001, the pharmacist invited patients to his clinic at next review where the continuation of each drug was evaluated. Sub optimal treatment, side effects of drugs, clinically relevant drug interactions or contraindications were identified in conjunction with the doctor. Patient education was provided where knowledge of disease or medications was lacking. These studies did not reduce unplanned hospital admissions (nine studies pooled RR 1.07 95% CI 0.96, 1.20). (Appendix 4 figure 3b)

These studies were grouped by the time at which hospital admission data was collected 3, 6 and 12 months however there was no effect on unplanned admissions at any of these time points (Appendix 4, Figure 3c-e).

<u>Heart failure</u>

Of the seven studies using pharmacists for the care and follow up of people with heart failure three studies used a clinical pharmacist, {Lopez 2006} {Stewart 1998} {Varma 1999} and four studies used a community pharmacist. {Bouvy 2003} {Holland 2007} {Murray 2007} {Bond 2007}

Among the three studies using clinical pharmacists Lopez *et al* began on the day of discharge with education of the patient and carer with monthly telephone follow up for the first 6 months and once every 2 months thereafter. Varma *et al* used a research pharmacist in an outpatient's clinic who provided education and self-monitoring instructions with information provided to physicians and community pharmacists. In Stewart *et al* study nurses educated the patient prior to discharge with the pharmacist providing one home visit assessing medication and compliance and providing counselling and compliance aids. Follow up was provided by study nurses only. No significant difference in unplanned admissions was seen for these studies (pooled three studies RR 0.64 95% CI 0.46, 0.90). (Appendix 4, figure 3f)

Four studies utilised community pharmacists. Bouvy *et al* used structured interviews to obtain medication histories and to discuss compliance and possible adverse drug reactions. Findings were reported to the patient's GP and patients were followed up monthly. Bond *et al* conducted a one off review of GP medical records and made recommendations to the GP without follow up.   Holland *et al* educated the patient and carer and provided basic dietary and exercise advice with a follow up visit 6-8 weeks later to reinforce the information provided. Murray *et al* were based in outpatients and collected medication history, gave verbal and written instructions on how and when to take medication and monitored the patients' medication with follow up once every 2 months. Findings were communicated to the study nurses and patient's GP. There was no reduction in unplanned admissions (three studies pooled RR 1.02 95% CI 0.83, 1.25). (Appendix 4, figure 3g)

In three studies unplanned admissions were collected at six months{Bouvy 2003} {Holland 2007} {Stewart 1998} and four studies at 12 months.{Lopez 2006} {Murray 2007} {Varma 1999} {Bond 2007} No significant effect was seen at 6 months (RR 1.06 95% CI 0.87, 1.27) and although not significant a 29% reduction in unplanned admissions was seen at 12 months (RR 0.71 95% CI 0.51, 1.00) (Appendix 4, figure 3h&i).

<u>Asthma</u>

The two studies involving asthma patients both used community pharmacists and included patients from the age of 16 – 60 years or 17-54 years.{Charrois 2006} {Herborg 2001} Charrois *et al* incorporated respiratory therapists into their intervention along with physicians with regular follow ups over a six month period. However compliance by the pharmacists with some aspects of the intervention such as education, action plan's and follow up was poor which would bias the results towards the null. Herborg *et al* focused on developing the relationship between the pharmacist and physician with monthly follow ups over a 12 month period. They both focused on patient education, optimisation of therapy and inhaler technique. Individually neither had a significant reduction in unplanned admissions (RR 0.31 95% CI 0.03, 2.88 Charrois, RR 0.33 95% CI 0.10, 1.01 Herborg).

<u>Other findings</u>

There were many different outcomes investigated by the included studies the most commonly reported ones were length of hospital stay (seven studies) quality of life (10 studies), mortality (12 studies) and compliance (nine studies). Two studies {Scullin 2007} {Stewart 1998} reported a significant shorter length of hospital stay in the intervention group, the remaining 6 studies did not show a significant difference.

<u>Summary</u>

There was no evidence of an effect on unplanned admissions from medication reviews whether focussing on the older population, those with heart failure or asthma (although the evidence was limited to two studies for the latter) carried out by clinical, community or research pharmacists.

F.   Education & self-management

Background

Patients with chronic conditions make day-to-day decisions about their illnesses. Whereas traditional patient education offers information and technical skills, self-management education teaches problem-solving skills. Self-management education complements traditional patient education in supporting patients to live the best possible quality of life with their chronic condition. {Bodenheimer 2002}

Definitions

Self-management is a term applied to any formalized patient education programme aimed at teaching skills needed to carry out medical regimens specific to the disease, guide health behaviour change, and provide emotional support for patients to control their disease and live functional lives.

Action plans consist of a written set of instructions given to patients for the management of chronic symptoms as well as for the prevention and management of exacerbations of their condition.

Results

Our searches found 38 RCTs which covered educational and self-management interventions. These included the conditions of asthma (n=20), COPD (n=8), Heart disease (n=9), older people (n=1).

Asthma

Previous reviews

There are eight recent Cochrane reviews looking at various types of education for asthma patients. Four of these reviews describe interventions for children {Wolf 2003} {Boyd 2009} {Bhogal 2009} {Welsh 2011} Three of these reviews describe interventions for adults {Gibson 2008} {Gibson 2009} {Tapp 2010} One review describe an intervention for both children and adults in culturally-specific context. {Bailey 2009} All the reviews have hospital admissions as an outcome of interest.

Adults

A Cochrane review of limited education interventions (information only) included 12 trials 12 RCTs. {Gibson 2008} Authors reported that the included studies were of variable quality. Limited asthma education did not reduce hospitalisation for asthma (weighted mean difference -0.03 average hospitalisations per person per year, 95% CI -0.09 to 0.03).

A further Cochrane review of self-management with education and practitioner review by the same authors {Gibson 2009} included 36 RCTs and 9 RCTs had data on hospital admissions. Self-management education reduced hospitalisations (relative risk 0.64, 95% CI 0.50, 0.82)

A further Cochrane review summarises educational interventions in the accident and emergency department. {Tapp 2010} The review includes 13 randomised controlled trials. From five studies involving 572 participants, there was a statistically significant reduction in subsequent hospital admission in the educational intervention groups (RR 0.50; 95% CI 0.27 to 0.91,). The data showed a moderate level of statistical heterogeneity.

Children

In a Cochrane review of written action plans for children with asthma, Four trials (3 RCTs and one quasi RCT) involving 355 children were included. {Bhogal 2009} Three studies examined the number of patients requiring hospital admission. The authors reported no significant difference in the number of patients requiring hospitalisation between symptom monitoring and peak flow monitoring group (RR 1.51; 95% CI 0.35, 6.65).

A Cochrane review of self- management with education for children with asthma {Wolf 2003} included 32 RCTs. Asthma admissions were a primary outcome in this review. Eight RCTs had hospital admissions data expressed as percentage and the number of people. There was no significant reduction in the number of hospitalizations associated with education (SMD -0.08, 95% CI -0.21 to 0.05) when the eight trials reporting complete data on this outcome were pooled. One additional trial involving 84 patients which could not be pooled due to missing data reported no significant reduction in hospitalizations associated with education {Szczepanski 1996}.

One Cochrane review looked at educational interventions for children with asthma in the A & E department. {Boyd 2009} A total of 38 studies involving 7843 children were included. Data from 18 RCTs showed that following educational intervention delivered to children, their parents or both, there was a significantly reduced risk of hospital admissions (RR 0.79, 95%

CI 0.69, 0.92, n = 4019) compared with control when using a fixed effects model but as the level of statistical heterogeneity was high, random-effects modelling gave a slightly lower relative risk and wider confidence intervals (RR 0.75, 95%CI 0.56,1.0) suggesting that there was no significant effect from the control group.

A further Cochrane review compared home-based asthma educational interventions with standard care, education delivered outside of the home or a less intensive educational intervention delivered at home. {Welsh 2010} A total of 12 studies involving 2342 children were included. Eleven out of 12 trials were conducted in North America within urban or suburban settings involving vulnerable populations. A total of 12 studies of overall good methodological quality involving 2342 children were included. Number of hospital admissions showed wide variation between trials with significant changes in some trials in both directions. The data could not be combined due to the heterogeneity of the data.

Culturally –specific interventions for asthma patients

One Cochrane review described culture-specific programs for children and adults from minority groups who have asthma. {Bailey 2009} The scope of the review was to include culture-specific asthma programmes, in comparison to generic asthma education programmes or usual care. Four studies were eligible for inclusion in the review. A total of 617 patients, aged from 5 to 59 years were included in the meta-analysis of data. There was a single study {Canino 2008}, reducing asthma exacerbations in children and a risk ratio for hospitalisations 0.32, 95%CI 0.15, 0.70.

More recent studies

We found 20 studies of which all but three were published prior to these reviews. There were four trials published in 2008 & 2009 which would not have been considered. {Bryant-Stephens 2008} {Huang 2009} {Indinnimeo 2009} {Shelledy 2009} Three of these RCTs did not have any effect on hospital admissions with the exception of Shelledy *et al* which looked at home based education intervention delivered by respiratory technicians or nurses for adults with mild to moderate asthma compared with usual care and showed a decrease over 6 months.

COPD

Previous reviews

There have been two previous Cochrane reviews for COPD patients, one on action plans and one on self-management. {Walters 2010a} {Effing 2007}

The Cochrane review on action plans for COPD compared to usual care included five studies (574 participants) with moderate or severe COPD, with follow-up from six to twelve months. There was no evidence that hospital admissions were reduced with the intervention (mean difference 0.23 95% CI -0.03, 0.49). {Walters 2010a}

One Cochrane review of self-management with education included 14 studies (RCTs & CTs). {Effing 2009} Enumeration of hospital admissions was a primary outcome. Eight RCTs had data collected at follow up times of 3-12mths. The studies showed a significant reduction in the probability of at least one hospital admission among patients receiving self-management education compared to those receiving usual care (OR 0.64; 95%CI 0.47, 0.89). This translates into a one year NNT ranging from 10 (6 to 35) for patients with a 51% risk of exacerbation, to an NNT of 24 (16 to 80) for patients with a 13% risk of exacerbation.

More recent studies

We found eight studies of which only one by Effing *et al* was not considered in these reviews. {Effing 2009} It was a RCT of 142 patients who were randomised to either self-management with or without training on how to deal with exacerbations of their COPD. The authors reported no significant effect on hospital admissions (0.20/patient/year in the self-treatment group vs. 0.33/patient/year in the control group; p = 0.388)

Heart Disease

Previous reviews

There is one Cochrane review looking at education for patients with coronary heart disease including MI and who have undergone surgery {Brown 2011} It included 13 RCTs (68,556 patients) and hospital admissions and cardiac related admissions were secondary outcomes. Six studies reported hospitalisations and data from four of these were able to be pooled in a meta-analysis. There was no evidence to support a reduction in hospitalisation with education (random effects RR: 0.83, 95% CI 0.65, 1.07, p=0.16,). The authors reported that analysis of the heart-related admissions in those participants who attended at least one

intervention session revealed statistically significant reductions in the intervention group with participants in the intervention group had 41% fewer heart-related admissions (p=0.05) than in the control group.

There is a recent systematic review on educational interventions for patients with heart failure {Boyde 2011} A total of 2686 patients were included in 19 RCTs. Most of the included studies comprised of an initial educational intervention which was a one-on-one didactic session conducted by nurses supplemented by written materials and multimedia approaches. The RCTs used a variety of outcome measures to evaluate their effectiveness. Of the RCTs reviewed, 15 demonstrated a significant effect from their intervention in at least one of their outcome measures.

More recent studies

Our searches found 9 RCTs of heart disease patients which all were published by 2009 with the exception of one. {Wright 2003} {Cline 1998} {Gwadry-Sridhar 2005} {Jaarsma 1999} {Linee 2006} {Sethares 2004} {Wheeler 2003} {Pedersen 2005} {Peters-Klimm 2009}.

The aim of the additional study by Peters-Klimm *et al* was to explore the impact of a multidisciplinary educational intervention for GPs (Train the trainer = TTT) on patient and performance outcomes**.** Primary care practices were randomly assigned to the TTT intervention or to the control group. 37 GPs were randomised and 168 patients diagnosed with ascertained CHF were enrolled. One of the secondary outcomes included hospital admissions, which was reported to be no different between the intervention and control group. {Peters-Klimm 2009}.

Older people

We found one RCT looking at education for the older people. {Parry 2009} The objective was to test whether a self-care model for transitional care could improve outcomes in Medicare Advantage and Medicare fee-for-service populations in the US. Intervention patients were less likely to be readmitted to a hospital in general, and for the same condition that prompted their index hospitalization, at 30, 90, and 180 days versus control patients.

Summary

Cochrane reviews concluded that education with self-management reduced UHA in adults with asthma and in COPD patients but not in children with asthma. There is weak evidence for the role of education in reducing UHA in heart failure patients.

G.   Exercise & rehabilitation

Background & definitions

Exercise plays a significant role in helping people to recover after a serious illness or injury. The Department of Health defines exercise as a planned episode of physical activity to improve or maintain a person's health or fitness. Physical activity is any form of activity that requires a person to use more energy than when they are resting.

Results

Our searches found 31 RCTs which covered exercise and rehabilitation interventions and met our inclusion criteria. These included the conditions of COPD (n=8), heart disease (n=10), older people (n=8 (plus 2 cost effectiveness papers)) and stroke (n=5).

COPD

Previous review

We found a Cochrane review on pulmonary rehabilitation for COPD patients who have experienced an admission [Puhan 2011]. Their primary outcome of interest was readmissions into hospital. This review included 9 RCTs of which 5 had readmissions data collected at maximum follow up (n=4 was 3mths, n=2 was 6mths).

The nine trials involved 432 patients and were of moderate methodological quality as assessed by the risk of bias tool. Pulmonary rehabilitation significantly reduced hospital admissions (pooled odds ratio 0.22 [95% CI 0.08 to 0.58], number needed to treat (NNT) 4 [95% CI 3 to 8], over 25 weeks). No adverse events were reported in three studies.

More recent studies

Our search found eight RCTs of COPD of which none were more recent than those assessed for the Cochrane review. {Boxall 2005} {Eaton 2009} {Gomez 2006}{Griffiths 2000} {Maltais 2005} {Molina 2005} {Ringbaek 2010} {Wittmann 2007}

Heart Disease

Previous review

We found a recent Cochrane on exercise-based cardiac rehabilitation for coronary heart disease.{Heran 2011} The aim of the review was to determine the effectiveness of exercise-based cardiac rehab (exercise alone or in combination with psychosocial or educational interventions) with coronary heart disease. Primary outcomes include total mortality, incidence of MI and total revascularisation, as well as total hospitalisation; cardiovascular specific and general.

This review included 47 RCTs of 10,794 patients. Ten studies involving 2379 patients reported hospital admissions, only one study reporting both up to a year and beyond one year. {Hofman Bang 1999} Exercise-based cardiac rehabilitation reduced hospital admissions [RR 0.69 (95% CI 0.51, 0.93)] (4 studies) in the shorter term (< 12 months follow-up) with no evidence of heterogeneity of effect across trials. In studies with follow up longer than 12 months there was no significant differences in total hospitalisations (7 studies).

More recent studies

Our search found ten RCTs of heart disease of which none were more recent than those assessed for the Cochrane review.{Austin 2008} {Austin 2005} {Belardinelli 1999} {Belardinelli 2001} {Belardinelli 2006} {Dracup 2007} {Jolly 2007} {Lewin 2009} {Neves 2009} {Robertson 2001}

Stroke

Previous review

We found one Cochrane review on therapy-based rehabilitation services for stroke patients at home. {Outpatient Service Trialists 2009}   This was initially published as a Cochrane review in 2003, which was also published in 2004 in the Lancet. {Legg 2004}. The Cochrane review was updated in 2009 but no further trials were added. Hospital admissions were a secondary outcome. The review focused on the effects of therapy-based rehabilitation for stroke patients resident in the community within one year of discharge from hospital and asked three questions namely the benefits of, components that are effective and which outcomes are influenced. Primary outcomes were death or a poor outcome and performance of personal activities of everyday living. Secondary outcomes included measures of resource

use including number of admissions to hospital. The review included 14 RCTs involving 1617 patients. Five studies described number of readmissions to hospital before the end of the scheduled follow-up, range 6-12mths. The overall estimate was OR 0.81 (95% CI 0.52, 1.26) p=0.4. Thus the results do not confirm any benefit in terms of reduced admissions but the authors state numbers are small so it is difficult to draw definite conclusions. There was no statically significant heterogeneity between trials (chi square=0.4.49 df=3, p=0.21)

More recent studies

Our searches found one study published in conference abstract form in 2009 {Andrjule 2009} which to date we have been unable to obtain.

Older people -prevention of falls

Previous reviews
We found three Cochrane reviews concerning interventions for the prevention of falls in older people based in the community, 'population based' and in nursing care facilities and hospitals [Gillespie 2009b] [McClure 2005] [Cameron 2010]. They all focused on reduction of falls and associated morbidity and did not include an outcome of hospital admissions or readmissions.

More recent studies

We found three papers investigating exercise/rehabilitation based interventions for the prevention of falls which included hospital admissions as an outcome. None of the studies found that the intervention had any effect on hospital admissions. {Hogan 2001} {Davidson 2005} {Kerse 2008}

Hogan *et al* in Canada investigated a 12 month community based consultation service which involved an exercise plan versus usual care in a RCT for 163 people aged over 65 years and who had fallen in the past three months. The intervention consisted of an in home assessment, the development of an individualised treatment plan which included an exercise program. The primary outcome was enumeration of falls. Admissions to hospital were a secondary outcome. In the 12 month period, 5/79 (6.3%) of the intervention group versus 6/84 (7.1%) control group experienced a fall-related admission p=0.084.

In a RCT based in the UK by Davidson *et al*, 313 cognitively intact people aged over 65 years presenting at A&E with a fall or fall related injury and one other fall in the previous year were randomised to either a multifactorial intervention (medical, physiotherapy and occupational therapy or conventional care for one year. The primary outcome was

enumeration of falls and hospital admission was one of the secondary outcomes. Hospital admissions were recorded prospectively from diary reports and checked retrospectively in hospital records at one year. There were no differences in hospital admissions due to another fall between the two groups (intervention group 14/159 (9%) vs. control group 17/154 (11%) (Risk ratio 0.80 95% CI 0.41, 1.56).

A functional activity programme was compared to usual care plus two social visits from a social science researcher to control for attention in a RCT carried out in New Zealand. {Kerse 2008} 682 people aged over 65 years living in one of 41 low level dependency residential care homes were randomised to one of the two groups for one year. The primary aim was to look at the effectiveness of the intervention on function, quality of life and falls. The intervention comprised of goal setting and individualised activities of daily living activities by a gerontology nurse and reinforced by usual heath care staff. Secondary outcome measures included hospital admissions at 12 months obtained from hospital records. Data were expressed as admitted at least once in the 12 month period and no difference was seen between the activity and the social group (103/330 (31%) vs. 120/352 (34%) incidence rate ratio 0.91 (0.65,1.25, p=0.55).

Older people- general

Previous reviews
No previous reviews were identified

More recent studies

We found 5 papers describing exercise/rehabilitation based interventions for the in older people {Munro 2004} {Cunliffe 2004} {Fleming 2004} {Courtney 2009} {Lannin 2007} of which two had associated cost effectiveness analysis papers. {Miller 2005} {Graves 2009}

Munro et *al* investigated the effectiveness and cost effectiveness of a community-based exercise programme in people over the age of 65 years. This was cluster randomised trial based at 12 general practices in Sheffield in the UK. There were 2283 eligible participants in the practices randomised to the intervention and 4137 from control practices. Eligible subjects were invited to free locally held twice weekly classes, made available for two years. Classes included activities aimed at improving joint mobility, muscle strength and endurance, flexibility, balance and coordination, and cardiorespiratory fitness. One of the main outcomes was hospital admissions. In the intervention practices, 590 (26%) attended at least one session and 1693 (74%) of those invited did not attend any sessions. Admissions were divided into all cause and specific causes over the two year period and no difference was

seen between the intervention and control practices. (all cause 39% vs. 41% p=0.09, specific causes 12.6% vs. 12.3% p=0.71).

Cunlife *et al* published a randomised controlled trial of 370 hospitalised older medical and surgical patients comparing an early discharge and rehabilitation for up to four weeks with standard hospital aftercare. Use of services was a secondary outcome. There were no differences in hospital admissions: the number of patients re-admitted to hospital by 3 months was 49 (26%) 40 (22%) RR = 1.21 (0.85, 1.76) and by 12 months 102 (55%) 90 (49%) RR = 1.13 (0.93, 1.38). The cost effectiveness analysis of the service which calculated as cost per QALY gained. At 12 months the mean untransformed total cost for the service was £8,361 compared to £10,088 for usual care, a saving of £1,727 (*P*=0.05). Cost-effectiveness acceptability curves showed a high probability that the service was cost effective across a range of monetary values for a QALY. {Miller 2005}

In a study by Fleming *et al* the effect of a care home rehabilitation service was evaluated using a randomised controlled trial design involving 165 elderly and disabled hospitalised patients who wished to go home but were at high risk of institutionalisation. The control group received usual health and social care. There was no effect on hospital admissions: the number of patients re-admitted to hospital from randomisation to 3 months was 22 (28%) 32 (38%) RR 0.71 (95% CI 0.46–1.12) and to 12 months 41 (51%) 46 (55%) RR = 0.92 (95% CI 0.69, 1.24).

Courtney *et al* conducted a randomised controlled trial involving 128 patients to evaluate the effect of an exercise-based model of hospital and in-home follow-up care for older people at risk of hospital readmission. The intervention consisted of comprehensive nursing and physiotherapy assessment and individualized program of exercise strategies and nurse-conducted home visit and telephone follow-up commencing in the hospital and continuing for 24 weeks after discharge. The intervention group required significantly fewer emergency hospital readmissions (22% of intervention group, 47% of control group, P=.007). In the cost effective analysis the authors calculated the mean change to total costs and QALYs for an individual over 24 weeks in the intervention group were: cost savings of $333 (95% Bayesian credible interval $ -1,932:1,282) and 0.118 extra QALYs (95% Bayesian credible interval 0.1:0.136). The mean net-monetary-benefit per individual for the intervention group compared to the usual care condition was $7,907 (95% Bayesian credible interval $5,959:$9,995) for the 24 week period. {Graves 2009}

In a very small RCT by Lannin *et al*, 10 patients participating in an inpatient rehabilitation program were randomly assigned to receive either a pre-discharge home visit (intervention), or standard practice in-hospital assessment and education (control), both conducted by an occupational therapist. Enumeration of readmission rates was one of the outcome measures. The authors reported one participant in the control group was readmitted to hospital twice, first within two weeks of discharge and then again between the two week and one month assessments. No other participants reported being readmitted to hospital during the three month study period.

Summary

Pulmonary rehabilitation is a highly effective and safe intervention to reduce hospital admissions who have recently suffered an exacerbation of COPD. Exercise-based cardiac rehabilitation is effective in reducing hospital admissions in shorter term studies. Therapy based rehabilitation targeted towards stroke patients living at home did not appear to improve unplanned hospital admissions.

There are limited data on the effect of fall prevention interventions in older people on unplanned admissions. The data that are available suggest they did not influence hospital admissions. The evidence to determine if exercise or rehabilitation has any effect on unplanned hospital admissions in older people was mostly negative.

H. Telemedicine

Background

Telehealth is frequently seen as a potential solution for supporting people with long-term conditions in their own homes. There is a large evidence base, including numerous systematic reviews, about telehealth.

