

# Effects of increased distance to urgent and emergency care facilities resulting from health services reconfiguration: a systematic review

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## Scientific summary

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# Scientific summary

## Background

The impact of reconfiguration of health services is important to commissioners, providers, patients and the public. Currently in the English NHS, programmes of service reconfiguration are being proposed at a local level by Sustainability and Transformation Partnerships, involving collaboration of relevant stakeholders. Some of the proposed reconfigurations will have the effect of increasing travel time and/or distance for patients to reach their nearest hospital or other urgent and emergency care facility.

Many communities value their local services and perceive that planned or proposed changes could worsen outcomes for patients. A systematic review of evidence relating to outcomes for patients following service reconfigurations that change the time/distance to the nearest urgent and emergency care facility is needed, to examine whether or not the available evidence supports this belief. Commissioners and service providers need evidence regarding the impacts of reconfiguration not only on patient outcomes, but also for the wider health-care system. A systematic review of the broader relationships between distance to an emergency care facility, morbidity/mortality and health system outcomes is needed to inform evidence-based decision-making.

## Objectives

The aim of this systematic review was to identify, appraise and synthesise existing research evidence regarding the outcomes and impacts of service reconfigurations that have the effect of increasing the time and/or distance for patients to reach an urgent and emergency care facility. A list of potentially time-sensitive conditions requiring treatment at an urgent and emergency care facility was developed by consensus.

We also aimed to examine the available evidence regarding associations between distance to an urgent and emergency care facility and outcomes for patients and services, together with factors that may influence (moderate or mediate) these associations.

The research questions were as follows.

- What is the evidence regarding effects on patients of service reconfigurations that increase the time/distance to an urgent and emergency care facility?
- What is the evidence regarding associations between time/distance from an urgent and emergency care facility and outcomes for patients requiring urgent and emergency care?
- What is the evidence regarding effects on the health system of service reconfigurations that have the effect of increasing the time/distance to an urgent and emergency care facility?
- What factors might mediate, moderate or mitigate the effects of increased distance to an urgent and emergency care facility on patient outcomes and/or the health system?

## Methods

### Data sources

We searched MEDLINE, EMBASE, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, Cumulative Index to Nursing and Allied Health Literature, Health Management Information Consortium and Web of Science in February 2019. The search was supplemented by citation-tracking and reference list checking to identify additional studies. A separate search was conducted to identify current systematic reviews of telehealth to support urgent and emergency care.

### Inclusion and exclusion criteria

#### Population

The population was adults or children with conditions that required emergency treatment including, but not limited to, acute myocardial infarction, stroke, major trauma, severe exacerbations of asthma, chronic obstructive pulmonary disease, or complications during pregnancy and the neonatal period. In practice, included studies encompassed data on any patient wishing to access emergency care.

#### Intervention

Studies looking at changes to the delivery of health-care services (service reconfiguration) that may have an effect on the time or distance for patients to access an urgent and emergency care facility were included. The review included reconfigurations that have an effect on access to any urgent and emergency care services including ambulance services, maternity services and hospital emergency departments. The review also included studies evaluating changes to service delivery that aim to mitigate negative effects of living at a distance from an urgent and emergency care facility. These included, for example, new forms of services providing care at the scene, such as first responders, or specialist centre retrieval services.

Given the substantial volume of research on telemedicine/telehealth, particularly for patients living in rural areas, we decided not to conduct a review of this literature. However, to contextualise the evidence identified, we provide a brief narrative summary of key review-level evidence in this field.

#### Comparison

Studies were included that compared outcomes in groups of people travelling different distances/times to receive care, or compared outcomes before and after a service reconfiguration that has an effect on time/distance to access care. Studies with no comparator were included if they met the other inclusion criteria.

#### Outcomes

Any outcomes for patients were included, including mortality/morbidity, travel time by ambulance or private care, or other perceived or measured effects, as well as outcomes or impacts on the health system, such as non-transportation, emergency admissions, increase or decrease in contacts/service use. Transportation by helicopter as an outcome was excluded because of its limited applicability in the UK (not funded by the NHS and, therefore, any findings would not be relevant).

#### Setting

The setting was the UK and other developed countries with relevant health-care systems. Absolute travel distances and density of population (which will affect distribution and density of health-care facilities) was taken into account in assessing applicability of findings to the UK. In particular, studies of 'remote' health-care from countries such as Australia were fully considered for relevance.

