NHS Winter Pressures, Winter Mortality and the “Amplification Effect” of NHS Performance

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The number of excess winter deaths, as a result of a seasonal peak in disease burden, has been steadily falling in the UK over the last 60 years, especially since the year 2000.

However, winter 2014/15 was different: there were 43,900 excess winter deaths in England and Wales, compared with an average over the last decade of 27,000, as shown in Figure 1, below. Winter 2014/15 also saw a dramatic reduction in A&E performance and saw many hospitals declare major incidents.

Given that mortality rates in autumn 2015 already look as high as last year, this article explores the potential causes and implications for winter 2015/16.

![Figure 1: Excess winter mortality in England & Wales by year (ONS)](image-url)
Winter 2014/15 put an abrupt end to the previous trend of reducing numbers of annual deaths, and saw the highest number of winter deaths since 1999/2000. Weekly deaths were above average throughout late summer and autumn 2014, before peaking very sharply in January 2015: The profile of last winter’s mortality peak is as shown in figure 2 below:

![Figure 2: 2014-15 weekly mortality (England & Wales) against the 5-year average](image)

As demonstrated in Figure 3, there was an inverse correlation between mortality and A&E performance during 2014/15 (a link that is not surprising). At this stage, this chart shows correlation, but does not give information about causation:

![Figure 3: Mortality and A&E performance showed a negative correlation in 2014/15](image)

As autumn 2015 progresses, the signs for winter 2015/16 are concerning. As

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1 The data shows registered deaths each week. The dips in the chart (both red lines and blue lines) at Christmas, Easter and May Bank holidays are believed to be associated with registrations during these weeks being held over to the following weeks.
shown in figure 4 below, mortality this autumn has been higher than the five year average for each of the last 9 weeks, and higher than last autumn for each of the last 7 weeks:

![Figure 4: 2015-16 weekly mortality rates, England & Wales](image)

The purpose of this paper is to explore the evidence for and against each of three hypotheses as to what is causing this higher mortality, to explore potential implications if each of the hypotheses were true, and to solicit input on further analyses that would crystallise the evidence. The three hypotheses are shown in table 1:

<table>
<thead>
<tr>
<th>#</th>
<th>Hypothesis</th>
<th>Potential implications if this hypothesis is correct</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>A higher-than-usual increase in disease burden last winter was the dominant cause of high winter mortality, and was a contributory cause of poor winter A&amp;E performance.</td>
<td>The NHS is ‘buffeted’ by random changes in disease burden from year to year. The NHS should watch mortality during each autumn to ensure it is as well prepared as possible.</td>
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<tr>
<td>2</td>
<td>A substantial increase in disease burden last winter triggered the initial increase in winter mortality, and the initial decline in A&amp;E performance – but the mortality peak was then amplified to some (small–moderate) extent by the decline in NHS performance in mid-winter.</td>
<td>This hypothesis, if correct, would imply that decline in NHS performance caused a substantial number of deaths, relative to what would have happened at normal levels of performance.</td>
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<tr>
<td>3</td>
<td>A normal increase in seasonal disease burden last winter triggered the initial increase in winter mortality, and the initial decline in A&amp;E performance – but the mortality peak was then substantially amplified by the decline in NHS performance in mid-winter.</td>
<td>This hypothesis, if correct, would imply that decline in NHS performance caused a very substantial number of deaths, relative to what would have happened at normal levels of performance.</td>
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Hypothesis testing

There is no dataset that can tell us, beyond doubt, which (if any) of these hypotheses is correct, and which is incorrect. However, there are several pieces of evidence that should be considered, and that can provide some directional evidence:

The evidence which supports hypothesis 1:

- Previous existing studies, such as the publication by Hogan et al, which assessed deaths in 2012/13 and in 2009 using a case-by-case review method, showed the proportion of avoidable deaths in hospital trusts to be 3.6% (95% confidence interval 3.0% to 4.3%). This provides some evidence to suggest that in general there are only a small number of deaths linked to system performance, but the study has a couple of limitations for answering whether winter pressures in 2014/15 led to more deaths: 1. the data used was from 2012/13, a year in which the number of deaths was around average and A&E performance was reasonable; and 2. the cases studied were taken at random across the whole year, rather than just winter.