Definitions

Telehealth: health-related services, education at a distance using telecom technologies.

Telecare: care directly to the end-user

Telemonitoring: automated transmission of health status and vital signs from distance to healthcare setting

Telemedicine: We have used the term to encompass all of the three above.

Previous reviews

Telemedicine has been extensively researched in primary studies as well extensively assessed in systematic reviews and meta-analysis. A recent programme of work called the Healthlines study carried out in the School of Social and Community Medicine at the University of Bristol in collaboration with the the Universities of Sheffield and Southampton included a meta-review of home-based telehealth for the management of long term conditions. Whilst the focus of their work was not specifically the reduction of unplanned hospital admissions, their final report/published paper reported relevant systematic reviews or meta-analysis which described the effect of telehealth on hospitalisations.{Rowsell 2011}

This report concluded that telehealth is effective in reducing admissions for heart failure, heart disease, diabetes and hypertension and reducing hospitalisations for elderly patients with long term conditions.{Barlow 2007},{Bowles 2007} {Hersh 2006} {Garcia-Lizana 2007} {Botsis 2008} However other reviews showed limited impact on service utilisation. {Murray 2009}{Stinson 2009} and meta-analysis reported that the evidence for a positive impact of telehealth on resource utilisation was questionable.{Tran 2008} {Murray 2009} {Stinson 2009}

More recent studies

Whilst we found potential 57 RCTs of telemedicine in our searches we choose to include this very recent meta-review above as opposed to reviewing individual trials.

Summary

Telemedicine is implicated in reduced UHA for heart failure, heart disease, diabetes, hypertension and the older people.

I. Finance schemes

Background

We were interested in financial management that may impact on unplanned hospital admissions such as pay for performance schemes. It was challenging to search for such studies as specific search terms are not available in databases.

Previous reviews

No previous reviews were identified

Recent studies

We found 14 controlled studies (three RCTs, four controlled studies & seven before and after studies) looking at various aspects of financial management including pay for performance schemes, patient payment schemes and GP fund holding which may impact on unplanned hospital admissions. {Chen 2010} {Cole 1994} {Davis 1995} {DesHarnais 1990} {Intrator 2004} {Kane 2004} {McCombs 1998} {Zhang 1998} {Beck 2004} {Farrar 2009} {Friedman 2001}{Zhan 2004}

Summary

We found insufficient evidence (a lack of information from the available studies) to make any conclusions on the role of financial management schemes on unplanned hospital admissions.

J.   Emergency department interventions

Background

Many admissions occur via the emergency department (ED or A&E) of acute hospitals and therefore there is the opportunity to reduce avoidable admissions. Various interventions have been evaluated in this setting including observation units and primary care base initiatives. Observation services allow for time to determine the need for hospitalisation in cases that are unclear after their initial evaluation and treatment. Another intervention identified is the use of primary and community services alongside or within hospital emergency departments. These types of interventions reflect a trend towards the provision of more comprehensive services in the hospital ED and aim to provide services for patients with minor conditions.

Results (Appendix 2, table 6)

Thirteen controlled trials were identified for inclusion within this area, nine were excluded and four studies included. {Goodacre 2004} {Murphy 1995} {Basic 2005} {Kline 2009}.

Previous Reviews

Observation units have also been reviewed extensively {Ogliviel 2005} {Macy 2010}{Daly 2003} {Cooke 2003} There is currently an on-going Cochrane review {Khangura 2011} looking at this type of intervention with a primary outcome of the percentage of patients admitted to hospital however during the course of this systematic review no RCT's of this type of intervention were identified.

Recent studies (Appendix 2, table 8)

Four other RCT's were found that were eligible for inclusion within this area. These used specialist doctors {Goodacre 2004} {Murphy 1995} and nurse {Basic 2005} in the emergency department and a pretest probability scoring measure in heart disease {Kline 2009}. Goodacre *et al* created a post of an emergency department physician to review patients referred from emergency department for medical admission and by accessing the appropriate clinics and diagnostic tests divert appropriate patients away from admission. The study showed overall, hospital admissions were increased by 0.9 per day when the emergency department physician was present (95% CI −1.8 to 3.6, p = 0.5). Murphy *et al* added GPs to the emergency department to assess non urgent presentations. They reported significantly fewer admissions by GP compared to emergency department staff for

patients assessed as triage level 3 whilst no significant difference was seen for those assessed as triage level 4. Basic *et al* utilised an aged care nurse to perform an early geriatric assessment within the emergency department. The study found that the intervention had no significant effect on admission to the hospital (OR, 0.7; CI, 0.3–1.7). Kline *et al* tested the use of a pretest probability score which is a previously validated computer-based method to estimate the pretest probability of acute coronary syndrome using the method of attribute matching. The intervention showed no significant reduction in readmissions within 7 days (RR 0.50 95% CI 0.24, 1.04) however a significant 60% reduction in readmissions was seen within 45 days (RR 0.30 95% CI 0.12, 0.73).

Summary

The evidence of the effect of interventions within the emergency department beyond the observational and short stay units is limited. The RCTs identified here found evidence of a reduction in admissions from the use of pre-test scoring in chest pain and from the provision of GPs within the emergency department but no effect from the presence of specialist nurses in the older population or of specialist physicians.

K.   Continuity of care

Background

Continuity of care is advocated as a cornerstone or essential element of general practice medicine, but health service researchers have been unable to provide unequivocal evidence of its value. The term continuity of care is frequently used but much less often defined. More than 10 distinct definitions have been found {Parker 2010}. The lack of clarity about what continuity actually means hinders service organisation and deliver. Problems have been identified both across health and social care boundaries and within service systems: ' If you do not know what it is then it is difficult to know whether, when and how we have achieved it' {Haggerty 2003}

Continuity of care refers to how an individual's health care is connected over time. Three types of continuity have been identified; informational continuity, management continuity and relationship continuity. Effective healthcare organisation has to embody all dimensions of continuity, alongside good access and systematic care.   Emphasis has been place on management and informational continuity with less attention on relationship continuity. Whilst informational continuity is necessary to link care and underpins management continuity by itself it does not guarantee that management is consistent or coherent. There is evidence that relationship continuity is important to patients, however it affects on other aspects of quality of care such as disease control and hospital admission whilst broadly positive is less consistent.

Results (Appendix 2, table 7)

Twelve studies were identified; 6 excluded. The six studies included, enhanced primary care (n=1), out of hours care (n=2), diabetes (n=2) and use of additional information (n=1).

Previous Reviews

A review by *Haggerty et al* looked at continuity of care across disciplines. {Haggerty 2003} Continuity of primary care is mainly viewed as the relationship between a single practitioner and a patient that extends beyond specific episodes of illness or disease. A trade-off is required between accessibility of healthcare providers and continuity. Mental healthcare literature emphasises coordination of services and the stability of patient-provider relationships over time. Unlike primary care the relationship is typically established with a team rather than a single provider. In the nursing context the emphasis is on information transfer and coordination of care over time. The goal is to maintain a consistent approach to care between nurses and to personalise care to the patient's changing needs during an

illness. In the management of chronic diseases continuity is seen as the delivery of services by different providers in a coherent and logical and timely fashion and is often referred to as continuum of care.

Saultz *et al* performed a critical review of the literature for interpersonal continuity in family practice the outcomes of which were published in 3 papers in 2003, 2004 and 2005. {Saultz 2005} The 2005 review published the results of care outcomes. They identified 8 studies which looked at hospitalisation rates however only two of these were RCT's both of which found a positive association between increased continuity of care and lower hospitalisation rates with only Wasson et al reporting emergency hospitalisation rates. The remaining studies were clinical trials or cohort studies which also found a positive association between increased continuity of care and decreased hospitalisation rates however these where not exclusively unplanned admissions.

Leibowitz *et al* looked at the organisation of out of hours primary care. {Leibowitz 2003} They identified 6 models of after-hours primary care: Practice based services, deputising services, emergency departments, co-operatives, primary care centres and telephone triage and advice services. They found one RCT reporting hospital admissions comparing a deputising and practice based service {Cragg 1997} and one comparing nursing and doctor telephone triaging services {Lattimer 1998}. Both of these studies have been included in this report. No significant difference was observed in hospital admissions between the different models of care in either study. They concluded that there was very little evidence about the advantages of one service model compared with another in relation to clinical outcomes.

Additional Studies (Appendix 2, table 7)

In addition to the two studies highlighted above {Cragg 1997} {Lattimer 1998}, this review identified an additional four RCTs. {Griffith 1998} {Morrison 2002} {Naji 1994} {Weinberger 1996} One was for primary care services however this was in a veteran's affairs medical centre. They found that enhanced primary care provided by a multidisciplinary team during inpatient and following discharge from hospital was associated with a significant increase in hospital admissions. {Weinberger 1996}

Two RCTs were found for people with diabetes mellitus. One was concerned with the continuity of midwifery services which reported a significant reduction in postnatal readmissions. {Morrison 2002} The second RCT was focused on integrated care however no difference was seen for the number of admissions for between the groups.{Naji 1994}

The remaining RCT identified in this report was for the provision of social history information to house officers. No difference was seen in the readmissions at 14 or 30 days{Griffith 1998}

Summary

Overall there is insufficient evidence (lack of studies) to comment on the effect of continuity of care in the role of prevention of unplanned hospital admissions.

L.   Vaccine programmes

Background

Whilst we didn't specifically search for vaccine schemes in this review, some studies were found as part of our comprehensive searches. We decided to include the topic as it is a service as opposed to a pharmaceutical intervention.

Results

Previous review(s)

We identified a series of Cochrane reviews looking at the effect of influenza vaccinations on a variety of vulnerable patients.

Asthma

This Cochrane review was performed by Cates *et al* and included randomised trials of influenza vaccination in children (over two years of age) and adults with asthma. {Cates 2008} Fifteen trials were included. The included studies covered a wide diversity of people, settings and types of influenza vaccination, but data from the more recent studies that used similar vaccines have been pooled. This review reported both asthma-related and all cause hospital admissions.   No effects on admissions were reported in any of the comparisons although data were limited.

COPD

A review of the safety and efficacy of influenza vaccination for COPD was published by Walters *et al.*   {Walters 2010b} Secondary outcomes of interest included hospital admissions. Seven studies were included.   There were only two studies which reported unplanned hospital admissions data.   Leech *et al* found no difference in rates of hospital admissions for pneumonia (RR 1.98; 95%CI 0.66, 5.91) or for acute exacerbations (RR 0.83; 95% CI 0.54 to 1.27) or for all causes (RR 1.01; 95% CI 0.72 to 1.41).{Leech 1987} Steentoft *et al* reported the actual numbers of participants admitted to hospital for the pneumococcal vaccination and control groups, with no significant difference between interventions (OR 0.95; 95% CI 0.26 to 3.48).{Steentoft 2006}

Seasonal influenza in people aged over 65 years old

A review on seasonal influenza vaccination in people aged over 65 years old {Jefferson 2010} looked at non-RCTs. The authors concluded that the available evidence is of poor quality and provides no guidance for outcomes including UHA.

Health workers who work with older people

A review of influenza vaccination on health workers who work with older people showed no effect on UHA. Two studies provided data giving a combined odds ratio 0.89 (95% CI 0.75 to 1.06, Z = 1.29, P = 0.20). {Thomas 2010}

More recent studies *(if any)*

Our searches found 14 controlled studies of which two were RCTs of vaccine programs for the older people {Gaughran 2007} {Hayward 2006} published prior to the above reviews.

Summary

Overall there was no evidence that influenza vaccination reduces UHAs in vulnerable population but data are limited.

M. Hospital at home

Background

Hospital at home schemes vary in their philosophy and focus of care, and may be community based or hospital resourced. The community based schemes build on existing community resources, which may include home health agencies; the hospital resourced schemes provide an outreach service with hospital staff making domiciliary visits. In the UK, hospital at home usually concentrates on providing personal, nurse-led care rather than technical services, building on the existing structure of primary care. {Shepperd 2010}

Definition

'Early discharge hospital at home' is a service that provides active treatment by health care professionals in the patient's home for a condition that otherwise would require acute hospital in-patient care.

Previous review(s)

Shepperd *et al* 2010 review of hospital at home following early discharge. 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 to 2.24; N = 705). There was insufficient evidence of a difference for readmission between groups in trials recruiting patients recovering from surgery.

More recent studies

We found 10 RCTs of hospital at home (n=5 COPD, n=3 older people, n=1 heart disease, n=1 post surgery) all of which were published prior to the above review. {Aimonino 2007} {Aimonino 2008} {Arya 2008} {Diaz 2005} {Harris 2005] {Hernadez 2003} {Nikolaus 1995} {Puig-Junoy 2007} {Shepperd 1998} {Wilson 1999}

Summary

There is evidence that readmission rates are significantly increased for older people with a mixture of conditions allocated to hospital at home services.

4- Summary

The overall aim of this series of systematic reviews was to evaluate the effectiveness and cost-effectiveness of interventions to reduce unplanned hospital admissions. 18,000 potential sources of data were identified from both academic reference sources and policy and practice databases. Screening and processing this information was a huge task and this review consequently represents one of the most comprehensive sources of evidence on interventions for unplanned hospital admissions. Our primary outcome measures of interest were reduction in risk of unplanned admission or readmission to a secondary care acute hospital, for any speciality or condition. In the majority of cases we identified either high quality systematic reviews or RCTs that we have summarised and reported in the results sections of the report. We prioritised those areas where systematic reviews were lacking, or where our advisory group felt there was a need for evidence for more comprehensive reviews of the available evidence. However, all areas have been covered in the report. We planned to look at the cost effectiveness of those interventions that were effective and where economic evaluations are available. However, we found very limited economic data to include.

The findings of the review are summarised below:

Case management: RCTs found by our searches covered older people, heart failure and COPD patients. Overall case management did not have any effect on unplanned admissions although we did find three positive heart failure studies in which the interventions involved specialist care from a cardiologist.

Specialist clinics: RCTs found by our searches covered heart failure, asthma and the older people. Overall specialist clinics for heart failure patients, which included clinic appointments and monitoring over a 12 month period, reduced unplanned admissions. There was no evidence to suggest that specialist clinics reduced unplanned admissions in asthma patients or older people.

Community interventions: A small number of RCTs based on home visits were found by our searches and covered older people, mother and child health and heart disease. Overall, the evidence is too limited to make definitive conclusions. However, there is a suggestion that visiting acutely at risk populations may result in less unplanned admissions e.g. failure to thrive infants, heart failure patients.

Pathways and guidelines

Care pathway and guideline systematic reviews have been conducted for many conditions. There is no convincing evidence to make any firm conclusions regarding the effect of these approaches on unplanned hospital admissions, although it is important to point out that data are limited for most conditions.

Medication review: RCTs found by our searches covered older people, heart failure and asthma. There was no evidence of an effect on unplanned admissions in older people and on those with heart failure or asthma carried out by clinical, community or research pharmacists.

Education & self-management: This was a topic covered by recent Cochrane reviews. Education with self-management reduced unplanned admissions in adults with asthma and in COPD patients, but not in children with asthma. There is weak evidence for the role of education in reducing unplanned admissions in heart failure patients.

Exercise & rehabilitation: This was a topic covered by recent Cochrane reviews. Pulmonary rehabilitation is a highly effective and safe intervention to reduce unplanned admissions in patients who have recently suffered an exacerbation of COPD. Exercise-based cardiac rehabilitation for coronary heart disease is effective in reducing unplanned admissions in shorter term studies. Therapy based rehabilitation targeted towards stroke patients living at home did not appear to improve unplanned admissions and limited data on the effect of fall prevention interventions for older people at risk suggest they did not influence unplanned admissions.

Telemedicine: Telemedicine has been extensively researched in primary studies as well as extensively assessed in systematic reviews and meta-analysis. Telemedicine is implicated in reduced unplanned admissions for heart disease, diabetes, hypertension and older people.

Vaccine programs: We identified a series of Cochrane reviews looking at the effect of influenza vaccinations on a variety of vulnerable patients. Reviews of asthma patients, COPD patients, healthy older people and health workers who work with the older people, all showed no effect on unplanned admissions.

Hospital at home: This was a topic covered by a recent Cochrane review of hospital at home following early discharge. Readmission rates were significantly increased for elderly patients with a mixture of conditions allocated to hospital at home services.

We found insufficient evidence (a lack of studies) to make any conclusions on the role of finance schemes, emergency department interventions and continuity of care for the reduction of unplanned admissions.

Conclusions

There was evidence that education/self-management, exercise/rehabilitation and telemedicine in selected patient populations, and specialist heart failure interventions can help reduce unplanned admissions. However, the evidence to date suggests that majority of the remaining interventions included in these reviews do not help reduce unplanned admissions in a wide range of patients. There was insufficient evidence to determine whether home visits, pay by performance schemes, A & E services and continuity of care reduce unplanned admissions.

The results of this review are important for policy makers, clinicians and researchers. Some of the findings may be disappointing but it is important to remember that some of the interventions may have demonstrable impact in other areas, for example case management appears to reduce length of hospital stay. In addition, in many health care economies a number of interventions are introduced across the system. Few research studies include evaluation of system wide approaches, hence the impact of programmes of interventions are rarely reported in the research literature. This highlights the importance of robust evaluation of interventions as they are introduced into health and social care systems.

Appendices

Appendix 1: general tables & figures

Table 1. List of electronic databases

Databases	Time period searched
ASSIA (Applied Social Sciences Index and Abstracts)	1987- 2010
CINAHL (*Cumulative Index to Nursing and Allied Health Literature)*	1982 - 2010
Cochrane Central Register of Controlled Trials	1996 - 2010
Cochrane Database of Systematic Reviews (CDSR),	1996-2010
ECONLIT	1969-2010
EMBASE	1980 -2010
HMIC (*Health Management Information Centre*)	1979-2010
MEDLINE	1950 - 2010
MEDLINE In-Process and Other Non-Indexed Citations	1951-2010
NHSEED (*NHS Economic Evaluation Database*)	1979 - 2010
Open SIGLE (System for Information on Grey Literature in Europe)	1980 - 2005[*]
Psycinfo	1806-2010
Social Care online	1970 - 2010
Social Services Abstracts	1979 - 2010
Sociological Abstracts,	1963 - 2010
Web of Knowledge — ISI Proceedings	1990 - 2010
Web of Knowledge — ISI Science Citation Index	1981 - 2010
Web of Knowledge — ISI Social Science Citation Index	1981 - 2010

Parent search strategy run in Medline

The following are explanations of the symbols used in the search strategy below.

/   after an index term (MeSH heading) indicates that all subheadings were selected.

*   before an index term indicates that that term was focused - i.e. limited to records where the term was a major MeSH/Emtree term.

.tw   indicates a search for a term in title/abstract

.mp.   indicates a free text search for a term

retrieves records that contain the search term with substituted character(s) in the specified location.

*   at the end of a term indicates that this term has been truncated.

?   in the middle of a term indicates the use of a wildcard.

adj   indicates a search for two terms where they appear adjacent to one another

1. randomized controlled trial.pt.

2. random$.tw.

3. control$.tw.

4. intervention$.tw.

5. evaluat$.tw.

6. or/1-5

7. animal/

8. human/

9. 7 not (7 and 8)

10. 6 not 9

11. Emergencies/

12. Emergency Medical Services/

13. Emergency Medicine/

14. Emergency Treatment/

15. Emergency Service, Hospital/td [Trends]

16. *Hospitalization/ec, td [Economics, Trends]

17. *"Length of Stay"/ec, sn, td [Economics, Statistics & Numerical Data, Trends]

18. Patient Readmission/

19. "Patient Admission"/ec, td [Economics, Trends]

20. Emergency hospital admission*.ti,ab.

21. emergency hospitali#ation.ti,ab.

22. unplanned hospitali#ation.ti,ab.

23. (overnight stay adj5 admission*).ti,ab.

24. (primary care adj5 admission*).ti,ab.

25. (ambulatory care adj5 admission*).ti,ab.

26. (admission* adj5 emergenc*).ti,ab.

27. (Emergency Treatment adj5 admission*).ti,ab.

28. ((emergency care adj5 admission*) or readmission*).mp.

29. (emergency room adj5 admission*).ti,ab.

30. emergency admission*.mp.

31. overnight stay.mp.

32. emergency medical admission*.mp.

33. (hospital* adj5 readmission rates).mp.

34. emergency referral*.ti,ab.

35. (admissions adj5 hospital days).mp.

36. (hospital admission* adj5 emergenc*).mp.

37. ((unscheduled or unplanned or un-planned or unanticipated or unexpected) adj5
(admission* or readmission* or hospitali#ation or care)).mp.

38. (admissions adj5 hospital days).mp.

39. (hospital admission* adj5 emergenc*).mp.

40. or/11-39

41. Ambulatory Care/

42. Aftercare/

43. After-Hours Care/

44. Case Management/

45. "Continuity of Patient Care"/

46. Patient education/

47. "Attitude of Health Personnel"/

48. Health Services Accessibility/

49. "Delivery of Health Care"/

50. Home Care Services, Hospital-Based/

51. Managed Care Programs/

52. Health Knowledge, Attitudes, Practice/

53. *"Outcome Assessment (Health Care)"/

54. "Drug Utilization Review"/

55. Intermediate Care Facilities/

56. *"Self Care"/

57. Community Health Services/

58. "Patient Discharge"/

59. Health Services Research/

60. Patient Satisfaction/

61. Primary Health Care/

62. Physicians, Family/

63. Treatment Outcome/

64. Risk Assessment/

65. Telemedicine/

66. Quality of care.mp.

67. (out-of-hours or OOH).mp.

68. access to care.mp.

69. access to services.mp.

70. Continuity of care.mp.

71. medication review.mp.

72. organisation of care.mp.

73. outreach.mp.

74. community matron.mp.

75. walk in centres.mp.

76. telemonitoring.mp.

77. "hospital at home".mp.

78. "virtual wards".mp.

79. self management.mp.

80. assessment units.mp.

81. observation wards.mp.

82. GPs in A&E.mp.

83. discharge plan*.mp.

84. primary care.mp.

85. telephone follow-up.mp.

86. home telehealth.mp.

87. (tele-homecare or telehomecare).mp.

88. (tele-nursing or telenursing).mp.

89. home telecare.mp.

90. on-line health.mp.

91. (e-health or ehealth).mp.

92. home telemedicine.mp.

93. general practitioner*.mp.

94. (reduction or reduce* or lessen or decrease or diminish or drop off).mp.

