Public Health England

Excess winter mortality 2012-13

Excess all-cause mortality has been high among elderly people in 2012-13. This document presents observations from routine mortality surveillance work done by the Respiratory Diseases Department (RDD) within Public Health England (PHE).

Routine weekly mortality surveillance

- Seasonal mortality is seen each year in England and Wales, with a higher number of deaths in winter months compared to the summer. Additionally, peaks of mortality above this expected higher level typically occur in winter, most commonly the result of factors such as cold snaps and increased circulation of respiratory viruses, in particular influenza.
- RDD's weekly mortality surveillance aims to detect and report acute significant weekly excess mortality above normal seasonal levels in a timely fashion. Excess mortality is defined as a significant number of deaths reported over that expected for a given point in the year, allowing for weekly variation in the number of deaths. This triggers further investigation of spikes and informs any public health responses. The aim is not to assess general mortality trends or precisely estimate the excess attributable to different factors, although some end-of-winter estimates and more in-depth analyses (by age, geography etc.) are undertaken.
- The General Registry Office provides mortality data to PHE daily during events when a population impact on mortality is expected to be rapid and detected through daily analysis of mortality data (such as during an influenza pandemic or a heatwave[1]).
- A summary of weekly mortality outputs is routinely published in the publically available influenza surveillance report[2] and reported to the EuroMOMO co-ordinating hub[3] in Denmark and subsequently the European Centre for Disease Prevention and Control (ECDC). A more in-depth end-of-season analysis is published routinely in the PHE annual influenza report[4]. Internal mortality reports are also produced and shared as required with other PHE groups (e.g. extreme events when a heatwave alert is reported) and post-event evaluations published[1].

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[1]Rapid estimation of excess mortality: nowcasting during the heatwave alert in England and Wales in June 2011. Green HK, Andrews NJ, Bickler G, Pebody RG. *J Epidemiol Community Health*. 2012 Oct;66(10):866-8
[2]Public Health England. (2013). PHE National Influenza Report. Available online: http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/SeasonalInfluenza/EpidemiologicalData/03influsweeklyreportpdfonly/
[3]European monitoring of excess mortality for public health action. (2011). http://www.euromomo.eu/
[4]Public Health England. (2013). PHE National Influenza Annual Reports. Available online: http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/SeasonalInfluenza/EpidemiologicalData/07influsInfluenzaannualreports/

Overall excess mortality (England and Wales)

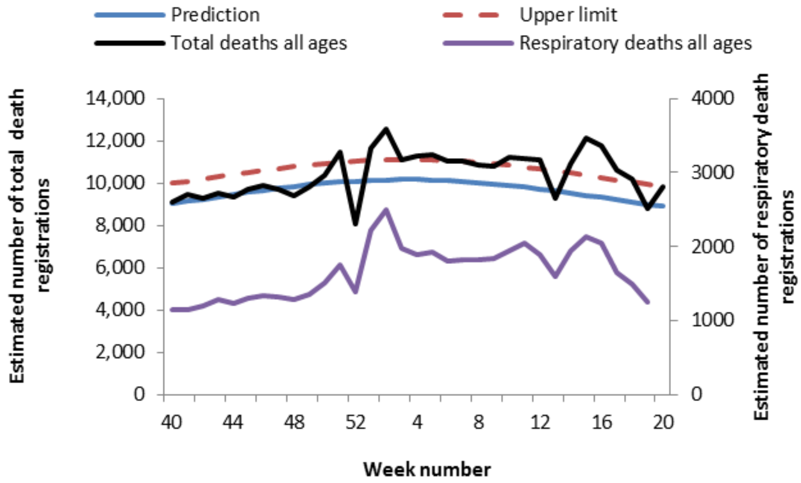
Background

- The Office for National Statistics (ONS) collates and reports to PHE estimated total all-cause death registrations[5] every week. PHE uses this data to statistically estimate the expected number of weekly death registrations for a given week in the year through a well-established Serfling regression model[6]. PHE can then assess whether the numbers of observed death registrations are significantly higher than the calculated expected numbers, allowing for variation, thus indicating an excess in all-cause mortality.

