Hospital at home for acute exacerbations of chronic obstructive pulmonary disease

[Review]

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Abstract

Background: Hospital at home schemes are a recently adopted method of service delivery for the management of acute exacerbations of chronic obstructive pulmonary disease aimed at reducing demand for acute hospital in-patient beds and promoting a patient centered approach through admission avoidance. However, evidence in support of such a service is contradictory.

Objectives: To evaluate the efficacy of "hospital at home" compared to hospital inpatient care in acute exacerbations of chronic obstructive pulmonary disease.

Search strategy: The Cochrane Central Register of Controlled Trials; electronically available databases e.g. MEDLINE (1966-current), EMBASE (1980-current), PubMed, ClinicalTrials, Science Citation Index and on-line individual respiratory journals; bibliographies of included trials were all searched and contact with authors was made to obtain studies. The most recent searches were carried out in August 2003.

Selection criteria: Only randomised controlled trials were considered where patients presented to the emergency department with an exacerbation of their chronic obstructive pulmonary disease. Studies must not have recruited patients that are usually deemed obligatory admissions.

Data collection and analysis: Two reviewers independently selected articles for inclusion, evaluated methodological quality of the studies and abstracted data.

Main results: Seven studies with 754 patients were included in the review. Studies provided data on hospital readmission and mortality both of which were not significantly different when the two study groups were compared (RR 0.89; 95%CI 0.72 to 1.12 & RR 0.61; 95%CI 0.36 to 1.05, respectively). Both the patients and the carers preferred hospital at home schemes to inpatient care (RR 1.53; 95%CI 1.23 to 1.90). Other reported outcomes included few studies.
Conclusions: This review has shown that one in four carefully selected patients presenting to hospital emergency departments with acute exacerbations of chronic obstructive pulmonary disease can be safely and successfully treated at home with support from respiratory nurses. This review found no evidence of significant differences between "hospital at home" patients and hospital inpatients for readmission rates and mortality at two to three months after the initial exacerbation. Both the patients and carers preferred "hospital at home" schemes to inpatient care.

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Background

There were 162,000 emergency hospital admissions for chronic obstructive pulmonary disease (COPD) in England during the financial years 1999 to 2001 (LAIA 2001). These included 75,600 COPD admissions (excluding asthma) in the over 65 year age group. Age-adjusted admissions rates for COPD have risen over 50% in the last nine years (LAIA 2001). Exacerbations of COPD are the most common cause of admission to hospital due to respiratory illness (NHS 1996) and they account for approximately 10% of all acute medical admissions in the UK (Kendrick 1994) with increased pressure of demand on hospital beds especially during winter months. The annual cost of COPD to the National Health Service at 1996/1997 prices has been estimated as [pounds]817.5 million (Guest 1999). Hospitalisation accounted for approximately 35% of this annual expenditure despite the fact that less than 2% of patients with COPD were admitted in the year examined. The cost of a typical hospital admission was estimated as [pounds]3000.

The Royal College of Physicians of London has recommended the provision of respiratory care helpers to improve the management of patients with COPD at home (RCPL 1981). It is believed that selected patients currently admitted with exacerbations of COPD could safely be cared for at home with sufficient support. Mortality from these episodes is closely related to the degree of hypercapnia and acidosis at admission and to the presence of non-respiratory comorbidities (Jeffrey 1992; Seneff 1995; Connors 1996). Many patients presently admitted to hospital do not have these features and it may be possible to manage them equally well outside the hospital environment.

Hospital at home services are a recent innovation in the management of acute exacerbations of COPD (Gravil 1998). In these schemes patients who would usually be managed in hospital have most of their care undertaken by a specialist respiratory nurse who makes regular visits to the patient's home. The rationale is that such services increase patient satisfaction and reduce costs, without an adverse effect on clinical outcome. Evidence in support of such a service is contradictory and has been extrapolated mainly from generic hospital at home schemes (Hughes 1997; Richards 1998; Shepperd 1998b; Wilson 1999). Despite the
paucity of objective evidence of efficacy, interest in hospital at home services for acute exacerbations of COPD has been considerable with many respiratory departments establishing their own schemes in the UK (Johnson 2001).

**Objectives**

To evaluate the efficacy of "hospital at home" compared to standard hospital inpatient care for acute exacerbations of COPD.

**Criteria for considering studies for this review**

**Types of participants**

All patients with a diagnosis of COPD with an acute exacerbation presenting to an emergency department for treatment. Studies must not have recruited patients that are usually deemed obligatory admissions (BTS 1997). This includes patients with an impaired level of consciousness, acute confusion, acute changes on the radiograph or electrocardiogram, arterial pH of less than 7.35, concomitant medical conditions or those patients presenting at the emergency department for social reasons.

**Types of intervention**

Patients randomised to home support would be under the care of a specialist respiratory nurse (under guidance of the hospital medical team). All patients randomised to home support would be provided with the treatment as deemed appropriate at the time of initial assessment on presentation to the emergency department. All home support patients would have regular scheduled visits by the nurse as well as additional visits as requested by the patient or deemed appropriate by the nurse or the medical team. All home support patients should be visited by the respiratory nurse until discharged from care. Patients randomised to in-hospital care would be treated as usual and at the discretion of the hospital medical team.

**Types of outcome measures**

Primary outcome measures:

* Re-admission rate
* Mortality

Secondary outcome measures:

* Health related quality of life measures
* Lung function measurements
* Exacerbations
* Bronchodilator use
* Patient and/or Carer satisfaction and preference
* Costs and/or health economics
* Total days of care provision in each study group

**Types of studies**

Only randomised controlled trials (RCTs) were considered where patients presenting to the emergency department with an exacerbation of their COPD were randomised to either home support or hospital admission. All patients randomised to home support must have been discharged from hospital within 72 hours of presenting to the emergency department and after an initial assessment by the hospital medical team. Randomisation with allocation...
concealment should however reduce the chances of this occurring.

**Search strategy for identification of studies**

An initial search was carried out using the Cochrane Central Register of Controlled Trials (CENTRAL) using the search terms: (hospital OR support OR *discharge AND home). Search of this database was conducted up to and including August 2003. CENTRAL contains records downloaded from MEDLINE, EMBASE and CINAHL, as well as records identified through hand searching and abstracts from meetings of the American Thoracic Society, British Thoracic Society and European Respiratory Society. Randomised controlled trials are identified in the register using the following search strategy: (placebo* OR trial* OR random* OR double-blind OR double blind OR single-blind OR single blind OR controlled study OR comparative study).

Separate additional searches were also conducted on MEDLINE (1966-August 2003), EMBASE (1980-August 2003), PubMed and other electronically available databases (e.g. ClinicalTrials, Science Citation Index and on-line individual respiratory journals) up to August 2003. This duplicate searching of databases was done in order to reduce chances of missing any potential studies.

Following this the bibliography of each RCT was searched for additional papers that might contain further RCTs. Authors of identified RCTs were written to, asking for other published and unpublished studies. Known trialists in the field were also contacted for any unpublished or ongoing trials.

**Methods of the review**

Two reviewers independently selected trials for inclusion in the review and assessed all trials that appeared potentially relevant. Agreement between two reviewers for inclusion of studies was recorded.

All trials were entered and graded using the following Cochrane principles regarding allocation concealment:
- Grade A - Adequate
- Grade B - Unclear
- Grade C - Inadequate

All data from the trials was abstracted by one of the reviewers (FSFR) and verified by another reviewer. Where 95% confidence intervals (95%CI) were presented in papers instead of the standard deviation (SD), SD was estimated using the following equation: difference between the 95%CI (Higher CI - Lower CI) divided by [(2 x 1.96) x square root of N].

**STATISTICAL CONSIDERATIONS**

Trials were combined using RevMan (Version 4.2.2). For continuous variables, a fixed effect weighted mean difference (WMD) or standardised mean difference (SMD) and 95% confidence interval (CI) was calculated for each outcome. All similar studies were pooled using fixed effect WMD or SMD and 95% CIs. For dichotomous variables, a fixed effect relative risk (RR) with 95% confidence intervals (95% CI) was calculated. All similar outcomes were pooled using fixed effect RR and 95% CIs. For pooled effects, heterogeneity was tested; p < 0.05 was considered statistically significant. If heterogeneity is found, a random effects model was used. In addition, quality weighting was used to test the robustness of the results. If sufficient number of trials had been included in the review, funnel plots would have been constructed to check for the presence of publication bias.

