Closing five Emergency Departments in England between 2009 and 2011: the closED controlled interrupted time-series analysis

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Scientific summary

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Background

Emergency care in England is under continued pressure, with demand continuing to increase across the emergency care system. Rising demand for emergency care comes at a time when emergency departments (EDs) are facing a staffing shortage. Significant staffing shortages coupled with rising demand may have implications for the safety of patients. One solution to this may be to concentrate resources in fewer sites by closing some of these EDs or by suspending services during the night. In recent years, a number of EDs have been closed or downgraded to a less acute facility, with NHS planners often citing reasons of inadequate staffing and safety implications. At the inception of this study, there was little research evidence to support decisions about closing EDs.

With further closures planned, this report seeks to establish the implications of this for the population and emergency care providers and, in doing so, to provide patients and the public, the NHS and policy-makers with evidence to inform decision-making about future ED closures.

Objectives

The objectives were to detect changes in:

- the number of NHS ambulance service incidents, and the time to take patients to hospital following the closure or downgrading of an ED
- the number of ED attendances following the closure or downgrading of an ED
- the number of emergency admissions for all conditions, and certain conditions that are relatively rich in 'avoidable emergency admissions', following the closure or downgrading of an ED
- the mortality of patients in emergencies for certain serious emergency conditions (SECs) following the closure or downgrading of an ED.

Methods

Study design

A controlled interrupted time-series analysis of a series of impact measures was undertaken to detect the overall impact of ED closures on the resident catchment populations of five type 1 EDs (based in the towns of Newark, Rochdale, Bishop Auckland, Hartlepool and Hemel Hempstead) that were closed or downgraded between 2009 and 2011. Five control areas were selected. As far as possible, the control areas were selected to provide a close sociodemographic and socioeconomic match to the intervention areas that they were paired with.

Calculation of the resident catchment population

In order to undertake the analysis, a resident catchment population for each of the 10 areas studied was identified. First, a geographical catchment area for the 10 EDs using Department for Transport (DfT) road travel times was identified. Journey times were modelled by the DfT from the centroid of every lower-layer super output area (LSOA) in England to every type 1 ED. For each of the EDs that closed and the control EDs, the set of LSOAs for which the ED had the shortest travel time was identified and this set of LSOAs became the catchment area of the ED. The resident population of each of the 10 catchment areas was used in the analyses.

Documentary analysis

Emergency and urgent health-care systems frequently develop to meet the changing needs of the population. We needed to account for any major changes to services in the emergency and urgent care system, other than the ED closing in the intervention areas, and any other major changes taking place in the control areas. An analysis of NHS annual reports in each of the 10 areas identified a number of major changes to emergency and urgent care system delivery including the introduction of NHS 111, the opening or relocation of a primary or urgent care centre and the diversion of emergency ambulances during the night to a neighbouring ED. These changes were included in the analytic models when assessing the impact measures.

Impact measures included

A number of measures were identified as being useful in understanding the impact of the ED closures on the emergency care system and the local population. We differentiated between primary and secondary measures. The primary measures were:

- Ambulance service activity – the total number of emergency ambulance incidents, the total number of emergency ambulance 'Red' incidents and the mean time from the 999 call being answered to arrival at hospital for 'Red' incidents.
- Emergency and urgent care attendances – the total number of emergency and urgent care attendances at the ED and the number of arrivals at the ED who are discharged without treatment or investigations that required hospital facilities ('minor attendances').
- Emergency hospital admissions – the total number of emergency admissions, the mean length of stay for these admissions and the number of emergency admissions for which admission can sometimes be avoided.
- Death/risk of death – the total number of deaths from SECs occurring within 7 days, the total number of out-of-hospital deaths from SECs and case fatality ratios for all SECs.

Data sources

We obtained Hospital Episode Statistics (HES) accident and emergency (A&E) data, HES admitted patient care data and Office for National Statistics (ONS) data from NHS Digital (previously the Health and Social Care Information Centre). In addition, mortality data were obtained from the ONS, journey times from the LSOA to type 1 ED were obtained from the DfT and ambulance service activity data were obtained from six English ambulance services.

Plan of analysis

We used a controlled interrupted time-series approach across 48 months (24 months pre and 24 months post ED closure). Specifically, we analysed the data in three ways.

1. We fitted a time-series regression model to the time series for the closure area, using a negative binomial model (for counts) and a Prais–Winsten model (for other types of data), to test for preliminary evidence that activity or performance had changed at the time of the ED closure. The model consists of a season effect, a linear time trend, terms for before and after the time when the site ED was downgraded or closed, and a before-and-after step term for any other potentially important changes introduced into the site (model 1).
2. We built on model 1 by adding a control site and comparing changes in each closure area catchment population with the changes in the corresponding control site catchment population (model 2).
3. We replaced the 'step model' (model 1) with a 'dose model'. In the dose model, instead of modelling the average effect across the whole of the closure area's catchment area, we made use of the fact that different parts of the catchment area might be differentially affected by the closure of an ED. For example, following a closure, the change in time from the LSOA to the nearest ED typically varied from 0 minutes to about 20 minutes. We dichotomised all of the LSOAs in the catchment area into 'high-dose' areas (with a change in travel time above the median change in time) and 'low-dose' areas (below the median change in time). We then fitted the interrupted time-series model (model 1), but compared high-dose and low-dose areas rather than closure and control areas (model 6).