- ONS data shows that the largest growth in deaths during winter 2014/15 was amongst deaths with a respiratory diagnosis, further supporting the hypothesis that there was a larger-than-normal disease burden. See figure 5. This is the source of some comments in the press that “Huge rise in winter deaths last year blamed on ineffective flu vaccine”.

Figure 5: Excess winter mortality by underlying cause of death (ONS)

Excess winter mortality index by underlying cause of death (ONS)

- Circulatory diseases (ICD-10 I00–I99)
- Respiratory diseases (ICD-10 J00–J99)
- Dementia and Alzheimer’s disease (ICD-10 F01, F03, G30)

Figure 5: Excess winter mortality by underlying cause of death, England & Wales

See: http://www.theguardian.com/society/2015/nov/25/excess-winter-deaths-rose-more-than-150-43900-2014
The evidence which supports hypotheses 1 and 2 but not hypothesis 3:

- Evidence suggesting that the disease burden was higher-than-usual in winter 2014-15, and across Europe, is shown in figure 6. This shows the number of deaths in 17 European countries (green trend) against weekly expected deaths (red), across the last four winters. The fact that a large rise in excess winter deaths was also seen in other European countries in 2014/15 indicates that either hypothesis 1 or 2 is most valid and hypothesis 3 is least valid.

![Figure 6: Excess winter deaths were seen across Europe as a whole in winter 2014/15](image)

The evidence which supports hypothesis 2:

- Research by JD Healy\(^3\) on excess winter mortality across 14 European countries between 1988 – 1997 indicated that, at that time, excess winter mortality in the UK was statistically significantly larger than in countries such as Germany, France, Denmark and Finland. The study concluded that there were statistically significant correlations between excess winter mortality and a number of different factors: “Countries that dedicate relatively high proportions of their national income to health care (Germany, France) are found to exhibit lower seasonality in mortality rates than those with relatively low health expenditure (Portugal, Ireland). Disaggregating the data shows that public health expenditure is far more strongly associated with seasonal mortality (a regression coefficient of 0.6, p = 0.001), while private health expenditure is found to be a less significant variable in the model (p = 0.11). Again, countries like Portugal, Ireland, and Greece (which all dedicate about 5% or less of per capita GNP on public health expenditure) demonstrate the highest variations in excess winter mortality in Europe. Per capita health expenditure (adjusted for purchasing power parity) is found to have the strongest association

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\(^3\) Excess winter mortality in Europe: a cross-country analysis identifying key risk factors, 2002
with relative excess winter mortality in Europe, with a regression coefficient of -1.19 (p < 0.001)."

- This study implies (albeit without categorical proof) that health service performance can have a significant impact on excess winter mortality.

- The long term (50+ years) picture of reduction in excess winter mortality, with occasional outlier years, is also broadly consistent with what you would expect from hypothesis 2. This long-term reduction, shown in Figure 7 below, has coincided with many factors that could be potential drivers of improvement, including economic growth/ reduction in poverty, improvement in housing stock, increase in investment in the NHS, and long-term improvement in performance in the NHS. The outlier years are consistent with increased disease burden in those years:

  ![Figure 7: Excess winter mortality by year (ONS, England & Wales)](image)

- Figure 5 (previous page) showed an increase in deaths from respiratory causes in winter 2014/15, but it also shows that there were substantial rises in deaths from non-respiratory causes, including circulatory diseases, dementia and Alzheimer’s which may indicate that system performance (primary, secondary, community health, and social care) had an impact.