**SUB-GROUP/SENSITIVITY ANALYSES:**
If sufficient number of studies had been included possible subgroup analysis would include; duration of intervention and disease severity. Sensitivity analysis in the presence of heterogeneity would have included trial quality.

**Description of the studies**

Seven RCTs were included in the review and are described below. For further details please refer to the table "Characteristics of included studies".

**Cotton 2000**

**STUDY LOCATION:** Glasgow Royal Infirmary, Glasgow, Scotland.

**METHOD OF RECRUITMENT:** A respiratory nurse visited every medical ward each morning and identified patients admitted as emergencies with a diagnosis of COPD.

**SELECTION CRITERIA:** Patients were excluded if they were not resident in Glasgow, homeless, unable to give written consent or did not have access to a telephone. Patients requiring inpatient management or investigation for other medical problems were excluded as were patients with life threatening respiratory failure (H+>45nM) at the time of assessment (not at admission). All eligible patients were recruited on the morning of the next working day after admission and in the same afternoon consenting patients were randomised to early discharge or to conventional inpatient management.

**FINAL RECRUITMENT:** After screening 412 acute COPD admissions over 14 months, 151 were eligible for recruitment. Eighty-one patients were randomised (37 refused to take part & 33 were already participating in other trials). Forty-one patients were randomised to early discharge and 40 to conventional inpatient management.

**ALLOCATION CONCEALMENT:** Randomisation was carried out by telephoning a non-clinical member of staff based in a separate building who held a treatment allocation schedule generated by random numbers.

**WITHDRAWALS:** One patient withdrew from each of the two the study arms due to personal reasons. Four patients withdrew from the early discharge group due to the recognition of some other medical problem.

**INTERVENTION:** Inpatients were treated for their exacerbation according to conventional hospital management. Thirty-six patients underwent early discharge. Thirty-four patients were discharged with nebulised bronchodilators and 16 with oxygen. Median duration of nurse follow-up (phone calls, home visits, etc) was 24 days and the median number of nurse home visits was 11. Patients were assessed at 60 days after their initial COPD exacerbation.

**Davies 2000**

**STUDY LOCATION:** University Hospital Aintree, Liverpool, England.

**METHOD OF RECRUITMENT:** Three respiratory nurses based in the emergency department screened patients who presented at the department with an exacerbation of their COPD.

**SELECTION CRITERIA:** Patients were excluded if they had history of asthma, marked use of accessory muscles, suspected malignancy on x-ray, pneumothorax or pneumonia, uncontrolled left ventricular failure, acute changes on electrocardiogram (ECG), requirement for full-time nursing care or intravenous (IV) therapy. All eligible patients had forced expiratory volume in one second (FEV₁) less than 80% of that predicted, FEV₁/forced vital capacity (FVC) ratio less than 70%, pulse rate less than 100 beats per minute (bpm), systolic
blood pressure greater than 100mmHg, pH less than 7.35, PaO₂ greater than 7.3 kPa, PaCO₂ less than 8 kPa & total white cell count 4 to 20 x 10⁹/L. Patients were assessed for recruitment into the study seven days a week from 8am to 6pm and those randomised to early discharge were done so as soon as possible and without an overnight stay in hospital.

FINAL RECRUITMENT: After screening 583 acute COPD admissions from February 1998 to August 1999, 192 were eligible for recruitment. One hundred and fifty patients were randomised (42 refused to take part). Patients were randomised in a ratio of 2:1 for early discharge or hospital admission. 100 patients were randomised to early discharge and 50 to conventional inpatient hospital management.

ALLOCATION CONCEALMENT: Patients were randomised in a ratio of 2:1 for early discharge or hospital admission using blinded sealed envelopes.

WITHDRAWALS: Five patients were lost to follow-up and four died in the conventional management group. In the early discharge group five were lost to follow-up, two refused further care and seven died.

INTERVENTION: Inpatients were treated for their exacerbation according to conventional hospital management. Patients randomised to early discharge were escorted home by one of the specialist respiratory nurses. Social support was immediately available if required. Nebulised ipratropium bromide and salbutamol with a compressor, oral prednisolone for ten days, and antibiotics for five days were prescribed. Nurses visited the early discharge patients mornings and evenings for three days and there after at the discretion of the nurses. Evening and night cover was provided by district nurses. If progress was unsatisfactory the nurse or patient could trigger admission. Fifty inpatients received the same drugs, with all other management being at the discretion of the ward team. Patients were assessed at two weeks and three months after the initial exacerbation.

Hernandez 2003
STUDY LOCATION: Hospital Clinic and Hospital de Bellvitge, Barcelona, Spain.

METHOD OF RECRUITMENT: All COPD exacerbations admitted to the emergency department on weekdays from 9am to 4pm were screened by a specialised respiratory team which consisted of one chest physician and one nurse in each hospital.

SELECTION CRITERIA: Patients were eligible for inclusion in the trial if two primary criteria were satisfied:
(1) COPD exacerbation as the major cause of referral to the emergency room (ER) and
(2) absence of any criteria for imperative hospitalisation as stated in the British Thoracic Society (BTS) guidelines (i.e. acute chest x-ray changes, acute confusion, impaired level of consciousness and arterial pH below 7.35).

FINAL RECRUITMENT: After screening 629 acute COPD admissions over 12 months (Nov 1999 to Nov 2000), 244 were eligible for recruitment. Twenty-two participants refused to take part. One hundred and twenty-one patients were randomised to early discharge and 101 to conventional inpatient management.

ALLOCATION CONCEALMENT: Patients were assigned (double blinded) to treatment groups using computer generated random numbers.

WITHDRAWALS: There are no report of withdrawals after randomisation into study.

INTERVENTION: Inpatients were treated for their exacerbation according to standard
hospital protocols but the support of a specialised nurse at the emergency department and at home was not provided to this group. At discharge, the patient was usually supervised by the primary care physician who was not aware of the study protocol. Patients underwent early discharge who were treated using Spanish Respiratory Society guidelines (available at http://www.separ.es). Median duration of nurse follow-up was eight weeks and the maximum number of nurse visits was five.

Nicholson 2001
STUDY LOCATION: Mater Adult Hospital and Princess Alexandra Hospital, Brisbane, Australia.

METHOD OF RECRUITMENT: All patients with COPD exacerbations presenting at the two hospital emergency departments (or respiratory outpatient clinic) were eligible for entry into the study.

SELECTION CRITERIA: Patients were eligible for inclusion in the trial if they met the following criteria: aged over 45 years, documented diagnosis of COPD, current or ex-smoker, FEV\(_1\) less than 60% predicted, admission required by general practitioner (GP) or considered necessary by outpatient clinic staff or ER staff, willing and able to give informed consent and had a telephone at home. Patients were excluded on the following criteria: unstable co-morbid conditions needing acute medical management, pneumonia on chest x-ray, hypoxia indicated by SaO\(_2\) of less than 90% or a PaO\(_2\) less than 60 mmHg on room air or usual flow rate of oxygen if on home oxygen therapy.

FINAL RECRUITMENT: One hundred and sixty-eight acute COPD admissions were screened over 12 months (Oct 1999 to Oct 2000). Twenty-five eligible patients were recruited, 13 were randomised to home care and 12 to hospital inpatient management.

ALLOCATION CONCEALMENT: No details on method used for allocation of treatment are provided.

WITHDRAWALS: There are no report of withdrawals after randomisation into study.

INTERVENTION: Inpatients were treated for their exacerbation according to usual hospital care and they had discussion about their treatment goals with the Clinical Care Coordinator. Early discharge patients had mandatory nursing visits on days one, two, three and seven and optional visits on days four, five and six. GPs were invited to participate in the trial when their patient was randomised to home care. Patients were reviewed by their own GP at home between the second and fourth day of home management. Allied health interventions were also done with home care patients which included dieticians, occupational therapy, pharmacy, physiotherapy and psychology.

Ojoo 2002
STUDY LOCATION: Castle Hill Hospital, Cottingham, Hull, England.

METHOD OF RECRUITMENT: Two respiratory nurses screened patients every morning who had presented at the accident and emergency department and been admitted due to an exacerbation of their COPD.