95. or/41-94

96. 10 and 40 and 95

97. 96 not (Algeria$ or Egypt$ or Liby$ or Morocc$ or Tunisia$ or Western Sahara$ or Angola$ or Benin or Botswana$ or Burkina Faso or Burundi or Cameroon or Cape Verde or Central African Republic or Chad or Comoros or Congo or Djibouti or Eritrea or Ethiopia$ or Gabon or Gambia$ or Ghana or Guinea or Keny$ or Lesotho or Liberia or Madagasca$ or Malawi or Mali or Mauritania or Mauritius or Mayotte or Mozambiq$ or Namibia$ or Niger or Nigeria$ or Reunion or Rwand$ or Saint Helena or Senegal or Seychelles or Sierra Leone or Somalia or South Africa$ or Sudan or Swaziland or Tanzania or Togo or Ugand$ or Zambia$ or Zimbabw$ or China or Chinese or Hong Kong or Macao or Mongolia$ or Taiwan$ or Belarus or Moldov$ or Russia$ or Ukraine or Afghanistan or Armenia$ or Azerbaijan or Bahrain or Cyprus or Cypriot or Georgia$ or Iran$ or Iraq$ or Israel$ or Jordan$ or Kazakhstan or Kuwait or Kyrgyzstan or Leban$ or Oman or Pakistan$ or Palestin$ or Qatar or Saudi Arabia or Syria$ or Tajikistan or Turkmenistan or United Arab Emirates or Uzbekistan or Yemen or Bangladesh$ or Bhutan or British Indian Ocean Territory or Brunei Darussalam or Cambodia$ or India$ or Indonesia$ or Lao or People's Democratic Republic or Malaysia$ or Maldives or Myanmar or Nepal or Philippin$ or Singapore or Sri Lanka or Thai$ or Timor Leste or Vietnam or Albania$ or Andorra or Bosnia$ or Herzegovina$ or Bulgaria$ or Croatia$ or Estonia or Faroe Islands or Greenland or Liechtenstein or Lithuani$ or Macedonia or Malta or maltese or Romania or Serbia$ or Montenegro or Slovenia or Svalbard or Argentina$ or Belize or Bolivia$ or Brazil$ or chile or Chilean or Colombia$ or Costa Rica$ or Cuba or Ecuador or El Salvador or French Guiana or Guatemala$ or Guyana or Haiti or Honduras or Jamaica$ or Nicaragua$ or Panama or Paraguay or Peru or Puerto Rico or Suriname or Uruguay or Venezuela or developing countr$ or south America$).ti,sh.

Figure 1. PRISMA diagram

**18,540
references**

Identified from main database searches
& websites for all interventions and for
all conditions**.**

*Abstracts screened by two
reviewers (AH & DS)*

*Any disagreements were
resolved by 3rd reviewer* (DH)

**1530
references**

- All controlled studies were added to
  Access database (395 RCTs, 145
  CTs)
- Decision made to use RCTs for most
  reviews

Included studies by topic

Case management 29 RCTs

Specialist clinics 27 RCTs

Other community interventions 10 RCTs

Pathways 9 RCTs

Medication 25 RCTs

Education/self-management 38 RCTs

Exercise/rehabilitation 31 RCTs

Telemedicine 57 RCTs

Finance 14 controlled studies

Emergency department interventions 3 controlled studies

Continuity of care 6 controlled studies

Vaccine programs 14 controlled studies

Hospital at home 11 RCTs

Appendix 2: tables of study characteristics

Table 1: Case management RCTs

Author date country	Population *Age Gender Ethic group Living alone	Intervention n= number randomised	Control n= number randomised	Outcome measure **(follow up time in months) Intervention vs. control (CI for RR SD for MD)
Older population				
Naylor 1999 USA	363 older people discharged from hospital (home dwelling) Mean age 75yrs 50% female 55% white (45%black) 44% have spouse	n= 177 APN visits patient every 48hrs whilst in hospital, twice during the first 48hrs post discharge and a visit 7-10 days post discharge followed by as many visits as required with no limits. Interventions focused on medication, symptom management, diet, activity, sleep, medical follow-up and emotional status.	n=186 Patients received discharge planning that was routine for adult patients at study hospitals. If referred, they received standard home care consistent with Medicare regulations.	Total no. of hospital readmissions (6mth) 49 vs. 107 RR 0.48 [0.37, 0.63] P<0.00001
Nikolaus 1999 Germany	545 older people discharged from hospital (home dwelling) **but recruited both on admission and in the community** No details given. 'baseline characteristics were similar'	n= 179 **Transition protocol:** comprehensive geriatric assessment in hospital. Plus whilst the patient was in hospital the team gave them additional treatment One home visit was performed whilst the patients was still in hospital. After discharge the team provided treatment which could not be provided by home services for the required time and intensity. At least one home visit was carried in the first 3 days after discharge plus a follow up visit at 3 months to check whether everything was running smoothly including home care. Then follow by telephone was carried out at 12 months.	n= 185 Assessment of activities of daily living and cognition followed by usual care in hospital and at home.	Total no. of hospital readmissions (12mth) 43 vs. 45 RR 0.96 [0.68, 1.36] p=0.83

Avulund 2002 Denmark	149 older patients who were discharged to go home from geriatric and medical wards. No details given. ' No significant differences between grps for age & gender.'	n= 59 patients were visited by a member of the geriatric team of the day of the discharge to determine patient's specific needs and then the member engaged various help and support from the persons cited above.	n=90 patients Existing norms for discharge planning was applied to all control patients.	Total no. of readmissions (3mths) Data are not reported in numbers except as % of those that were in the medical ward (selected population). (no differences found between grps)
Caplan 2004 Australia	739 older people sent home from the emergency department Mean age 82yrs 60% female 39% living alone	n=370 patients visit within 24 hours of being at home. Care plan devised by team member. This was discussed at weekly interdisciplinary meetings. Any interventions needed were provided within 4 weeks and referrals were made to the patients GP, specialist physicians or surgeons, community health nurses or other community services.	n=399 patients Usual care: participants were allowed to go home after randomisation with no alteration to the discharge plan formulated by the medical officer in the emergency department.	Total no. of emergency readmissions to hospital (1mth & 18mth) 1mth: 42 vs. 51 intervention vs. control Calculated RR 0.89 [0.61, 1.30] P=0.54 18mth: 164 vs. 201 RR 0.79 [0.69, 0.89]p=0.0002
Lim 2003 Australia	654 older people from hospital (home dwelling) Mean age 77yrs 68% female	n=340 patients Staff assessed patient, devised discharge plan as normal but with extra time & expertise. They also provided short-term case management comprising of: telephone follow up if required, availability to patients in event of crisis, liaison with service providers, co-ordination of service provision and ensuring adequate referral before discharge.	n=341patients received usual hospital discharge planning, provided by nursing staff and social work department. Services were typically to several nursing visits as well as community services	Mean no of unplanned admissions (6 mths) 0.4 (95% CI 0.3, 0.5) vs. 0.5 (95% CI 0.4,0.6) p=0.19
Melin 1992 Sweden	249 frail older patients at discharge from hospital Mean age 80yrs	n= 110 patients patients' district nurse and home service assistant called on patients on day of	n=73 patients Usual care and discharge procedure. Care at home and home	% (no. could not be calculated) of people experiencing readmissions or multiple

	72% female 74% living alone	discharge. Team physicians assessed medical and functional status and to initiate treatment plan There were weekly interdisciplinary care planning conferences The physician was available for routine and emergency visits and was available at end of phone for the primary care staff. 24 hour telephone service was an 'add on' to the service	assistance but without the intervention program or 24 hour service.	readmissions (6mths) No difference between grps 46% vs. 44%)
Bernabei 1998 USA	200 home dwelling older people identified through home health services or home assistance programs Mean age 81yrs 70% female 50% living alone	n=99 participants Initial assessment: physical function, cognitive function, mood, diagnosis, drug treatments, number of home visits by GP, and then every 2 months. Initial assessment was fed back to the geriatric unit. They were constantly available to deal with problems, monitor provision of services and to guarantee extra help as requested by patients and GPs. examinations. The multidisciplinary team discussed problems emerging from home visits at weekly meetings.	n=100 participants received primary and community care within the conventional and fragmented organisation of services including visits to GP, home visits , nursing and social services, home aids and meals on wheels.	Total no. of acute hospital admissions (12mths) 36 vs. 51 RR 0.71 (0.52, 0.99) p=0.04
Dalby 2000 Canada	142 frail older people living in the community identified through a postal screening questionnaire.	n=73 participants were visited by nurse, who reviewed each medical record and completed a	n=69 participants Usual care: participants were allowed to go home	Mean number of hospital admissions (14mth) 0.4 ±0.7 vs. 0.3

	Mean age 79 yrs 75% female 39% living alone	comprehensive assessment addressing physical, cognitive, emotional and social function, medication use and home environment. A care plan was developed together with the primary care physician, the patient, the family, the caregivers and other health professionals. Follow up visits and phone calls were conducted over the 14 months	after randomisation with no alteration to the discharge plan formulated by the medical officer in the emergency department.	±0.8 mean difference 0.1 (-0.3, 0.2) p=0.33
Gagnon 1999 USA	427 older people discharged from hospital (home dwelling) (within 12mths of being discharged from emergency department) Mean age 81yrs 69% female 56% living alone	n=212 patients NCM were expected to support patients in transition e.g. Hospital to home. NCM coordinates the work of all healthcare providers. Patients were assessed for all needs in a series of early visits: health history, care giver data, community services used, current health status (physical, functional, social and environmental) as a review of the needs /concerns of caregivers.	n=215 patients Usual care in which hospital and community services were provided separately. Hospital care varied due to variety of health care providers and community care was determined by whether the person was known to the community centre.	Mean no of hospital admissions (10mth) 0.5 ±0.8 vs. 0.4 ±0.7 mean difference 0.09 [-0.05,0.23] ns
Nikolaus 1999 Germany	545 older people discharged from hospital (home dwelling) **but recruited both on admission and in the community** No details given. 'baseline characteristics were similar'	n= 181 participants **Community protocol:** comprehensive geriatric assessment & recommendations followed by usual care at home	n= 185 participants Assessment of activities of daily living and cognition followed by usual care in hospital and at home.	Total no. of hospital readmissions (12mth) 38 vs. 38 RR 1.01 [0.69, 1.48]

Vass 2008 Denmark	Home dwelling older people over the age of 75yrs (randomisation was on municipality level as opposed to the participant level)	n=17 municipalities Home visitors (intervention municipality employees) were then expected to focus and react to early signs of disability whilst respecting individual variation and endeavouring to provide an interdisciplinary co-ordinated follow up in the local setting in cooperation with the GP.	n=17 municipalities No education or training was provided. Home visitors carried out home visits as usual.	a) Total no. of hospital admissions b) mean no. of admissions (36mth) a) 985 vs. 935 RR 0.96 [0.93, 0.98] b) 2.5 (95% CI 1,15) vs. 2.4 (95% CI 1,19) p=0.65
Heart failure				
Harrison 2002 Canada	192 HF patients admitted into two study units within one medical centre Mean age 76yrs 45% female 48% living alone	n=92 patients Before discharge: normal discharge planning, comprehensive education, letter from transfer nurse to home nurse After discharge: Phone call within 24hrs , two visits within two wks Tailored case management	n=100 patients Before discharge: Normal discharge planning After discharge: number of home visits	'All cause' hospital admissions as % of patients (3mths) 23% vs. 31% Chi squared =0.28 d.o.f p=0.26 (authors state underpowered to made a statement)
Larmee 2003 USA	287 HF patients admitted with a primary or secondary diagnosis of HF Mean age 71yrs 46% female	n=141 patients Before discharge: education by nurse CM, early discharge planning & co-ordination of care by CM nurse After discharge: Letter to primary care physician Scheduled telephone calls by CM 1-3 days after discharge , weekly, biweekly and then monthly	n= 146 Usual care Standard discharge planning & contact with primary care physician	Total no. of HF readmissions (3mths) 18 (14%) vs. 21(17%) p=0.49 Calculated RR 0.89 [0.49,1.59] p=0.69

		To co-ordinate Patients could phone CM Physician contacted at 6 wks. if treatment plan not being followed		
Naylor 2004 USA Not in Cochrane review	239 patients who were hospitalised with HF Mean age 76yrs 58% female 64% white (36% African-American) 69% without spouse	n=18 patients Care co-ordinated by three APN 3mths from admission until 3mths following hospital discharge involving team of geropsychiatric clinical nurse specialist, pharmacist, nutritionist, social worker, physical therapist & cardiologist APN visit with in 24 hrs of admission, daily during admission, and at least 8 weekly visits after discharge If hospitalised in this period APN continued	n=121 patients Received usual care which included referrals to specialised care as required	Total no. of readmissions (index related) (12months) 40 vs. 72 p<0.184
Rich 1995 USA	282 patients with HF admitted to hospital Mean age 79yrs 64% female 43% living alone 55% 'non-white '	n=142 patients Before discharge : education from CM nurse plus care co-ordination in terms of diet, social services, medications , home care services After discharge: This continuing including home care services, home visits and telephone contact with team.	n=140 Usual care : standard treatments & services ordered by primary care physicians	Total no. of HF readmissions (3mths) 24 vs. 54 p=0.04 Calculated RR 0.44[0.29,0.67] p=0.0001
Stewart 1999 & 2002 (follow up) Australia	200 HF patients discharged home after an acute hospital admission for their condition Mean age 75yrs 38% female	n= 100 patients Usual discharge plan followed by home visit by specialist CM nurse 7-14 days after discharge. Clinical assessment performed and care coordinated, education of patient &	n=100 usual discharge planning including appointment with primary care physicians	a) Total no. of all cause readmissions b) Rate of all-cause readmission per month at 6mths, 18mths & 4.2rs 6 mths:

	34% living alone	carers/family. Report sent to primary care physician & cardiologists and regime fed back. Only more home visits if there was a readmission but CM nurse phoned at 3 & 6 mths.		a) 68 vs. 118 b) 0.14 (0.10,0.18) vs. 0.34 (0.19-0.49) p=0.031 18mths: a) 118 vs. 156 b) 0.15 (0.11,0.19) vs. 0.37 (0.19, 0.55) p=0.053 4.2yrs: a) 396 vs.475 b) 0.17 vs. 0.29 P=<0.05 No confidence intervals given
Inglis 2004 Australia Not in Cochrane review	152 patients who have been hospitalised due to chronic atrial fibrillation (AF)stratified into presence or absence of HF (pilot study to decide power of a larger RCT) Mean age 73yrs 47% female 23% non-English speaking	n=68 patients (AF only n=31, AF & HF n=37) received a structured home visit within 7-14 days post discharge by a nurse or pharmacist to determine clinical & socio-demographic profile , optimising the patients access to effective management , ensuring quality of medication, patient & family education of AF and HF , early detection of deterioration, ensuring patient could contact them and applying guidelines of best practice.	n=84 patients (AF only n=34, AF & HF n=50) normal discharge planning, GP contact and clinic visits	Rate of recurrent hospital readmission per patient per month AF only 1.9 vs. 2.5 (-27%) AF & HF 2.9 vs. 3.4 (-15%) Analysis is based on presence or absence of HF not intervention vs. usual care
Kasper 2002 USA	200 HF patients who have been hospitalised due their condition Mean age 62yrs 60% female 64% white (36% Afro-Caribbean)	n=102 patients Before discharge: treatment plan devised by cardiologist After discharge: Telephone nurse CM phones within 72hrs then weekly, biweekly then monthly	n=98 Patients Usual care care by primary care physicians following cardiologist treatment plan (no contact with	Total no. of readmissions (6mths) 59 vs. 43 p=0.09 by log transformation p=0.03 by Poisson

		Monthly follow up with HF nurse (mostly in clinic) Primary care physicians notified of any problems. patients received medication, dietary , exercise & educational information Meals on wheels if necessary	cardiologist)	model Calculated RR 1.32 (1.00,1.74) p=0.07
Peters-Klimm 2010 Germany Too recent for Cochrane review	197 patients with HF in primary care Mean age 69yrs 28% female 27% living alone	97 patients received structured CM: Delivery system design, self-management support, decision support & clinical information system	100 patients received usual care	Total no. of admissions (12mths) 18 vs 9 Calculated RR 2.07 [1.02,4.5] p=0.05
COPD Patients				
Egan 2002 Australia	66 COPD patients admitted into an acute hospital Mean age ~67yrs 40% female	n=33 Following admission, CM made comprehensive nursing assessment, co-ordinated care including case conferences and provided support during hospitalisation and this continued beyond discharge	n=33 'normal care' No CM, no case conferences, no follow-up on discharge	Mean number of unplanned hospital admissions at 1 month post discharge 2.1 (range 1.0 to 5.0) vs. 2.6 (range 1-6) ns
Hermiz 2002 Australia	177 COPD patients identified attending A & E or previously admitted into an acute hospital Mean age 67yrs 52% female ~12% non-English speaking	n=84 Two home visits by community nurse. First visit: Detailed health assessment & respiratory function in first week. Co-ordinated care with other providers and gave support Second visit: reviewed progress, checked for follow ups & provided support	n=93 Usual care No nurse follow up	a) Number & percentages patients experiencing readmissions b) Total no. & no of respiratory readmissions Both at 3 months a)16(24%) vs. 14 (18%) b) 25(12) vs. 19(14) ns
Smith 1999 Australia	96 COPD patients either attending as an inpatient or outpatient in acute care hospital Mean age 70 yrs 40% female	N=48 Inpatients were visited by resp nurse, case conferences as appropriate and co-ordinated care with	N=48 Usual care services from outpatient clinics & GP services	Total number of people experiencing admissions (12mths) 47 vs. 45 not significant

		other providers initiated. Early visit upon discharge. Outpatients were recruited via GP, unmet were assessed and domiciliary services arranged Both groups were visited every 2-4 weeks, results reported to GP and support was given to patients		ns
Sridhar 2008 UK	122 patients with COPD in the community but identified via hospital admissions records Mean age ~70 yrs 50% female	n=61 Started with two visits to rehab programme based in hospital Then received baseline home visit by specialist nurse for an assessment. then monthly telephone calls and visits every 3 months providing support.	n=61 Usual care Not attempt was made to alter this.	Mean no of admissions per patient (2 years) 1.0 (range 0-6) vs. 1.0 (0-6) ns
Other conditions				
Anderson 2000 Denmark	155 stroke patients with persistent impairment & disability identified during inpatient rehab. Mean age ~71yrs 54% female 59% living alone	n=54 patients Home visits from GP. Three one hour home visits involving comprehensive assessment of health and needs, problems identified and referrals to services made. Information given & telephone contact available (n=53 received instructions from physiotherapist at home)	n=48 patients 'Standard care – outpatient rehab from hospital or GP	Number of patients experiencing readmissions (6 months) 14 (26%) vs. 21 (44%) p=0.028 Calculated RR 0.59 [0.34,1.03] p=0.06
Latour 2006 & 2007 (economic analysis)	208 general medical outpatients who had been admitted to departments of internal medicine, gastroenterology, pulmonary and cardiology for at least 2	n=101 patients Within 1-3 days after discharge a CM (trained nurse specialist) had made an appointment and saw patient within 3-10days .The patients'	n=107 patients Usual care provided by medical specialist & GP as seen appropriate	No. of patients experiencing readmissions (5months) 16 (20.6%) vs. 11 (15.9%)

Netherlands	nights.

Mean age ~64yrs

49% women | status was assessed using the INTERMED instrument and then psychosocial, medication and allied health professionals/speciali st plus self-management, GP co-ordinated. Home visits were made every 2 mths and patients were regularly contacted by telephone | | The crude RR (1.30; 95% CI: 0.64–2.58) p=0.79 for emergency readmission remained similar after adjustment for baseline differences (author calculation). |
| **Sadowski**

2009

USA | 407 homeless adults with chronic conditions requiring repeated care/admissions identified through referral from social workers

Mean age ~47yrs

24% women

83% African American | n=201 homeless people received CM services from social worker including plans for discharge to respite care prior to rehousing. Respite & housing CM social workers facilitated housing and medical care, with referrals as needed. Participants had bi-weekly contact. CNs had weekly meetings to co-ordinate care. | n=206 homeless people referred back to original hospital social worker received discharge planning but no follow-up | a) no. of readmissions b) mean no. of readmissions per person per year (18 months)

a)272 vs. 462

b)(0.93 vs. 1.53) mean difference -0.6 [-1.0, -0.3] hospitalisations per person per year |
| **Young**

2003

Canada | 146 post MI patients discharged and living in the community (exact point of recruitment/randomisati on unclear)

Mean age 69yrs

40% women

26% living alone | n=71 patients who were subject to the nursing checklist 'speciality care management', communication systems, discharge summary ,nurses visit report and patient education. Patients received minimum of 6 home care visits from a cardiac nurse. | n=83 patients received 'currently practised home care' | Total no. of admissions due to MI (12mths)

9 vs. 14 Data were split into 6 cardiac related outcomes |
| **Bellantonio**

2008

USA | 100 older adults dementia who had relocated to assisted living

Mean age 82yrs

63% female | n=48 residents Received 4 systematic , multidiscipline assessments conducted by geriatrician/ geriatric practice nurse, physical therapist, a dietician and medical social worker with the first 9 months of assisted living . | n=52 residents Usual clinical care. Resident's PC physician within 7 days of admission or just prior to admission. Any further action and treatment at the PC physician's discretion | Change in risk of hospitalisation (9 months) 45% reduction (range 18% -74%)

P=0.13

No numbers except total number of admissions for both grps were 34 |

		Recommendations made and were reviewed twice monthly. Members of the team were available by phone at any time.		
Johansson 2001 Sweden	416 newly diagnosed elderly cancer (breast, GI & prostate) patients in primary care Mean age 63yrs 57% female	n=218 participants received an 'intensified support intervention' comprising intensified primary healthcare, nutritional support and individual psychological support involving a home care nurse & GP who both got additional training	n= 198 participants 'standard care'	Mean no. of admissions stratified by patients <70yrs and those > 70yrs (3months) <70yrs 1.0 vs. 0.9 >70yrs 0.4* vs. 0.9 *Tukey test p<0.001 compared with other grps
Shelton 2001 USA	412 Medicare-eligible **care-givers** of persons with dementia were randomised. Mean age 75yrs 65% female 4% minority race	n=210 both dementia patients and their carers were given a comprehensive health & social needs assessment at home by CM. This was repeated 6mths later. Care plans were devised. These CM authorised and monitored all services	n= 202 Control grp were provided with information about supportive services in the are an d normal medicare provision	No. of carers experiencing admissions during the 'study period' (mean enrolment period 18 months) 39 (18.6%) vs. 62(30.7%) OR 0.58 (0.35—0.97) p=0.037 But authors also say that of the carers (both intervention & control) there was no differences in the total number of hospitalisations p=0.727) Cost data showed no significant difference between grps.

Abbreviations: HF heart failure, APN advanced practitioner nurse, CM case management

*These values are reported if available and are given as means in the total population unless there were significant differences between the groups.

** The follow up time of the studies is the same as the duration of the intervention in the studies, (any variation on this is reported).