Results

- The number of observed death registrations during 2012-13 was higher than expected. Out of 32 weeks (week 40 in 2012 to week 20 in 2013) 25 (78%) were above baseline levels and 14 (44%) were above the upper significance limit (figure 1).
- Further analysis of subdivisions of all-cause data showed the excess to be found predominantly in the elderly (85 years and over) and in deaths coded as resulting from respiratory causes (typically seen in winter when temperatures are low and influenza is circulating – figure 1).

*Figure 1. Weekly number of estimated all-age all-cause (black line) and respiratory (purple line) ONS death registrations by week of registration, England and Wales, 2012-13**



**The sharp drops in number of estimated death registrations correspond to weeks when there were bank holidays and so are artefactual.*

- For week 40 in 2012 to week 20 in 2013, the number of excess death registrations above the 95% upper significance threshold was higher than that for the three previous seasons (figure 2), but less than in 2008-09, a severe A(H3N2) influenza season, and 2001-02 and 2002-03, when influenza A(H1N2)/A(H3) and influenza A(H3)/B respectively were circulating.

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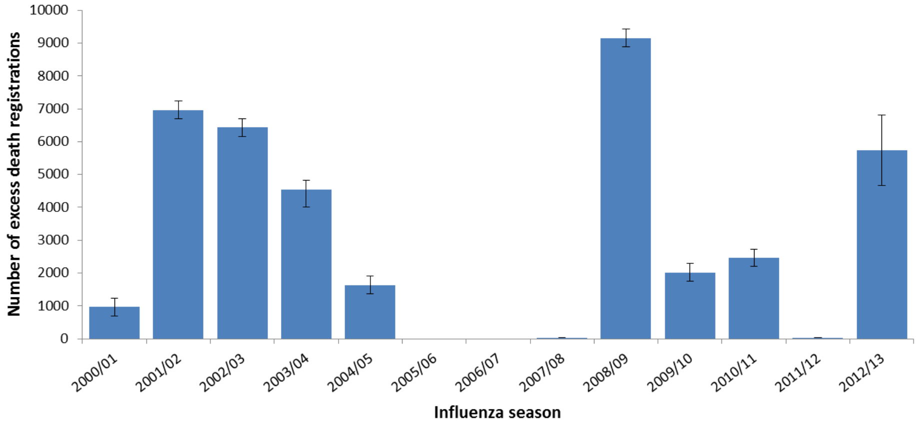
[5] Office for National Statistics. (2013). Weekly provisional figures on deaths registered in England and Wales. Available online: http://www.ons.gov.uk/ons/rel/vsob2/weekly-provisional-figures-on-deaths-registered-in-england-and-wales/index.html

[6] Serfling RE, Sherman IL, Houseworth WJ Excess pneumonia-influenza mortality by age and sex in three major influenza A2 epidemics, United States, 1957–58, 1960 and 1963. *Am J Epidemiol* 1967;86:433–41

Figure 2. Number of total excess all-cause death registrations in England and Wales in influenza seasons (week 40 to week 20) from 2000-01 to 2012-13 with 95% confidence intervals



Excess mortality by age and region (England)

Background

- Reporting the number of deaths by week of death registration can obscure the true mortality pattern, because there are days when deaths are not registered (such as bank holidays) resulting in artefactual dips and the delay between death and registration biasing weekly numbers.
- ONS additionally collates and reports to PHE deaths with information on the week of death, age and region. The EuroMOMO algorithm[7], a standardised approach developed and utilised by a European network of national surveillance centres, provides expected number of deaths and observed number of deaths by week of death corrected for reporting delay. This standardised reporting has been in use since the 2009 pandemic[8] and enables a direct comparison between excess mortality in participating countries.