SELECTION CRITERIA: Patients were excluded if they had a concomitant medical condition, residence over 15 miles from the hospital, complications of exacerbation (e.g. acidosis, cor pulmonale, changes in ECG), newly diagnosed type 2 respiratory failure. Social exclusion was discretionary and depended on level of domiciliary support and performance status of the patient. Eligible patients could be male or female, over 18 years of age,
FEV1/FVC ratio less than 70%, FEV1 reversibility to salbutamol less than 15% (obtained on previous admission), worsening symptoms with any combination of increased sputum purulence and/or volume, and worsening dyspnoea. Patients were assessed for recruitment into the study from Monday to Thursday. All patients were initially admitted to the Medical Chest Unit and clinical management was instituted according to the BTS guidelines. They were reviewed the following morning for possible inclusion in the trial. Patients randomised to the home care group were discharged within 48 hours of admission with a discharge package.

FINAL RECRUITMENT: Three hundred and twenty-eight acute COPD admissions were screened (between May 1999 and February 2000). Sixty eligible patients were recruited. Thirty in each arm of the study.

ALLOCATION CONCEALMENT: Patients were randomised using sealed envelopes to one of the two study arms.

WITHDRAWALS: Six patients were lost to follow-up (three from each arm). Three due to clinical deterioration (two in the early discharge group were readmitted) and one patient was found to have predominantly asthma, one withdrew consent and one patient self-discharged from hospital.

INTERVENTION: Fifty inpatients were treated for their COPD exacerbation according to the current BTS guidelines (BTS 1997). All patients who underwent early discharge were monitored daily by nurses who also carried out patient and carer education and reassurance. Nurses monitored the patients and completed daily progress and symptom score charts for patients in both study arms. All patients were discharged with nebulised bronchodilators, oral and inhaled steroids, antibiotics and oxygen as necessary. The patients' general practitioners (GPs) were made aware of early discharge but were not involved in their immediate clinical care. Evening and night cover was provided by a direct line to the Medical Chest Unit. Patients were assessed at three months after their initial exacerbation.

Shepperd 1998a
STUDY LOCATION: Kettering General Hospital NHS Trust, England

METHOD OF RECRUITMENT: Recruitment: patients were recruited from 26 GP practices.

SELECTION CRITERIA: A Mixed population of patients was recruited with some of the data presented separately for COPD patients. Patients were eligible if their hospital consultant and GP agreed to their entry into the study, patients home was suitable for hospital at home study and carer consented to participate as well. Patients were excluded if they were under 60 years of age.

FINAL RECRUITMENT: No break down of patient recruitment was provided for any of the four different diseases. Fifteen patients underwent early discharge. Seventeen patients received in-hospital care.

ALLOCATION CONCEALMENT: Patients were randomised using computer generated numbers and allocation was done using sealed envelopes. Allocation was revealed through a telephone randomisation service, independent of the service providers.

WITHDRAWALS: No details provided on withdrawals.

INTERVENTION: Hospital at home care was provided as a direct alternative to inpatient
care for patients who were clinically stable and did not require immediate access to
diagnostic or specialist medical care. The services provided included nursing, physiotherapy,
occupational therapy and pathology. Patients were also provided with a mobile phone if
required. Care in the hospital at home scheme consisted of observation, administration of
drugs, nursing care and rehabilitation. Nursing care was available 24 hours a day in the
patients home if necessary. General practitioners held clinical responsibility and were
reimbursed for visits they made to patients admitted to hospital at home schemes.

Skwarska 2000
STUDY LOCATION: Royal Infirmary of Edinburgh, Edinburgh, Scotland.

METHOD OF RECRUITMENT: A team of nursing and medical staff was created known
as the ARAS (acute respiratory assessment service) who screened all acute COPD
presentations on weekdays from 09.00 hrs to 17.00 hrs. Patients presenting overnight were
assessed at 09.00 hrs the following morning.

SELECTION CRITERIA: All COPD exacerbations were assessed with respect to 13
indicators of severity (BTS 1997 guidelines). Participants with any of the following four
indicators - impaired level of consciousness, acute confusion, acute changes on radiography
or an arterial pH of less than 7.35 were deemed obligatory admissions. Except for patients
with concomitant medical conditions or social reasons, all other patients were considered
suitable for recruited into the study.

FINAL RECRUITMENT: After screening 1006 acute COPD presentations between
November 1996 to mid May 1998, 208 patients were found to be eligible, 24 declined
consent, 122 were randomised to home care and 62 to inpatient care.

ALLOCATION CONCEALMENT: Participants were randomised in a ratio of 2:1 for
early discharge or hospital admission using computer generated random numbers.

WITHDRAWALS: Nine participants in the early discharge group were readmitted and two
were not accounted for as only 111 were reported to have completed the trial. One patient in
the inpatient group died and 61 completed the trial.

INTERVENTION: The treatment offered at home and in hospital (oxygen, nebulisers,
antibiotics, corticosteroids) was prescribed and reviewed according to BTS guidelines (BTS
1997) and clinical judgement. One hundred and twenty-two patients who underwent early
discharge were visited by a nurse the following morning and thereafter at two to three days to
monitor the need for treatment. When patients were considered by the nursing team to have
recovered sufficiently to no longer require nursing support at home, they were discharged
from home care. Eight weeks after discharge from either study arm patients were reassessed
at home.

**Methodological qualities of included studies**

All included studies stated that the allocation of treatment to participants was randomised.
All except one study (Nicholson 2001) adequately described the allocation concealment method
used therefore six were graded as "A" using the Cochrane grading and one "B". There was
total agreement between at least two reviewers on Cochrane study quality grading for all
included studies. Due to the nature of the intervention, double blinding was not possible. A
sensitivity analysis excluding the Nicholson et al. study (Nicholson 2001) did not alter the
overall result where the study contributed data (hospital readmission rates and economic
analysis).
All except three studies (Hernandez 2003; Nicholson 2001; Shepperd 1998a) adequately reported withdrawals and dropouts. All included studies were of high methodological quality, therefore it is unlikely that study quality would influence heterogeneity tests or the overall results. The authors of all included studies were written to, asking for additional information or verification of study quality and to obtain further data. To date two authors (Nicholson 2001; Shepperd 1998a) have responded.

Results

The search for studies revealed a total of 105 abstracts of which 24 were selected as potentially relevant. Four studies were identified from references in published studies, however no abstracts were received from trialists and no ongoing or unpublished studies were found. Full text of 28 citations were obtained. Sixteen studies were excluded due to: retrospective case control study (n=1), not an RCT (n=7), participants included in the study had a variety of illnesses with COPD patient data not presented separately (n=2) and patients not presenting with an exacerbation of their COPD at time of study (n=4). Twelve studies were originally included in the review. However, five of these were duplicate publications, therefore seven studies were eventually included in the review (Shepperd 1998a; Cotton 2000; Davies 2000; Skwarska 2000; Nicholson 2001; Ojoo 2002; Hernandez 2003). There was complete agreement between two reviewers on the inclusion and exclusion of studies.

PRIMARY OUTCOME MEASURES

* HOSPITAL READMISSION RATE (AFTER DISCHARGE FROM INPATIENT OR HOME CARE) [Comparison 01:01]:

All seven included studies reported hospital readmission data. A total of 754 participants contributed data towards this outcome which did not show a significant difference in hospital readmission rate when the two study arms were compared (RR 0.89; 95%CI 0.72 to 1.12). One study (Hernandez 2003) reported a significant difference in hospital emergency room visits (without in-patient admission) between the two study arms [Comparison 01:02]. One study that reported median days of readmission (Shepperd 1998a) showed that at three month follow-up readmissions tended to be of longer duration in the hospital at home group than in the hospital in-patient group (5 and 0, p=0.08, respectively).

* MORTALITY [Comparison 01:03]:

Six studies with 729 participants reported mortality data. No significant difference was found in mortality rates when the two study arms were compared (RR 0.61; 95%CI 0.36 to 1.05).

SECONDARY OUTCOME MEASURES:

* LUNG FUNCTION [Comparison 02:01 & 02 & 03]:

Three studies reported data on lung function (Davies 2000; Hernandez 2003; Ojoo 2002). All studies reported FEV₁. Unfortunately the individual study data could not be combined in the meta-analysis as the three studies used different methods to measure changes in FEV₁. Davies 2000 reported change in FEV₁ post-bronchodilator in 150 participants (mean difference -0.03 L; 95%CI -0.14 to 0.08), Hernandez 2003 reported actual values at the end of the intervention (mean difference 0.10L; 95%CI -0.03 to 0.23) and Ojoo 2002 reported change in FEV₁ from baseline in a selection of 60 patients (mean difference -0.10 L; 95%CI -0.03 to 0.23). In none of the studies were the changes in FEV₁ significantly different between the early discharge or
inpatient study groups. Ojoo 2002 and Hernandez 2003 also reported FVC which did not differ between the two study groups (mean difference 0.05 L; 95%CI -0.25 to 0.35 and mean difference 0.20L; 95%CI -0.04 to 0.44). One study (Hernandez 2003) reported FEV1/FVC ratio which also failed to differ between the two study groups.