'Calculated RR' were calculated by the authors of this review. Other results presented in primary papers were checked by us if possible7

Table 2: Specialist clinic RCTs

Author Date country	Population Age Gender	Intervention n= number randomised	Control n= number randomised	Outcome measure **(follow up time in months) Intervention vs. control (CI for RR & OR, SD for MD)
Heart Failure				
Atienza 2004[21] Spain	338 subjects primary diagnosis HF Age median (range) 69 (61-74) years	Multidisciplinary team of GP, nurse and cardiologist. Education before discharge which included signs and symptoms of worsening disease, self-monitoring, diet and exercise, medication effects and compliance. GP monitored clinical progress and provided additional education and referred back to hospital if required. Clinic appointments provided further education, monitoring and improved treatment regimens and adherence. Also provided referral for specialist's diagnostic tests and treatments. Tele-monitoring throughout follow-up providing a 24hr mobile contact number. Intervention began before discharge. GP visit 2 weeks following discharge Clinic appointments every 3 months. Continuous tele-monitoring. (Intervention continued over the full 12 month period author confirmed)	Patients received discharge planning according to the routine protocol of the study hospitals.	<u>12 months</u> a) Number of patients b) Rates of readmission per year a) 39, 79 b) 0.18, 0.37 19% (95% CI 0.09, 0.29) reduction in the rate of readmission <u>Calculated</u> RR 0.52 (95% CI 0.38, 0.72)
Blue 2001[18] HF due to left	165 subjects HF due to left	Nurse- led care in the community with attachment to hospital outpatient clinics .Education which included self-monitoring. Optimisation of	Usual care by admitting physician	<u>12 months</u>

UK	ventricular systolic function Age mean (SD) 75.6 (7.5) years	treatment and monitoring of electrolyte concentrations. Liaison with other health care and social workers to provide psychological support Telephone contact and home visits occurring with decreasing frequency depending on patient need. The first home visit took place within 48hours of discharge. Subsequent visits took place at 1, 3 and 6 weeks followed by 3, 6, 9 and 12 months [37] Scheduled telephone calls took place 2 and 4 weeks and 2, 4, 5, 7, 8, 10 and 11 months.	and subsequently by GP. They were not seen by specialist nurses after discharge	a) Number of patients b) Number of readmissions (per patient per month) a) 26 (32%), 12 (14%) Hazard ratio 0.38 (95% CI 0.19, 0.76) p=0.044 b) 45 (0.069), 19 (0.027) Rate ratio 0.40 (95% CI 0.23, 0.71) p=0.0004 Calculated RR 0.45 (95% CI 0.24, 0.82)
Bruggink 2007[24] Netherlands	240 subjects with NYHA class III-IV Age mean (SD) 70 (10) years	Multidisciplinary team including HF physician, Nurse and dietician. Outpatient clinic. Education of patients on disease aetiology, medication, compliance, and adverse effects. Diet and fluid restriction, weight control and exercise advice provided. Dietician advice and patient diary. Physical examinations, laboratory workups and ECG monitoring. Optimisation of treatment. Intensive follow up. Clinic appointments every 2 weeks for first 2 months following discharge (weeks 1, 3, 5 and 7) and 3 monthly thereafter (month 3, 6, 9 and 12)	Usual care	12 months a) Total readmissions b) Rate ratio c) Rate difference d) NNT a) 11, 24 b) 0.49 (95% CI 0.30, 0.81) c) 0.215 (95% CI 0.07, 0.36) d) 5 Calculated Rate ratio 0.47 (95% CI 0.23, 0.97) a) Number of patients with at least 1 admission

				a) 11, 22 RR 0.52 (95% CI 0.26, 1.02)
Capomolla 2002[17] Italy	234 subjects CHF Age mean (SD) 56 (8) years	Multidisciplinary team of cardiologist, nurses, physiotherapists, dietician, psychologist and a social assistant. Day hospital A plan of care structured for each patient including risk stratification, tailored therapy according to national and international guidelines, integration of physical training and counselling on daily life activities, checking clinical stability according to EBM criteria, correction of risk factors for hemodynamic in-stabilisation. Education and counselling focusing on knowledge of CHF, pharmacologic therapies and self-management. Telephone follow-up with access to day hospital for worsening HF. Planned appointments individualised for each patient	Patients were referred to their primary care physician and cardiologist. During follow-up the process of care was driven by the patient's needs into a heterogeneous range of emergency room management, hospital admission, and outpatient access. After 12 months all patients were re-evaluated at the HFU by repeating the baseline tests and investigations.	<u>12 months</u> a) Number of patients readmitted, b) Total number of hospitalisations a) 9 (8%), 37 (35% b) 13 (14%), 78 (86%) <u>Calculated</u> RR0.26 (95% CI 0.13, 0.52) Rate ratio 0.18 (95% CI 0.12, 0.28)
Doughty 2002[22] New Zealand	197 subjects Primary diagnosis of HF Age mean (SD) 72.5 (7.6) years	Multidisciplinary team of GP, Cardiologist and nurse. Outpatient clinic and general practice. Pharmacological treatment was based on evidence based guidelines current at the time of the study. Education (plus booklet) and a patient diary, for daily weights, medication record, clinical notes and appointments. Sessions were initially one on one, and group education lasting 1.5-2 hours. Two sessions were offered within the first 6 weeks of hospital discharge and another after 6 months A detailed letter was faxed to the patients GP and	Patients randomized to the control group continued under the care of their GP with additional follow-up measures as usually recommended by the medical team responsible for their in-patient care.	<u>12 months</u> a) Number of patients b) Total readmissions a) 21, 23 b) 36, 65 <u>Calculated</u> RR 0.88 (95% CI 0.52, 1.48) Rate ratio 0.54 (95% CI 0.36, 0.81)

		was followed-up with a phone call to the GP to discuss any relevant changes in the management plan. Clinic review within 2 weeks of discharge. 1 visit every 6 weeks alternating between GP and Cardiologist, Plus 3 group education sessions 2 within the first 6 weeks and 1 after 6 months with cardiologist and nurse.		
Ekman 1998 [19] Sweden	158 subjects NYHA class III-IV Age mean (SD) all subjects 80.3 (6.8) years	Nurse-led outpatient's clinic. Education and counselling to recognise and monitor symptoms of deterioration and be knowledgeable about the effects and side effects of the medication prescribed. Notebooks provided with specific forms for daily weight monitoring, weekly medication calendars and written guidelines for early recognition of warning signs of clinical problems and information about when and where to report such symptoms. Clinic visit 1 week after discharge Number of subsequent visits tailored to the patient need. Telephone follow-up	Usual care	6 months a) Number of patients b) Mean number (SD) c) Mean difference a) 36 (46%), 38 (49%) b) 1.1(1.3), 1.2(1.5) c) 0.1 (95% CI -0.5, 0.3) Calculated RR 0.95 (95% CI 0.68, 1.32)
Jaarsma 2008 [20] Netherlands	1,049 HF due to Left ventricular ejection fraction Age mean (SD) all subjects 71 (11) years	Outpatients and home visits. a) Basic intervention 4 contacts with cardiologist and 9 contacts with the nurse b) Intensive 4 visits with cardiologist, 18 visits with the nurse, 2 home visits by the nurse and 2 multidisciplinary advice sessions. Contacts occurred over the full 18 month follow up period (author confirmed) Both had education prior to discharge using a protocol and behavioural strategies used to improve adherence. With regular clinic visits for	Standard care provided by a cardiologist	18 months a) Number of patients b) Total readmissions a) Basic intervention 84 (25%), Intensive intervention 92 (27%), total intervention 176, control 84 (25%) b) basic 121, Intensive 134,, total 255, control 120 Calculated Basic – RR 1.01 (95% CI 0.82, 1.24)

		monitoring Materials used included a patient diary, brochures on heart failure and its management and samples of sodium restricted food seasonings. Intensive Intervention had more clinic and home visits with weekly telephone calls		Rate ratio 1.01 (95% CI 0.78, 1.29) Intensive – RR 1.10 (95% CI 0.90, 1.34) Rate ratio 1.10 (95%CI 0.86, 1.41) Total intervention - RR 1.04 (95% CI 0.83, 1.30) Rate ratio 1.05 (0.85, 1.31)
Kasper 2002[23] USA	200 subjects NYHA III-IV age mean (SD) 60.2 (13.8) years	Nurse, GP, cardiologist and a nurse telephone co-ordinator. Outpatients Clinic visits with occasional home visits. Diet and exercise advice with a treatment plan individualised for all patients and weekly patient care meetings. Patients with limited financial resources were provided a scale, 3g sodium "meals on wheels" diet, medications, transportation to clinic and a telephone. All provided with a pill sorter, a list of correct medications, a list of dietary and physical activity recommendations and patient education material. Monthly clinic visits, Home visits. Telephone follow-up weekly for first month once a fortnight during the second month and once a month thereafter for the full follow up period (author confirmed).	Patients assigned to the non-intervention group were cared for by their primary physicians. The baseline therapeutic plan designed by the CHF cardiologist was documented in the patient's chart, without further intervention.	6 months a) Number of patients b) Total number of admissions c) Mean a) 26, 35 b) 43, 59 c) 0.5, 0.7 Calculated RR 0.71 (95%CI 0.47. 1.09) Rate ratio 0.70 (95% CI 0.47, 1.04)
McDonald 2001[27] and 2002[28] Republic of Ireland	70 subjects CHF Age mean (SD) 69.9 (11.3) years	Cardiologist and nurse Inpatient and outpatient clinic. In-patient investigations: echocardiography and right and left catheterization where indicated. Appropriate medication. Dietary and social work consultation as requested by cardiologist. Education and dietetic consults focused on daily weight monitoring, disease and medication	Patients were referred back to their primary physician with a letter stating participation in the study and that routine management of their condition can carry	30 days[27] Number of patients No readmissions within 30 days either group

		understanding and salt restrictions. Similar advice given to carer / next of kin where appropriate. On discharge: a letter was given to the referring physician informing them of the study and that management of chronic heart failure related issues should be referred to the clinic or nurse. Patients were also asked to contact clinic if any clinical deterioration or weight gain of more than 2kg or more over 1-3 days. Inpatient seen 3 or more times by nurse and dietician Outpatient clinic attendance at 2 and 6 weeks. Telephone follow-up weekly	on as they see fit, including review by the hospital cardiology service, if required. Both the patient and their physician were asked to inform the study centre if admission to any hospital occurred before the 3-month follow-up period. All patients were reviewed at 3 months at the cardiology clinic as per protocol.	3 months[28] a) Number of patients b) Total readmissions a) 1, 9 b) 1, 11 Calculated RR 0.10 (95% CI 0.01, 0.78) Rate ratio 0.08 (95% CI 0.01, 0.65)
Wierzchowi ecki 2006[25] Poland	129 subjects HF Age mean (SD) 68 (10.5) years	Multidisciplinary team of cardiologist, nurse, physiotherapist and psychologist. Education (booklet provided) 30-40 minute clinic visits informed patients of worsening signs and symptoms and adverse reactions to drugs which required them to contact clinic, ambulance or other health care facilities. Monitored medication compliance, gave dietary advice, physical activity, vaccinations, travel opportunities and work. Patients were taught how to measure heart rate, blood pressure and weight and to evaluate dyspnoea, oedema and respiratory rate. If changes in these parameters were identified in a telephone consultation medication changes or an	Routine care	6 months Total hospitalisations 8, 11 Calculated Rate ratio 0.74 (95% CI 0.30, 1.84) a) Number of patients with at least 1 admission a) 8, 10 RR 0.81 (95% CI 0.34, 1.93)

		outpatient or clinic visit were suggested. A group education program was provided monthly by cardiologists for patients and their families. Nurse education and counselling in group and on an individual basis in the patients home and over the telephone. The physiotherapist provided individual rehabilitation and education of patients. The psychologist provided psychotherapy for patients with high levels of anxiety and depression. Clinic visits at 2 weeks 1, 3 and 6 months post discharge		
Older population				
Scott 2004 USA	Age mean (SD) years: 74.2 (7.6), Female %: 61	145 patients Cooperative health care clinic model The initial group meeting was set up via telephone contact. Groups met every month with their primary care physician for 90 minutes. Other providers attended as needed depending on the topics scheduled for discussion during the group visit. A typical group meeting consisted of a warm-up period, an education component, a caregiving period, and a question and answer period followed by planning the next meeting. After each meeting the physician met with each patient one on one as needed. The warm up period - 15 minutes in length and was spontaneous or organised. Initially reminiscence therapy techniques were used to identify common experiences to build a sense of	127 with 125 included in analysis General medical wards (usual care) Treated according to the routines of the department of internal medicine. Physiotherapy and occupational therapy were given when prescribed by the doctor. When considered appropriate by hospital staff arrangements for discharge were	Number of unplanned hospital admissions 24 months 40 vs 59 Calculated RR 0.59 (0.43, 0.82)

		group cohesiveness. In latter groups this process was informal with jokes and stories.	discussed with the community nurses.
		Education - 30 minute presentation on specific health-related topics following the warm up. Six core topics were presented during meetings after introduction to the program: patient care notebooks, routine health maintenance, pharmacy brown bags, advance directives, emergency care, and continuing care. Other topics included chronic pain, nutrition, exercise, home safety, and disease processes such as: stroke, hypertension, arthritis, osteoporosis, and Alzheimer Disease. The patients requested some topics and the physician and other members of the team presented them.	No further details provided. After hospital discharge GPs were responsible for medical treatment in both groups.
		Care-giving period - 20 minutes which the nurse took blood pressures, reviewed patient charts for immunisations, lab tests, and immediate healthcare needs and scheduled future physician appointments if needed. At the same time the physician responded to minor patient concerns refilled prescriptions and responded to individual needs.	
		Question and answers: 15 minutes about material covered in the presentations or any other patient's inquiry. An additional 10 minutes were used to elicit next month's topic and to schedule the meeting.	
		Physician one on one session: 60 minutes for patients needing private office visits to meet individually with their physician for 5-10 minutes.	
		Physician, nurse, physical therapists, pharmacist, occupational therapists, individuals representing community resources and dietician.	

		54	55	Hospital admissions
Fletcher 2004 UK	Age (SD) years 81.2 (4.8) Male %: 37	targeted assessment All practices administer a brief assessment questionnaire either by post, layperson or practice nurse. The questionnaire covers all areas specified in the GP contract: social environment, activities of daily living, sensory problems, mobility, physical symptoms including incontinence, mental condition, use of medications. Additional questions included alcohol consumption, cigarette smoking and physical activity. The detailed assessment covers the same areas as the brief assessment but in greater depth e.g. whispered voice test for hearing, Glasgow acuity cards for vision, mini mental state examination for cognitive impairment and the geriatric depression scale. Additional questions include more detailed assessment of symptoms rose chest pain questionnaire for angina, respiratory problems urinary and faecal incontinence, examination of legs and feet and a modified version of a checklist for possible drug interactions. Additional biological measurements include blood pressure, heart rate, and dipstick for blood, protein and urine. A blood sample was taken for a full biochemical screen. Additional investigations are triggered by responses to the questions. The study nurse then follows a protocol based on results and responses to make referrals to the clinical teams PC or GM as randomised, other medical services health care workers or agencies and emergency referrals to GP's. Targeted assessment: A detailed assessment by the practice nurse is only conducted on those	universal assessment, Following the brief assessment practices assigned to universal arm carry out a detailed assessment by the practice nurse. Usual Primary care The management teams follow their usual practice and there was no attempt to impose a formal protocol. No further detail provided.	Hospital admissions 36 months 7,275 vs 7,443 <u>Calculated</u> RR 0.92 (0.90, 0.95)

		patients who "trigger" on the brief assessment. The triggers were 3 or more problems identified by the brief assessment or any one of 4 "serious" symptoms (vomited blood, coughing blood, unexpected weight loss and more than 4 falls in the previous 6 months). Intervention 2 - Multidisciplinary geriatric team management		
Tulloch 1979 UK	Age: 70-80 years plus Male %: 67	Number randomised: 170 with 145 included after exclusions and 95 completing **Screening and surveillance** Patients in the study group were sent a letter detailing the project and seeking cooperation. They were also advised that a nurse would be calling in 2 weeks to discuss the programme so that they could refuse to take part. At this visit the nurse questioned the patients about socioeconomic and functional problems. 2 weeks later the patient was sent a second letter enclosing a medical questionnaire and the offer of a physical examination which was conducted at the surgery. Followed by investigations of any condition found. Thereafter the patients were kept under regular surveillance in a geriatric clinic run by the research practice nurses and health visitors for a period of 2 years. Factors under review were illness support, suitability of accommodation, amount of social contact, loneliness and financial status. Functional disability was also assessed while medical disorders were listed only if they were thought to have material bearing on health.	Number randomised: 169 (150 after exclusions with 99 completing) Control: Usual care Patients were not screened and continued with their usual care.	Hospital admissions and rate per 100 patients 37 vs 29 25 vs 19 No significant difference
		Number randomised: 80	Number randomised:	Mean number of admissions

| Toseland

1997

USA | Age mean years: 71.7
Gender: exclusively male
Ethnicity: White 75 black 5 | Outpatient GEM clinic with comprehensive follow up
Primary functions of the GEM team included: an initial comprehensive assessment, the development of a care plan, implementation of the care plan, periodic reassessment, monitoring and updating of the care plan and referral to and coordination with other health and social service providers. The comprehensive assessment took approx. 2 hours to complete. Team members met weekly to discuss assessments and to develop care plans. Patients were seen in the GEM clinic for routine follow-up and were followed by members of the team upon hospitalisation. Team members also provided emergency care during the normal tour of duty; served as the attending providers for patients who were hospitalised for intermediate care; provided treatment recommendations for patients hospitalised for acute care; and were involved acutely in discharge planning
The team consisted of a board certified geriatrician, a nurse practitioner and a social worker. The majority of direct medical care was provided by the nurse with supervision from the geriatrician. | 80
Control: Usual care
Patients attended primary care clinics. Usual outpatient clinics were staffed by internist with nursing support. he internist provided the bulk of primary outpatient care but made referrals to speciality clinics and services as needed. | 0.64 vs 0.60
No significant difference |
| Englehardt

1996
USA | Age mean (SD) years: 71.7
Gender: exclusively male
Ethnicity %: White 93.7 | Number randomised: 80
Outpatient GEM clinic with comprehensive follow up
Primary functions of the GEM team included: an initial comprehensive assessment, the development of a care plan, implementation of the care plan, periodic reassessment, monitoring and updating of the care plan and referral to and coordination with other health and social service providers. Patients were seen in the GEM clinic for routine follow-up and were followed by members of the team upon hospitalisation. Team | Number randomised: 80
Control: Usual care
Patients attended primary care clinics. Usual outpatient clinics were staffed by internist with nursing support. The internist provided the bulk of primary outpatient care but | Number of patients

Total number of admissions

16 months

31vs 42
70 vs 82
<u>Calculated</u>
RR 0.74 (0.52, 1.04) |

		members also provided treatment recommendations for patients hospitalised for acute care; and were involved actively involved in discharge planning The team consisted of a board certified geriatrician, a nurse practitioner and a social worker. The majority of direct medical care was provided by the nurse with supervision from the geriatrician.	made referrals to speciality clinics and services as needed.	
Coleman 1999 USA	Age mean: 77.3 Female %: 47.9 Ethnicity %: non-white 2.8	Number randomised: 5 practices (96 patients) Chronic care clinics Patients in each practice were divided into cohorts of 6-8 patients who were invited to participate in scheduled half day visits with their primary care team every 3-4 months. Including extended visit (30mins) to the patients' physician and team nurse dedicated to developing a shared treatment plan that emphasized the reduction of disability; a pharmacist visit held at the primary care team treatment room that addressed polypharmacy and medications associated with functional decline; and a patient self-management/support group session (45mins), led by a team nurse or social worker, that emphasized self-management skills and group problem solving for chronic health problems and the provision of status assessment information to the practice team at the time of the chronic care clinic visit. In addition physicians and team nurses also received training in population-based medicine and management strategies designed to enhance their management of selected geriatric syndromes.	Number randomised: 4 Practices (73 patients) Control - Usual care	frequency of hospitalizations 24 months >1 hospitalisation/year (%): 36.5 vs 34.3 p=0.77 Hosp. admits (mean/year): 0.58 vs 0.59 p=0.94

Burns 1995 USA	Age mean (SD) years: 71.7 (6.3) Male %: 95 Ethnicity%: White 67	Number randomised: 60 Comprehensive patient evaluation with long term management. The clinic focus was both evaluation and long term management or primary care. Particular attention was paid to the special problems of older adults, including functional limitations, gait impairment, incontinence, polypharmacy, depression and cognitive impairment, In addition the resources of the patient and if applicable the care giver were reviewed. The needs of the caregiver /spouse were also evaluated in the context of the patient evaluation. The initial assessment took approximately 2 hours, after the assessments were complete the team developed goals interventions treatment and individualised follow up for each patient. Follow-up and aftercare ranged from short-term hospital admissions to routine care in the clinic with telephone follow up. For follow up care in the GEM clinic the patient saw the most clinically relevant health care professional for on-going care with consultations to other team members as appropriate. There were no set scheduled return visits except for study data collection and patients were followed up indefinitely and did not return to their previous providers except at their request. Physicians, nurse practitioner, social worker, psychologist and clinical pharmacist. Members of this team had worked together for 3 years and had participated in extensive team training and development.	Number randomised: 68 **Control:** Usual care At the time of hospital discharge the inpatient treatment team referred the patient back to his/her previous providers or to new providers as appropriate. Outpatient care was provided in the ambulatory care clinics of the medical centre or by local physicians in the community. For those who had a primary care provider the care may have been provided by a general internists, subspecialists or medical residents under the supervision of an attending internist as required by the patient's medical problems.	Mean hospital admissions at 3, 6 and 12 months 3 months 0.20 vs 0.19, 6 months 0.28 vs 0.28, 12 months 0.38 vs 0.57 No significant difference

Asthma				
Pilotto 2004 Australia	Age mean (SD) years: 46.8 (15.7) Female n (%): 44 (55%)	Number randomised: 6 practices (only 5 participated) Asthma clinic Review of and instruction about inhaler technique. Provided with a package of information about asthmas, the types and use of asthma medication and how they worked and options for smoking cessation (if appropriate) at initial visit. They were then seen by their GP to discuss their lung function results and answer any remaining queries. The clinic nurses then arranged a follow-up visit for within 2 weeks for review of inhaler technique to answer any questions and to encourage the patients to develop an asthma action plan with the GP. The patients met with the GP when a blank asthma action plan was included in their notes. A further follow up visit with the nurses and GP arranged at 3 months. 2 trained respiratory nurses and GP's	number randomised: 6 Control: usual care GP	Health service utilization 8 vs 2 Calculated RR 4.50 (0.98, 20.57)
Salisbury 2002 UK	Age mean (SD) years: 13 (12-14) Male n (%): 80 (51.3)	number randomised: 157 The care provided was similar to that offered at a nurse-led asthma clinic in general practice, but the discussion was specifically targeted at the needs and interests of the adolescent. Details were sent to the patients GP. Normal follow up was at 1 and 6 months	Number randomised: 151 Control: normal care in general practice all invited for an asthma review by	1 vs. 0 Calculated RR 2.89 (0.12, 70.30)

		after initial assessment. Pupils requiring treatment change or who had poor symptom control at had a further follow up at 3 months. Who: school nurses with specialist asthma training	doctor or practice nurse and in a designated clinic or routine surgery according to the practice's normal procedure.	
Harish 2001 USA	No data provided on the age/gender/ethnicity of the subjects. Aged between 2 and 17 years	Number randomised: 150 with 60 patients completing the study Paediatric Asthma Centre Initial intake consists of 3 1 hour visits 2 weeks apart. Visit 1 - Dedicated to reviewing the patient's history, asthma regimen, adjustment of medication in compliance with the National Heart, Lung, and Blood institute guidelines, review or introduction of metered dose inhaler or spacer techniques, review of clinical signs of asthma and respiratory distress and a review of asthma pathogenesis and pharmacopoeia using a computerised asthma teaching program. Visit 2 - Dedicated to teaching the patient how to use peak flow expiratory flow rate meter (PEFR) for patients > 5years and the creation of an asthma emergency plan should PEFR fall below 80% of personal best. Visit 3 - skin-tests for common perennial and seasonal aeroallergens. Those found to be atopic received a detailed explanation of environmental control measures. Allergen-impermeable mattress and pillow encasements are provided free-of-cost to dust mite allergic patients who could not afford them.	Number randomised: 150 however only 69 included in analysis Control: Usual care	Overnight hospital admissions for asthma during the 12 month study period: Hospitalised at least once during the 12 months after the study period: 22 vs. 29, 16 vs. 18, 8 vs. 7 <u>Calculated</u> RR 1.02 (0.57, 1.82)

		The patient care givers are also encouraged to phone the clinic 24hrs a day 7 days a week for any symptoms that do not respond to a single treatment of inhaled bronchodilators. All patients are further provided with both inhaled and oral corticosteroids to be used only if instructed by the provider on call. Who have access to an up-to-date computerised database with all of the medications PEFR scores and dates of the most recent corticosteroid use. A home visit by the Nursing service of the Bronx is also provided. The nurse reviews medication usage and inspects the home for potential environmental allergens. Allergy immunotherapy is recommended to all patients who clearly have an allergic etiology for their asthma and whose asthma is unstable despite the implementation of environmental control measures and prophylaxis with inhaled corticosteroids and/or cromolyn sodium. Paediatric allergist, Paediatric nurse practitioners and a social worker.		
Mayo 1990 USA	Age mean (SD) years 42 (15) Gender %: Male 14 female 33, Ethnicity %: Hispanic 40, Black 6, White 1,	Number randomised: 47 patients with 37 attending clinic Outpatient program in the chest clinic The initial 2 visits lasted 1 hour involving detailed repetitive discussion of pathophysiologic concepts and treatment modalities and emphasized self-management strategies designed to fit each patient's particular asthma pattern and personality.	Number randomised: 57 Control: routine clinic Patients were discharged to their previous regular outpatient care. No attempt was made	8 month admissions for asthma total number of readmissions Hospital admissions per patient: 19 vs70

		Subsequent visits were scheduled for 30mins per patient. The frequency of visits was determined by the patient's preference and level of asthma activity. Patient education occurred during repeated contacts between the patient and health care provider. All patients were provided with a phone number of the clinic for use in business hours and answering machine for non-business hours. Medical regimens were tailored to each patients asthma pattern and were designed to encourage compliance as much as possible A physician and a nurse practitioner	by the special clinic staff to alter their treatment.	0.4 vs. 1.2
Heard 1999 Australia	Age mean (95% CI) years: 27.5 (23.6-31.4) Male %: 42	Number randomised:98 patients Asthma clinic within a general practice Each general practice operated 1 three hour asthma clinic per week. Education was provided in asthma management strategies, including written asthma management plan, spirometry and instruction on using peak flow meters, inhalers and an asthma diary card. This was followed by a consultation with a GP. each patient was asked to attend 3 asthma clinic sessions Asthma educators - practicing registered nurses with, G.P. extensive experience in respiratory care.	Number randomised: 97 Control - standard treatment (No details provided about control) protocol	Hospital admissions during last 6 months 0.02 vs. 0.05, OR 0.31 (95% CI 0.05-1.75)

Other conditions				
Welin 2010 Sweden	Stroke patients Age mean (SD) years: 71.2 (9.9) Women n (%): 33 (41)	Number randomised:81 Specialised outpatient clinic At the nurse visits the patient's handicap, perceived health and depression was assessed. Blood pressure was measured and health advice and information offered. Patients could also be referred to a physiotherapist or occupational therapist if required. At the physician visits drug therapy was assessed and other medical problems detected. Referrals were made to other specialists or therapist if required. 1.5, 6 and 12 month visits with stroke nurses 3 and 9 months with a physician. Patients recruited in the first were offered a 4 yr visit whilst those recruited in the second year were offered a 3yr visit.	un-planned hospitalisations Number randomised: 82 Control: Usual care the quality of follow up care for stroke differs in Sweden between no follow up at all to regular visits every third or fourth month. general practitioner Stroke nurses met patients in control group at 12mnths and after 3 or 4 years.	