#### Study design

Scoping work undertaken for this review found two types of relevant studies. The first was studies reporting the relationship between distance and outcome for particular groups of patients in a

particular health system/setting without an actual change to service delivery. The second was studies of changes to travel distances/times/outcomes following changes to the health system. These studies generally have observational or experimental design including before-and-after/longitudinal, cohort, case-control or randomised designs.

The initial scoping also identified a third group of studies that used population-level data to examine the associations between population mortality/morbidity and the distance to the nearest hospital. The review is investigating immediate access to care; thus, studies that provided data only for whole populations rather than for particular groups of patients were excluded.

Any identified mixed-methods or qualitative studies that reported perceived effects on patients or services of reconfigurations that increased time/distance to access care were included.

### **Other inclusion criteria**

- Literature published since 2000.
- Literature published in English.
- Grey literature in the form of service evaluations or reports from the UK.

### **Other exclusion criteria**

- Studies that merely describe reconfigurations or initiatives without providing any quantitative or qualitative data.
- Conceptual papers and projections of possible future developments.
- Studies conducted in low- or middle-income country health systems.
- Theses, conference abstracts, articles in professional magazines, books and book chapters.

### ***Data extraction and risk of bias***

We extracted and tabulated key data from the included studies, including study design, population/setting, results and key limitations. Risk of bias was assessed using The Joanna Briggs Institute Checklist for Quasi-Experimental Studies. Data extraction and risk-of-bias assessment were performed by one reviewer with a 10% sample checked for accuracy and consistency.

### ***Data synthesis***

We performed a narrative synthesis structured around the prespecified research questions and outcomes. Overall strength of evidence was assessed using a previously described method. Evidence was rated as 'stronger', 'weaker', 'inconsistent' or 'very limited' based on study numbers and design. Moderating and mediating factors extracted from included studies were summarised using a logic modelling approach.

## **Results**

We included 44 studies in the review. Of these, 12 evaluated the effects of an intervention or change to the health-care system (reconfiguration studies), 30 examined associations between travel distance or time and outcomes in the absence of a specific intervention (association studies), and two evaluated interventions to mitigate the effects of being at distance from an emergency care facility (mitigation studies). Eight studies were from the UK.

Many of the studies were inherently at high risk of bias because there was not an independent control group. In the reconfiguration group, the most common design was before–after and only four studies compared outcomes between settings with and without changes in distance/time.

Most of the included reconfiguration studies reported on changes in mortality rates following reconfiguration. For studies of general urgent and emergency care populations (six studies), there was no evidence that reconfiguration resulting in increased travel time/distance affected mortality rates. This was classed as stronger evidence, being derived from studies with control groups. By contrast, there was evidence of increased risk from studies restricted to patients with acute myocardial infarction (two studies in three publications). Evidence for other conditions was inconsistent or very limited and none of the included studies looked at stroke patients specifically. Evidence on health system outcomes was inconsistent, reflecting the diverse outcomes and settings included.

The association studies found evidence that increased travel time or distance is associated with increased mortality risk for the acute myocardial infarction (10 studies) and trauma (seven studies) populations, whereas for maternity the evidence was inconsistent. There was also weaker evidence of an association from two studies of patients with a range of conditions typically requiring emergency care. Weaker but consistent evidence was found for adverse maternity outcomes and access to thrombolysis for stroke patients being influenced by distance from specialist services.

Studies that reported quantitative estimates of the relationship between travel distance or time and mortality risk varied widely in their methodology. In particular, authors calculated an effect either per unit of distance (e.g. 10 miles or 10 km) or between different distance categories (e.g. highest vs. lowest quintile). This, together with the variety of different outcomes measured (e.g. in-hospital mortality, 30-day mortality or mortality at various follow-up points) makes it difficult to pool outcomes across studies.

The two included mitigation studies provided very limited evidence for the effectiveness of improved service co-ordination for ST elevation myocardial infarction in a US rural setting and of a specialist stroke ambulance in an urban setting.

A summary of findings on factors influencing the effect of distance/time on outcomes is presented in *Figure a*.

