

## Rising Emergency Admissions in the UK and the Elephant in the Room

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### Abstract

Growth in emergency medical admissions in the UK is not following trends consistent with the assumed mechanisms of growth. Is 'policy-based evidence' ignoring the existence of very large outbreaks of a novel infectious agent?

**Keywords:** Emergency care systems; Acute medicine; Deaths/mortality; Dementia; Epidemiology

### Introduction

It is clear that the demand on the NHS in the UK is rising, and that innovation is required to meet the demand in cost effective ways. Rising numbers of elderly people require non-acute solutions to their end-of-life care [1].

However, it is intrinsically incorrect to assume that deficiencies (real or perceived) in how health care services may be currently delivered are in some way causative of rising demand, rather than contributory to rising demand.

In this respect, my interest in unusual growth in emergency medical admissions was triggered in the early 1990's when a series of 'events' in 1993, 1996 and 1999 led to a period of very high and unexplained growth. The literature surrounding these events has been recently reviewed [2], and unexpected evidence for spatiotemporal patterns similar to those expected from an infectious event has since emerged [3-6].

### Actual versus expected growth

As an example of the disparity between actual and expected growth in emergency admissions, Figure 1 shows a running 12 month total of emergency admissions in England commencing with the 12 month period April 2007 to March 2008. By definition, each point on a running 12 month total chart increments forward by 1 month and gives the running total, hence the second data point in this chart is the total from May 2007 to April 2008, etc.

One of the benefits of a running 12 month total is that underlying seasonality is largely removed from the trend, and that sudden and unexpected step-like changes in activity are revealed as a ramp with onset of the step-change at the foot of the ramp (Figure 1). Also displayed on Figure 1 is the increase in emergency admissions expected due to the ageing population (change in the total population plus change in the age structure).

This chart clearly shows that demand is rising far faster than implied by population growth and change in the age structure, and also partly explains why emergency services are currently struggling to deal with

the demand since current staffing and physical capacity have not risen in parallel.

### Explaining the trend

Figure 1 requires some further explanation. Firstly, the magnitude of the change during the '2008 event' was slightly exaggerated due to ongoing growth in zero day stay emergency 'admissions' arising out of the 2002 A&E four-hour target [7]. However, the contribution from this factor diminished over time such that while emergency admissions increased 3.8% between 2013/14 and 2014/15, the proportion of these which were zero day stay only rose one percentage point from 27.4% to 28.4% respectively [8]. These figures are apposite since the two years span the 2014 'event', and the peculiar increase therefore arises more so from overnight stay admissions than from zero day stay admissions.

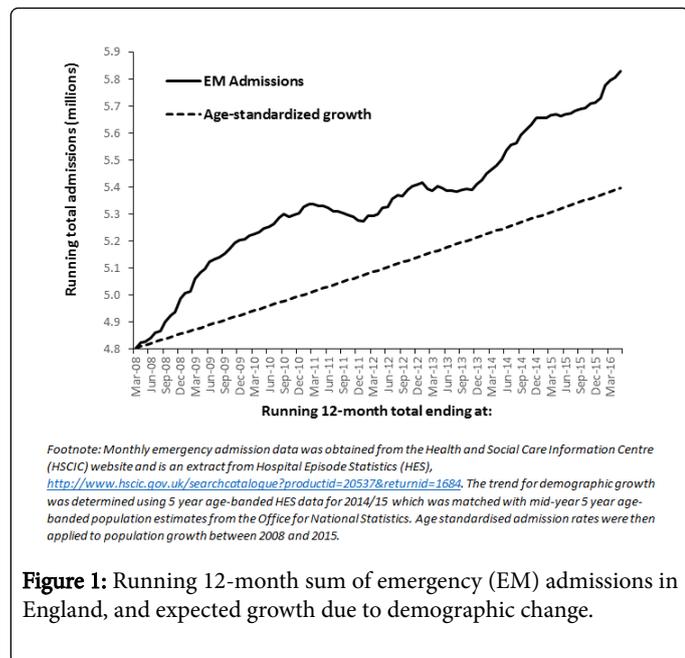
Secondly, while the initiation for the 2012, 2014 and 2016 'events' may be obvious those for 2008 and 2010 are not. These dates have been identified by a parallel change in the total number of deaths (all-cause mortality) occurring at these points [9], and this is demonstrated in Figure 2. In addition, the onset of these events are also marked by a sudden increase in emergency department (ED) attendances, an unexpected increase in sickness absence [10], and a wobble in the gender ratio at birth [11]. The assumptions within the calculation of hospital mortality also appears to be invalidated by these events [12]. The 2008 event was also marked by unexplained increases in GP referral which swept across the whole UK (not just England) [13]. While this increase in GP referral is more subdued during the other events, changes in the ratio of follow-up to first attendance also occur in parallel to the changes in deaths, medical admissions and A&E attendances [10]. It would also seem that the unexplained growth in emergency admissions is matched by a parallel unexplained growth in adult appendicitis (especially with increasing age), with inflections in the trends at the onset of the 'events' [14]. These events can be traced back to the 1950's [9], and cannot be attributed to a recent period of austerity in health and social care budgets, as some have claimed [15]. Although along with other factors; austerity may well be a contributory but not a causative factor [2].

