Title:

Population variation in admission rates and duration of inpatient stay for bronchiolitis in England

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**Introduction**

Bronchiolitis is a seasonal respiratory infection of viral origin, most often caused by human respiratory syncytial virus. Disease varies in severity from mild coryza to respiratory failure. Up to a third of all infants are affected by the age of one year. While most cases are managed conservatively in the community, about 2% of all infants in industrialised countries are admitted to hospital for symptomatic support. This typically involves gavage feeding and supplemental oxygen, but may in some cases involve mechanical ventilation(1)

The seasonal epidemic nature of bronchiolitis means healthcare resource planning and other care is disproportionately affected by the surge of bronchiolitis admissions. Hospital admission and duration of inpatient stay disrupts family life and can impact upon carer’s finances. A recent NHS publication has identified the need to investigate the impact of healthcare-related factors on health outcomes.(2)

The objective of this study was to explore the variation in hospital admission rates and length of stay (LOS) for bronchiolitis across England. We interrogated the broader local healthcare system using data analysed by population rather than by individual provider institutions, since requirement for admission and discharge planning are not solely based on hospital practices, but also reflect the quality and accessibility of primary care services and community support for families to safely and confidently care for affected children at home.

**Methods**

Hospital Episode Statistics (HES) were used to identify all children aged below 2 years who were discharged from hospital with a primary code of bronchiolitis (ICD-10:J21) in England, between 1 April 2007 and 31 March 2010 ([www.who.int/classifications/icd/en/](http://www.who.int/classifications/icd/en/)).

Although bronchiolitis classically affects infants below one year of age, the 2-year age limit was used to include those children at higher risk of developing severe bronchiolitis beyond the age of one year (e.g. those with underlying respiratory disease or significant congenital heart disease).(1)

The chosen population boundary by which to analyse the data was the Primary Care Trust (PCT). The population of each PCT is served by a single commissioning body, which has sole responsibility for healthcare provision for that population. Analysis by commissioning boundaries allows more meaningful analysis in terms of outcomes for that population, and reduces the impact on data analysis of local healthcare system factors such as idiosyncrasies in referral patterns or in the practice of individual hospital providers.

HES entries for individual patients were linked to PCT by GP registration. Admission rates were calculated per 100,000 children aged under 2 years in each PCT. Mean LOS (by whole day) was calculated for total admissions in each PCT. All data were standardized by population of children under two years in each PCT using figures from the Office for National Statistics.

The degree of variation is presented as the Coefficient of Variation (CV) (i.e. [standard deviation]/[mean]), which quantifies the variation of the mean measured rate from the norm (i.e. a CV of 0.10 would show that a PCT’s average rate is 10% above or below the national average rate).

The Spearman’s rank correlation (r, ranging from 0 to +/-1) was used to elicit the effect of socioeconomic deprivation on admission rates and LOS using the Indices of Multiple Deprivations 2010 (IMD2010) value (<http://www.communities.gov.uk/documents/statistics/pdf/1871208.pdf>), a composite figure for average level of multiple deprivations within each PCT.

**Results**

In the three-year period, there were a total of 75,318 admissions in children under 2 years old for bronchiolitis (ICD-10:J21) across all 152 PCTs in England .

There was a fifteen-fold variation across PCTs in England in the admission rate for bronchiolitis (351 to 5140 admissions per 100,000 children aged under 2 years; CV=0.43) (Figure 1) There was a six-fold variation across PCTs in England in LOS for children with bronchiolitis (0.7 to 4.1 days; CV=0.27) (Figure 2)

Rates of hospital admission by PCT were positively correlated with socioeconomic deprivation as measured by IMD2010 values (r=0.332, p<0.0001). (Figure 3) LOS showed no correlation with socioeconomic deprivation (IMD 2010) by PCT (r=0.129, p=0.114)

**Discussion**

There is significant variation in the rates of admission and LOS for infants with bronchiolitis across England.

Much of the literature on bronchiolitis has shown that incidence and severity of illness correlate positively with measures of socioeconomic deprivation. A recent report suggests that it is the link between multiple deprivations and household smoking that drives this, rather than deprivation *per se* (3). Our findings mirror this, with LOS showing no correlation with deprivation, suggesting that the six-fold variation is likely to be associated with other factors.

Although admission rates were positively correlated with deprivation, the correlation is modest (r=0.332, p<0.0001). In particular, on interrogating the data for the PCTs at either extreme of deprivation, we find considerable variation even amongst PCTs of similar socioeconomic profile. The magnitude of variation is over fifteen-fold even amongst the ten most deprived PCTs (range 351.5 to 5139.6 admissions per 100,000 children, CV=0.62) and three-fold amongst the ten least deprived (range 838.9 to 2297.5 admissions per 100,000 children, CV = 0.35).

Based on this data, socioeconomic deprivation alone does not account for the magnitude of variation shown. Other factors known to affect incidence and severity of bronchiolitis include premature birth, low birth weight, low admission weight, young age and household smoking(3). Of these, only young age is not correlated with socioeconomic deprivation, but it is extremely unlikely that, over the three-year study period, there would be significant variation among PCTs of age range for children below the age of 2 years.

Other factors must therefore be influencing the variation in rates of admission and LOS. Variation in clinical management is one likely factor. Evidence already exists to suggest that variation in the threshold for oxygen supplementation and criteria for admission and discharge for bronchiolitis have a significant impact on LOS (4). More broadly, bed capacity in children’s inpatient units has been shown to be positively correlated with rates of discharge from hospital (5). In the absence of other explanatory causes, we believe that these healthcare provider factors are likely to contribute to the variation demonstrated.

A major limitation to the study is in the quality of the source data. Not only is data coding for HES reportedly inconsistent, it also limits the analysis to whole-day admissions, which may not reflect the trend towards zero-day “short-stay ward” admissions for bronchiolitis. This may partially explain why single-study reports have yielded less dramatic variation in admission rates and duration than we have shown. Additionally, diagnosis can be clinically challenging, particularly in children in the second year of life, which may be another source of variation.

Admission rates for asthma and epilepsy in children have also been shown to vary substantially (2), suggesting that variation is likely to be due to both disease-specific care processes and broader system-wide factors. Research into the effect of these factors in the wider context of other paediatric conditions would be an important next step in reducing variation.

**Conclusion**

We speculate that healthcare provider factors manifested by variation in clinical decision-making are responsible at least in part for variation in rates of admission and LOS for children with bronchiolitis in England. These factors are likely to include thresholds for admission and discharge; and variation in therapies. Further research is required to identify which specific factors are having the greatest effect, in order to reduce unnecessary admissions and the burden this places on families, children and the wider healthcare economy.

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