* HEALTH RELATED QUALITY OF LIFE SCORES [Comparison 03:01]:

Three studies reported health related quality of life scores using the St. George's Respiratory Questionnaire (SGRQ) (Davies 2000; Ojoo 2002; Hernandez 2003). Ojoo 2002 reported percentage improvement in SGRQ (discharge score - initial admission score) in 60 participants. Davies 2000 only reported SGRQ scores in a subgroup of 50 participants. Davies 2000 and Hernandez 2003 reported absolute mean change in SGRQ (discharge score - initial admission score). However, no SD's were reported in the Hernandez 2003 study therefore the results could not be pooled. The three studies were not combined in the meta-analysis (using standardised mean differences) as the Davies 2000 study only provided SGRQ scores in a subgroup of participants, which could lead to potential bias in the overall combined result. Individual studies did not report differences between "hospital at home" or inpatient groups.

* SATISFACTION WITH CARE [Comparison 04:01: 01 & 02]

One study reported data on satisfaction with care that could be used in the meta-analysis. Ojoo 2002 reported satisfaction with care both with the participants and the carer. Fifty-four participants reported satisfaction with care provided (RR 1.04; 95%CI 0.88 to 1.24) and 34 carers also reported satisfaction (RR 0.97; 95%CI 0.79 to 1.19). There were no differences in satisfaction of care provided at home for the early discharge participant group or those participants that remained in hospital as inpatients. The overall satisfaction (combined participant and carer data) was also not significantly different between the two study groups (RR 1.01; 95%CI 0.89 to 1.16). Another included study (Skwarska 2000) also administered a satisfaction questionnaire with 95% of respondents reporting complete satisfaction with "hospital at home" service. Unfortunately the authors in this study did not ascertain the degree of satisfaction of those participants randomised to inpatient care and nor did the authors document the views of the carers.

* PREFERENCE FOR TYPE OF CARE [Comparison 05:01:01 & 02]

Two studies reported retrospective preference for type of care by both participants and carers at the end of the study (Shepperd 1998a; Ojoo 2002). Both the participants who were treated at home and their carers had a higher preference for "hospital at home" care than those who had received inpatient care (RR 1.54; 95%CI 1.17 to 2.04 & RR 1.52; 95%CI 1.08 to 2.14, respectively) with the combined overall preference in favour of "hospital at home" care (RR 1.53; 95%CI 1.23 to 1.90).

* PERCENTAGE RECRUITMENT [Additional Table 1]

Data was abstracted from the included studies on the percentage of patients presenting with acute exacerbations who were eligible for treatment at home. Six of the included studies provided recruitment data that could be used for this analysis. One study (Shepperd 1998a) which had a mixed population of patients did not provide a numerical breakdown by disease state and therefore could not be included. However, the mean percentage recruitment from the six studies was 26.7% or 744/2786.

* ECONOMIC COSTS - DIRECT COST PER PATIENT ([pounds] - pound sterling) [Comparison 06:01:02]
Two studies included mean cost analysis (Nicholson 2001; Hernandez 2003). The overall results showed significant cost saving of approximately [pounds]540 per patient with hospital at home service when compared to inpatient care (WMD using fixed effect model -[pounds]536.78; 95%CI -540.65 to -532.91) & (WMD using random effects model -[pounds]591.10; 95%CI -704.79 to -477.41). The overall result was heterogeneous. This was probably due to differences in ways costs were calculated in these two studies and also due to the estimated standard deviations (as these were computed from the 95%CI's) as well as the lower methodological study quality with Nicholson 2001. Nevertheless both studies had reported a substantial per patient cost saving with hospital at home schemes. One study reported median hospital cost which included readmission costs (Shepperd 1998a) that showed cost to be greater in patients in hospital at home group compared to hospital in-patient group, this difference was not statistically significant ([pounds]1,389 & [pounds]1,198 respectively). However, this study (Shepperd 1998a) also showed that the overall median health care cost to be significantly higher in the hospital at home group compared to the hospital in-patient group ([pounds]2,379 and [pounds]1,247, p=0.01, respectively).

There did not appear to be any influence of the time of reassessment on outcome effect size (using user-defined category in Forest plots, time of reassessment recorded as months). No data was available for exacerbations, bronchodilator use or total days of care in each study group.

**Discussion**

This review found no significant differences between "hospital at home" patients and hospital inpatients for readmission rates and mortality two to three months after the initial exacerbation. This suggests that selected patients presenting to hospital emergency departments with acute exacerbations of COPD can be safely and successfully treated at home when discharged to "hospital at home" care with support from visiting respiratory nurses.

Patient and carer satisfaction with both types of care were high. Both patients and carers preferred "hospital at home" care to inpatient care. Only two studies (Shepperd 1998a; Ojoo 2002) with a small sample size contributed data for preference limiting the generalisability of this finding. However, it does seem that hospital at home is the preferred option and future studies should confirm this finding.

Limited data was available for lung function measures and quality of life. Therefore, no meaningful conclusions could be derived regarding these outcomes.

Although the overall results were heterogeneous, two studies reported cost analysis in a usable format which showed substantial cost saving with hospital at home schemes. In addition, although their results were not in a format suitable for use in the meta-analysis and devoid of details, Skwarska et al. (Skwarska 2000) showed that the mean health service cost for hospital at home care was roughly half that of hospital inpatient care ([pounds]877 and [pounds]1753, respectively) and the authors went on to conclude that there could also be a notional saving of 433 bed days per year. Cotton et al. (Cotton 2000) also concluded that there could be a saving of 201 bed days per year with such schemes. An additional issue with the majority of the included studies was that they did not include weekends and this may have important cost implications. One study (Shepperd 1998a) reported significantly higher median cost with hospital at home schemes compared to in-patient care ([pounds]2,379 and [pounds]1,247 respectively). This study (Shepperd 1998a) also reported higher median readmission duration with hospital at home scheme (5 days versus 0), which would contribute substantially to the total cost of hospital at home care group.
One of the disadvantages of comparing hospital at home schemes is the differences in the interventions and also how the patients were recruited in each of the studies. In some of the studies patients who presented at casualty were assessed and randomised to hospital at home or in-patient groups without admission (e.g. Hernandez 2003) but some studies admitted all patients presenting at casualty and randomised them into hospital at home or in-patient groups within 72 hours (e.g. Shepperd 1998a). In addition, interventions varied from admission avoidance using nurses based in an emergency department, through to admission and next day discharge, and early discharge with support at home with or without general practitioner care. Due to the paucity of data on costs of these different interventions no conclusions can be made about their cost-effectiveness. The intensity of home support was also variable. This has important implications for hospitals and health communities considering similar programmes. Further research is required to define the optimal level of home support.

Since COPD exacerbations are such a common occurrence hospital at home schemes may be suitable for a select few uncomplicated cases of COPD who present to hospital emergency departments. Many COPD admissions do not come about as a result of severe exacerbations but because of comorbidities and social circumstances (e.g. frail partner, patient living alone and unable to cope, respite for partner or carer, social isolation, low social class with no food or heating). However, as experience and confidence grows throughout the UK with hospital at home schemes and as multidisciplinary organisational arrangements providing such hospital at home services become harmonised, we will feel better able to discharge patients earlier with nursing and other relevant healthcare support. However, the cost of starting such a scheme requires to be considered more closely. It is also important that more strategies are developed to prevent these exacerbations from happening in the first instance and or to make patients aware of their symptoms at an earlier stage of an exacerbation.

There are also difficulties with reviewing hospital at home scheme studies as they tend to include "distant" outcomes (e.g. readmission rates, mortality). As a result we are unable to obtain information on the speed of recovery of exacerbations and therefore the health burden of the index exacerbation. There are also a significant number of exacerbations that do not recover and adequate therapy is important and needs to be ensured in this group of patients.