The next intriguing fact is that during these events both deaths and medical admissions show evidence for spatial spread within the UK. Such differences in the point of onset can be observed at both local authority level and at very small area level within each local authority, i.e. there is both inter- and intra-local authority spread [3-6]. Factors

relating to acute admission thresholds (and counting of zero day stay admissions) have been excluded as a possible cause. This was achieved by investigating the small area behaviour within the catchment population of a number of acute hospitals during the 2008, 2010 and 2012 events [3-6,10]. Hence Figure 1 is actually a composite picture of small-area changes across the whole of England.

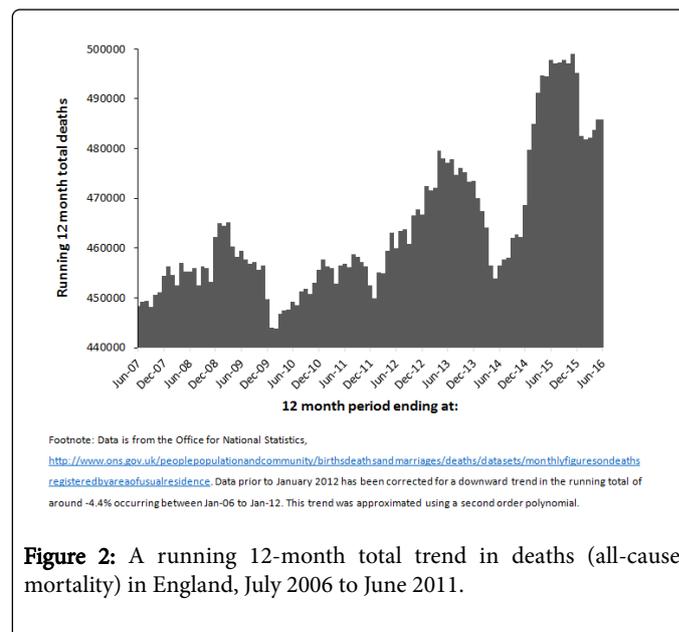
Lastly, in a running 12-month total chart the recurring 'ramp-like' features which appear to be associated with periods of high growth, are in fact indicative of explosive growth. This explosive growth occurs in an almost step-like fashion, such that the foot of the ramp marks a sudden transition to higher admission rates, i.e. in a running total a sudden increase in admission rates takes 12 months for the step-change to be fully reflected in the running 12-month total. It is this sudden change in admission rates (and persons approaching death) which overwhelms the resources in secondary, primary and social care.

Whatever else may or may not be happening, it is also becoming increasingly clear that those suffering from neurological disorders (Alzheimer's disease, dementia and Parkinson's disease) are especially prone to dying during the periods delineated by these events [16,17].



However, there are additional differences between Figures 1 and 2. Firstly, deaths mainly occur in those aged over 85 while admissions occur mainly above age 65, hence the two Figures reflect the impact of the events/outbreaks on different age groups.