Results

Age group

- The pattern of excess mortality by week of death corresponded to the pattern observed by week of death registration. During 2012-13, two periods of excess mortality were seen in England across all regions: firstly for four weeks from week 50 in 2012 to week 1 in 2013, and secondly from week 9 to 15 in 2013.
- When an age group was modelled, excess mortality was seen in the over 65s in the same weeks as above (week 50 in 2012 to week 1 in 2013 and week 9 to 15 in 2013 – figure 3). A small excess was also seen for one week in the 5-14 year age group (week 51 in

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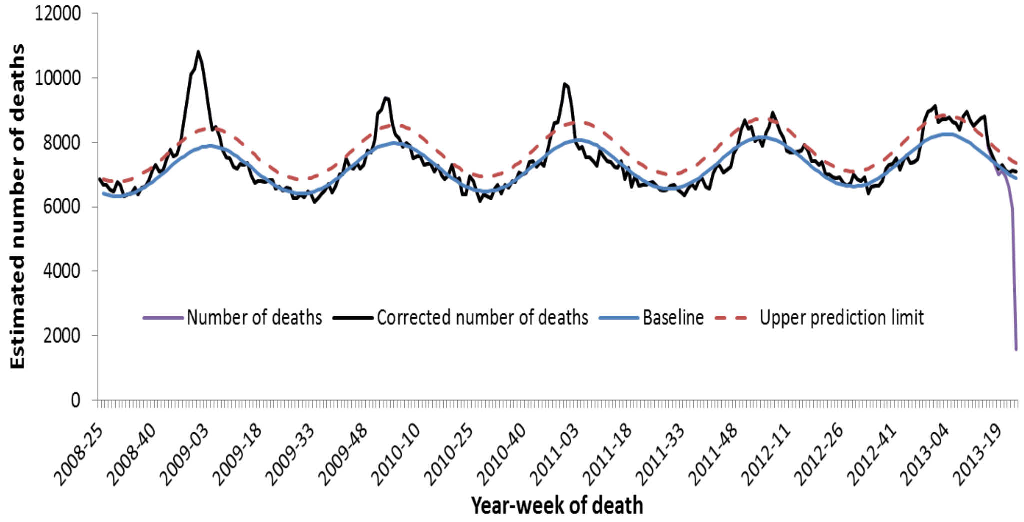
[7]Excess mortality among the elderly in 12 European countries, February and March 2012. Mazick A, Gergonne B, Nielsen J, Wuillaume F, Virtanen MJ, Fouillet A, Uphoff H, Sideroglou T, Paldy A, Oza A, Nunes B, Flores-Segovia VM, Junker C, McDonald SA, Green HK, Pebody R, Mølbak K. *Euro Surveill*. 2012 Apr 5;17(14).

[8]Excess mortality monitoring in England and Wales during the influenza A(H1N1) 2009 pandemic. Hardelid P, Andrews N, Pebody R. *Epidemiol Infect*. 2011 Sep;139(9):1431-9.

2012). No significant excess was seen in under five year olds or among the 15-64 year olds.

- The cumulative number of excess deaths among the over 65s (defined as the number of deaths relative to the baseline summed across the season) during 2012-13 is the highest since 2008-09. A similar observation was made in several countries across Europe.

Figure 3. Weekly number of estimated all-cause deaths by week of death among over 65s, England, 2008-13