Soler	COPD patients	Number randomised: 13	Number randomised: 13	Hospital admissions per month
2006	Age mean (SD) years: 74 (7)	Specific program	Control - Conventional management	- control 1 year before study 0.09, study period 0.11 no significant difference. Intervention 1 year before study 0.15, study period 0.04 p= 0.016. p<0.001 (73% reduction in hospital admission from baseline in intervention group)
Spain		Monthly visits to a specialised clinic and a short educational program. In addition to their personal medical consultation, patients attended group educational sessions led by the nursing team (4-6 patients). Patients and their families also attended an informative session that included an explanation of COPD and recommendations on how to manage the disease (anti-smoking advice, use of inhalers, exercise, nutrition, sleeping habits etc.). The educational program was supported by specially designed printed material. Patients were not instructed in self-management of exacerbations, and no self-management plan was provided. Pharmacological treatment was standardised. All current smokers were enrolled in smoking cessation program.	Patients received the same treatment as those in the intervention group. However consultation with specialist physician took place every 3 months. There was no educational program but patients did receive information about COPD and how to manage the disease including nutritional advice and insistent recommendations about the need for physical exercise. Instruction on proper inhaler use was given at the first visit.	

Priebe	Mental health patients	Number randomised: 141	Number randomised: 65	
2006		Day hospital		
UK	Intervention 36.9 (SD 12.0), Control 36.5 (SD9.4)	Organised around a structured intensive group-based programme which included a range of verbal, non-verbal, creative and work-based interventions. There were two alternative strands to meet the different needs of the patients and ensure manageable sizes for group activities: one was more structured with a focus on practical activities and protected interactions; the other was more stimulating with a focus on creative group programmes and verbal communication. The day hospital was integrated into a modern community care system, i.e. the consultant responsibility remained with the catchment area consultants and care programme approach coordination with the care co-coordinators in the fully developed and integrated community mental health teams.	Control - In-patient wards

Conventional psychiatric care, including a limited programme of optional daily activities (No further details provided) | |
	gender: Intervention male 45 (64%) female 55 (77%), Control male 55 (36%) female 45 (29%)			
	Ethnicity:			
	White: Intervention 55 (77%), control 54 (35%)			
	Asian (Bangladeshi, Indian, Pakistani, other): Intervention 21 (29%), control 15 (10%)	Patients were expected to attend the full programme from 9.30 am to 16.30 every weekday; patients who failed to attend for 3 consecutive days were discharged. At weekends there was an optional drop in service.		
	Black (Caribbean, African, other): Intervention 21 (30%), control 29 (19%)			
	Mixed: Intervention 1			

	(2%), control 0 (0%) Other: Intervention 1 (2%), control 3 (2%) Unknown: Intervention 1 (1%), control 0 (0%)			
Herz 2000 USA	Mental health patients intervention 33.3 (8.8), control 26 (9.3) Male: intervention 27 (66), 26 (63) Ethnicity: White intervention 27 (66), control 25 (61), African American 10 (24) 14 (34), Other 4(10) 2 (5)	Number randomised:41 program for relapse prevention standard doses of medication in addition to 5 components: education of patients and family members about the process of relapse and how to recognise prodromal symptoms and behaviours, active monitoring for prodromal symptoms by treatment team, clinical intervention within 24-48 hours when prodromal symptoms detected with increased frequency of crisis problem solving supportive therapy visits and increased medication as needed, 1 hour weekly supportive group therapy emphasising improving coping skills or 30-45 min individual supportive therapy sessions if patients refused group therapy, and 90 min multifamily psychoeducation groups that family members were encouraged to attend biweekly for 6 months and monthly thereafter. Psychiatrist, masters-level nurse clinician or certified social worker and case manager.	Number randomised: 41 Control: Treatment as normal Individual supportive therapy and medication management biweekly for 15-30 mins. This is a higher frequency of treatment visits than is usual in many treatment settings. Treatment teams were instructed to were instructed to provide their usual treatment approaches.	rates over 18 months rehospitalisation: 22% (9 patients) vs 39% (16 patients) p=0.03. Risk ratio 2.7 p=0.03 cox regression.

			Who: team was made of of the same disciplines at intervention group but different personnel.	
Campbell 1998 UK	Coronary heart disease patients Age mean (SD) years: 65.9 (7.9)	Number randomised:673 allocated 551 attended at least 1 appointment Secondary prevention clinics in general practice Promotion of medical and lifestyle aspects of secondary prevention and regular follow up. Symptoms and treatment reviewed, use of aspirin promoted, blood pressure and lipid management reviewed, lifestyle factors assessed and if appropriate behavioural change negotiated 1st appointment within 3 months with 2-6 monthly follow ups depending on clinical circumstances. Nurse- led	Number randomised: 670 Control -Usual care General practitioner	Cardiac admissions:intervention 36 (7%), Control 49 (9%) intervention - before the study 132/540 (24%) during the study 106 (20%), control - 137/518 (26%) before the study, 145 (28%) during the study odds ratio for requiring hospital admission for the intervention group was 0.64 (95% CI 0.48, 0.86 p=0.003)
Murphy 2009 UK	Age mean (SD) years: 68.5 (9.3) Male n (%): 311 (70)	Number randomised: 24 practices 444 pts Tailored practice and patient care plans. Tailored practice care: Action plans created for each practice and regularly reviewed by research nurse. Study nurse maintained regular contact with practices. The practice received a 2 page newsletter every 4 months.	Number randomised: 24 practices 459 pts Control: Usual care No contact was made with usual care practices after	Hospital admission for a cardiac cause: baseline intervention 24.5% (106/443), control 31.8% (143/449) Follow up intervention 25.8% (107/415) control 34% (148/435)

| | | An academic general practitioner made one 90min educational outreach visit to each practice to promote drug prescribing guidelines through interactive case based scenarios. A study nurse delivered another 90 mins session on behaviour change which was intended to facilitate reflection on patient lifestyle and through role play new techniques to be used by the practice.

Tailored patient care: At the first consultation the patient and GP identified areas of management that could be improved and the patient was invited to prioritise one particular aspect of his or her lifestyle for change. Possible ways of achieving targets reflecting on optimal management were identified and action plans individualised so that small realistic goals for change were agreed. A booklet containing information on all the key risk factors for coronary heart disease was used by practitioners in discussions on initial target setting and then given to the patients. Patients were invited for an appointment with the GP or nurse every 4 months; targets and goals for optimal prevention were reviewed at each visit. | the collection of baseline data. They continued with usual care which in Northern Ireland involved a system for annual review of blood pressure, cholesterol concentration, smoking status, and prescribed drugs, in accordance with the criteria specified within the NHS GP contract quality and outcomes framework. In the republic of Ireland usual care may have included monitoring of risk factors and providing appropriate advice and drug management when patients sought a repeat prescription. | |

Table 3: Community intervention RCTs

Author date country	Population *Age Gender Ethic group Living alone	Intervention n= number randomised	Control n= number randomised	Outcome measure **(follow up time in months) Intervention vs. control (CI for RR SD for MD)
Older population				
Dunn 1994 UK	204 consecutive discharges of elderly patients from geriatric wards Mean age 83yrs 66% female 62% living alone	n=102 before discharge randomised to receive one home visit at 72hrs (range 48-96hrs) the aim was to stabilise the patients in their home and avoid readmissions	n=102 received 'normal follow-up services'	Total no. of unplanned readmissions & no. of people experiencing at 6mths Total no. 49 vs. 51 (Calculated RR 0.96 [0.73, 1.27] p=0.78) No. of people 40 vs. 43 p>0.05 NS

Mason 2007 UK	3018 patients aged over 60yrs who have called the emergency services Mean age 82yrs 72% female	n=1547 received active paramedic practitioner service. Delivery of patient centred care for elderly people who called the emergency services with conditions triaged as not immediately life threatening .[3 wks of training , 45days in supervised practice]	n=1469 Standard 999 service	Total no. of unplanned hospital admissions at 28 days 626 vs. 683 RR 0.87 (95% CI 0.81,0.94) (authors) p<0.001
Garåsen 2007 & 2008 Norway	142 patients aged 60yrs or more admitted to a community or general hospital due to acute illness or exacerbation of a chronic condition	n=72 patients received individualised care including evaluation by community hospital physician with GP, general hospital, community home care services & family information followed by treatment of each patients diseases Main focus on improving patient's ability to manage daily activities at home.	n= 70 received standard care during their inpatient care in a general hospital	No. of patients readmitted to a general hospital at 6 & 12 mths follow-up 6mths 14 (19.4%) vs. 25 (36%) (calculated RR 0.54 [0.31, 0.96] P=0.04) 12mths 46 (25 patients) vs. 51 (20 patients) (calculated RR 0.88 [0.70, 1.10] p=0.25)

Post-natal /infant health				
York 1997 USA	96 high-risk childbearing women (diagnosed with diabetes or hypertension in pregnancy.)	The intervention group (n= 44) was discharged early using a model of clinical nurse specialist transitional follow-up care.	The control group (n =52) was discharged routinely from the hospital.	During pregnancy, the intervention group had significantly fewer rehospitalisations than the control group. The mean total hospital charges for the intervention group were 44% less than for the control group. A net savings of $13,327 was realized for each mother-infant dyad discharged early from the hospital.

Raynor 1999 UK	83 children aged 4-30mths who had been referred for failure to thrive at a consultant –led outpatient clinic Mothers mean age 26yrs 20% living alone	n=42 received specialised health visitor intervention ; in which experienced health visitor who was trained in managing eating problems, assessment of parent-child interactions, counselling skills & nutrition, and consulted with psychologist, dietician & paediatrician No details on frequency given Duration ~1year	n=41 received 'conventional care '	Total no of children admitted to hospital at 12mths Original data 6/37 vs. 14/37 p=0.036 Calculated RR 0.43 [0.18, 0.99]
Boulvain 2004 Switzerland	459 women with a single uncomplicated pregnancy at low risk of caesarean section recruited at antenatal visits Mean age 29yrs 70% 'Swiss origin'	n=228 received home based postnatal care following 24-48hrs in hospital. Visits by midwives & the interval in between was determined by the needs of the family [an extra 2 hospital days was added for caesarean sections in both grps]-similar rate in both grps	n=231 received hospital-based postnatal care. Women remained in hospital for 4-5 days	Total no of readmissions for a)mother b) infant at 1mth, 2-6mth, 6mths Mother 1mth 4 vs. 2 RR 2.0 (0.37,11) p=0.41 2—6mth 4 vs. 3 RR 1.4 (0.31,6.0) p=0.69 Infant

				1mth 12vs. 5 RR 2.4 (0.87,6.8) p=0.09 2-6mths 18vs. 6 RR 3.0 (1.2,7.5) p=0.02
Sainz Bueno 2005 Spain	430 mothers with healthy term neonates (37-42wks) weighing >2.5kg, vaginal delivery & normal evolution Mothers age range ≤19->40yrs (54% aged 20-30yrs)	213 mothers discharged within 24hrs postpartum & monitored by nurse qualified in puerperal & neonatal care over the next 24 to 48 hours at home , at 7-10days at the practice and at 1, 3 & 6mths by telephone	217 mothers discharged after the usual minimum of 4 hrs postpartum , monitored at 7-10 days in practice and at 1,3 & 6 mths by telephone	Total no. of maternal & neonatal readmissions at 6mths Mother 4/213 vs. 5/217 RR 0.81 (0.21, 3.03) p=0.76 Neonate 3/213 vs. 5/217 RR 0.61 (0.15,2.56) p=0.5
Heart conditions				

| Benatar

2003

USA | 216 patients admitted to hospital with **congestive HF**

Mean age 63yrs

68% female

85% African-American | n=108 received HF specific home care provided by one of three agencies for a period of 3mth following agency guidelines and included: performance of physical, psychosocial, environmental and compliance assessments, medication administration, patient & family education & disease management counselling. Range of no. of visits 3-12 | n=108 received telenursing using trans telephonic home monitoring devices and APN working in collaboration with cardiology fellow & consultant for 3mths. Vital signs measured daily by patient. If problems with data, APN telephoned, assessed over phone & directed interventions over phone. APN also phoned once weekly | Total no. of readmissions at 3,6 &12mth

3mth
24 vs. 13
(calculated RR
1.85 [0.99, 3.43]
p=0.05

6mth
63 vs.38
(Calculated RR
1.66 [1.23, 2.24]
p=0.001)

12mth

103 vs. 75
(Calculated RR 1.37
[1.20, 1.57])
P<0.00001 |
|---|---|---|---|---|

Sinclair 2005 UK	324 patients aged 65yrs or over discharged home after hospitalisation with **suspected MI** Mean age 74yrs 43% female 2-3% 'non-white' 33% living alone	n=163 received In addition to usual care, patients received at least two home visits from cardiac support nurse (1-2 & 6-8 wks post discharge. Extra visits were permitted if necessary. Nurse's remit was broad: info about treatment regime, support, guidance, advice about exercise & stress management, diet & encourage resumption of normal life.	n=161 Usual care which included general advice from ward-based staff, outpatient clinic as necessary and access to cardiac rehab clinic offered.	No. (%) of patients readmitted within 100 days & relative risk calculated by authors 35 (21%) vs. 51 (32%) RR 0.68 (95% CI 0.47-0.98) p<0.05
Carroll 2007 USA	247 partnered older adults who has **recently experienced MI** (n=93) **or CAB surgery** (n=154) recruited from 5 academic medical centres Mean age 76.4ys 66% female	n= 121 Home visit within 72 hrs and telephone calls at 2, 6 & 10 wks. from APN & 12 weekly calls from per advisor. The aim was to encourage participation in a cardiac rehabilitation clinic	n=126 usual care	Primary outcome was attendance at rehab clinic but also Total cardiac readmissions between 3, 6 & 12 mths post event 3mths 9 vs. 9 (Calculated RR 0.96 [0.39,2.34] p=0.093 6mths 2 vs. 9 (calculated RR 0.21[0.05, 0.97] P=0.05 12mths 6vs 9 (Calculated RR 0.64 [0.23,1.74] P=0.38

Table 4 – Pathways RCTs

Author date country	Population *Age Gender Ethic group Living alone	Intervention n= number randomised	Control n= number randomised	Outcome measure **(follow up time in months)	Results Intervention vs. control (CI for RR SD for MD)
CAP					
Palmer 2000 Canada Critical pathway	65.4 (20.0) Male 377 (52.7)	716 patients 9 hospitals The critical pathway has 3 components: use of a clinical prediction rule to assist the admission decision, treatment with levofloxacin and practice guidelines for the care of inpatients. Patients having a suspected diagnosis of CAP were assessed in the ED and treated by primary care physicians and/or specialists according to usual practice. Clinical prediction: Emergency department nurses were instructed on the use of the pneumonia severity index (PSI), a clinical prediction rule that assigns a score based on 20 items that include demographic factors, coexisting illnesses, physical examination findings and laboratory and radiographic findings. For each subject a PSI score was calculated by a nurse who made this determination available to the ED physician. Patients with scores of 90 points or lower were recommended for discharge whereas higher scores for	10 hospitals 1,027 patients Usual practice of individual specialists or primary care physicians. Separate investigator meetings, study protocols and correspondence were used to ensure that health care personnel remained unaware of critical pathway components. Levofloxacin was not available and no attempt was made to implement PSI.	Percentage of patients admitted to hospital: Percentage of patients hospitalised following ED discharge:	intervention 53.4 control 62.9. intervention 11.7 control 12.0

		admission. Levofloxacin: patients treated as outpatients received 500mg of oral levofloxacin once per day for 10 days. Those admitted received a single 500mg dose of parenteral drug and were subsequently treated according to the guidelines. Practice guidelines: admitted patients were assessed each day by a study nurse who placed a note on the patients chart when the criteria for discontinuation of intravenous therapy or hospital discharge were fulfilled. Following discahrge patients continued with levofloxacin for a maximum of 10 days.			
Asthma					
Mitchell 2005 New Zealand Clinical pathway	No patient details provided Children	Number randomised: 11 cells Each general practitioner within the intervention group was given a 2hr group education session which consisted of discussion of the algorithms for the management of acute asthma and chronic asthma (algorithum diagrams are provided in the paper), role playing, and description of the study.	10 hospitals 1,027 patients Usual practice of individual specialists or primary care physicians. Separate investigator meetings, study protocols and correspondence were used to ensure that health care personnel remained unaware of critical pathway components. Levofloxacin was not available and no attempt was made to implement PSI.	Percentage of patients admitted to hospital: Percentage of patients hospitalised following ED discharge:	intervention 53.4 control 62.9. intervention 11.7 control 12.0

Johnson 2000 USA Clinical Pathway	Age mean 8.2 years Male 38 Black 50	Number randomised 55 Clinical pathway with weaning guidelines Pathway – Nurse driven protocol for weaning bronchodilators, peak flow measurement (children >5 yrs.) every 4 hours before and after nebulisation, asthma teaching essentials, including spacer and peak flow meter training, beginning the day of admission, prescriptions for home therapies given to family prior to discharge, early contact between attending physician and private medical doctor to establish plan for asthma management and improve coordination of care. 4 months before starting the study all nursing staff on the intervention unit were taught how to assess patients with asthma using the train-the-trainer approach, with 1 attending physician and 4 senior residents as the educators.	Number randomised 55 Usual care Patients received education about the use of an inhaler and spacer, as well as some coordination of post discharge care from the case management team.	Frequency of readmissions within 2 weeks of discharge	No patient was readmitted within 2 weeks.
COPD					
Panella 2009 Italy Clinical pathway	81.7 (8.5) Male 47.4%	Number randomised:214 patients What: One physician or nurse with at least 2 years of experience of clinical pathways was assigned to facilitate project implementation. The teams consisted of internal medicine physicians, cardiologists, epidemiologists, pathologists, psychologists, nurses, hospital pharmacists, social workers and	Number randomised: 215 What: No details provided	Rate of unscheduled readmissions:	7.9 (4.3, 11.6)% intervention, 13.9 (9.3, 18.6)% control p=0.053

		support staff. The teams were formed on a voluntary basis, received 3 days of training in the development of CP and constructed the CP over a 6 months period. All groups analysed their care processed, reviewed best evidence provided by senior investigators, defined appropriate goals of the pathways, dealing with the results into protocols and documentation including the sequence of events and expected progress of the patients over time. Essentially the clinical pathway used in each study was not completely identical because of the organisational adaptions in some sites. However they coincided substantially with the existing European guidelines on the hospital treatment of heart failure.			
Philbin 2000 USA Clinical pathway	75 Female 55%	Number randomised:840 patients What: The quality improvement intervention attempted to maximise the implementation of an inpatient critical pathway for heart failure. Its format was a Gantt chart or time task matrix. The pathway recommended diagnostic test, treatments that were considered to be highly indicated based on the published clinical trial results, expert guidelines or wide acceptance as current standards, but omitted those considered experimental or controversial. In addition several other components aimed at	Number randomised: 664 patients What: control hospitals were not restricted from initiating their own local quality management programs, but were barred access to study related data, documents and resources. No further details on control provided.	Heart failure hospital readmission:	20.1% intervention, 21.3% control. Intervention effect: -0.2% (-16.4%-15.9%) p=0.97

		improving provider and patient knowledge, expediting diagnosis and treatment and reducing readmissions were provided. These included a critical pathway for use in the emergency department, which emphasized rapid diagnosis of heart failure and initiation of intravenous diuretic therapy, and a home care pathway for use by home health personnel after hospital discharge.			
Roberts 1997 USA Accelerated diagnostic protocol	47.3 (9.9) Male 45 (54.9%) African American 59.8%	Number randomised: 82 patients Patients received 12hrs of rhythm monitoring; CK-MB levels performed at 0, 4, 8 and 12 hrs, ECG's, Clinical exam, aspirin, 2L oxygen, and an intravenous line. Patients with recurrent ischaemic chest pain, or any positive test during the first 12 hrs were hospitalised. Patients with clinical or ECG findings suggestive of myocardial infarction were hospitalised. If all clinical and test findings were negative patients underwent an ECG exercise stress test. Patients with positive or indeterminate ECG exercise stress test results were admitted to hospital.	number randomised: 83 patients Admission to hospital to the telemetry unit for standard management. 3 sets cardiac enzyme studies, 2ECG's and 24 hrs cardiac and clinical monitoring.	unplanned admissions: 8 wk follow up admissions:	intervention (37) 45.1%, Control 100% intervention 6.1%, 4.8% control
Guidelines CAP					
Fine 2003	Age mean (SD) years	283 patients, 57 groups	325 patients, 59 groups	Rehospitalisation within 30	intervention 37 (14), control 33 (11)

