Investigating the impact of out-of-hours GP services on A&E attendance rates: multilevel regression analysis

Summary

This paper sets out how we used an analytical technique called multilevel regression modelling to investigate the factors affecting levels of attendance at accident and emergency (A&E) departments by patients registered at a GP practice.

Background

In September 2014, our report on *Out-of-hours GP services in England* (HC 439, Session 2014-15) examined the performance and assurance arrangements for out-of-hours GP services. These services operate from 6.30pm to 8.00am on weekdays and all day at weekends and on bank holidays. As part of this study, we carried out a regression analysis to gain insight into the impact of out-of-hours GP services on levels of attendance at major (type 1) or single-specialty (type 2) A&E departments.

In 2013, NHS England began a review of urgent and emergency care, which suggested that the quality of, and access to, out-of-hours GP care are strongly associated with levels of A&E attendance. However, a patient's decision to attend A&E could be influenced by a range of factors in primary, community and social care, as well as how easy it is for them to access A&E. A recent study suggested that most of the variation in levels of A&E attendance could be explained by differences in the underlying patient population; and that better access to primary care, including in-hours GP care, is also associated with lower rates of A&E attendance.[1]

Method

We used a **multilevel regression model** to investigate whether, and to what extent, the levels of A&E attendance by patients registered at a GP practice is affected by out-of-hours GP services, controlling for other known factors such as gender, age and deprivation.

NHS services are organised in a hierarchical structure (**Figure 1**). While in-hours primary care is provided by individual GP practices, an estimated 90% of practices have opted out of providing out-of-hours care. Local commissioners are responsible for commissioning these out-of-hours services. Since April 2013, clinical commissioning groups have performed this role; however, during the period for which we had relevant data the role rested with their predecessors: primary care trusts (PCTs).

Variations in levels of A&E attendance could have been due to differences in:

- services provided at the PCT level (or common cultural and environmental factors within PCTs which might have affected all GP practices within that area);
- the performance of individual GP practices within each PCT; or
- the characteristics of the underlying population registered with each GP practice or PCT.

Given this hierarchical structure and the number of PCTs (151), a simple linear regression is not particularly suitable for separating the PCT-level and practice-level effects.

A multilevel regression model, however, allows us both to control for the characteristics of the underlying population and other service factors, and to account for possible correlations between GP practices within each PCT.

We used the multilevel model to examine whether, and the extent to which, the variation in levels of A&E attendance (our dependent variable) could be explained by variations in the:

- performance of out-of-hours GP services;
- performance of overall GP services;
- provision or performance of other services including community health services and social care; and
- provision of A&E services in an area.

The statistical package used for the modelling was SPSS.

Figure 1
Hierarchical service structure in the NHS before April 2013
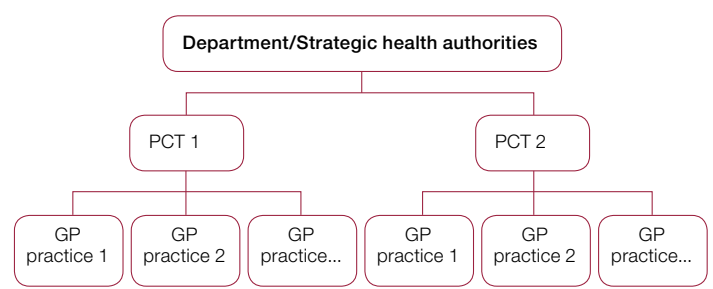
1   TE Cowling et al, Access to Primary Care and Visits to Emergency Departments in England, PLOS ONE, June 2013.

Data

The dependent variable for the model was the level (rate) of A&E attendance by GP practice per 1,000 registered practice population by age group. We analysed A&E attendance at all times (ie *overall*) and A&E attendance during out-of-hours separately to test whether the association between out-of-hours GP care and A&E attendance is time dependent.