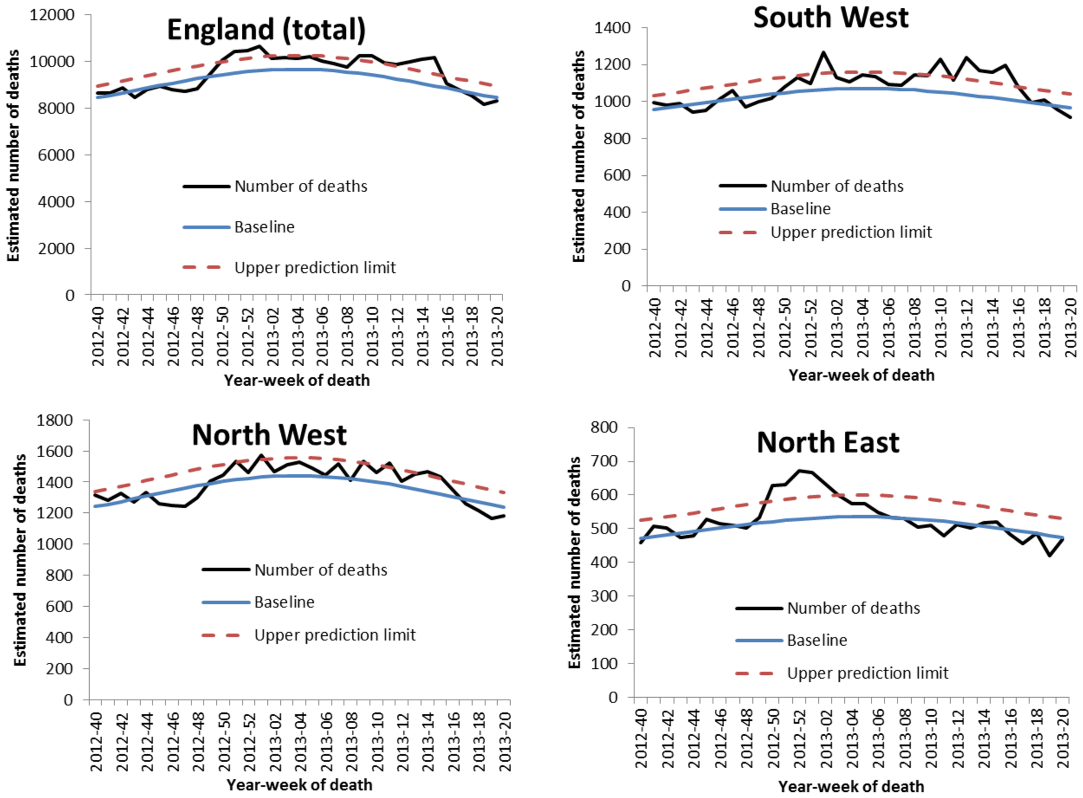


Region

- The pattern of excess mortality by region in 2012-13 differed considerably (figure 4). Some regions (e.g. South West England) had a pattern of excess mortality similar to all of England, some regions (e.g. North West England) had no clear excess, and North East England had a peak of excess mortality earlier than other regions.

- RDD is doing further work on regional variation in mortality and potential explanatory factors.

Figure 4. Weekly number of estimated all-cause deaths by week of death in England (total), South West England, North West England and North East England, 2012-13



Potential explanatory factors (England)