Hospital at home schemes are currently not a suitable option for the majority of COPD exacerbations. As shown by this review it appears that about one in four of all COPD patients presenting to hospital with an acute exacerbation may safely be managed at home with respiratory nurse support. This may reflect the limited generalisability of the intervention or the strict clinical trial inclusion criteria. An additional explanation may be patient refusal (which was not reported in the included studies), reflecting patient anxiety and the difficulty in recruiting acutely ill patients into clinical trials. Nevertheless, the small percentage of patients discharged early with nursing support may bring with it cost savings both in terms of direct financial cost and the number of free hospital bed days and importantly it offers patients' choice. Due to the paucity of data from included studies on cost analysis there is a need for further studies that address financial and hospital bed days in order to estimate savings by utilising hospital at home schemes. Such studies should incorporate the "real" and full/overall cost of running such services so that comparisons with hospital inpatient care can be justified.

Conclusions
Implications for practice

"Hospital at home" schemes for exacerbations of COPD can be used as an alternative to hospital admission for about one in four COPD patients and are a safe, effective and preferred option for suitable patients. The results of this review should encourage clinicians to consider this form of management.
Although this review has shown that treatment of acute exacerbations of COPD in a "hospital at home" scheme is safe, acceptable and as effective as inpatient care, it is clear that the majority of patients cannot be managed in this way and many will continue to need hospital treatment for their exacerbation.

This review provides valuable data to drive change. It has shown that "hospital at home" services can be safely used to care for properly selected patients with acute exacerbations of COPD who would otherwise be admitted to hospital. It is important that all COPD exacerbations presenting to an emergency department undergo an initial hospital assessment (e.g. radiography, blood gas analysis, clinical assessment, etc.) in order to assess suitability for a "hospital at home" scheme.

**Implications for research**

The results of this review are promising. However, there still remains a need for further properly conducted trials in this area. Future studies should include and report more relevant outcomes including patient and carer satisfaction and preference, health-related quality of life, and the organisational (multidisciplinary, multi-agency) arrangements or components of such schemes that would provide the greatest benefit.

An important gap in the evidence is about cost-effectiveness. Future trials should incorporate an economic evaluation of both indirect and direct costs, to describe the resources required to establish hospital at home services and the cost savings from early discharge.

Future hospital at home schemes need to determine which models or components of delivery of care in which patient groups (severity, complications) delivered by whom (respiratory nurses or generic skills staff), can safely, effectively and acceptably manage such patients at home.

**Internal sources of support to the review**

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* Felix Ram received funding from The Netherlands Asthma Foundation NETHERLANDS

**Potential conflict of interest**

There are no known conflicts of interest.

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**Contribution of Reviewer(s)**

Felix Ram (FSFR) came up with the idea for the protocol, devised the protocol, conducted all aspects of the review and wrote the text for the completed review with help from the following persons. Michael Greenstone (MAG) helped with the protocol development and commented on the completed review. Wisia Wedzicha (JAW) and John Wright (JW) helped with various aspects of conducting the review.

**Synopsis**
In selected circumstances people with acute episodes of chronic obstructive pulmonary disease receiving 'hospital at home' services prefer it, and have similar outcomes to people who are hospitalised.

This review of "hospital at home" service has shown that patients presenting to hospital emergency departments with acute exacerbations of chronic obstructive pulmonary disease can be successfully treated at home when supported by visiting respiratory nurses at home. This review found no evidence of differences between "hospital at home" patients and hospital inpatients for readmission rates and mortality at two to three months after the initial exacerbation. Both patients and carers preferred "hospital at home" care to inpatient care. However, only one in four patients were suitable for "hospital at home" schemes.

**Table of comparisons**

**Fig 01 Hospital at Home versus Standard Inpatient Care**

<table>
<thead>
<tr>
<th>Study</th>
<th>Hospital @ Home n/N</th>
<th>Inpatient Care n/N</th>
<th>Relative Risk (Fixed) 95% CI</th>
<th>Weight (%)</th>
<th>Relative Risk (Fixed) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton 2000</td>
<td>12 / 48</td>
<td>12 / 48</td>
<td>1.9</td>
<td>10.9</td>
<td>0.98 [0.59, 1.61]</td>
</tr>
<tr>
<td>Davies 2000</td>
<td>37 / 100</td>
<td>17 / 50</td>
<td>2.3</td>
<td>36.3</td>
<td>1.06 [0.68, 1.72]</td>
</tr>
<tr>
<td>Nicholls 2001</td>
<td>8 / 11</td>
<td>2 / 12</td>
<td>1.9</td>
<td>1.27 [0.69, 2.37]</td>
<td></td>
</tr>
<tr>
<td>Ojo 2002</td>
<td>10 / 30</td>
<td>13 / 30</td>
<td>1.16</td>
<td>0.77 [0.40, 1.47]</td>
<td></td>
</tr>
<tr>
<td>Shapland 1998</td>
<td>9 / 15</td>
<td>8 / 17</td>
<td>1.6</td>
<td>1.61 [0.68, 3.86]</td>
<td></td>
</tr>
<tr>
<td>Skarska 2000</td>
<td>27 / 112</td>
<td>21 / 42</td>
<td>24.9</td>
<td>0.06 [0.01, 0.86]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>123 / 442</td>
<td>97 / 112</td>
<td>106.0</td>
<td>0.09 [0.71, 1.12]</td>
<td></td>
</tr>
</tbody>
</table>

Test for heterogeneity chi-squared=7.35 df=6 p=0.29
Test for overall effect=0.06 p=0.5

Hospital in-patient readmissions

<table>
<thead>
<tr>
<th>Study</th>
<th>Hospital @ Home n/N</th>
<th>Inpatient Care n/N</th>
<th>Relative Risk (Fixed) 95% CI</th>
<th>Weight (%)</th>
<th>Relative Risk (Fixed) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hernandez 2001</td>
<td>11 / 121</td>
<td>21 / 101</td>
<td>0.44</td>
<td>6.04 [2.22, 1.00]</td>
<td></td>
</tr>
</tbody>
</table>

Hospital emergency room visit only (with no in-patient admission)
Mortality

Table of comparisons

Fig 02 Lung function

FEV1

FVC
**Table of comparisons**

Fig 03 Health related quality of life scores

SGRQ (higher negative score is better)

**Table of comparisons**

Fig 04 Satisfaction with care

**Table of comparisons**

Fig 05 Preference for type of care
**Preference for "Hospital at home care"**

### Table of comparisons

**Fig 06 Economic costs**

<table>
<thead>
<tr>
<th>Study</th>
<th>Hospital at Home</th>
<th>Inpatient Care</th>
<th>Average Cost</th>
<th>Weight (%)</th>
<th>Relative Risk (Fixed) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>100.0</td>
<td>1.52 [1.21, 1.90]</td>
</tr>
<tr>
<td>01 Patient preference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ojoo 2002</td>
<td>28 / 27</td>
<td>19 / 27</td>
<td></td>
<td>37.4</td>
<td>1.65 [1.16, 2.24]</td>
</tr>
<tr>
<td>Sheppard 1999a</td>
<td>11 / 15</td>
<td>9 / 17</td>
<td></td>
<td>18.7</td>
<td>1.36 [1.81, 2.38]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>39 / 42</td>
<td>25 / 44</td>
<td></td>
<td>57.2</td>
<td>1.54 [1.17, 2.04]</td>
</tr>
<tr>
<td>02 Carer preference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ojoo 2002</td>
<td>17 / 23</td>
<td>5 / 14</td>
<td></td>
<td>16.5</td>
<td>1.96 [1.65, 3.73]</td>
</tr>
<tr>
<td>Sheppard 1999a</td>
<td>12 / 15</td>
<td>12 / 17</td>
<td></td>
<td>26.3</td>
<td>1.22 [1.06, 1.77]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>29 / 38</td>
<td>17 / 31</td>
<td></td>
<td>42.0</td>
<td>1.62 [1.08, 2.44]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>67 / 77</td>
<td>40 / 75</td>
<td></td>
<td>100.0</td>
<td>1.52 [1.21, 1.90]</td>
</tr>
</tbody>
</table>

**Characteristics of included studies**

**Study:** Cotton 2000

**Methods:** Design: Randomised trial stratified by sex, living alone and whether ever smoked.

Location: Glasgow Royal Infirmary, Glasgow, Scotland

Recruitment: a respiratory nurse visited every medical ward each morning and identified...
patients admitted as emergencies with a diagnosis of COPD.