USA Guidelines	69 (17) Female n (%) 156 (55) non-white n (%) 49 (18)	The study intervention consisted of an educational mailing delivered to physicians and a daily assessment of patient stability that was coupled with a multifaceted strategy to implement the project guideline once the patient met the criteria for stability. Patient stability was assessed prospectively each day by research nurses beginning on hospital day 3. Patient stability for conversion (or discharge) was defined as the first day that guideline criteria were met. Daily assessments of stability were discontinued once a patient was determined to be stable. The assessment of patient stability was terminated before day 10 if the patient developed a metastatic infection site, methicillin-resistant staphylococcus aureus infection or coagulase-positive staphylococcal bacteraemia; or if the patient was discharged. The patient-specific intervention was not implemented for patients who did not meet the corresponding stability criteria by day 10. The intervention included placement of a detail sheet in the patient's medical record once a patient met guideline criteria for stability, a follow up recommendation to the attending physician, and an offer to arrange follow-up nursing home care. One of the three site specific detail sheets promoting the recommended action was placed in the physicians progress notes section of	Both groups of physicians received the educational mailing during the month before patient recruitment began. The mailing included a cover letter signed by the hospitals utilisation management director describing the rationale for the guideline and written version of the guideline. (No further detail provided.)	days	RR 1.29 (0.83, 2.00)

		each patients chart immediately following the determination of the corresponding type of stability. At this time the research nurse telephoned or directly approached the patient's attending physician to state that the patient met guidelines for conversion to oral antibiotic therapy or hospital discharge; to indicate that the detail sheet had been placed in the medical record and review its content with the physician; and to offer to take a verbal order for oral antibiotic therapy and make arrangements for home nursing care.			
Premaratne 1999 UK Guidelines	15-50 years no details of participants provided	Number randomised: 18 practices 681 patients Six teaching sessions on the core elements of asthma care were offered to all practice nurses in the intervention group. The nurse specialists then visited the practices, helped the practice nurse organise the clinics in keeping with their teaching, assisted them in improving the management of their patients and gradually devolved responsibility to them. The nurse specialists also ensured continuity of care in practices when practice nurses left. The practices used the British thoracic society's guidelines for asthma management (BMJ 1993; 306:776-82). A survey questionnaire was sent out to all patients within the practices those who reported asthma symptoms within the last 12 months were asked to complete a longer	Number randomised: 22 practices 935 patients no details provided	Average admission rates per 1000 person years over the study.	There were 220 admissions for asthma among 156 patients registered with study practices. 0.86 control 0.91 intervention

		questionnaire. .			
COPD					
Tinelli 2003 Italy Guidelines	67.8 (10.7) male 76.4%	Number randomised: 12 GP's 72 patient's The study was carried out under natural conditions so no follow ups were pre-arranged during the year: consultations took place according to normal clinical practice that is when required for clinical need or when suggested by the guidelines. The GP's allocated to this group were provided with a programme presenting the guidelines as an easily consultable algorithm.	number randomised: 10 GP's 51 patients No details provided	Number of admissions to hospital because of COPD:	No admissions: control 66.7% (51 patients in the group), intervention 70.8% (72 patients in the group) Low admissions (one admission): control 23.5%, intervention 19.4% High admissions (two or more): control 9.8%, 9.7%

Table 5: Medication review

Study/Country	Setting	Who/How often/how intense	Intervention components	Follow up period/effect size
Older people				
Bond 2000 2,301 subjects Scotland	GP surgeries	community pharmacists monthly protocol checks and GP 3monthly review with	Patients were provided with sufficient 3 monthly instalment prescriptions to last until a review date, set by the GP according to clinical need. The prescriptions were kept by the pharmacist of the patient's choice and dispensed monthly following a protocol to check whether the items were needed, patients were complying, or experiencing symptoms of side-effects, adverse events or drug interactions. Information was recorded on specially designed patient record cards retained by the pharmacist.	12 months RR 1.04 (95%CI 0.75,1.46)
Crotty 2004 110 subjects Australia	Hospital discharge	Transition pharmacist, Community pharmacist At discharge, 10-14 following transfer and 14-28 days following transfer	The intervention focused on transferring information on medications to care providers in the long-term care facilities, including nursing staff, the family physician, and the accredited community pharmacist. On the patients discharge from the hospital to the long-term care facility both the family physician and the community pharmacist were faxed medication transfer summary complied by the transition pharmacists and signed by the hospital medical officer. This communication supplemented the usual hospital discharge summary and included specific information on changes to medications that had been made in the hospital and aspects of medication management that required monitoring. After transfer of the patient to the long-term care facility the transition pharmacist coordinated an evidence based medication review that was performed by the community pharmacist contracted to the facility within 10-14 days of the transfer. The transition pharmacist also coordinated a case conference involving him or herself, the family physician, the community pharmacist, and a registered nurse at	2 months RR 0.64 (0.24, 1.68)

			the facility within 14-28 days of the transfer. At this conference the transition pharmacist provided information concerning medication use and appropriateness.	
Gillespie 2009a 400 subjects Sweden	Inpatient	Clinical pharmacist on admission and throughout inpatient stay with discharge counselling and a two month post-discharge telephone call	A comprehensive list of current medications complied on admission to complement that obtained in the ED, ensuring that the medication list received by the ward was correct. A comprehensive drug therapy review was performed which addressed issues of indication effectiveness safety and adherence and advice was given to the patients physician on drug selection dosages and monitoring needs with the final decision made by the physician in charge. Patients were monitored and educated throughout the admission process and received discharge counselling. Counselling was provided to individual patients regarding newly commenced or newly discontinued drugs. These were not standardised or recorded. Patient received counselling to the extent that the pharmacist thought appropriate. Information about discharge medications was communicated to the primary care physicians by the clinical pharmacists. A telephone call to patients 2 months after discharge was conducted to ensure adequate home management of medications.	12 months RR 0.98 (95%CI 0.83, 1.17)
Holland 2005 872 subjects UK	Home based	Study/research pharmacist 1 home visit following recruitment and 1 follow up visit 6-8 wks. later	Initial referral to a review pharmacist included a copy of the patients discharge letter. Pharmacists arranged home visits at times when they could meet patients and carers. Pharmacists assessed patient's ability to self-medicate and drug adherence, and they completed a standardised visit form. Where appropriate, they educated the patient and carer, removed out of date drugs, reported possible drug reactions or interactions to GP and reported the need for a compliance aid to the local pharmacist. Where a compliance aid was recommended, this was provided within the trial and a filling fee was paid to the local pharmacist. 1 follow up visit occurred at 6-8 weeks after recruitment to reinforce the original advice.	6 months RR 1.22 (95% CI1.01, 1.47) Rate ratio 1.29 (95% CI 1.06, 1.56)

Krska 2001 381 subjects UK	Home based	Clinical pharmacists One home visit followed by GP contact and implementation of agreed action plans.	Clinically trained pharmacists completed detailed profiles for each patient using medical notes and practice computer records. All patients were then interviewed in their own homes about their use of and responses to medication, and their use of health and social services. A pharmaceutical care plan was drawn up for each intervention group patient, listing all potential and actual pharmaceutical care issues, together with the desired outputs, the actions planned to achieve the outputs and the outcomes of any potential pharmaceutical care issues already resolved by the pharmacist. Copies of the plan were then inserted into the medical notes and the GP asked to indicate their level of agreement with each pharmaceutical care issues identified and actions. The pharmacist then implemented all remaining agreed actions.	3 months RR 0.73 (95%CI 0.26, 2.06)
Lenaghan 2007 136 subjects UK	Home based	Community pharmacist first visit within 2 weeks of consent with a follow up visit 6-8 wks. later. Pharmacist and GP had regular meetings throughout.	The first visit took place within 2 weeks of consent. The referral to the pharmacist included a copy of the patient's current medication and medical history. This was used to highlight areas to be addressed at the visit including possible drug interactions adverse effects or storage. Wherever possible the home visit was arranged for a time when the pharmacist could meet any carers who helped with the patients medicines. At the first visit the pharmacist educated the patient removed out of date drugs and assessed the need for an adherence aid. The review pharmacist and lead GP held regular meetings. Possible changes to the patient's medication were discussed and agreed amendments were put into action by the GP or delegated to the practice dispensing team. A follow up visit was arranged 6-8 weeks later to reinforce the original advice and assess whether there were any further pharmaceutical care issues to address with the GP.	6 months Rate ratio 0.92 (95%CI 0.50, 1.71)
Lipton 1994 706 subjects USA	Inpatient and outpatient	Clinical Pharmacist before discharge, post discharge 1 week, 2-4 weeks, 2 months and 3 months	Clinical pharmacist review of medical records and drug regimens and consultations with the patients and physicians. Booklets were provided on discharge in which to record medication information such as drug purpose, dosage and schedule. After reviewing the patient's records to determine clinical condition and to access the appropriateness of	6 months RR 1.09 (95% CI 0.89, 1.33) Rate ratio 1.10

				(95%CI 0.86, 1.42)
			prescribing, the pharmacists conducted a face-to-face consultation before discharge to discuss the purpose and use of their medications and potential drug related problems. Follow up consultations following discharged were conducted at 1 week, 2-4 weeks, 2 months and 3 months. The post discharge consultations were generally 15 mins. The majority were provided by telephone and the remainder took place in the pharmacist's hospital office or in the patient's home. When significant prescribing problems were detected consultations were provided with the patient's physician. The pharmacist promoted the use of fewer medications and simplified regimens where appropriate.	
Lisby 2010 99 subjects Denmark	Inpatient	Clinical pharmacist and pharmacologist on admission to hospital	The intervention was conducted within 24hrs of admission or by first coming day of the week. The intervention had two steps firstly, a clinical pharmacist systematically collected information about the patient's medication and secondly the collected medical histories were discussed with a clinical pharmacologist according to the patient's entire medical records including medical histories and laboratory tests. Discrepancies, inappropriate drugs, doses, routes, dosing schedules or inappropriate interactions between drugs were described in an advisory note with recommendation for changes. (This was in addition to usual care)	12 months RR 0.98 (95%CI 0.47, 2.05) Rate Ratio 1.06 (0.48, 2.33)
Mcmullin 1999 259 subjects	Inpatient	Clinical pharmacists on admission to hospital	5 pharmacists attended physician rounds or reviewed patient's medication profiles. The 6th pharmacist assessed the appropriateness of physician's requests on an antibiotic approval pager. Each pharmacist recorded all interventions over a 30 day period. Interventions were characterised as either quality of care or cost saving. Only those interventions that provided equivalent quality of care at less expense were randomised. These interventions included discontinuing unnecessary medication, switching to an oral formulation of the same medication, recommending a less expensive agent, or reducing the dosage based on clinical indication.	30 day readmission RR 1.20 95% CI 0.71, 2.01
Naunton 2003	Home-based	Study pharmacist first home visit 5 days post	5 days after discharge the study pharmacist visited patients at home. Patients were telephoned 1 day prior to the visit to	3 months

| 121 subjects Tasmania | | discharge follow up visit 90 days | arrange a suitable time for the review. The objective of this visit were to educate patients about their medications, answer any queries from patients or their caregivers, optimise medication management and improve compliance, detect DRPS and improve liaison with community based health services. The study pharmacist performed a pill count to assess compliance with the medication regimen. Prior to discharge medications, dosages and quantities supplied were noted. Patients who were deemed non-compliant either by pill count or appeared to have poor understanding of their medications were offered a compliance device or their community pharmacist was requested to provide additional services such as filling and delivering the compliance device. Where possible caregivers were requested to provide increased support or community nurses asked to provide services such as filling and compliance. The study pharmacist performed a comprehensive medication review to assess the need for all for all medications and identify any drug related issues. A brief letter outlining the patients medication regimen and any suggested changes or monitoring procedures was composed in the patients home and given to them to present to their doctor. Soon after the home visit the study pharmacist contacted the patients GP and community pharmacist to inform them of the study and to discuss any urgent issues. The patients were re-visited at home 90 days after discharge to evaluate the outcomes of interventions made on day 5. | RR 0.62 (95%CI 0.38, 1.06) |

Nazareth 2001 362 subjects UK	Inpatient and home based	Clinical and community pharmacists – discharge planning with home visits at 7-14 days post discharge with further visits as pharmacists discretion	Integrated discharge plan including an assessment of the patient' medication, rationalization of their drug treatment, assessment of patients ability to manage their medication, provision of information on their current drugs and liaison with carers and community professionals where appropriate. Each discharge plan held key information on discharge medication, and medication support required by the patient. A copy was given to the patient a community pharmacist of their choice and general practitioner and any other carers or professionals involved. 7-14 days following discharge the community pharmacists visited the patient's home. They checked for discrepancies between the medicines the patient was taking and those prescribed on discharge. The pharmacist assessed the patients understanding of and adherence to the medication regimen and intervened when appropriate. Interventions included counselling on the purpose and appropriate doses of the medication, disposing of excess medicines and liaising with GPs. Further community visits were arrange at the pharmacists discretion. A revised care plan was issued if the patient was re-admitted within 6 months.	6 months RR 0.98 (95%CI 0.68, 1.42)
Roberts 2001 3,230 subjects, Australia	Nursing home	Clinical pharmacist, nurses. Extensive nurse education	Relationship building, nurse education and medication review. The clinical pharmacy service model introduced to each nursing home was supported with activities such as focus groups facilitated by a research nurse, written and telephone communication and face-to-face professional contact between nursing home staff and clinical pharmacists on issues such as drug policy and specific resident problems, together with education and medication review. Problem-based education sessions were provided to nurses (6-9 sessions totalling approx. 11hrs). Sessions addressed basic geriatric pharmacology and some common problems in long-term care. Sessions were supported by wall charts, bulletins, telephone calls and clinical pharmacy visits averaging 16hrs	12 months Mean difference -2.50 95% CI -8.74, 3.74

| | | | contact per home over the study.

Written referenced drug regimen reviews were prepared by the clinical pharmacists for 500 residents selected by the nursing home staff. The reviews highlighted the potential for: adverse drug effects, ceasing 1 or more drugs, adding drugs, better use of specific therapy, nondrug interventions and adverse effect and drug response monitoring. Initial reports were audited by a geriatrician. Reports were placed in each resident's nursing home record, made available to the GP and discussed with the nursing staff. | |
| **Scullin**
2007
762 subjects
Northern Ireland | Inpatient and discharge | Clinical Pharmacist on admission, Intensive inpatient monitoring (daily) and discharge | Each patient received pharmaceutical care throughout each of the 3 IMM stages: admission, inpatient monitoring and counselling and discharge.

Admission: demographic details and previous medical history were collected. The clinical pharmacist constructed an accurate medication history using a variety of sources which included the patients admission prescription list, patients GP, patients own drugs, information from the patient or carer and the regular community pharmacist. Additional information on allergies, side-effects and adherence was complied. Discrepancies with the hospital prescription list were dealt with and product standardisations implemented. This is a joint initiative between the local health board and the hospital trust to improve patient safety by promoting the continuity of medicines across primary and secondary care. Therefore products were substituted with an agreed preferred brand of the same drug. Technicians used an algorithm at the time of admission to assess the safety and suitability of the patients own drugs for return to the patient at discharge.

Inpatient monitoring and counselling: Intensive clinical pharmacy service. Drug treatment was reviewed daily taking into account therapeutic goals, relevant clinical chemistry and | 12 months

RR 0.86 (95%CI 0.73, 1.03) |

			haematology results and where appropriate therapeutic drug monitoring. Counselling tailored to the needs of individual patients provided by the clinical pharmacists. This was focused on drugs which had been commenced or discontinued, high risk drugs, use of devices and other situations were pharmaceutical advice was deemed necessary. Technicians provided counselling on inhaler techniques. They also implemented an enhanced management of stock on wards which included: maintenance of stock levels, daily kardex and drug trolley reviews to manage non-routine stock and transfer of patients moving between wards. Discharge: The pharmacist generated and authorised a discharge prescription according to protocols. The project technician assessed which drugs required dispensing taking into account any of the patients own drugs stored on admission. A medicines record sheet outlining all medicines and dosage instructions was prepared by the pharmacist prior to discharge. This along with steroid cards anticoagulation booklets and patient information leaflets during a final patient consultation and counselling sessions. The medications record sheet also outlined relevant information such as changes to the patient's medication and laboratory findings whilst in hospital. This was faxed to the patients GP and community pharmacist.	
Sellors 2003 889 subjects Canada	General Practice	Community pharmacists – Initial consultation with patients followed by a consultation with the GP. Further GP –pharmacist consultations at 3 and 5 months with follow up pharmacist-patient telephone monitoring at 1 and 3 months.	Structured medication assessment by the pharmacist in the physician's office. After the interview the pharmacist wrote a consultation letter to the physician which summarised the patients medications, identified drug related problems and recommended actions to resolve any such problems. The pharmacist subsequently met with the physician to discuss the consultation letter. After the meetings physicians used a data collection form to indicate which recommendations they intended to implement and when. The pharmacist and physician met again 3 months later to discuss progress in implementing the recommendations. 5 months after the initial visit the pharmacist met with the physician to determine which	5 months Rate Ratio 1.13 (0.77. 1.66)

			recommendations had been put in place. 1 and 3 months after meeting with the physician the pharmacist monitored each patient's drug therapy using a semi structured telephone interview with the patient.	
Spinewine 2007 186 subjects, Belgium	GEM clinic Inpatient	Clinic pharmacist – admission to discharge	Clinical pharmacist providing pharmaceutical care from admission to discharge. The pharmacist was present in the unit 4 days per week, participated in medical and multidisciplinary rounds, had direct contact with patients and care givers and had access to patient's medical records. The pharmacist performed a medication history on admission and prepared a patient record with clinical and pharmaceutical data. The appropriateness of treatment was analysed and a pharmaceutical care plan was prepared. Whenever an opportunity for optimization was identified it was discussed with the prescriber who could accept or reject the intervention. At discharge the pharmacist provided written and oral information on treatment changes to the patient or caregiver as well as written information to the general practitioner.	12 months RR 0.97 (95%CI 0.63, 1.48)
Taylor 2003 69 subjects USA	Physician's office	Study/community pharmacists regularly scheduled visits	Patients received standard medical care along with pharmacotherapeutic interventions by a pharmacist during regularly scheduled office visits. A patient typically met with a pharmacist for 20 minutes before seeing a physician. The intervention was based on the principles of pharmaceutical care, a uniform process for preventing or identifying and resolving problems related to drug therapy. Published therapeutic algorithms and guidelines were used as the basis of the pharmacist's recommendations. The pharmacists were specifically trained to evaluate a therapy's indication, effectiveness, and dosage as well as the correctness and practicality of directions, drug interactions, drug-disease interactions, therapeutic duplication, the duration of treatment, untreated indications and expense. The pharmacist reviewed the medical record for medication related problems conducted a chart review to ensure that information on drug therapy and allergies was accurately documented, examined the medication history to determine compliance with and complications of	12 months Rate ratio 0.20 (95% CI 0.04, 0.89)

			medications and provided comprehensive individualised patient education that included a brief review of the disease important lifestyle modifications and basic drug information. Therapeutic recommendations were communicated to physicians through discussions or progress notes. The pharmacist also provided drug and disease information during follow up visits and answered patient's questions. Written materials were provided. The pharmacists monitored patient's responses to drugs and attempted to improve compliance by consolidating medication regimens reducing dosage frequency devising medication reminders and teaching patients techniques for using such devices as inhalers, peak flow monitors, glucometers and pill boxes.	
Zermansky 2001 1,188 subjects UK	GP surgery	Community Pharmacist	The pharmacist invited patients to his clinic when their next review was due. Patients with no review date were invited to attend when convenient. Immobile patients were visited at home. Non-attenders were invited once more by phone. During each consultation with the patient undertakes: 1. Data gathering - identify drugs taken, Identify the original indications for each drug from the medical records, assess adherence to the medications, identify un addressed medical problems. 2. Evaluation - The continuation of each drug should be evaluated with the doctor, identify sub optimal treatment of recognised disease, identify any side effects of the drugs, identify any clinically relevant drug interactions or contraindications, consider the costs of therapy switching to a less expensive but equally efficacious alternative. 3. Implementation - The changes required should be implemented either by the pharmacist themselves (if appropriate) or in consultation with the GP or the patient should be referred to the GP for assessment. Patient education where	12 months RR 1.14 (95% CI 0.88, 1.46)

			knowledge of disease or medications is lacking. Communication and record keeping - the pharmacist should record all recommendations and implementations and all should be communicated with the patient and GP.	
Zermansky 2006 661 subjects UK	Nursing homes	Clinical pharmacist	A clinical medication review was conducted by the study pharmacist within 28 days of randomisation. It comprised a review of GP clinical record and a consultation with the patient and carer. The pharmacist formulated recommendations with the patient and carer and passed them on a written proforma to the GP for acceptance and implementation. GP acceptance was signified by ticking a box on the proforma.	6 months RR 0.98 (95% CI 0.71, 1.35)
Heart Failure				
Bond 2007 2,014 subjects UK	GP practice utilising medical notes	Community pharmacist A single medication review	Pharmacists were sent the names of the intervention patients following baseline data collection. They conducted a single review of the patient medical records and recommended to the GP any changes for action using their knowledge of medicines and their specialist knowledge of the target conditions based on the study training. Recommendations were communicated to the GP using a study referral form and were not systematically followed up. Standardised proformas for the medication review and compliance assessment were also used.	12 months RR 0.91 (95%CI 0.61, 1.36)
Bouvy 2003 152 subjects Netherlands	Community	Community Pharmacists Initial review with monthly follow up contact	Community pharmacists received training for the intervention which consisted of a structured interview on the patient's first visit to the pharmacy after inclusion into the study. A computerised medication history was used to discuss drug use, reasons for non-compliance such as possible adverse drug reactions and difficulties to integrate medication use in daily life to reinforce medication compliance. A short report of this interview was sent to the GP. Pharmacists then contacted patients on a monthly basis for a maximum of 6 months.	6 months RR 3.16 (95% CI 0.89, 11.23) Rate ratio 1.12 (95% CI 0.56, 2.27)
Holland 2007 293 subjects UK	Home based	Study pharmacists Home visit 2 wks. post discharge with a follow up visit 6-8wks later.	Study pharmacists were provided with copies of the patients discharge letter. The pharmacist arranged home visit within 2 weeks of discharge when they could meet the patient and/or carers. Where appropriate, pharmacists educated the patient/carer about heart failure and their drugs and gave basic	6 months RR 1.01 (95% CI 0.80, 1.26)

			exercise, dietary and smoking cessation advice. They also encouraged completion of simple sign and symptom monitoring diary cards, removed discontinued drugs, fed back recommendations to the general practitioner and fed back to the local pharmacist any need for drug adherence aid. All pharmacists were provided with a detailed manual describing the expected components of their visit and asked them to deliver education in line with the British Heart Foundation's booklet living with heart failure which they left with patients after the first visit. One follow-up visit occurred 6-8 weeks after discharge to review progress and reinforce original advice.	Rate ratio 1.15 (95% CI 0.89, 1.48)
Lopez 2006 134 subjects Spain	Postdischarge form hospital	Day of discharge from hospital with monthly telephone calls for the first 6 months followed by 2 monthly for the remaining 6 months	The program activities focused on 2 different issues: 1. Information - the day of hospital discharge a personal interview was performed, aimed at the patient and his caregiver particular dealing with information on the disease - Explaining with a simple language, adapted to the social and cultural level of the patient and supported by audio-visual and written educational material, designed for this purpose, the main characteristics of heart failure. Diet education - explaining the need for reducing the sodium supply of diet and giving graphical easily assimilable information to the patient on food that should be avoided or its consumption reduced. Information on drug therapy - The patient information form provided in the program was the basis to explain to the patient the value of the prescribed drugs and the need for following the prescriptions detailed in the treatment sheet. 2. Telephone strengthening - contact telephone; a phone number and the name of the pharmacist were given to the patients, to whom they could ask any doubt arising during the treatment or the disease. Monthly during the first 6 months of follow-up and subsequently every 2 months a telephone call was made to the home of the patient as a strengthen to the intervention and to solve any doubts or problems that could	12 months Rate ratio 0.47 (95% CI 0.39, 0.56)