Descriptive comparison

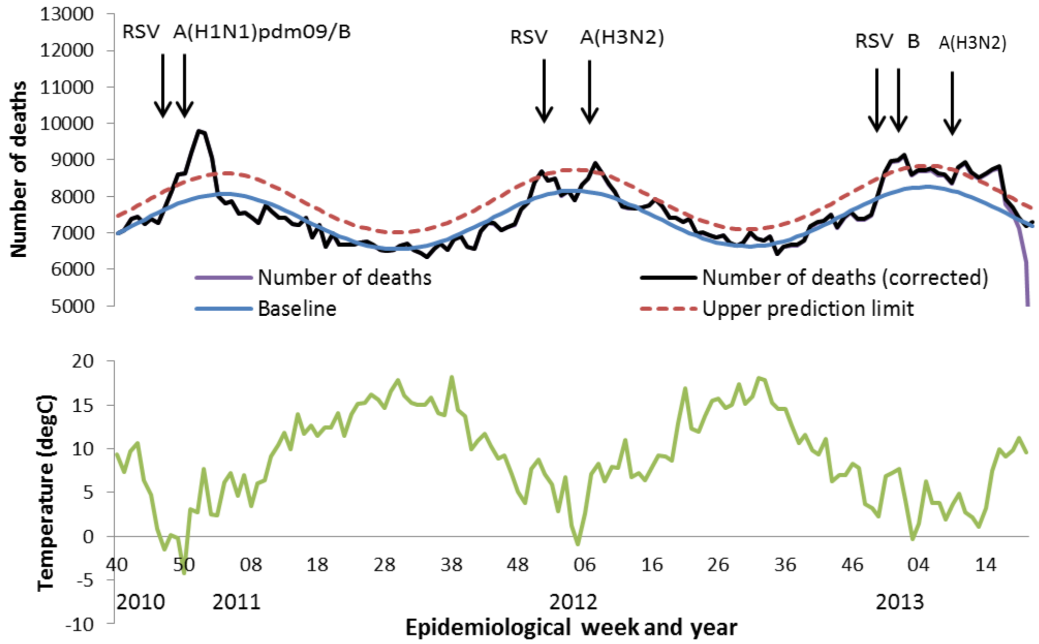
- Both influenza and cold weather, which can typically result in excess winter mortality, are underreported as causes of death, which makes attribution of excess mortality difficult. As a result, statistical methods[9] are required to estimate the attribution. As a first step, mortality patterns can be descriptively compared to influenza activity and temperature data to help interpretation, although sometimes they temporally coincide, making the effects difficult to separate.
- 2012-13 was an unusually prolonged influenza season in England, dominated initially by influenza B in weeks 49 in 2012 to 4 in 2013 and then influenza A (predominantly A(H3N2) with some A(H1N1)pdm09 circulating) in weeks 5 to 15 in 2013. Temperatures were low in 2013 from week 3 to 14 in 2013, which is unusually late (figure 5).
- The weeks that flagged significant national excess mortality by week of death (week 50 in 2012 to week 1 in 2013 and week 9 to 15 in 2013), coincided with the national peak for circulating respiratory virus activity (influenza and respiratory syncytial virus (RSV)) and/or cold weather (figure 5). The first peak in activity coincided with influenza B (peaking in week 52 in 2012) and post-peak RSV activity (peaking in week 49 in 2012). The second

[9]Influenza-related deaths-available methods for estimating numbers and detecting patterns for seasonal and pandemic influenza in Europe. Nicoll A, Ciancio BC, Lopez Chavarrias V, Mølbak K, Pebody R, Pedzinski B, Penttinen P, van der Sande M, Snacken R, Van Kerkhove MD. *Euro Surveill*. 2012 May 3;17(18).

peak in activity coincided with prolonged A(H3N2) circulation (remaining high from week 5 to 15 in 2013) and comparatively low temperatures for the time of year relative to previous seasons.

- This temporal coincidence with influenza and/or cold weather was also seen regionally where different mortality patterns were observed. For example, the early peak in excess mortality in North East England corresponds to the comparatively earlier circulation of influenza A in this region relative to the rest of England.

*Figure 5. Weekly number of estimated all-cause deaths by week of death among over 65s, England, and weekly mean Central England Temperature, week 40 in 2010 to week 20 in 2013. Week of national peak virus activity is indicated**



**Note these patterns differed by region*

- Cumulative excess all-cause mortality was higher in the elderly than seen over the previous few seasons across Europe[3]. While this cannot be attributed directly to influenza, the temporal coincidence with influenza A(H3N2) across the UK and Europe suggests that influenza has contributed significantly.