This mismatch between ages therefore appears to partly explain the differences in behaviour between Figures 1 and 2. In addition, those who die can no longer be admitted, while those infected (but still alive) can go on to have further admissions.



**Figure 2:** A running 12-month total trend in deaths (all-cause mortality) in England, July 2006 to June 2011.

### The Link between Deaths and Admissions

While deaths in Figure 2 generally revert back to the baseline after each event/outbreak (see below for discussion of the 2016 event), it is evident that emergency admissions (Figure 1) attempt to revert back but the next outbreak lifts the total to a new high before this can fully occur. Something similar to a persistent infection appears to be occurring.

Deaths and emergency admissions are primarily linked via the fact that emergency admissions mainly occur during the last 6 months of a person's life [1,18], hence it is the marginal changes in total deaths (as opposed to age-standardized mortality) which lead to marginal changes in emergency admissions.

During these events there are somewhere in excess of 10 additional emergency admissions for every additional death [2,19].

### A Further Outbreak in 2016

Since 2000 these events appear to have occurred every two years and both Figures 1 and 2 indicates the possibility of a 2016 outbreak. Tables 1 (England and Wales) and 2 (London) gives the likely dates for onset of the 2016 event/outbreak in the 80 largest regions and counties in England and Wales and also for London.

Typical spread between regions and counties is seen in Tables 1 and 2. Both West Midlands and Yorkshire and the Humber appear to have the highest proportion (46% of counties/cities) of early initiation in Feb-16.

Also included at the bottom of Table 1 are the results for the local authority areas in Berkshire where the spread of this agent was studied in detail during the 2012 event/outbreak [3]. As in this previous study, Slough appears to initiate early in the outbreak [3].

Table 2 also appears to confirm previous results for a generally later start for these outbreaks in London [9], which has the lowest population average age in the UK, with 45% of local authority areas initiating after April 2016.

As has been previously noted admissions appear to initiate around one month before deaths [19], i.e. illness precedes eventual death, strongly implicating an infectious etiology. This is seen in the one-month difference in the inflection (initiation) points between Figures 1 and 2.

Region	County	16-Feb	16-Mar	16-Apr	16-May	16-Jun	16-Jul
England	Entire Country		→				
East	Cambridgeshire		→				
East	Central Bedfordshire			→			
East	Essex		→				
East	Hertfordshire			→			
East	Norfolk			→			
East	Suffolk				→		
East	Entire Region			→			
East Midlands	Derby		→				
East Midlands	Leicester						
East Midlands	Leicestershire		→				
East Midlands	Lincolnshire	→					
East Midlands	Northamptonshire			→			
East Midlands	Nottingham				→		
East Midlands	Nottinghamshire				→		
East Midlands	Entire Region				→		
London	Barnet					→	
London	Bromley			→			
London	Croydon						→
London	Outer London			→			
London	Entire Region			→			
North East	County Durham		→				
North East	Newcastle on Tyne						→
North East	Sunderland				→		
North East	Tyne and Wear				→		
North East	Entire Region		→				
North West	Bolton			→			
North West	Cumbria			→			
North West	Greater Manchester		→				
North West	Lancashire		→				
North West	Liverpool	→					
North West	Manchester		→				
North West	Merseyside		→				
North West	Sefton			→			
North West	Stockport					→	

North West	Wigan		→				
North West	Wirral						→
South East	Arun		→				
South East	Buckinghamshire						→
South East	East Sussex		→				
South East	Hampshire		→				
South East	Kent		→				
South East	Oxfordshire	→					
South East	Surrey			→			
South East	West Sussex				→		
South East	Entire Region		→				
South West	Bristol	→					
South West	Devon		→				
South West	Dorset	→					
South West	Gloucestershire		→				
South West	Somerset		→				
South West	Wiltshire						→
South West	Entire Region		→				
Wales	Cardiff	→					
Wales	Swansea		→				
Wales	Entire Country		→				
West Midlands	Birmingham	→					
West Midlands	Coventry						→
West Midlands	Dudley			→			
West Midlands	Sandwell				→		
West Midlands	Shropshire			→			
West Midlands	Staffordshire					→	
West Midlands	Stoke-on-Trent						→
West Midlands	Walsall	→					
West Midlands	Warwickshire	→					
West Midlands	Wolverhampton	→					
West Midlands	Worcestershire	→					
West Midlands	Entire Region	→					
Yorkshire and Humber	Bradford	→					
Yorkshire and Humber	Doncaster	→					
Yorkshire and Humber	East Riding						→