Participants: Demographics: Inpatient management group, mean (SE): age 68 (1.2), M/F 16/24, living alone 13, home nebuliser 19, home oxygen 5, oral steroids 5, PaO2 (kPa) 9.2 (0.4), PaCO2 (kPa) 5.5 (0.2), H+ (nM) 40 (0.8), FEV1 (L) 0.94 (0.06), FEV1/FVC (%) 46 (2), BMI (kg/m2) 25.8 (1.1).

Early discharge group, mean (SE): age 65.7 (1.6), M/F 19/22, living alone 11, home nebuliser 24, home oxygen 8, oral steroids 4, PaO2 (kPa) 8.5 (0.4), PaCO2 (kPa) 6.0 (0.3), H+ (nM) 39.3 (0.8), FEV1 (L) 0.95 (0.08), FEV1/FVC (%) 45 (2), BMI (kg/m2) 26 (1.2).

Selection Criteria: Patients were excluded if they were not resident in Glasgow, homeless, unable to give written consent or did not have access to a telephone. Patients requiring inpatient management or investigation for other medical problems were excluded as were patients with life threatening respiratory failure (H+>45nM) at the time of assessment (not at admission).

All eligible patients were recruited on the morning of the next working day after admission and in the same afternoon consenting patients were randomised to early discharge or to conventional inpatient management.

Recruitment: After screening 412 acute COPD admissions over 14 months, 151 eligible patients were recruited. 81 patients were randomised (37 refused to take part & 33 were already participating in other trials). 41 patients were randomised to early discharge and 40 to conventional inpatient management.

Withdrawals: One patient withdrew in the conventional management group as he wished to go home early with nurse support and one withdrew in the early discharge group as he wished a longer period of respite for his wife. Four patients withdrew from the early discharge group due to the recognition of some other medical problem.

Interventions: Inpatients were treated for their exacerbation according to conventional hospital management.

36 patients underwent early discharge. 34 were discharged with nebulised bronchodilators and 16 were discharged with oxygen.

Median duration of nurse follow-up was 24 days and the median number of nurse visits was 11.

Outcomes: Readmissions.

Days to readmission from day of initial admission.

Length of initial admission.

Mortality at follow-up (60 days).

Notes: Randomisation was carried out by telephoning a non-clinical member of staff based in a separate building who held a treatment allocation schedule generated by random numbers.

Data: reported and analysed on an intention-to-treat basis.
Allocation concealment: A

Study: Davies 2000

Methods: Design: Randomised trial.

Location: University Hospital Aintree, Liverpool, England

Recruitment: three respiratory nurses based in the accident and emergency department screened patients who presented at the department with an exacerbation of their COPD.

Participants: Demographics: Inpatient management group, mean (SD): age 70 (8), M/F 30/20, current smokers 19, ex-smokers 30, non-smokers 1, pack years 43 (24), pre-bronchodilator FEV1 (L) 0.65 (0.21), post-bronchodilator FEV1 (L) 0.76 (0.28), % predicted post-bronchodilator FEV1 35.1 (14.7), RR (bpm) 23 (4), pH 7.39 (0.04), PaO2 (kPa) 9.0 (1.2), PaCO2 (kPa) 5.2 (0.8). Treatment at assessment with number of participants: inhaled beta agonists 45, inhaled anticholinergics 31, inhaled corticosteroids 42, oral corticosteroids 19, antibiotic therapy 19, nebulised beta agonists 11, theophylline 10, inhaled long-acting beta agonists 10, oxygen cylinder 6, LTOT 3.

Early discharge group, mean (SD): age 70 (8), M/F 45/55, current smokers 34, ex-smokers 60, non-smokers 6, pack years 41 (31), pre-bronchodilator FEV1 (L) 0.71 (0.33), post-bronchodilator FEV1 (L) 0.82 (0.37), % predicted post-bronchodilator FEV1 36.1 (17.2), RR (bpm) 24 (4), pH 7.4 (0.05), PaO2 (kPa) 9.7 (2.9), PaCO2 (kPa) 5.2 (1.0). Treatment at assessment: inhaled beta agonists 94, inhaled anticholinergics 53, inhaled corticosteroids 75, oral corticosteroids 36, antibiotic therapy 56, nebulised beta agonists 29, theophylline 23, inhaled long-acting beta agonists 18, oxygen cylinder 10, LTOT 4.

Selection Criteria: Patients were excluded if they had history of asthma, marked use of accessory muscles, suspected malignancy on x-ray, pneumothorax or pneumonia, uncontrolled LVF, acute changes on ECG, requirement for full-time nursing care or IV therapy.

All eligible patients had FEV1<80% predicted, FEV1/FVC ratio <70%, pulse rate <100bpm, systolic blood pressure>100mmHg, pH>7.35, PaO2>7.3 kPa, PaCO2<8 kPa & total white cell count 4-20 x 10^9/L.

Patients were assessed for recruitment into the study seven days a week from 8am to 6pm and those randomised to early discharged were discharged as soon as possible and without an overnight stay in hospital.

Recruitment: After screening 583 acute COPD admissions from February 1998 to August 1999, 192 eligible patients were recruited. 150 patients were randomised (42 refused to take part). Patients were randomised in a ratio of 2:1 for early discharge or hospital admission. 100 patients were randomised to early discharge and 50 to conventional inpatient hospital management.

Withdrawals: Five patients were lost to follow-up and four died in the conventional management group. In the early discharge group five were lost to follow-up, two refused further care and seven died.

Interventions: Inpatients were treated for their exacerbation according to conventional hospital management.
100 patients underwent early discharge. Patients were escorted home by one of the specialist nurses. Social support was immediately available if required. Nebulised ipratropium bromide and salbutamol with a compressor, oral predisolone for ten days, and antibiotics for five days were prescribed.

50 inpatients received the same drugs, with all other management being at the discretion of the ward team.

Nurses visited the patients mornings and evenings for three days and there after at the discretion of the nurses. Evening and night cover was provided by district nurses. If progress was unsatisfactory the nurse or patient could trigger admission.

**Outcomes:** Readmissions to hospital during the first two weeks of home care and over three months.

Cause of readmission at three months.

Changes in FEV1 post-bronchodilator at two weeks and three months.

Health status in random subgroup sample of patients randomised to the two study arms using the St George's respiratory questionnaire (SGRQ) during the first week of the exacerbation. 50 of these patients completed the questionnaire a second time at three months.

Mortality at follow-up (at three months).

**Notes:** Patients were randomised in a ratio of 2:1 for early discharge or hospital admission using blinded sealed envelopes.

Data: analysed on an intention-to-treat basis.

**Allocation concealment:** A

**Study:** Hernandez 2003

**Methods:** Design: Randomised trial.

Location: Hospital Clinic and Hospital de Bellvitge, Barcelona, Spain

Recruitment: All COPD exacerbations admitted to the ER on weekdays from 9am to 4pm were screened by a specialised respiratory team which consisted of one chest physician and one nurse in each hospital.

**Participants:** Demographics: Inpatient management group, mean (SD): age 70.5 (9.4), M/F 98/3, home oxygen 19, smokers 17.8%, influenza vaccination 65.3%, respiratory rate bpm 26.8 (5.9), PaO2 (mmHg) 64.7 (16.4), PaCO2 (mmHg) 43.8 (8.9), pH 7.4 (0.3).

Early discharge group, mean (SD): age 71.0 (9.9), M/F 118/4, home oxygen 15, smokers 27.3%, influenza vaccination 66.1%, respiratory rate bpm 26.9 (6.0), PaO2 (mmHg) 65.0 (13.6), PaCO2 (mmHg) 42.7 (7.5), pH 7.4 (0.4).

Selection Criteria: Patients were eligible for inclusion in the trial if two primary criteria were satisfied. (1) COPD exacerbation as the major cause of referral to ER and (2) absence of any criteria for imperative hospitalisation as stated in the BTS guidelines (i.e acute chest x-
ray changes, acute confusion, impaired level of consciousness and arterial pH below 7.35).

All eligible patients were recruited between 9:00am to 4:00pm Monday to Friday.

Recruitment: After screening 629 acute COPD admissions over 12 months (Nov 1999 to Nov 2000), 244 eligible patients were recruited. 22 participants refused to take part. One hospital used 1:1 randomisation where as the other used a 2:1 randomisation for the first three months than 1:1 thereafter. 121 patients were randomised to early discharge and 101 to conventional inpatient management.