We calculated a rate of A&E attendance using data from hospital episode statistics for 2012-13 and the population profile for each GP practice for 2012 published by Public Health England. Any age group with a registered practice population of less than 25 (small numbers) or an attendance rate of 3,000 or more per 1,000 population (outliers) was excluded from the analysis.

Multilevel regression models assume that the dependent variable is *normally* distributed (ie a bell curve). As the A&E attendance rate had a skewed distribution, we applied a (logarithmic) data transformation (**Figure 2**). Due to this transformation, the estimated association between the rate of A&E attendance and the explanatory variables are rate ratios.

Figure 2

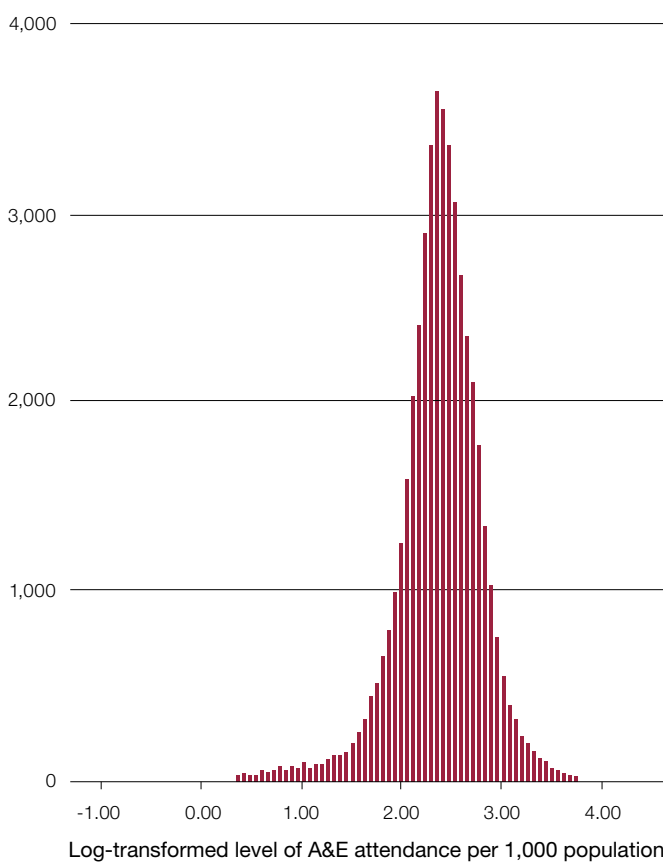Effect of data transformation on the distribution of A&E attendance rates

Before transformation

Number of patient groups

Level of A&E attendance per 1,000 population

After transformation

Number of patient groups

Log-transformed level of A&E attendance per 1,000 population
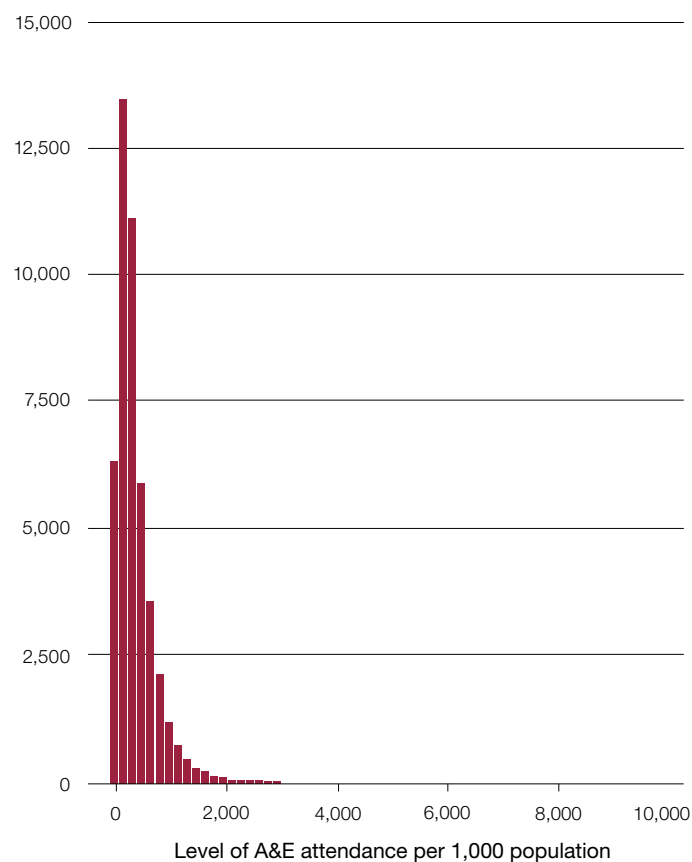
Note
1   Patients were grouped by GP practice and age category (5 years).