For each of the impact measures, we then combined the results from the five individual areas to estimate the average effect of the closure of the five type 1 EDs included in this study.

Results

There was significant heterogeneity in the results for most of the outcome measures between sites.

Statistical analyses of the five ED closure areas were combined, following the closure, for residents of the catchment area affected by an ED closure.

Ambulance service performance

There was some evidence of a large increase of 13.9% [95% confidence interval (CI) 3.5% to 24.4%] in the total number of emergency ambulance incidents compared with the control areas. A similar increase (12.3%, 95% CI 3.5% to 21.1%) was also evident in the total number of emergency ambulance 'Red' incidents. Regarding the mean time taken from a 999 'Red' call being answered to arrival at hospital, there was an increase of 3.9 minutes (95% CI 2.2 to 5.6 minutes). However, a lack of reliable data did not allow comparison with the control areas.

Emergency and urgent care attendances

No consistent effects were found regarding the emergency and urgent care attendance measures. The model estimates suggested that, on average across the sites, there was a decrease in the total number of attendances at an emergency or urgent care department and also a decrease in those minor attendances of patients who were discharged without treatment or investigations that required hospital facilities. However, the evidence was not statistically reliable.

Emergency admissions

No consistent effects were found regarding the emergency admission measures. There was some statistically unreliable evidence of a decrease on average across the sites in emergency admissions and in those admissions that were 'potentially avoidable'.

Mortality

The estimates relating to the impact on mortality were much more consistent across sites, but they also found no statistically reliable evidence to suggest a change in the number of deaths following an ED closure in any site or on average across all sites. However, there was some evidence to suggest that, on average across the five sites, there was a small increase in an indicator of the 'risk of death' for specific emergency conditions when compared with the five control areas studied.

Population now living further away from the nearest emergency department

For those residents whose distance to an ED changed the most when their local ED closed, there was strong evidence of an increase in the mean time from their 999 call being received to arriving at hospital of 9.1 minutes (95% CI 4.8 to 13.5 minutes) compared with those whose distance changed least. There was some statistically unreliable evidence of a decrease in the number of emergency and urgent care attendances and emergency hospital admissions.

Conclusions

The impact measure that is probably of most importance to the public, health-care providers and policy-makers is mortality. The public, in particular, requires reassurance that the closure or downgrade of an ED does not result in increased death rates within the population. In the five geographical areas studied here, there was no statistically reliable and consistent evidence of an increase in deaths among the population from SECs in the period following the reorganisation of care. This suggests that any negative effects caused by increased journey

time to an ED can be offset by other factors; for example, if other new services are introduced and care is more effective than it used to be or if the care received at the now-nearest hospital is more effective than that provided at the hospital where the ED closed.

Given such a major reorganisation of emergency and urgent care, we might expect there to be some changes in emergency and urgent care activity. This was apparent in our study.

Nationally, ambulance service call volumes in England continue to rise. Our study found some evidence of an increase in emergency ambulance incidents on average across the five sites, over and above the increase in the control area. This suggests that the ED closures studied here may have contributed to an additional increase in workload within these areas.

As with ambulance service call volumes, there is also a national trend towards increasing numbers of attendances at EDs and emergency hospital admissions. However, our study found no statistically reliable and consistent evidence of an impact of the ED closures on hospital activity, although the direction of change pointed to a decrease in activity on average.

Recommendations for further research

Although our study has determined the impact of closing or downgrading EDs, we have identified further opportunities for research to further inform reorganisation.

- This study relied wholly on routine data and was designed to highlight the effects of ED closure rather than provide an understanding of why the effects were evident. In order to further understand why an effect is apparent, it is often necessary to investigate this as the change happens in practice. Given that further ED closures are imminent, we see value in undertaking further data collection as reorganisation happens, in real time. We believe that there are four important areas to consider:

    1. Why are there differences in impact in different places when EDs close?
    2. What processes are used by commissioners and health-care providers to implement reorganisation in order to minimise any adverse effect on local populations and health services?
    3. How do patients experience reorganisation? Do patients change their help-seeking behaviour following reorganisation and how does this affect their satisfaction with care?
    4. What is the effect on neighbouring areas? Are hospitals able to absorb any additional workload? What are the implications for the population in these areas? Is there any impact on the workforce in these areas in terms of satisfaction?

- Without doubt, emergency care is expensive. The average 2015/16 cost of an A&E attendance was £138 and the average cost of a non-elective inpatient stay was £1609. The closure or downgrade of a type 1 ED may have financial implications both in and out of hospital. An economic evaluation to identify the cost consequences of such reorganisation on the emergency and urgent care system as a whole may be useful.
- This study looked at the impact on emergency care performance only, namely the ambulance service, EDs and emergency admissions. Analysis of the wider health system should be considered; for example, to understand if such reorganisation of care has any impact on primary care.

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