			have arisen.	
Murray 2007 314 subjects	Post discharge	Research pharmacist Enough medication provided to last 2 months.	A pharmacist delivered the intervention using a protocol that included a baseline medication history of all prescription and over the counter drugs and dietary supplements taken by patients whom patients brought with them to the baseline interview and the results of an assessment of patient medication knowledge and skills. The pharmacist dispensed enough of the patient's medications to last 2 months. When dispensed the pharmacist provided patient centred verbal instructions and written materials about the medications by using a schema for instruction that has been tested. We assigned each a medication category an icon. The same icon appeared on the container label and lid and on the written patient instructions. Written instructions were aimed at patients with low health literacy and contained an easy to follow timeline to remind patients when to take their medications. The pharmacist monitored patient's medication use and health care encounters, body weight and other relevant information by using a study database. Information about patients was communicated as needed to clinic nurses and primary care physicians by face-to-face visits, telephone, paging and email.	9 months active interventions with 3 further months of follow up Mean difference -0.04 (95%CI -0.16, 0.08)
Stewart 1998 97 subjects Australia	Home base	Study nurse and pharmacist. Before discharge and 1wk post discharge	Before discharge patients were visited by the study nurse and Counselled in relation to complying with the treatment regimen and reporting any signs of clinical deterioration or acute worsening of their heart failure. One week following discharge the patients were visited by the study nurse and pharmacist. On arrival the study pharmacist performed an assessment of the patients' knowledge of the prescribed medications and the extent of compliance. Patients who demonstrated poor medication knowledge or non- compliance received a combination of the following: remedial counselling, initiation of daily reminder routine to enhance timely administration of medications, introduction of a weekly medication container enabling pre distribution of does, incremental monitoring by caregivers, provision of medical information and reminder card,	6 months RR 1.05 (95% CI 0.87, 1.27) Rate ratio 0.56 (95% CI 0.37, 0.84)

			referral to a community pharmacist for more regular review. Patients were further reviewed by the study nurse to detect any clinical deterioration adverse effects. Those requiring medical review were sent to their primary care provider.	
Varma 1999 83 subjects Northen Ireland	Outpatient clinic	Research pharmacist, community pharmacist and physician	Education by a research pharmacist in as structured way about CHF, prescribed drugs and management of CHF symptoms. A printed booklet was developed for the education session for patients to take home containing the symptoms, aims of treatment, types of drugs and side effects, diet and lifestyle changes and information on action to take if dose was missed. Instruction of self-monitoring of signs and symptoms and compliance with drugs. Daily monitoring cards were provided. Physicians and community pharmacists were contacted by phone to discuss the research project and self-monitoring program.	12 months Rate ratio 0.46 (95% CI 0.37, 0.56)
Asthma				
Charrois 2006 71 subjects Canada	Community	Community Pharmacists, respiratory therapist, physician. Initial visit followed by a telephone call at 2 weeks with further follow up at 1, 2, 4 and 6 months by pharmacists and 2 and 6 months by respiratory therapist.	Education on asthma, assessment and optimisation of drug therapy, respiratory therapist referral and physician referral. The education included medication teaching on all asthma medications, inhaler technique assessment/education, and provision of written asthma education materials and development of a written action plan. The action plan was based on the Canadian guidelines and has been developed and approved by the local pharmacists, physicians and respiratory therapist at the first investigators' meeting. The educational component was initiated by the community pharmacist and reinforced by the respiratory therapist. Optimisation of drug therapy included an assessment of medications by the study pharmacist in concordance with the Canadian guidelines, in particular ensuring all patients are prescribed an inhaled corticosteroid. An assessment of adherence to current drug therapy helps to determine if the patient is not taking their current therapy optimally.	6 month RR 0.31 (95%CI 0.003, 2.88)

| | | | Patients were referred to their physician if therapy adjustments are suggested, as determined by the drug therapy assessment. A physician referral is faxed to the patient's family physician identifying patients as high risk and included any recommendations to the physicians regarding current asthma therapy and the education being provided to the patient including a copy of the patients written action plan. Patients are referred to the respiratory therapist within 1 week of randomisation for measurement of FEV1 and reinforcement of education.

Follow up by the pharmacist included a follow up telephone call at 2 weeks. Follow up by the pharmacist for educational reinforcement, medication assessment, assessment of outcome events and reassessment of written action plan at 1, 2, 4 and 6 months. Follow up by the respiratory therapist for educational reinforcement, measurement of pulmonary function and reassessment of written action plan occurred at 2 and 6 months. | |
| **Herborg**

2001
500 patients
Denmark | Community | Community pharmacists once a month | Designed to foster cooperation among pharmacist's patients and physicians. It uses a structured cyclical outcome improvement process consisting of the seven steps: 1. Establish patient-pharmacist-physician relationship, 2. Collect patient data (interview), 3. Identify and analyse drug therapy problems, 4. outline therapeutic goals, 5. Choose individual intervention and monitoring plan, 6. Implement monitoring and follow up, 7. Document and report to physician and patient. (More details of each step provided in the paper). Patients were asked to visit their pharmacist once a month during the study year. During the visits the pharmacist recorded the patient's inhalation technique, PEFR and asthma symptoms. Daily peak flow measurements and symptoms experienced which had been recorded in the PEFR diary were monitored at these encounters. Patients discussed with pharmacists their daily experiences with the disease together with possible solutions to any subjective problem. | 12 months

RR 0.33 (95% CI 0.10, 1.01) |

Table 6: Emergency department interventions studies published since previous review

Author date country	**Population** *Age Gender Ethic group Living alone	**Intervention** n= number randomised	**Control** n= number randomised	**Outcome measure** **(follow up time in months)	**Results** Intervention vs. control (CI for RR SD for MD)
Heart disease					
Kline 2009 USA	Age mean (SD) 46 (12) Gender female 118 (64%) Ethnicity: White 83 (45%) Black 101 (55%)	n=200, pre-test probability score. Using a previously validated computer-based method to estimate the pre-test probability of acute coronary syndrome using the method of attribute matching. This method produces a point estimate of pre-test probability by first obtaining 8 predictor variables from a patient undergoing evaluation for possible acute coronary syndrome: age, sex, race, history of coronary artery disease, chest wall tenderness to palpation that reproduces chest pain, diaphoresis, ST depression greater than 0.5 mm in 2 leads and-wave inversion greater than 0.5 mm in 2 leads. The remainder of the protocol was observational; no member of the research team made any written or verbal recommendations about specific elements of clinical management such as the need for diagnostic testing or admission.	n=200 usual care Patients and clinicians assigned to the control group received no printout, and the research coordinator did not determine the results of the computerized device until more than 45 days later.	Readmission within 7 days and 45 days	7 days RR 0.50 (95%CI 0.24, 1.04) 45 days RR 0.30 (0.12, 0.73)

Older/elderly					
Basic 2005 Australia	Age mean (SD) 78.4 (5.8) Gender Male 80 (70)	n=114 Specialist nurse within the emergency department. Baseline assessments of intervention patients were recorded in the medical file, with an emphasis on active geriatric problems. The nurse also liaised with the patients' carers and health care providers, including general practitioners and community-based agencies. Patients discharged home from the ED with unmet medical, functional, psychological or social needs were referred to a community or social agency and/or the GP. The nurse assisted in the care of those admitted to the hospital by documenting suggestions in the medical file, including recommendations for formal geriatric assessment.	n=110 Usual care Baseline assessment data from control group patients were withheld, and the nurse had no further involvement in their care (including out-of-hospital care).		The intervention had no significant effect on admission to hospital OR 0.7 (95% CI 0.3-1.7)
General population					
Goodacre 2004 UK	Age Gender	n=59 days specialist ED physician. Their role was to review patients referred from ED for medical admission and, using their experience, access to diagnostic tests and outpatient clinics, divert appropriate cases away from medical admission. They worked from 9 am to 6 pm on weekdays.	n=65 days usual care	Daily number of admissions	presence of the A&E physician was associated with a reduction of only 0.7 medical admissions per day (95% CI –1.7 to 3.2, p = 0.561) Overall, hospital admissions were increased by 0.9 per day when the A&E physician was

					present (95% CI – 1.8 to 3.6, p = 0.5).
Murphy 1996 Republic of Ireland	Age Triage 3 31 (22-47) Triage 4 28 (20-40) Male Triage 3 902 (59) Triage 4 488 (62)	General Practitioner Triage 3 n = 1,516, Triage 4 n = 787 A triage nurse assessed patients on presentation to the department and assigned them to their appropriate triage categories. Patients are then seen in order of triage priority and registration time. The GPs worked as an integral part of the ED service and had access to the same facilities as the usual medical staff.	Usual care by ED staff Triage 3 n=1,837 Triage 4 n = 544. No further information provided.	Admissions	Triage 3 Control 229 (12%) intervention 103 (7) % relative risk 45 (32 to 56) Triage 4 Control 8 (1) intervention 0 NS Triage 3 RR 0.55 (0.44, 0.68) Triage 4 RR 0.04 (0.00, 0.70)

Table 7: Included continuity of care studies

Author date country	Population *Age Gender Ethic group Living alone	Intervention n= number randomised	Control n= number randomised	Outcome measure **(follow up time in months)	Results Intervention vs. control (CI for RR SD for mean difference
Relationship continuity Primary care					
Weinberger 1996 USA Follow up paper Oddone et al Effec Clin Prac 1999; 2: 201-9	Patients with diabetes, COPD, and congestive heart failure Hospitalised patients in the general medical service RCT Intervention/control 63 vs. 62.6 yrs 99% vs.98% male Ethnicity: White 64.2% vs. 65.9%, Black 28.5% vs. 26.4%, Other 7.3% vs. 7.7%	n=695 Team consisting of a registered nurse and a primary care physician. The intervention consisted of an inpatient phase which began after randomisation and an outpatient component which began at discharge. Inpatient - 3 days prior to discharge primary care nurse assessed post discharge needs, developed a list of medical problems, provided educational materials, and assigned a primary care physician The physician visited within 2 days before discharge to review as necessary. Appointment made for patient to attend primary care clinic 1 week post discharge. Outpatient - Nurse phones patient within 2 days of discharge. Physician & nurse reviewed and updated the treatment plans at the first post-discharge appointment.	n=701 Usual care No restriction on care. They did not receive a primary care nurse or supplemental education or assessment of needs beyond customary.	6 months Number of readmissions/month.	All patients: intervention: 0.19±0.4 Control: 0.14 ±0.2 p=0.005 Diabetes: 0.13±0.2 0.11±0.2 CHF: 0.28±0.7, 0.15±0.32 COPD: 0.19±0.3, 0.17±0.2 >1 diagnosis: 0.23±0.3, 0.17±0.2 Proportion readmitted: all patients 49.4, 44.2 p=0.06 Diabetes 37.1, 38.0 CHF: 52.2, 41.5

					COPD: 53.4, 48.2 >1 diagnosis: 60.3, 50.0
Out of hours care					
Cragg 1997 UK Follow up paper McKinley et al BMJ 1997; 314:190-7	RCT General population No details provided for patients Comparison of out of hours care provided by patients own GP or deputising service	n=49 practice doctors For duty periods covered participating practice doctors agreed to provide out of hours care personally or to use a deputising service as determined by randomisation. Duty periods were stratified to include a proportionate number of weekday evenings and nights, weekends and bank holidays and then randomly allocated care provided by either deputising services or practice doctors. Patients contacted their practice for care as usual throughout.	183 deputising doctors	8 weeks 118 Patients interviewed were referred to hospital.	There were no significant differences in the number of patients referred, the numbers subsequently admitted or the duration of admissions
Lattimer 1998 UK Pilot study SWOOP group BMJ 1997: 314; 198-9	RCT General population intervention 41% male, 59% female, control 42% male 58% female Primary outcome was to establish whether there was equivalence in the	156 matched pairs Nurse telephone consultation During the intervention periods all incoming calls to the cooperative were received by a receptionist who took the patients details and were then diverted to one of two nurses on duty. The nurse conducted a systematic assessment of the caller's problem and recommended an appropriate course of action, including management with nurse advice alone,	156 matched pairs Usual care During the control period the receptionist took the patients details and then passed calls onto the doctor.	12 months Unplanned hospital admissions	Intervention 803/7184 (11.2%) Control 947/7308 (13%) RR 0.86 (0.79, 0.94)

	number of adverse events generated by a general practice co-operative augmented by nurse consultation compared to standard cooperative service.	contact with the general practitioner (by phone, at the surgery or home visit) or direct contact with ambulance services. The nurse was aided by a telephone advice system a computer based primary care call management system. Confidential records on each call new maintained on computer. Calls about children under 1 year and second calls about a patient on the same day were always referred to a doctor unless callers were specifically asked to call back to report progress after being given advice and their condition improved. Patients and callers wishing to speak to the doctor were always able to do so.			
Management/Relationship Continuity Diabetes Mellitus					
Morrison 2002 New Zealand	32.6 (4.8) All female 33 (35%) European, 14 (11%) Maori, 41 (31%) pacific Island, Asian 30 (22%), Indian 10 (7%), other 5 (4%)	Intervention: Continuity of midwifery care N:134 Continuity of care consisted of antenatal, intrapartum and postnatal care by a team of three midwives, who provided care via a 24 hour on call system. Each woman had contact with all three midwives but had one dedicated midwife who was responsible for planning the midwifery management and where possible was present for the woman's labour and delivery.	Control: routine midwifery care N 138 Antenatal care by one of two dedicated diabetic clinic midwives. Intrapartum care was provided by the delivery unit midwives whom the women had not previously met and postnatal care was provided by the postnatal ward midwives with input from the dedicated diabetic clinic midwives. The diabetic clinic	Postnatal readmission:	control 10 (7%), intervention 2 (1.5%) p=0.04 RR 0.21 (0.05, 0.92)

			obstetrician, physician and dietician regularly saw all women regardless of study group. Hospital protocols for postnatal discharge, infant serial blood glucose monitoring and paediatric feeding were followed in both arms of the study. Postnatal care in the community provided by a home setting midwife was the same in both arms of the study.		
Naji 1994 UK	58.1 (15.5)	Intervention: Integrated care for diabetes N 139 Seen in general practice every three or four months and in the hospital clinic annually. Arrangements for routine consultations were at the discretion of each practice. Practices received guidelines on the requirements of integrated care, including measurements and examinations to be undertaken, and on the current diabetes management policy. Clinic staff were not given protocols or guidelines. General practitioners responsibilities: at each visit review and optimise glycaemic control, record weight and	Control: usual care N 135 Patients allocated to conventional care were seen at roughly four monthly intervals as before the trial. No further details provided.	admissions for diabetes:	no differences between the groups but no data provided

| | | results of urine analysis, measure venous plasma glucose and glycated haemoglobin. During the course of the year check and record blood pressure, arterial pulses, visual acuity, condition of feet and tendon reflexes and sensory findings.

Hospital clinics responsibilities: at the annual visits review and progress and plan management, perform funduscopy and record results measure serum creatinine and glycated haemoglobin.

Control: usual care

Number randomised: 135

What: Patients allocated to conventional care were seen at roughly four monthly intervals as before the trial. No further details provided. | | | |
|---|---|---|---|---|---|

Informational Continuity Additional information					
Griffith

1998
USA | 69.4 (6.1)
CHF
COPD | Intervention: Patient social history information N 68

A research assistant blinded to the purpose of the study approached the patients and asked them to answer a | Control: Usual care N 66

Social history data was collected as detailed above however it was not provided to the | Percentage readmitted after 14 days:

Percentage readmitted after 30 | intervention 24, control 20

intervention 34, control 28 |

		standard social history questions. The comprehensive social history items were those recommended by consensus in the four most commonly used physical diagnosis textbooks. The items included hometown and town where they were raised, highest educational level, marital status, number of children and proximity/closeness, military service, typical daily activities, hobbies, tobacco/alcohol use, sources of social support, past or present employment, recent stressors, insurance/financial status an religion. The research assistant also noted social information recorded by the house officer. This information was then provided to the house officer in 2 ways: 1) a written synopsis of the patients comprehensive social history information was given to the house officer, 2) the research read the comprehensive social history information to the house officer to ensure that they had some exposure to the information as they may not read the written information.	house officer. All other aspects of care remained the same between the 2 groups	days:	14 days RR 1.19 (0.62, 2.29) 30 day RR 1.24 (0.74, 2.08)

Appendix 3: Risk of bias

Figure 1a: Risk of bias for RCTs for case management for the older population

Figure 1b: Risk of bias for RCTs for case management for heart failure

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding (performance bias and detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Inglis 2004	?	?	?	+	+	?
Kasper 2002	+	+	?	+	+	?
Larmee 2003	+	?	?	+	+	?
Naylor 2004	+	?	?	+	+	?
Peters-Klimm 2010	+	?	?	+	+	?
Rich 1995	+	?	?	+	+	?
Stewart 1999	+	+	?	+	+	?

Figure 1c: Risk of bias for RCTs for case management for COPD

Figure 1d: Risk of bias for RCTs for case management for other conditions

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding (performance bias and detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Andersen 2000	+	+	?	+	+	?
Bellantonio 2008	+	?	?	+	+	?
Johansson 2001	+	?	?	+	+	?
Iatour 2007	+	?	?	+	+	?
Sadowski 2009	+	+	?	+	+	?
Shelton 2001	?	?	?	?	+	?
Young 2003	+	?	?	+	+	?

Figure 2a: Risk of bias for RCTs of specialist clinics for heart failure

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Atienza 2004	+	+	−	−	+	+	−
Blue 2001	+	+	−	+	+	+	+
Bruggink 2007	+	?	−	+	+	+	−
Capomolla 2002	?	?	−	?	+	+	?
Doughty 2002	+	+	−	−	+	+	+
Ekman 1998	+	+	−	?	+	+	+
Jaarsma 2008	+	+	−	+	+	+	−
Kasper 2002	+	+	−	+	+	+	−
McDonald 2001	?	?	−	+	+	+	?
Wierzchowiecki 2006	?	?	−	?	+	+	?

Figure 2b: Risk of bias for RCTs of specialist clinics for the older population

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Burns 1995	+	?	?	?	+	+	+
Coleman 1999	?	?	−	+	+	+	−
Englehardt 1996	?	?	−	+	+	+	−
Fletcher 2004	+	+	−	+	+	+	−
Scott 2004	+	?	−	+	−	+	−
Toseland 1996	?	?	−	+	+	+	−
Tulloch 1979	?	?	−	+	+	+	−

Figure 2c: Risk of bias for RCTs of specialist clinics for asthma

Figure 2d: Risk of bias for RCTs of specialist clinics for other conditions

Figure 3 Risk of bias for RCTs of community interventions

Figure 4: Risk of bias for RCTs of medication review

Appendix 4: Forest plots

Case management

Figure 1a: Case management initiated in hospital or on discharge versus usual care in the older population: relative rate of readmissions

Study or Subgroup	log[Relative rate]	SE	Weight	Relative rate IV, Random, 95% CI
Caplan 2004	-0.27444	0.105	41.1%	0.76 [0.62, 0.93]
Naylor 1999	-0.79851	0.219	29.0%	0.45 [0.29, 0.69]
Nikolaus 1999	-0.01005	0.21	29.9%	0.99 [0.66, 1.49]
Total (95% CI)			100.0%	0.71 [0.49, 1.03]

Heterogeneity: Tau² = 0.08; Chi² = 7.13, df = 2 (P = 0.03); I² = 72%
Test for overall effect: Z = 1.82 (P = 0.07)

Favours case management   Favours usual care
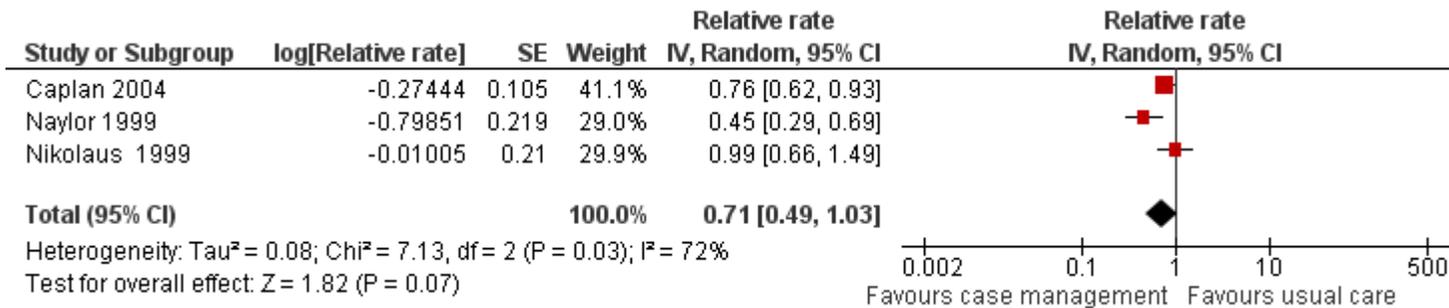
Figure 1b) Case management initiated in the community versus usual care in the older population: mean difference in admissions

Study or Subgroup	Case management Mean	SD	Total	Usual care Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Boult 2011	0.7	1.06	446	0.72	1.19	404	39.9%	-0.02 [-0.17, 0.13]
Dalby 2000	0.4	0.7	70	0.3	0.8	69	14.8%	0.10 [-0.15, 0.35]
Gagnon 1999	0.5	0.8	212	0.4	0.7	215	45.4%	0.10 [-0.04, 0.24]
Total (95% CI)			728			688	100.0%	0.05 [-0.04, 0.15]

Heterogeneity: Chi² = 1.44, df = 2 (P = 0.49); I² = 0%
Test for overall effect: Z = 1.06 (P = 0.29)

Favours case management   Favours usual care

Figure 1c) case management for heart failure: relative rate of readmissions

Study or Subgroup	log[Relative rate]	SE	Weight	Relative rate IV, Fixed, 95% CI	Relative rate IV, Fixed, 95% CI
Larmee 2003	-0.18633	0.32	25.9%	0.83 [0.44, 1.55]	
Naylor 2004	-0.59784	0.195	69.6%	0.55 [0.38, 0.81]	
Rich 1995	-0.79851	0.765	4.5%	0.45 [0.10, 2.02]	
Total (95% CI)			**100.0%**	**0.61 [0.44, 0.83]**	

Heterogeneity: Chi² = 1.36, df = 2 (P = 0.51); I² = 0%
Test for overall effect: Z = 3.08 (P = 0.002)

