

BMJ Open Protocol for an overview of systematic reviews of interventions to reduce unscheduled hospital admissions among adults

Niklas Bobrovitz,¹ Igbo Onakpoya,¹ Nia Roberts,² Carl Heneghan,¹ Kamal R Mahtani¹

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¹Nuffield Department of Primary Care Health Sciences, University of Oxford, Oxford, England, UK
²University of Oxford, Bodleian Health Care Libraries, Oxford, Oxfordshire, England, UK

Correspondence to

Niklas Bobrovitz;
niklas.bobrovitz@phc.ox.ac.uk

ABSTRACT

Introduction: Unscheduled hospital admissions are an increasing burden on health systems worldwide. To date, initiatives to reduce admissions have had limited success as it is unclear which strategies effectively reduce admissions and are supported by a strong evidence-base. Therefore, we will conduct an overview to find, assess and summarise all published peer-reviewed systematic reviews of randomised controlled trials that examine the effect of an intervention on unplanned admissions among adults.

Methods and analysis: This is a protocol for a systematic overview of reviews. We will search four databases: Ovid MEDLINE, PubMed, Cochrane Database of Systematic Reviews and the Cochrane Database of Abstracts of Reviews of Effects. We will consider systematic reviews and meta-analyses of randomised controlled trials in adults (≥ 16 years old) evaluating the effect of any intervention on unscheduled hospital admissions including those to treat, monitor, diagnose or prevent a health problem. We will only include reviews that identified unscheduled hospitalisations as a prespecified outcome. Two authors will independently screen articles for inclusion using a priori criteria. We will assess the quality of included reviews and extract ratings of the quality of evidence from within each review. We will create a hierarchical list of interventions based on estimates of absolute admission reductions and the quality of the evidence. Presentation of results will align with guidelines in the Cochrane Handbook of Systematic Reviews of Interventions and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement.

Ethics and dissemination: Ethics approval is not required. We will submit the results of this study for peer-review publication. The results will inform future research and could be used by healthcare managers, administrators and policymakers to guide resource allocation decisions and inform local implementation and optimisation of interventions to reduce unscheduled hospital admissions.

Strengths and limitations of this study

- We are using a novel methodology to hierarchically rank interventions to reduce unscheduled admissions.
- We anticipate this to be one of the largest overviews of systematic reviews.
- Potentially relevant studies could be missed despite use of robust search strategies.

INTRODUCTION

Over the past decade there have been dramatic increases in the number of unscheduled patient admissions to acute care hospitals in healthcare systems all over the world.^{1–5} Unscheduled hospital admissions are unpredictable and occur at short notice because of a perceived need for immediate healthcare.⁶ Increases in these non-elective hospitalisations have been reported in Scotland, Wales,¹ the USA,^{2–3} Australia,⁴ and New Zealand,⁵ although the largest and most consistent increases have been in England.¹ Between 2000 and 2012 England experienced a 27% rise from 77 admissions per 1000 population to 98 admissions per 1000.¹

These increases have seriously strained health systems, primarily due to the cost of caring for hospitalised patients.^{7–8} For example, the estimated cost to the National Health Service of unscheduled admission increases in England between 2004 and 2009 was £330 million,⁹ with total costs for unscheduled in-patients growing to £12.5 billion in 2013.¹ On-going increases have been deemed financially unsustainable.^{1–10} However, cost is not the only issue; unscheduled admissions are problematic for the timely delivery of services as they can result in delays and cancellations for elective operations and procedures.¹

Furthermore, hospitalisation is disruptive to the lives of patients and represents a threat to their safety as in-patients are at risk of medical errors, adverse events and hospital-acquired infections.^{11–13}

Reducing unscheduled admissions has become vital for health service organisations in many countries in order to alleviate pressure on acute care systems, ensure the solvency and quality of healthcare, and minimise patient burden.^{1 14–18} However, most initiatives to reduce admissions in practice have had limited success as it is unclear which interventions are effective and are supported by a strong evidence-base.¹⁹ A key limitation in campaigns to reduce admissions has been an inadequate utilisation of existing evidence. Many published studies have reported unscheduled admissions as a primary or secondary outcome in evaluations of health interventions, yet there have been few attempts to systematically compare these studies.