Withdrawals: There is no report of withdrawals after randomisation into study.

**Interventions:** Inpatients were treated for their exacerbation according to standard hospital protocols but the support of a specialised nurse at the ER and at home was not provided to this group. At discharge, the patient was usually supervised by the primary care physician who was not aware of the study protocol.

101 patients underwent early discharge who were treated using Spanish Respiratory Society guidelines (available at [http://www.separ.es](http://www.separ.es)).

Median duration of nurse follow-up was eight weeks and the maximum number of nurse visits was five.

**Outcomes:** In-patient hospital readmissions

ER readmissions

SGRQ (total, symptoms, activity, impact)

SF-12 (physical, mental)

Mortality at follow-up (eight weeks).

Percentage of patients hospitalised <1 day to >3 days.

Days of hospitalisation

Patient satisfaction

Spirometry

Ecnomic analysis (average cost per person)

Disease knowledge

**Notes:** Patients were assigned (double-blinded) to treatment groups using computer generated random numbers.

Data: reported and analysed clinical data on an intention-to-treat basis.

**Allocation concealment:** A

**Study:** Nicholson 2001
**Methods**: Design: Randomised trial.  

Location: Mater Adult Hospital and Princess Alexandra Hospital, Brisbane, Australia.

Recruitment: All patients presenting with COPD exacerbations at the two hospital ER departments (or respiratory outpatient clinic) were eligible for entry into the study.

**Participants**: Demographics: No patients demographics were provided for either study group. However, clear inclusion and exclusion criteria were provided.

Selection Criteria: Patients were eligible for inclusion in the trial if they met the following criteria: aged > 45 years, documented diagnosis of COPD, current or ex-smoker, FEV1 < 60% predicted, admission required by GP or considered necessary by outpatient clinic staff or ED staff, willing and able to give informed consent and have a telephone at home. Patients were excluded on the following criteria: unstable co-morbid conditions needing acute medical management, pneumonia on chest x-ray, hypoxia indicated by SaO2 of <90% or a PaO2 < 60 mmHg on room air or usual flow rate of O2 if on home oxygen therapy.

Patients had to present between the hours 7.30am to 4.30pm weekdays between October 1999 and October 2000. Patients who presented out-of-hours and fulfilled the inclusion criteria were admitted for one night and were invited to participate in the trial the following morning.

Recruitment: After screening 168 acute COPD admissions over 12 months (Oct 1999 to Oct 2000), 25 eligible patients were recruited. 13 participants were randomised to home care and 12 to hospital inpatient management.

Withdrawals: There are no report of withdrawals after randomisation into study.

**Interventions**: Inpatients were treated for their exacerbation according to usual hospital care and they had discussion about their treatment goals with the Clinical Care Coordinator.

12 patients underwent early discharge. They had mandatory nursing visits on days one, two, three and seven and optional for days four, five and six. GPs were invited to participate in the trial when their patient was randomised to home care. Patients were reviewed by their own GP at home between the second and fourth day of home management. Allied health interventions were also done with home care patients which included dieticians, occupational therapy, pharmacy, physiotherapy and psychology.

**Outcomes**: Spirometry

Oximetry

6MWD

Carer strain questionnaire

Seattle Obstructive Lung Questionnaire

Anxiety and depression scores (HADS)

Patient satisfaction
Health professional questionnaire

Costs

Notes: Wrote to author for data, and randomisation method. Author (C Nicholson) replied providing full report.

Data: no figures provided for mortality.

Recruitment rate is only 15% (lower than other included studies) as one of the hospitals used in this study (Princess Alexandra) admits respiratory patients into a number of medical units. Therefore the respiratory registrar may not have been aware of the total number of patients that may have fulfilled the selection criteria.

Allocation concealment: B

Study: Ojoo 2002

Methods: Design: Randomised trial.

Location: Castle Hill Hospital, Cottingham, Hull, England

Recruitment: two respiratory nurses screened patients the next morning after presenting at the accident and emergency department and being admitted due to an exacerbation of their COPD.

Participants: Demographics: Inpatient management group, mean (SD): age 70.1, M/F 15/15, admission FEV1 (L) 0.85 (0.34), admission FVC (L) 1.83 (0.80), SGRQ total score 67.6 (16.3), living alone 9, in nursing home 1, receiving home help or district nurse 4.

Early discharge group, mean (SD): age 69.7, M/F 16/14, admission FEV1 (L) 1.0 (0.38), admission FVC (L) 1.99 (0.77), SGRQ total score 67.9 (10.7), living alone 9, in nursing home 0, receiving home help or district nurse 4.

Selection Criteria: Patients were excluded if they had a concomitant medical condition, residence over 15 miles from hospital, complications of exacerbation (acidosis, cor pulmonale, changes in ECG), newly diagnosed type 2 respiratory failure, social exclusion was discretionary and depended on level of domicillary support and performance status of the patient.

All eligible patients were of either gender, >18 years of age, FEV1/FVC ratio <70%, FEV1 reversibility to salbutamol <15% (obtained on previous admission), worsening symptoms with any combination of increased sputum purulence and/or volume, and worsening dyspnoea.

Patients were assessed for recruitment into the study from Monday to Thursday. All patients were initially admitted to the Medical Chest Unit and clinical management was instituted according to the BTS guidelines. They were reviewed the following morning for possible inclusion in the trial. Patients randomised to the home care group were discharged within 48 hours of admission with a discharge package.

Recruitment: After screening 328 acute COPD admissions from May 1999 to February 2000, 60 eligible patients were recruited. 30 in each arm of the study.
Withdrawals: 6 patients were lost to follow-up (3 from each arm). Three due to clinical deterioration (2 in the early discharge group were readmitted) and one patient was found to have predominantly asthma, one withdrew consent and one patient self-discharged from hospital.

**Interventions:** Inpatients were treated for their exacerbation according to the current BTS guidelines.

30 patients underwent early discharge. Patients were monitored daily by the nurses who also carried out patient and carer education and reassurance. Nurses filled in daily progress and symptom score charts for patients in both study arms. Assessment involved vital signs, spirometry, oxygen saturation and supplemental oxygen and nebuliser usage. All patients were discharged with nebulised or inhaled bronchodilators, oral and inhaled steroids, antibiotics and oxygen as necessary. The GPs were aware but were not involved with the early discharge patients.

50 inpatients received inhospital care according to BTS guidelines for the management of acute exacerbations of COPD.

Nurses monitored the patients daily.

Two weeks after discharge an independent person administered a satisfaction questionnaire to both the patient and the carer. Evening and night cover was provided by a direct line to the Medical Chest Unit.

**Outcomes:** Readmissions at three months.

Improvement in FEV1, FVC and symptom score.

Number of days in care

Patient and carer satisfaction and preference for site of care

Mortality

**Notes:** Patients were randomised using sealed envelopes to one of the two study arms.

**Allocation concealment:** A

**Study:** Shepperd 1998a

**Methods:** Design: Randomised trial.

Location: Kettering General Hospital NHS Trust, England

Recruitment: patients were recruited from 26 GP practices. Mixed populations of patients were recruited with some of the data presented separately for COPD patients.

**Participants:** Demographics: Mixed populations included hip and knee replacement, hysterectomy, elderly medical and COPD. For the COPD inpatient management group, mean (SD): age 73 (10.1), M/F 3/14, no data provided on lung function.

Early discharge group, mean (SD): age 71 (7.2), M/F 5/10, no data provided on lung
function.

Selection Criteria: Patients were eligible if their hospital consultant and GP agreed entry into the study, patients home was suitable for hospital at home study and carer consented to participate. Patients were excluded if they were under 60yrs of age.

Recruitment: no break down of patients recruitment provided for each of the four different diseases.

Withdrawals: no details provided on withdrawals.

Interventions: Hospital at home care was provided as a direct alternative to inpatient care for patients who were clinically stable and did not require immediate access to diagnostic or specialist medical care. The services provided included nursing, physiotherapy, occupational therapy and pathology. Patients were also provided with a mobile phone if required. Care in the hospital at home scheme consisted of observation, administration of drugs, nursing care and rehabilitation. Nursing care was available 24 hours a day in the patients home if necessary. General practitioners held clinical responsibility and were reimbursed for visits they made to patients admitted to hospital at home schemes.

Outcomes: Readmissions at three months
Cost
Mortality

Notes: Patients were randomised using computer generated numbers and allocation was done using sealed envelopes. Allocation was revealed through a telephone randomisation service, independent of the service providers.