For telehealth, we included 12 systematic reviews published between 2010 and 2019. Seven of the reviews were published in 2017 or later. Four reviews dealt with ‘telestroke’, two dealt with trauma care and the remainder dealt with a variety of other telehealth applications. A review of pre-hospital applications concluded that use of telehealth technology to transmit information from the ambulance to hospital and to allow early initiation of treatment can help to mitigate the effects of distance from a hospital emergency department or stroke unit. Real-time telemetry and telemedical pre-hospital notification were identified as complementary applications of the technology in trauma, but evidence of effectiveness in this setting remains limited. Two reviews identified barriers to uptake of telehealth care in pre-hospital settings, including ambulances. Meta-analyses suggested that telehealth technologies can reduce time to treatment for people with stroke and ST elevation myocardial infarction.

## Conclusions

Studies that examined outcomes before-and-after reconfiguration found no evidence that increasing travel time or distance increased mortality risk for general populations of patients attending urgent and emergency care facilities. There was some evidence of an increased risk from studies restricted to

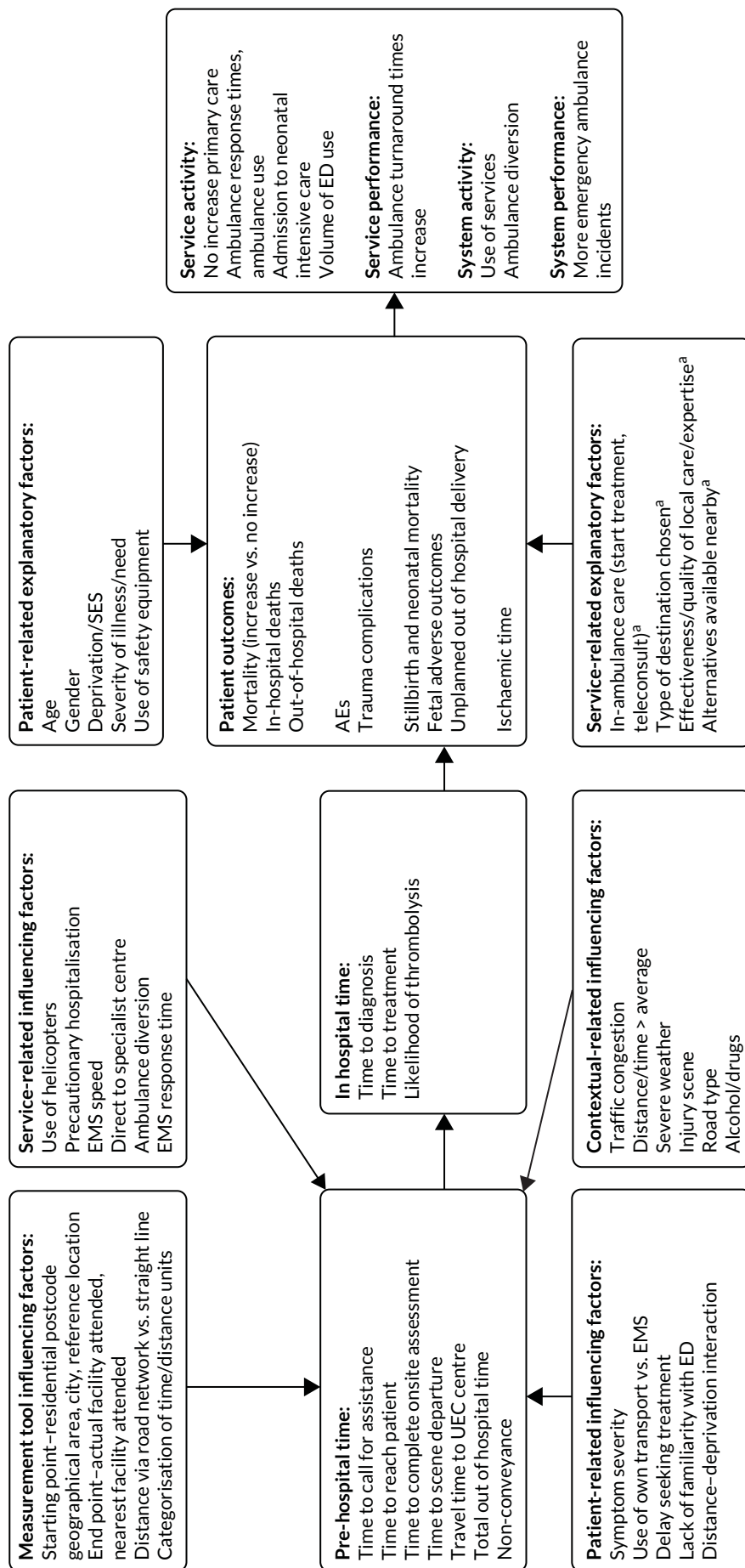


FIGURE a Summary of moderating and mediating factors. a, Potentially mitigating. AE, adverse event; ED, emergency department; EMS, emergency medical services; SES, socioeconomic status; UEC, urgent and emergency care.