Yorkshire and Humber	Kirklees			→			
Yorkshire and Humber	Leeds			→			
Yorkshire and Humber	North Yorkshire	→					
Yorkshire and Humber	Rotherham			→			
Yorkshire and Humber	Sheffield				→		
Yorkshire and Humber	South Yorkshire	→					
Yorkshire and Humber	Wakefield						→
Yorkshire and Humber	West Yorkshire	→					
Yorkshire and Humber	Entire Region	→					

Monthly deaths in England and Wales by area of residence were obtained from the Office for National Statistics. A running 12-month total was constructed and initiation was assumed to occur in the month after a minimum of deaths was seen in the running 12-month total.

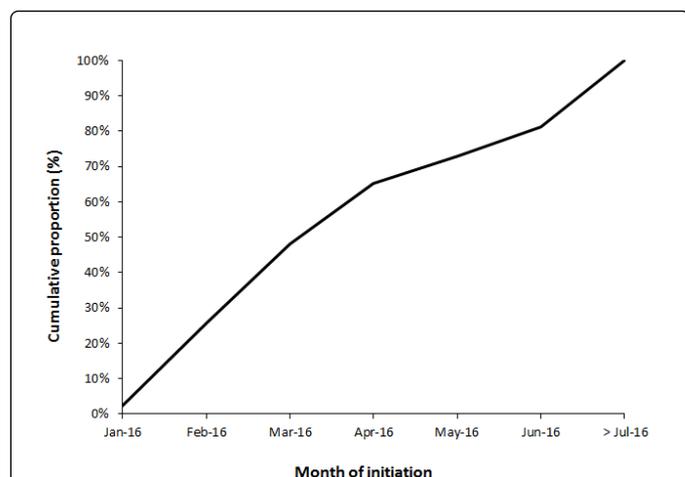
**Table 1:** Likely apparent initiation date for a 2016 outbreak based on monthly deaths. (A Jul-16 date indicates that initiation may occur in or after July 2016. Initiation date for the larger regions will be driven by the largest population groups affected by the outbreak).

Region	Local Authority	16-Feb	16-Mar	16-Apr	16-May	16-Jun	> Jul-16
London	Total			→			
Inner London	Total						→
Inner London	Camden						→
Inner London	City of London	→					
Inner London	Hackney					→	
Inner London	Hammersmith and Fulham						→
Inner London	Haringey	→					
Inner London	Islington						→
Inner London	Kensington and Chelsea	→					
Inner London	Lambeth		→				
Inner London	Lewisham			→			
Inner London	Newham						→
Inner London	Southwark			→			
Inner London	Tower Hamlets			→			
Inner London	Wandsworth	→					
Inner London	Westminster			→			
Outer London	Total			→			
Outer London	Barking and Dagenham						→
Outer London	Barnet					→	
Outer London	Bexley			→			
Outer London	Brent				→		
Outer London	Bromley			→			

Outer London	Croydon						→
Outer London	Ealing		→				
Outer London	Enfield						→
Outer London	Greenwich				→		
Outer London	Harrow				→		
Outer London	Havering		→				
Outer London	Hillingdon					→	
Outer London	Hounslow	→					
Outer London	Kingston upon Thames		→				
Outer London	Merton		→				
Outer London	Redbridge				→		
Outer London	Richmond upon Thames						→
Outer London	Sutton		→				
Outer London	Waltham Forest			→			

**Table 2:** Likely apparent initiation dates for local authority residents in London.

The situation preceding the 2016 event is somewhat concerning. As in previous events, deaths are supposed to revert back to the baseline position following cessation of the event. This does not occur following the 2014 event, and deaths then jump to a new higher level. In a running 12 month total a spike in deaths arising from the Jan-2015 influenza event will have left the running total by Dec-15 (as seen in Figure 2).