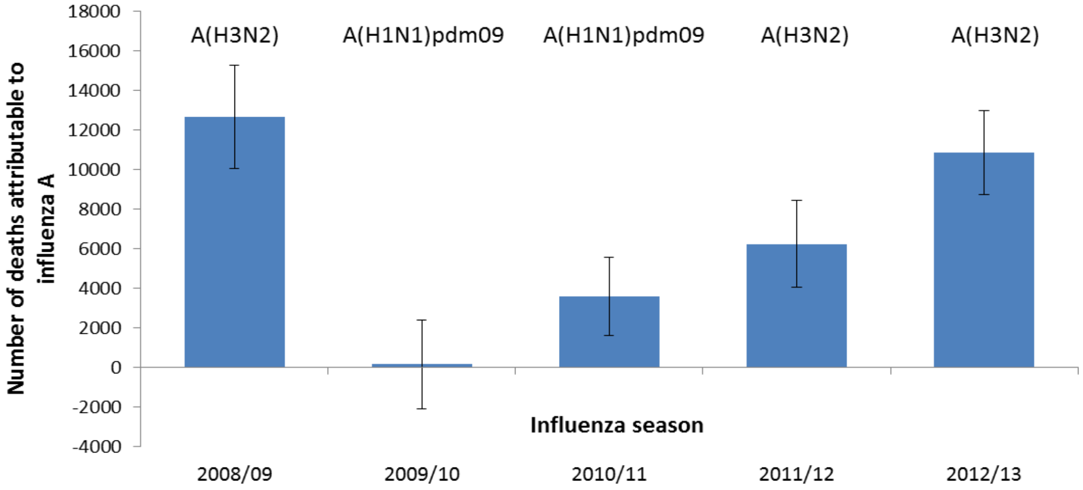
Relative contribution of influenza

- The relative contribution of potential explanatory factors can be indirectly statistically estimated. RDD has developed a specific regression model[10,11] to estimate mortality attributable to influenza each season. While the confounding factors of cold weather and RSV activity have been adjusted for in this model, attribution of mortality to RSV and cold weather requires further work to quantify and so cannot at present be estimated.

[10]Mortality caused by influenza and respiratory syncytial virus by age group in England and Wales 1999-2010. Hardelid P, Pebody R, Andrews N. *Influenza Other Respi Viruses*. 2013 Jan;7(1):35-45.
[11]Mortality attributable to influenza in England and Wales prior to, during and after the 2009 pandemic. Green HK, Andrews N, Fleming D, Zambon M, Pebody R. Submitted.

- During the past five influenza seasons, the highest number of deaths attributable to influenza A has been among the over 65s in 2008-09 followed by 2012-13. No significant deaths attributable to influenza B were detected in any season as previously seen[11] (figure 6).
- The trend in magnitude of influenza A attribution over the past few seasons mimics the trend in magnitude of excess mortality, suggesting that influenza activity is a major explanatory factor. The severe influenza season seen in 2008-09[10] was due to A(H3N2). There was an age shift of the burden of seasonal influenza from the elderly to young adults during the A(H1N1)pdm09 pandemic, which continued in 2010-11 when the strain continued to circulate. 2011-12 saw a mild influenza season with overall low levels of activity reported.

Figure 6. Number of influenza A attributable all-cause deaths among the over 65s by influenza season in England. Predominant influenza A subtype circulating each season is indicated*



**Note, there are several caveats with these results. This analysis is typically done a year after the season has ended to allow the majority of deaths to be registered[11]. To rapidly assess the mortality in 2012-13 with this regression method, delay corrected counts through the EuroMOMO algorithm have been used, so these results are preliminary and provisional. The correctly formatted data was only available from 2008 onwards, resulting in a relatively short period of data to assess. The age grouping of the data was not the same as the age grouping in the model – only the over 65s were compatible and as such are the results presented. Delay correction is only currently applied to all-cause data.*

Conclusions

- 2012-13 has seen the largest excess all-cause mortality in England since 2008-09.
- Further analysis showed the excess was found predominantly in the elderly and in deaths coded as resulting from respiratory causes.
- The magnitude of excess all-cause mortality varied considerably by region within England.
- Excess mortality in 2012-13 coincided with influenza, RSV and cold weather, with an unusually prolonged influenza season and late cold period reported.
- Statistical regression modelling of excess mortality over the past few seasons, including 2012-13, has shown influenza to be a major explanatory factor.

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