patients with acute myocardial infarction, whereas evidence for other conditions was inconsistent or very limited. Studies that examined the association between distance and outcomes in the absence of reconfiguration found evidence of an association between distance and mortality for general, acute myocardial infarction and trauma populations, whereas evidence for maternity was inconsistent.

The relatively low quality of much of the research suggests that findings should be interpreted cautiously.

### **Implications for service delivery**

Based on the included studies, we have identified the following implications for service delivery.

Timely and equitable access to urgent and emergency care is important to all population groups in both urban and rural settings. Ensuring such access requires commissioners and providers of health services to work effectively together, informed by their understanding of the evidence and data relevant to their local context.

Empirical studies of the effects of emergency department closures and reconfigurations have provided insights into how change can be managed to minimise any adverse effects on patients or the stability of the wider health and care system. Important factors include early notification and discussion of planned changes, co-operation between different stakeholders, and appropriate changes to staffing and organisation of the workforce.

Several included studies suggest that the effects of increased travel distance/time on outcomes may be temporary, lasting 1 or a few years. The research suggests that health services may be able to minimise the transition period by measures such as investment in emergency medical services (e.g. ambulance services) and by providing capacity elsewhere before any closures take place.

Another approach to handling increased distance to urgent and emergency care facilities is through new service delivery models. This review has identified a number of different models that decision-makers may wish to consider, including 'hub-and-spoke' telehealth models and facilities for pregnant women from remote regions to travel to a more central facility in advance of their expected delivery date.

Although increased distance to urgent and emergency care is generally discussed in terms of possible risks, included studies also suggested some potential benefits to patients and the health system. Emergency departments may close or be downgraded for reasons to do with quality of care, potentially encouraging patients to use superior services. Reconfiguration of services may encourage hospitals to organise their work more efficiently and a greater volume of patients may enable staff to improve the quality of the care they deliver through increased experience. The review also provides some evidence that closures may reduce self-referral and encourage patients to seek treatment in alternative, more appropriate facilities.

There is a consistent message from both UK and international research about the importance of considering the emergency medical services implications of planned service changes. Ambulance staff cover the whole catchment area of a specialist service, meaning that increased travel distances result in increased job cycle times and more resources needed to maintain the same response to demand.

Health services need to ensure that increases in time or distance to urgent and emergency care are not associated with increased health inequity. We found evidence that people in more deprived areas were less willing/able to travel to attend an emergency department. This suggests that consideration should be given to ensuring that urgent and emergency care services are not located far away from socially deprived areas.

### **Implications for research**

Research is needed in the following areas:

- To examine the longer-term effects of service reconfigurations on the whole urgent and emergency care system and to take into account the impact of other service and technological changes over time.
- To better understand how local and regional health systems plan for and adapt to increases in travel distance/time.
- Data analysis to address uncertainty about how risk increases with distance/time within the range relevant to UK urban and rural populations, and to examine whether or not urgent and emergency care reconfigurations reduce overall demand for emergency department care or merely displace demand to other parts of the health-care system. Data can also be used to examine the nature and extent of variation between different localities with a view to reducing unnecessary variation.
- To assess patient outcomes other than mortality and hospital admission/length of stay. This could include effects of service reconfiguration on families that may incur additional social and financial costs because of increased travel distance/time to visit patients.
- Proposals to reconfigure urgent and emergency care services are often opposed by local communities based on concerns that increased travel distance/time may increase the risk of adverse outcomes. Further research would be valuable to understand public attitudes to risk and preferences for different alternatives. Research could involve a variety of methods including consultation via citizens' assemblies or similar.

### **Study registration**

This study is registered as PROSPERO CRD42019123061.

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