**Figure 3:** Cumulative proportion of initiation in 256 local authorities (England and Wales) with fewer than 1,500 deaths per annum.

However, it has been proposed that the 2014 event may have interacted with the influenza outbreak in January 2015, with this interaction possibly potentiated by vaccination of the population (in late 2014) with a poorly matched vaccine [8,19]. This remains conjecture, but requires urgent investigation.

These events/outbreaks show variable levels of synchrony ranging from very low in the 2010 outbreak to very high in the 2014 outbreak. In this respect, Figure 3 suggests that the 2016 outbreak may have exhibited unusually high synchrony with 65% of smaller local authority areas initiating by April 2016. Further investigation is required to examine if the Jan-15 influenza outbreak acted to enhance the synchrony in the 2016 event/outbreak.

An estimate of the increase in deaths due to the 2016 event/outbreak can be determined by extrapolating the slope of the running total to the point 12 months from initiation. Hence in England and Wales deaths actually jumped (step-increase) to around 530,000 per annum, while the baseline position should have been somewhere around 485,000 deaths per annum, i.e. the 2016 event/outbreak has added somewhere around 45,000 extra deaths (and by extrapolation at least 450,000 extra emergency admissions). The figure of 45,000 extra deaths is roughly in line with previous events [2,9].

We need to ask the question as to why are notification of these events/outbreaks being left to an individual researcher rather than the usual route via government agencies, along with appropriate public health measures?

### The events are international in scope

A potential criticism of this work is that a genuine infectious outbreak would not be confined to the UK. In this respect the same behaviour has been demonstrated across 27 European Countries [2], and also in Australia, New Zealand and the USA [20,21].

Unpublished analysis reveals the same behaviour in Canadian provinces. Also note that the four counties comprising the UK run separate health care systems with different funding, organisation and policies – yet the same events occur across each country [2].

## Conclusion

Clearly something highly unusual is occurring, leading to spurts of far higher growth in both deaths and emergency attendances/admissions than could otherwise be anticipated. It is mathematically impossible for this behaviour to be replicated in both deaths and emergency admissions (mostly medical), at all levels of geographic size, and roughly synchronously around the world. These events appear to evade traditional disease surveillance methods by virtue of the unique kinetics of spread, and duration of the effects of 'infection' [22].

While I have proposed that these unusual events may be due to a novel type of infectious outbreak involving a relatively difficult to transmit agent [19], it is important that others investigate further. We need to uncover root causes, rather than assuming it is all to do with an ageing population and/or deficiencies in the way in which care is delivered [8].

The NHS is a very political arena, and it is suspected that anything which contradicts the policy direction (such as Figures 1 and 2) is never shown to the NHS (nor the public) least they question the wisdom of the science behind current policy. Indeed, my attempts to raise this issue with UK government agencies appears to have been met with 'discreet' silence, and one can only assume that the discovery is politically embarrassing, and conflicts with the accepted wisdom of 'policy-based evidence'.

## Conflict of Interest

None to declare.

## Footnote

In this short opinion piece, it has not been possible to cover all aspects of these events/outbreaks in detail. For further studies including the effects on hospital bed occupancy and health care costs refer to: [www.hcaf.biz/2010/Publications\\_Full.pdf](http://www.hcaf.biz/2010/Publications_Full.pdf).

## Key Messages

### What is already known on this subject?

- Emergency admissions and emergency department attendances have been growing faster than expected for many years.
- Social factors and the way in which health and social care are organised are contributory to these trends but not causative.

### What might this study add?

- Emergency and unscheduled demand is growing via a series of unexplained spurts or step-like changes.
- These spurts are accompanied by increases in sickness absence and a wobble in the gender ratio at birth.
- Both deaths and medical admissions show small area spread during these events
- Existing mechanisms cannot explain this growth.

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