The explanatory variables we used were:

- characteristics of the underlying population registered at each GP practice – age, gender, ethnicity, level of morbidity and socio-economic deprivation;

- indicators for the performance of out-of-hours GP services – satisfaction with, and awareness of, out-of-hours GP services (as reported in the GP Patient Survey 2012 for each GP practice) – and types of service provider (NHS body, commercial organisation or social enterprise);

- indicators for the performance of overall GP services – satisfaction with, and access to, overall GP services (as reported in the GP Patient Survey 2012 for each GP practice), the size of GP practice and location of GP practice (rural or urban);

- other health and social care service indicators – level of delayed discharges due to social care, and community health services spending as a proportion of total PCT spending; and

- access to A&E services – direct distance between the GP practice where a patient is registered and its closest major A&E unit.

To see if there would be any added value in using a multilevel regression analysis, we ran an initial analysis of variation without any explanatory variables. Most (80%) of the variation in the level of A&E attendance (log-transformed) is associated with variation at the GP practice level, with about 20% of the variation attributable to factors at the PCT level, indicating that there would be added value in using a multilevel regression model as opposed to a simple linear model.

Results

Characteristics of the underlying population (including age, gender and socio-economic deprivation) explain most of the variation that could be explained with the model.

There are some regional variations in the level of A&E attendance even after controlling for the other explanatory factors included in the model: people from the East of England and South Central regions are least likely to attend A&E overall while people in London are most likely to attend A&E out-of-hours.

The relationship between awareness of out-of-hours GP services and A&E use is complex. The model suggests that higher awareness of, and patient satisfaction with, out-of-hours GP services may not reduce demand in major A&E departments.

PCTs with better patient awareness of out-of-hours GP care have a lower rate of attendance at A&E during out-of-hours – a 1% increase in out-of-hours care awareness is associated with a 2% reduction in the rate of out-of-hours A&E attendance. However, awareness is not associated with the level of overall attendance at A&E; this may suggest that some of the avoided out-of-hours A&E attendance is being delayed rather than avoided.

We found no association between the perceived quality of out-of-hours care as measured by the GP Patient Survey and the rate of A&E attendance both overall and during out-of-hours only.

We also found that:

- The satisfaction with overall GP services is significantly associated with the level of attendance at A&E both overall and during out-of-hours only. A 1% increase in 'patients satisfied with their GP practice's opening hours' is associated with a 1% reduction in A&E attendance.

- Patients registered with larger GP practices are less likely to attend A&E – on average, for every extra GP in a GP practice, there is a 4% reduction in the rate of A&E attendance.

- Patients from GP practices closer to a major A&E unit are more likely to attend A&E. For every kilometre further away from a major A&E unit, the level of attendance by a practice's patients is 2% lower during out-of-hours and 1% lower overall.

- PCTs spending a higher proportion of their budget on community health services also have a lower rate of A&E attendance – a 1% increase in the proportion of spending on community services is associated with a 3% reduction in the level of A&E attendance.

Limitations

Most of the data we used are from publicly available, administrative performance data and have not been quality assured by us. For our analysis, only type-1 and type-2 A&E attendance were included. Some hospitals may not record the types of A&E attendances consistently which could contribute to the observed variations. Other factors we have not controlled for include the impact of other types of emergency and urgent care services, for example ambulance services and walk-in centres. Due to these limitations, the results should be interpreted cautiously.