- Further analysis of European winter mortality data shows that during winter 2014/15 England had the most statistically significant increase in excess winter deaths compared to other countries. This difference in size of peaks across countries would be consistent with some sort of

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The possibility of an overstretched system leading to higher death rates has backing in the literature, for example the review by Bernstein et al. (2009) found that “A growing body of data suggests that ED crowding is associated… with objective clinical endpoints, such as mortality”. This evidence would point away from hypothesis 1, and towards hypothesis 2.

There is evidence that increased patient-to-doctor ratios in the NHS are associated with increased mortality⁵. It is undeniable that patient-to-doctor ratios increased last January, both in crowded A&Es, and in wards which were full and with all escalation areas full.

There is some evidence that inpatients who are “outliers”⁶ have higher mortality (for instance, see “Relationship between in-hospital location and outcomes of care in patients of a large general medical service”). The NHS does not collect data centrally on numbers of outliers, but operational experience is that the proportion of outliers increases as

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⁵ Includes research by Sheena Astana published in HSJ; also analysis that 2020 Delivery has performed that demonstrates statistically significant correlations between SHMI and numbers of consultants per 100 beds (with that statistically significant correlation existing across the entire NHS, and within groups of similar hospitals).

⁶ An “outlier” is a patient who is not able to be accommodated in the appropriate ward for their condition, due to high bed occupancy.
occupancy increases. Bed occupancy was exceptionally high in the NHS during winter 2014/15.

- Finally, there was a substantial increase in number of emergency admissions in autumn and early winter 2014, followed by a steep fall during January 2015, as mortality was at its highest. See figure 9. When compared to the previous year (2013/14) the increase prior to January was greater and the fall steeper. This drop in admissions in January 2015 is highly unlikely to have been a result of reduced clinical need, and instead may have been a result of lack of bed availability forcing clinicians to raise their admission thresholds.

![Emergency Admissions (via A&E), England, per week](image)

**Figure 9: Admission rates rose sharply before January 2015 compared to 2014**

The evidence which supports hypothesis 3:

We found no clear evidence that supports hypothesis 3 over hypothesis 2.

Implications

We are interested to hear views of readers as to additional analyses that might help us to provide additional evidence to distinguish between hypotheses 1, 2 and 3, in particular analyses that can provide stronger evidence of causation. Additional analyses considered so far include: (1) Review coding of deaths from ONS statistics: this demonstrates some spike due to respiratory in 2014/15, but a larger spike that was not coded as respiratory. Our initial conclusion is that this demonstrates gaps in coding more than anything else; (2) Local analysis: we have accessed monthly mortality data at a local level and plan to cross-reference with A&E and DTOC performance; (3) Casenotes review: this would be a high quality approach, but would be expensive relative to using national datasets; (4) Expected numbers of deaths each year. ONS publishes projections of expected numbers of deaths each year, in the context that death rates have been falling, and that absolute numbers of deaths are expected to begin to increase from 2017 onwards, as baby boomers reach their 70s and as total population increases.
rather than merely of correlation.

Based on the evidence gathered so far as part of this research, it would seem that hypothesis 2 is most likely. This would mean that a substantial increase in disease burden last winter (as seen across many European countries) triggered the initial increase in winter mortality, and the initial decline in A&E performance – but the mortality peak was then amplified to some (small-moderate) extent by the decline in NHS performance in mid-winter.

If the evidence were to support hypothesis 2 conclusively, it would clearly have big implications:

- Locally, if an amplification effect is taking place, there are actions that can be taken early in a developing “peak” to mitigate that amplification. For instance, some Trusts took action early in December 2014 as their performance declined, declaring major incidents early, and using this as a mechanism to change working arrangements within the Trust, with GPs, within community services and with social care. Some of those Trusts then saw smaller declines in A&E performance in New Year 2015 than did Trusts who had not taken corrective action.

- Nationally, much of the press reporting of major incidents at A&Es during January 2015 took the perspective that this was a service in crisis, that it was not providing the service it should have been, and that there was a big impact on patient experience. There was no mention of how many additional deaths this might be causing, and of the relative implications for government in that scenario.

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