Leppin *et al*²⁰ reviewed randomised controlled trials of hospital to home transition interventions to prevent 30-day readmissions and showed that select discharge interventions were effective. However, early hospital readmissions only form a portion of unscheduled admissions and the evidence for reducing initial hospitalisations was not assessed. Furthermore, readers are provided with estimates of relative risk which do not indicate the number of admissions that could be avoided if the interventions were implemented in practice, thereby making comparative evaluations of the interventions more challenging. Purdy and colleagues produced a report consisting of multiple systematic reviews (three of which were subsequently peer-reviewed published) of interventions that were developed to reduce emergency admissions.^{14 20–22} The authors concluded that there was sufficient evidence for the effectiveness of a small number of interventions however, they did not assess the vast literature of interventions for clinical management, treatment or diagnosis that have assessed unscheduled admissions as an outcome.

To better utilise existing evidence, an examination of a broader scope of interventions, methods and strategies to reduce admissions is needed. Therefore, we will conduct an overview to find, assess and summarise all published peer-reviewed systematic reviews and meta-analyses of randomised trials that examine the effect of any intervention on unscheduled hospital admissions among adults including those to treat, monitor, diagnose or prevent a health problem. We will use our results to create a hierarchy of interventions based on estimates of the absolute reduction in unscheduled admissions and the quality of the evidence. We hope this hierarchical index will provide guidance for clinicians, researchers and policymakers and decisionmakers aiming to adopt and optimise the use of evidence-based interventions to reduce unscheduled hospitalisations. To our knowledge, no overview of this type has been published.

OBJECTIVES

1. Identify systematic reviews of randomised controlled trials which report unscheduled hospitalisations as an outcome.
2. Produce a hierarchical index of interventions that have been shown to significantly ($p < 0.05$ and a 95% CI that does not include the null value) reduce unscheduled admissions using estimates of the absolute risk difference and the quality of the evidence.
3. Compare, contrast and discuss the ranked interventions with consideration given to the absolute risk difference, the quality of the evidence and other relevant factors including the quality of the reviews, heterogeneity within reviews, mortality, cost-effectiveness, other healthcare utilisation, health-related quality of life and adverse events.
4. Discuss implementation and optimisation of the top ranked interventions in practice.

METHODS AND ANALYSIS

Protocol and registration

Methods for this overview were developed based on criteria for conducting overviews of reviews in the *Cochrane Handbook of Systematic Reviews of Interventions*.²³ This protocol is registered on the International prospective register of systematic reviews (PROSPERO: CRD42014014779).²⁴ Ethics approval is not required for this review as we will analyse published literature only.

Types of reviews

We will include peer-reviewed systematic reviews and meta-analyses of original randomised controlled trials that examine the effects of any intervention or combination of interventions on unscheduled hospital admissions. We will focus on systematic reviews rather than original trials in order to utilise the widest range of relevant evidence and compare the best estimates of effectiveness of different interventions. To be included, a review must report an estimate of the effect of an intervention on unscheduled hospital admissions. If the event rates for the control group are not calculable from data in the review, we will obtain the largest and highest-quality RCT reporting unscheduled admissions in the review and use the control event rate in that study to calculate an absolute effect size.

We will only include reviews that identified unscheduled hospitalisations as a prespecified outcome. We define an unscheduled hospital admission as an unanticipated admission or readmission to hospital in-patient status that occurs at short notice because of a perceived need for immediate healthcare.⁶ We will not consider admission only to the emergency department or an observational unit to be an unscheduled admission. We will include reviews that report a composite outcome of unscheduled hospitalisation with mortality or emergency department visit. We consider these

events on a continuum with hospitalisation and this information may be useful for readers of this overview. We will not include reviews reporting admissions for preterm birth, however, we will include reviews that report antenatal admissions for other reasons (ie, pre-eclampsia).

Reviews of comparative effectiveness trials will be flagged for a future study. The effect estimates from these trials cannot be contextualised without knowledge of the effect of the comparison intervention versus placebo or usual care. Therefore, analysis of the results of those reviews will require specialised methods.

Reviews that include studies of different designs (eg, RCTs and observational studies) will only be included if results of the RCTs are presented in a distinct subgroup.

Our data analysis will focus on reviews of interventions associated with a significant reduction in admissions as these are candidates for immediate implementation in practice, while those showing no effect or harm are not. We will include reviews regardless of the statistical significance of the reported results, however, only those with a pooled estimate of effect showing a significant reduction in admissions will be listed in our hierarchical index. We define statistical significance as $p < 0.05$ and a 95% CI that does not include the null value.