0.05   0.2   1   5   20
Favours experimental   Favours control
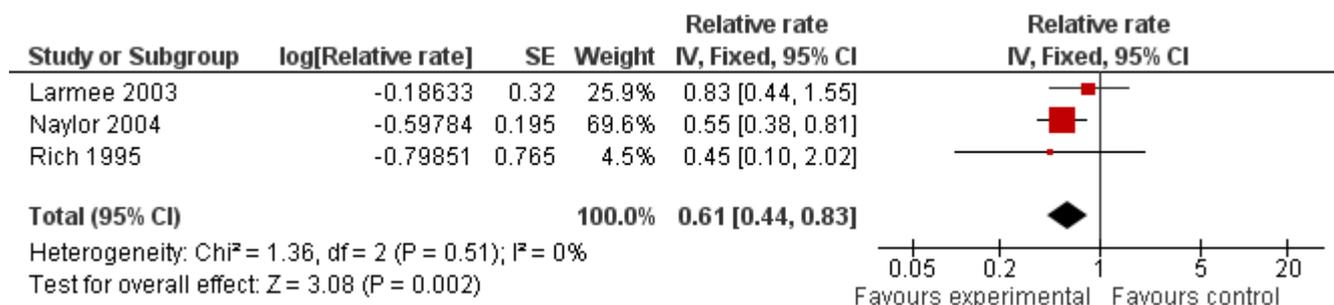
Specialist clinics

Figure 2a Specialist clinic studies for heart failure with a 6 month follow up period: Relative risk of admission

Study or Subgroup	Intervention Events	Total	Usual care Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
Ekman 1998	36	79	38	79	45.4%	0.95 [0.68, 1.32]	
Kasper 2002	26	102	35	98	42.7%	0.71 [0.47, 1.09]	
Wierzchowiecki 2006	8	64	10	65	11.9%	0.81 [0.34, 1.93]	
Total (95% CI)		245		242	100.0%	**0.83 [0.65, 1.07]**	
Total events	70		83				

Heterogeneity: Chi² = 1.09, df = 2 (P = 0.58); I² = 0%
Test for overall effect: Z = 1.42 (P = 0.15)

0.01   0.1   1   10   100
Favours intervention   Favours usual care

Figure 2b: Specialist clinic studies for heart failure with a 12 month follow up period: Relative risk of admission

Study or Subgroup	Intervention Events	Total	Usual care Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
Atienza 2004	39	164	79	174	41.7%	0.52 [0.38, 0.72]	
Blue 2001	12	84	26	81	14.4%	0.45 [0.24, 0.82]	
Bruggink 2007	11	118	22	122	11.8%	0.52 [0.26, 1.02]	
Capomolla 2002	9	112	37	122	19.3%	0.26 [0.13, 0.52]	
Doughty 2002	21	100	23	96	12.8%	0.88 [0.52, 1.48]	
Total (95% CI)		578		595	100.0%	**0.51 [0.41, 0.63]**	
Total events	92		187				

Heterogeneity: Chi² = 7.94, df = 4 (P = 0.09); I² = 50%
Test for overall effect: Z = 6.06 (P < 0.00001)

0.01   0.1   1   10   100
Favours intervention   Favours usual care

Figure 2c-f: Forest plot of the intensity of follow up: relative risk of admission

c) Intensive follow up: relative risk of admission

Study or Subgroup	Intervention Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Doughty 2002	21	100	23	96	16.3%	0.88 [0.52, 1.48]
Jaarsma 2008	92	353	84	348	58.8%	1.08 [0.84, 1.39]
Kasper 2002	26	102	35	98	24.8%	0.71 [0.47, 1.09]
Total (95% CI)		555		542	100.0%	0.96 [0.78, 1.17]
Total events	139		142			

Heterogeneity: Chi² = 2.79, df = 2 (P = 0.25); I² = 28%
Test for overall effect: Z = 0.44 (P = 0.66)

Risk Ratio M-H, Fixed, 95% CI — scale 0.01 0.1 1 10 100 — Favours Interventon / Favours Control

d) Decreasing intensity: relative risk of admission

Study or Subgroup	Intervention Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Blue 2001	12	84	26	81	46.4%	0.45 [0.24, 0.82]
Bruggink 2007	11	118	22	122	37.9%	0.52 [0.26, 1.02]
McDonald 2001	1	35	9	35	15.8%	0.11 [0.01, 0.83]
Total (95% CI)		237		238	100.0%	0.42 [0.27, 0.65]
Total events	24		57			

Heterogeneity: Chi² = 2.07, df = 2 (P = 0.35); I² = 4%
Test for overall effect: Z = 3.87 (P = 0.0001)

Risk Ratio M-H, Fixed, 95% CI — scale 0.01 0.1 1 10 100 — Favours intervention / Favours control

e) Tailored follow up: relative risk of admission

Study or Subgroup	Intervention Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Capomolla 2002	9	112	37	122	47.5%	0.26 [0.13, 0.52]
Ekman 1998	36	79	38	79	52.5%	0.95 [0.68, 1.32]
Total (95% CI)		191		201	100.0%	0.52 [0.14, 1.95]
Total events	45		75			

Heterogeneity: Tau² = 0.84; Chi² = 12.26, df = 1 (P = 0.0005); I² = 92%
Test for overall effect: Z = 0.97 (P = 0.33)

Risk Ratio M-H, Random, 95% CI — scale 0.01 0.1 1 10 100 — Favours intervention / Favours control

e) Regular follow up: relative risk of admission

Study or Subgroup	Intervention Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Atienza 2004	39	164	79	174	39.2%	0.52 [0.38, 0.72]
Jaarsma 2008	84	348	84	348	41.2%	1.00 [0.77, 1.30]
Wierzchowiecki 2006	8	64	10	65	19.6%	0.81 [0.34, 1.93]
Total (95% CI)		576		587	100.0%	0.75 [0.45, 1.23]
Total events	131		173			

Heterogeneity: Tau² = 0.14; Chi² = 9.41, df = 2 (P = 0.009); I² = 79%
Test for overall effect: Z = 1.15 (P = 0.25)

Risk Ratio M-H, Random, 95% CI — scale 0.01 0.1 1 10 100 — Favours intervention / Favours control

f) <u>Inpatient interventions:</u> odds ratio of admission

All three studies

Study or Subgroup	Intervention Events	Total	Control Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Atienza 2004	39	164	79	174	41.3%	0.38 [0.24, 0.60]
Jaarsma 2008	176	701	84	348	43.6%	1.05 [0.78, 1.42]
McDonald 2001	1	35	9	35	15.1%	0.08 [0.01, 0.71]
Total (95% CI)		900		557	100.0%	0.47 [0.17, 1.29]
Total events	216		172			

Heterogeneity: Tau² = 0.59; Chi² = 17.47, df = 2 (P = 0.0002); I² = 89%
Test for overall effect: Z = 1.46 (P = 0.14)

Odds Ratio M-H, Random, 95% CI
0.01 0.1 1 10 100
Favours intervention   Favours control

g) Inpatient interventions

Sensitivity analysis due to contamination of control group

Study or Subgroup	Intervention Events	Total	Control Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Atienza 2004	39	164	79	174	75.1%	0.38 [0.24, 0.60]
Jaarsma 2008	176	701	84	348	0.0%	1.05 [0.78, 1.42]
McDonald 2001	1	35	9	35	24.9%	0.08 [0.01, 0.71]
Total (95% CI)		199		209	100.0%	0.26 [0.07, 0.92]
Total events	40		88			

Heterogeneity: Tau² = 0.50; Chi² = 1.81, df = 1 (P = 0.18); I² = 45%
Test for overall effect: Z = 2.09 (P = 0.04)

Odds Ratio M-H, Random, 95% CI
0.01 0.1 1 10 100
Favours intervention   Favours control

Medication review

Figure 3a: Clinical pharmacist RCTs of older people: relative risk of admission

Study or Subgroup	Intervention Events	Intervention Total	Usual Care Events	Usual Care Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.2.4 Inpatient only						
Lisby 2010	11	50	11	49	2.2%	0.98 [0.47, 2.05]
McMullin 1999	25	126	22	133	4.3%	1.20 [0.71, 2.01]
Scullin 2007	141	371	172	391	33.6%	0.86 [0.73, 1.03]
Spinewine 2007	29	89	28	83	5.8%	0.97 [0.63, 1.48]
Subtotal (95% CI)		636		656	46.0%	**0.91 [0.79, 1.06]**
Total events	206		233			

Heterogeneity: Chi² = 1.57, df = 3 (P = 0.67); I² = 0%

Test for overall effect: Z = 1.18 (P = 0.24)

Study or Subgroup	Intervention Events	Intervention Total	Usual Care Events	Usual Care Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.2.7 Inpatient with follow up						
Gillespie 2009	106	182	110	186	21.9%	0.98 [0.83, 1.17]
Lipton 1994	126	350	118	356	23.5%	1.09 [0.89, 1.33]
Nazareth 2001	38	181	43	181	8.6%	0.88 [0.60, 1.30]
Subtotal (95% CI)		713		723	54.0%	**1.01 [0.89, 1.15]**
Total events	270		271			

Heterogeneity: Chi² = 1.04, df = 2 (P = 0.59); I² = 0%

Test for overall effect: Z = 0.19 (P = 0.85)

Study or Subgroup	Intervention Events	Intervention Total	Usual Care Events	Usual Care Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Total (95% CI)		1349		1379	100.0%	**0.97 [0.88, 1.07]**
Total events	476		504			

Heterogeneity: Chi² = 3.83, df = 6 (P = 0.70); I² = 0%

Test for overall effect: Z = 0.67 (P = 0.50)

Test for subgroup differences: Chi² = 1.05, df = 1 (P = 0.31), I² = 4.4%

Favours Intervention Favours Control

Figure 3b: Community Pharmacist RCTs of older people: relative risk of admission

Study or Subgroup	Intervention Events	Intervention Total	Usual Care Events	Usual Care Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.3.9 Community pharmacists						
Bond 2000	54	904	80	1397	13.7%	1.04 [0.75, 1.46]
Holland 2005	162	415	133	414	29.1%	1.22 [1.01, 1.46]
Krska 2001	6	168	8	164	1.8%	0.73 [0.26, 2.06]
Lenaghan 2007	17	66	17	69	3.6%	1.05 [0.58, 1.87]
Naunton 2003	16	57	29	64	6.0%	0.62 [0.38, 1.02]
Sellors 2003	52	431	46	458	9.7%	1.20 [0.83, 1.75]
Taylor 2003	2	33	9	36	1.9%	0.24 [0.06, 1.04]
Zermansky 2001	110	579	92	550	20.6%	1.14 [0.88, 1.46]
Zermansky 2006	61	331	62	330	13.6%	0.98 [0.71, 1.35]
Subtotal (95% CI)		2984		3482	100.0%	**1.07 [0.96, 1.20]**
Total events	480		476			

Heterogeneity: Chi² = 11.88, df = 8 (P = 0.16); I² = 33%

Test for overall effect: Z = 1.23 (P = 0.22)

Study or Subgroup	Intervention Events	Intervention Total	Usual Care Events	Usual Care Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Total (95% CI)		2984		3482	100.0%	**1.07 [0.96, 1.20]**
Total events	480		476			

Heterogeneity: Chi² = 11.88, df = 8 (P = 0.16); I² = 33%

Test for overall effect: Z = 1.23 (P = 0.22)

Test for subgroup differences: Not applicable

Favours Intervention Favours control

Figure 3c:

Number of older patients with an unplanned hospital admission at 3 months: relative risk of admission

Study or Subgroup	Intervention Events	Total	Usual Care Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
Krska 2001	6	168	8	164	17.4%	0.73 [0.26, 2.06]	
Lisby 2010	11	50	11	49	23.9%	0.98 [0.47, 2.05]	
Naunton 2003	16	57	29	64	58.7%	0.62 [0.38, 1.02]	
Total (95% CI)		**275**		**277**	**100.0%**	**0.73 [0.49, 1.06]**	
Total events	33		48				

Heterogeneity: Chi² = 1.03, df = 2 (P = 0.60); I² = 0%
Test for overall effect: Z = 1.64 (P = 0.10)

Figure 3d:

Number of older patients with an unplanned hospital admission at 6 months: odds ratio

Study or Subgroup	Intervention Events	Total	Usual Care Events	Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Odds Ratio M-H, Fixed, 95% CI
Holland 2005	162	415	133	415	28.1%	1.36 [1.02, 1.81]	
Lenaghan 2007	17	69	17	66	4.5%	0.94 [0.43, 2.05]	
Lipton 1994	126	350	118	356	26.0%	1.13 [0.83, 1.55]	
Nazareth 2001	38	136	43	151	10.2%	0.97 [0.58, 1.63]	
Sellors 2003	52	431	46	458	13.6%	1.23 [0.81, 1.87]	
Zermansky 2006	61	331	62	330	17.6%	0.98 [0.66, 1.44]	
Total (95% CI)		**1732**		**1776**	**100.0%**	**1.16 [0.99, 1.35]**	
Total events	456		419				

Heterogeneity: Chi² = 2.72, df = 5 (P = 0.74); I² = 0%
Test for overall effect: Z = 1.82 (P = 0.07)

Figure 3e:

Number of older patients with an unplanned hospital admission at 12 months: odds ratio

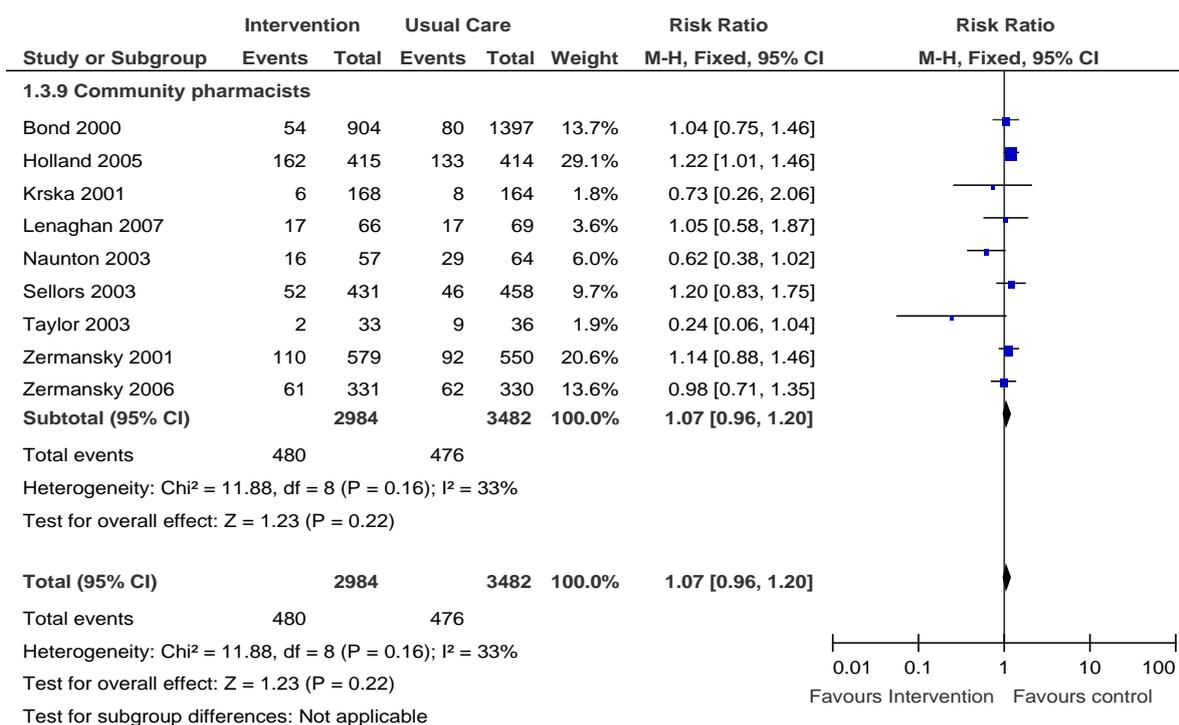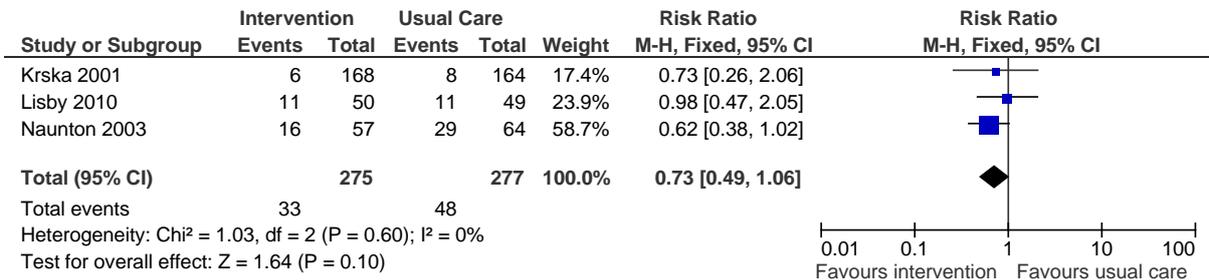| Study or Subgroup	Intervention Events	Total	Usual Care Events	Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Odds Ratio M-H, Fixed, 95% CI
Bond 2000	54	904	80	1397	18.9%	1.05 [0.73, 1.49]	
Gillespie 2009	106	182	110	186	14.5%	0.96 [0.64, 1.46]	
Scullin 2007	141	371	172	391	33.2%	0.78 [0.58, 1.04]	
Spinewine 2007	29	89	28	83	6.3%	0.95 [0.50, 1.79]	
Taylor 2003	2	33	9	36	2.6%	0.19 [0.04, 0.97]	
Zermansky 2001	110	579	92	550	24.5%	1.17 [0.86, 1.58]	
Total (95% CI)		**2158**		**2643**	**100.0%**	**0.95 [0.81, 1.11]**	
Total events	442		491				

Heterogeneity: Chi² = 7.53, df = 5 (P = 0.18); I² = 34%
Test for overall effect: Z = 0.67 (P = 0.51)

Figure 3f: Clinical pharmacist RCTs for heart failure patients: relative risk of admission

Study or Subgroup	Intervention Events	Total	Usual care Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Lopez Cabezas 2006	23	70	31	64	40.3%	0.68 [0.45, 1.03]
Stewart 1998	24	39	31	48	34.6%	0.95 [0.69, 1.32]
Varma 1999	12	42	20	41	25.2%	0.59 [0.33, 1.04]
Total (95% CI)		**151**		**153**	**100.0%**	**0.75 [0.59, 0.95]**
Total events	59		82			

Heterogeneity: Chi² = 3.03, df = 2 (P = 0.22); I² = 34%
Test for overall effect: Z = 2.34 (P = 0.02)

Figure 3g: Community pharmacist RCTs for heart failure patients: relative risk of admission

Study or Subgroup	Intervention Events	Total	Usual care Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bond 2007	42	896	47	912	37.6%	0.91 [0.61, 1.36]
Bouvy 2003	9	74	3	78	2.4%	3.16 [0.89, 11.23]
Holland 2007	76	148	73	143	60.0%	1.01 [0.80, 1.26]
Total (95% CI)		**1118**		**1133**	**100.0%**	**1.02 [0.83, 1.25]**
Total events	127		123			

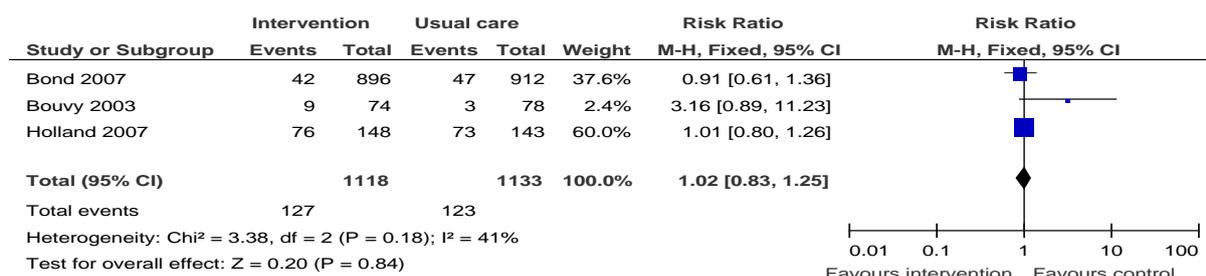Heterogeneity: Chi² = 3.38, df = 2 (P = 0.18); I² = 41%
Test for overall effect: Z = 0.20 (P = 0.84)

Figure 3h:

Number of heart failure patients with an unplanned admission at 6 months: relative risk of admission

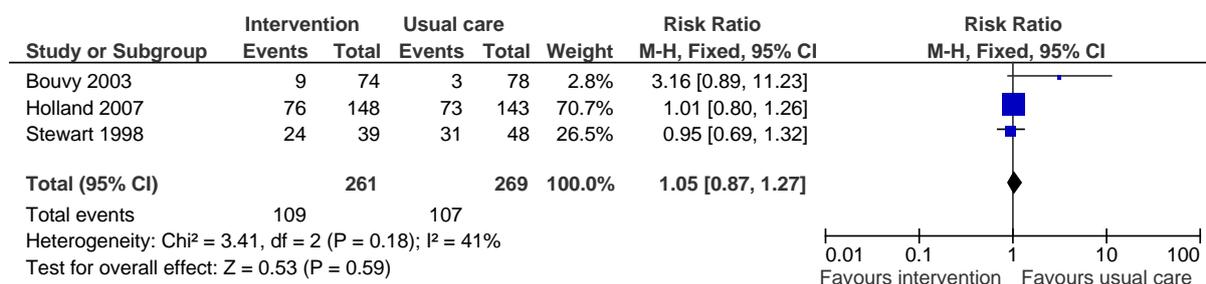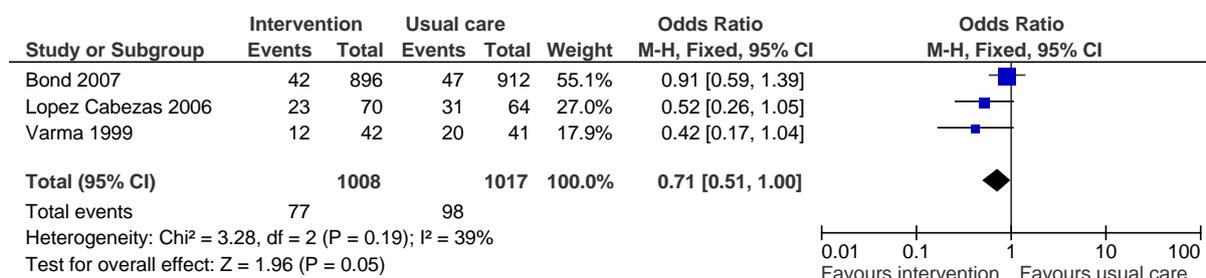| Study or Subgroup	Intervention Events	Total	Usual care Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bouvy 2003	9	74	3	78	2.8%	3.16 [0.89, 11.23]
Holland 2007	76	148	73	143	70.7%	1.01 [0.80, 1.26]
Stewart 1998	24	39	31	48	26.5%	0.95 [0.69, 1.32]
Total (95% CI)		**261**		**269**	**100.0%**	**1.05 [0.87, 1.27]**
Total events	109		107			

Heterogeneity: Chi² = 3.41, df = 2 (P = 0.18); I² = 41%
Test for overall effect: Z = 0.53 (P = 0.59)

Figure 3i:

Number of heart failure patients with an unplanned admission at 12 months: relative risk of admission

Study or Subgroup	Intervention Events	Total	Usual care Events	Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Bond 2007	42	896	47	912	55.1%	0.91 [0.59, 1.39]
Lopez Cabezas 2006	23	70	31	64	27.0%	0.52 [0.26, 1.05]
Varma 1999	12	42	20	41	17.9%	0.42 [0.17, 1.04]
Total (95% CI)		**1008**		**1017**	**100.0%**	**0.71 [0.51, 1.00]**
Total events	77		98			

Heterogeneity: Chi² = 3.28, df = 2 (P = 0.19); I² = 39%
Test for overall effect: Z = 1.96 (P = 0.05)

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