Allocation concealment: A

Study: Skwarska 2000

Methods: Design: Randomised trial.

Location: Royal Infirmary of Edinburgh, Edinburgh, Scotland

Recruitment: a team of nursing and medical staff was created known as the ARAS (acute respiratory assessment service) who screened all acute COPD presentations on weekdays from 09.00 hrs to 17.00 hrs and patients presenting overnight were assessed at 09.00 hrs the following morning.

Participants: Demographics: Inpatient management group, means: age 69.9, M/F 24/38, current smoker 36.7%, ex-smoker 60%, respiratory rate 23.2 bpm, PEFR 144.9 L/min, FEV1 (L) 0.66, oxygen saturation 91.9%, PaO2 on air 10.0 kPa.

Early discharge group, means: age 68.5, M/F 63/59, current smoker 40.5%, ex-smoker 57.9%, respiratory rate 22.8 bpm, PEFR 179.8 L/min, FEV1 (L) 0.77, oxygen saturation 92%, PaO2 on air 8.4 kPa.

Selection Criteria: All COPD exacerbations were assessed with respect to 13 indictors of severity (BTS 1997 guidelines). Patients with any of the following four indicators - impaired level of consciousness, acute confusion, acute changes on radiograph or an arterial pH of
<7.35 were deemed obligatory admissions. Except for patients with concomitant medical conditions or social reasons, all other patients were considered suitable for recruited into the study.

Recruitment: After screening 1006 acute COPD presentations between November 1996 to mid May 1998, 208 patients were found to be eligible, 24 declined consent, 122 were randomised to home care and 62 to inpatient care.

Withdrawals: 9 patients in the early discharge group were readmitted and 2 were not accounted for as only 111 were reported to have completed the trial. One patient in the inpatients group died and 61 completed the trial.

**Interventions:** 62 inpatients were treated for their exacerbation according to the current BTS guidelines.

122 patients underwent early discharge. Patients were visited by a nurse the following morning and thereafter at two to three days to monitor the need for treatment. When patients were considered by the nursing team to have recovered sufficiently no longer to require nursing support at home, they were discharged from home care. Patients were left with a short questionnaire on satisfaction with the service.

The treatment offered at home and in hospital (oxygen, nebulisers, antibiotics, corticosteroids) was prescribed and reviewed according to BTS guidelines and clinical judgement.

Eight weeks after discharge from either study arm patients were reassessed at home. This assessment included spirometry, quality of life (CRDQ), additional care from GP, social work services or informal care.

**Outcomes:** Readmissions

Mortality

GP and nurse support

The following measurements were made between initial & discharge assessment and also between discharge and final assessments at eight weeks (respiratory rate, PEFR, FEV1, oxygen saturation).

Improvement in FEV1, FVC and symptom score.

Number of days in care

Patient and carer satisfaction and preference for site of care

Mortality

**Notes:** Patients were randomised in a ratio of 2:1 for early discharge or hospital admission using computer generated random numbers.

**Allocation concealment:**

FEV1: Forced expiratory volume in one second
FVC: Forced vital capacity
BMI: Body Mass Index
RR (bpm): Respiratory Rate, breaths per minute
LTOT: long term oxygen therapy
LVF: left ventricular failure
ECG: Electrocardiogram
IV: Intravenous
SGRQ: St George's respiratory questionnaire
SF-12: Short-form 12
GP: General practitioner
ER or ED: Emergency Room or Department
6MWD: Six minute walk distance
PEFR: Peak expiratory flow rate
CRDQ: Chronic respiratory diseases questionnaire

Characteristics of excluded studies

Study: Barber 2001
Reason for exclusion: Not a RCT.

Study: Brown 1997
Reason for exclusion: Not a RCT, but a before and after study.

Study: Callaghan 1999
Reason for exclusion: Retrospective case study.

Study: Caplan 1999
Reason for exclusion: Study involved participants with a variety of acute conditions, however no patients had COPD.

Study: Farrero 2001
Reason for exclusion: Participants not presenting with an acute exacerbation of COPD but all in stable state and were selected from Spanish NHS records.

Study: Gibbons 2001
**Reason for exclusion:** Not a RCT, but an audit of practice after implementation of "hospital at home" service.

**Study:** Gravil 1998

**Reason for exclusion:** Not a RCT, case study.

**Study:** Hermiz 2002

**Reason for exclusion:** At the time of recruitment patients had not presented to accident & emergency department with an exacerbation of their COPD. Patients were selected from hospital records. Patients were randomised to either home care with nurse or to GP care.

**Study:** Hughes 1992

**Reason for exclusion:** Study involved participants with a variety of conditions. Data on COPD patients not presented separately.

**Study:** Hughes 2000

**Reason for exclusion:** Participants not presenting with an acute exacerbation of COPD. No reply from author, so could not verify the information.

**Study:** Leff 1999

**Reason for exclusion:** Not a RCT, but a case series report.

**Study:** Mair 2002

**Reason for exclusion:** Patients were not randomised to hospital inpatient care but rather to two types of "hospital at home" care (home telecare vs conventional home care).

**Study:** O'Reilly 2001

**Reason for exclusion:** Not a RCT.

**Study:** Richards 1998

**Reason for exclusion:** Mixed population of patients and not sure if COPD patients included. No reply from author on correspondence.

**Study:** Smith 1999

**Reason for exclusion:** Participants not reported to be presenting with an acute exacerbation of COPD. Study entry criteria required all patients to be in stable state.

**Study:** Wilson 1999

**Reason for exclusion:** Mixed population of patients. COPD patients not included in list of conditions recruited for in study (see appendix in paper for conditions).

**Table 01 Percentage recruitment (number of patients entered into trial/total screened)**

http://gateway.ut.ovid.com/gw2/ovidweb.cgi
Study Reference: Cotton 2000
Total recruited: 81
Total screened: 360
Percentage: 22.5

Study Reference: Davies 2000
Total recruited: 150
Total screened: 583
Percentage: 25.7

Study Reference: Hernandez 2000
Total recruited: 244
Total screened: 629
Percentage: 38.7

Study Reference: Nicholson 2001
Total recruited: 25
Total screened: 168
Percentage: 14.8

Study Reference: Ojoo 2002
Total recruited: 60
Total screened: 328
Percentage: 18.2

Study Reference: Shepperd 1998a
Total recruited: 32
Total screened: not reported
Percentage:-

Study Reference: Skwarska 2000
Total recruited: 184
Total screened: 718
Percentage: 25.6

Study Reference: TOTALS (does not include Shepperd 1998a)

Total recruited: 744
Total screened: 2786
Percentage: 26.7

References to studies included in this review

Cotton 2000

Davies 2000

Hernandez 2003

Nicholson 2001
Ojoo 2002


Shepperd 1998a


Skwarska 2000


References to studies excluded in this review

Barber 2001


Brown 1997


Callaghan 1999


Caplan 1999


Farrero 2001


Gibbons 2001


Gravil 1998


http://gateway.ut.ovid.com/gw2/ovidweb.cgi

10/01/2005
**Hermiz 2002**


**Hughes 1992**


**Hughes 2000**


**Leff 1999**


**Mair 2002**


**O'Reilly 2001**


**Richards 1998**


**Smith 1999**


**Wilson 1999**


**Additional references**

**BTS 1997**


**Connors 1996**


**Gravil 1998**


**Guest 1999**

Guest JF. The annual cost of chronic obstructive pulmonary disease to the UK's National Health Service. Disease Management and Health Outcomes Journal 1999;5:93-100. [Context Link]

**Hughes 1997**


**Jeffrey 1992**


**Johnson 2001**


**Kendrick 1994**

Kendrick S. The increase in the number of emergency admissions: age, diagnosis, frequency. Working paper for the acute beds research group. Information and Statistics Division. NHSIS 1994. [Context Link]

**LAIA 2001**


**NHS 1996**


**RCPL 1981**


**Richards 1998**


**Seneff 1995**

Seneff MG, Wagner DP, Wagner RP, Zimmerman JE, Knaus WA. Hospital and 1-year survival of patients admitted

**Shepperd 1998b**


**Wilson 1999**


Medical Subject Headings (MeSH): Human; Acute Disease; *Home Care Services, Hospital-Based; Hospitalization; *Pulmonary Disease, Chronic Obstructive/tp (therapy); Randomized Controlled Trials

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