If there are multiple reviews of the same intervention and patient population we will select the most recent Cochrane review unless a more recently published review of similar quality includes additional studies. If there is no Cochrane review we will select the most recently published review. We will carefully examine all included studies to ensure we analyse and report the most recent review of an intervention.

There is a possibility that two or more reviews of the same intervention and patient population are published in a short time period (< 2 years) but with conflicting results for example, one showing a significant reduction in admissions and one showing no effect. In these cases we will explore the similarities and differences in the full texts of the reviews and lists of included studies. We will descriptively report the results of our comparisons and outline the rationale for our selection of reviews to include.

Quality criteria

To ensure the included reviews are 'systematic' and meet a minimum level of methodological rigour, we will only include those studies that included the following two items of the Assessment of Multiple Systematic Reviews tool (AMSTAR): *were two or more electronic sources searched?*, and *was the scientific quality of the included studies assessed and reported?*²⁵ Other overview authors have used similar quality criteria²⁶ or limited inclusion to only Cochrane reviews to ensure a minimum level of quality and rigour.^{27–28} We will expand our search beyond the Cochrane library in hopes of capturing additional relevant reviews, however, we anticipate a large number of included studies. Therefore, these exclusion criteria will

ensure our overview is feasible to complete and is focused on reviews of a minimum quality.

Types of interventions

We will include reviews of any intervention including those to treat, monitor, diagnose or prevent a health problem. Interventions may include organisational and supportive systems within which healthcare is provided and any tools or strategies used to improve the performance of the health system, if the ultimate goal of such improvements is to produce better health outcomes.^{29–31}

Other potential interventions include pharmacological agents; devices; equipment or supplies; clinical or surgical procedures; diagnostic tests; screening programmes; information provision; and access strategies. Interventions must be compared to placebo or usual care.

Types of participants

We will include reviews of interventions for any disease or condition. The population of interest in the current overview is adults (≥ 16 years of age). If reported results of a review include both adult and paediatric populations, we will only include the data if the mean age of patients is over 18. We will highlight reviews with mixed aged populations when reporting results.

Search methods for identification of studies

We will search four databases: Ovid MEDLINE, PubMed (past 12 months to capture articles not yet indexed in MEDLINE), Cochrane Database of Systematic Reviews (Cochrane Library, Wiley) and the Cochrane Database of Abstracts of Reviews of Effects (DARE). The initial search strategy (table 1) was developed for the Ovid MEDLINE database using subject headings and free-text words that describe unscheduled admissions to hospital. Search strategies for the other databases will be adapted as necessary. No date or language restrictions will be placed on our search, however, there may be restrictions due to the criteria within the individual reviews. References will be managed using Endnote V.5.0 (Thomson Reuters).

Table 1 MEDLINE search strategy

1	Hospitalization/
2	Patient admission/
3	Patient readmission/
4	(admission? or admitted or readmission? or re-admission? or readmitted or re-admitted or hospitali* or rehospitali* or re-hospitali*).ti,ab.
5	1 or 2 or 3 or 4
6	Cochrane database of systematic reviews.jn. or search.tw. or meta-analysis.pt. or Medline.tw. or systematic review.tw.
7	5 and 6

Selection of studies

Two authors will independently screen titles and abstracts to identify relevant studies for full-text review and will independently screen full texts for final inclusion. Agreement on the independent inclusion of titles/abstracts and full-text articles will be quantified using a κ statistic.³² Any discrepancies in the inclusion of abstracts or full-text articles will be resolved by discussion and reaching a consensus. If a consensus cannot be reached a third author will arbitrate.

Data extraction and management

Two reviewers will independently perform data extraction for each review and populate a predefined table. Discrepancies in the data extracted will be resolved by discussion and reaching a consensus, and if necessary, arbitration by a third author.

We will only conduct full data extraction on reviews reporting a pooled effect estimate resulting from meta-analysis that shows a statistically significant reduction ($p < 0.05$ and a 95% CI that does not include the null value) in unscheduled hospital admissions. There are three subsets of reviews that we will not be subject to full data extraction and inclusion in our hierarchy. First, reviews with pooled estimates indicating no effect ($p > 0.05$ and a 95% CI that includes the null value) or an increase in admissions ($p < 0.05$ and a 95% CI that does not include the null value). Second, reviews that do not report pooled effect estimates due to heterogeneity. In these reviews it will be difficult to discern which of the multiple estimates reported best represents the 'true effect' and therefore we would be unable to rank them based on effect size against other interventions. Third, reviews that only report results from a single RCT. Reviews with only single RCTs may be more prone to spurious findings (type 1 error), bias and there is no chance the results could have been replicated or refuted, all of which decrease confidence in the results.³³

Although we will not conduct full extraction on these types of reviews, we will obtain the following information for all included reviews: details of the review including first author name, year of publication, number of included studies; details of the populations including specific diseases and conditions (ie, myocardial infarction) and major body systems (ie, cardiovascular); specific settings where the intervention are implemented including the home, rehabilitation facility, long-term care facility, general practitioner clinic, out-patient consultant clinic, accident and emergency department, surgical operating theatre, or hospital ward; category of the intervention including drug, vaccine, device, equipment/supplies, clinical procedure, surgical procedure, diagnostic test, screening programme, provision or teaching of information/education/self-management, access tools/strategies, or organisational tools/strategies; and a description of the outcome measures used including hospitalisations (ie, admissions or combined admissions/readmissions) or hospital readmissions.

This information will be valuable in order to map the existing evidence. It will also be necessary to identify potential discrepancies in the result of similar reviews. These results will be published in appendices with the final manuscript.

For studies showing significant reductions in admissions we will extract the following additional information: date of publication of included RCTs; countries in which RCTs were conducted; number of included participants; median sample size of included RCTs; description of participants (ie, median of mean ages, median percent of male participants, median percent of Caucasian participants); description of the intervention including agent (ie, trade/generic name of drug, procedure, device, activity) dose, duration and frequency; purpose of the intervention including primary prevention, secondary prevention, treatment; description of the comparison (ie, placebo, usual care); mean/median and range (ie, minimum–maximum or IQR) of duration of follow-up; a description of cause-specific admissions being avoided (ie, heart failure, asthma exacerbation); the number of patients in the intervention and control group; control event rate; the point estimate for the relative risk, OR, HR, or absolute risk reduction and corresponding 95% CIs (if not provided these will be calculated); the p value for the test statistic resulting from meta-analysis; the Grading of Recommendations Assessment, Development and Evaluation (GRADE);³⁴ name of other quality assessment tools, if used, along with the mean or median score and the range of scores (ie, minimum–maximum or IQR); and details of statistical tests for heterogeneity including the reported χ^2 value or Cochrane Q -value, the degrees of freedom, p value for the test statistic, and the I^2 value as a percentage. We will record if heterogeneity was statistically explored in the study either through subgroup analysis or meta-regression. Narrative descriptions of heterogeneity will be summarised. We will also record whether the intervention was associated with a statistically significant ($p < 0.05$ and a 95% CI that does not include the null value) change in mortality, cost, healthcare utilisation (other than hospitalisations), health-related quality of life (HRQOL) or adverse events.

Assessment of methodological quality of included reviews

Two authors will independently assess the quality of each review using the AMSTAR tool.³⁵ Each of the 11 criteria will be given a rating of 'yes' (definitely done), 'no' (definitely not done), 'can't answer' (unclear if completed) or 'not applicable'. Criteria that are rated as 'not applicable' will be removed from the denominator in the overall quality ranking. Discrepancies in the ratings of the methodological reviews will be resolved by consensus between the authors and, if necessary, arbitration by a third author.

Assessment of the quality of the evidence in reviews

We will aim to extract GRADE ratings from each included review. If other measures of quality were utilised, we will

report the tool used (eg, Jadad scale)³⁶ and record the quality score for each relevant trial (ie, those reporting our outcomes of interest). Similar to previous overviews, we will make judgments to downgrade or upgrade the quality of evidence based on the risk of bias using criteria specified by the GRADE working group.^{34–37} This re-evaluation will only be conducted on reviews included in the finally hierarchical index of interventions. Discrepancies in the ratings of the quality of evidence will be resolved by consensus between the authors and, if necessary, arbitration by a third author.

Data synthesis and presentation

Presentation of results will align with guidelines in the *Cochrane Handbook of Systematic Reviews of Interventions*³⁸ and the *Preferred Reporting Items for Systematic Reviews and Meta-Analysis* (PRISMA) statement.³⁹ A PRISMA flow diagram will be used to summarise study selection. We will summarise the characteristics of included reviews in tables by tabulating proportions for dichotomous data and means with 95% CIs or medians with IQRs for continuous data.

We will rank interventions based on estimates of the absolute risk difference and the quality of the evidence. We will present corresponding 95% CIs and p values for hospitalisations. We will generate estimates of absolute risk difference with 95% CIs if they are not provided. For example, if relative risk is reported, we will use the following formulae to convert to absolute risk difference:^{40–41}

$$\text{Absolute risk difference} = \text{Baseline event rate} \times (\text{Relative risk} - 1) \quad (\text{A})$$

Where

$$\begin{aligned} \text{Baseline event rate} = \\ \frac{\text{Number of admissions (or readmissions) in the control group}}{\text{Total number of participants in the control group}} \end{aligned} \quad (\text{B})$$

Where

$$\text{Relative risk} = \text{Estimate of pooled relative risk provided in the review} \quad (\text{C})$$

$$\begin{aligned} 95\% \text{ CI lower bound of risk difference} \\ = (\text{Baseline event rate}) \\ \times (\text{lower bound of } 95\% \text{ CI of relative risk} - 1) \end{aligned} \quad (\text{D})$$

$$\begin{aligned} 95\% \text{ CI upper bound of risk difference} \\ = (\text{Baseline event rate}) \\ \times (\text{upper bound of } 95\% \text{ CI of relative risk} - 1) \end{aligned} \quad (\text{E})$$

Appropriate formulae will be used for conversion to absolute risk difference if reviews report ORs⁴² or HRs⁴³

(ie, inverse of the number needed to treat). If the data to calculate an absolute effect size are not available we will list the results in a secondary hierarchy.

Summary tables will be used to present data in a structured format. Outcome data that is not quantitative will be descriptively reported. We will report any descriptive explanations of heterogeneity provided by the review authors when the I^2 is greater than 50% as this may represent substantial heterogeneity.³⁸ Therefore, users of the results can give greater consideration to the conditions in which the effect estimates are applicable. Also, we will highlight cases where descriptive explorations of heterogeneity are not provided and the I^2 is over 50% as a point of caution when interpreting or using the results.

We will present data graphically to visually demonstrate the diversity of data in terms of quality of evidence, quality of reviews and effect sizes. We will also present the data in tabular form. We will produce hierarchical lists of interventions ranked with consideration of the quality of the evidence, review AMSTAR score and magnitude of the absolute reduction of unscheduled admissions. Narrative descriptions to explain heterogeneity from each review will be summarised and provided.

Subgroup analysis

We will explore subgroup analyses based on the following patient populations to understand which interventions most effectively reduce admissions for different conditions: multimorbidity, cardiovascular, respiratory, rheumatoid, endocrine, oncological, renal, mental health, and traumatic injury.

POTENTIAL LIMITATIONS

It is possible that relevant studies may be missed despite using robust search strategies of multiple databases with no language restrictions and input from an information specialist (NR).

DISCUSSION

This will be an overview of systematic reviews and meta-analyses of interventions to reduce unscheduled hospital admissions. We will produce a list of effective, evidence-based interventions to reduce unscheduled hospitalisations. This list will inform research into the current use of the interventions in practice. Our list could also be used by healthcare managers, administrators and decisionmakers and policymakers to guide resource allocation decisions and inform local implementation and optimisation of interventions. Our results will include information about the impact of the interventions on key outcomes including mortality, cost, healthcare utilisation, HRQOL and adverse events and therefore may support decision-making to lower unscheduled admissions without increasing cost or threatening patient safety and quality of care. We will also identify gaps in the evidence which will inform suggestions for future research priorities.

If the results of this overview are translated into changes in patient care and healthcare practices then patients will benefit from the reduced burden of hospitalisation either through improved disease treatment and management or better preventative care.

Contributors NB, IO, KRM and CH designed the study. NB developed and refined the study protocol with contributions from all coauthors (NB, NR, IO, KRM, CH). NB, NR, KRM and CH developed the search strategy. NB and NR designed the literature search. NB and IO will undertake data extraction, analysis, interpretation and report writing. All authors read and approved this manuscript.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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