Jones R (2016) Clear the decks of Summary Hospital-level Mortality Indicator. ***British Journal of Healthcare Management*** 22(6): 335-338. Please use this to cite.

Clear the decks of Summary Hospital-level Mortality Indicator

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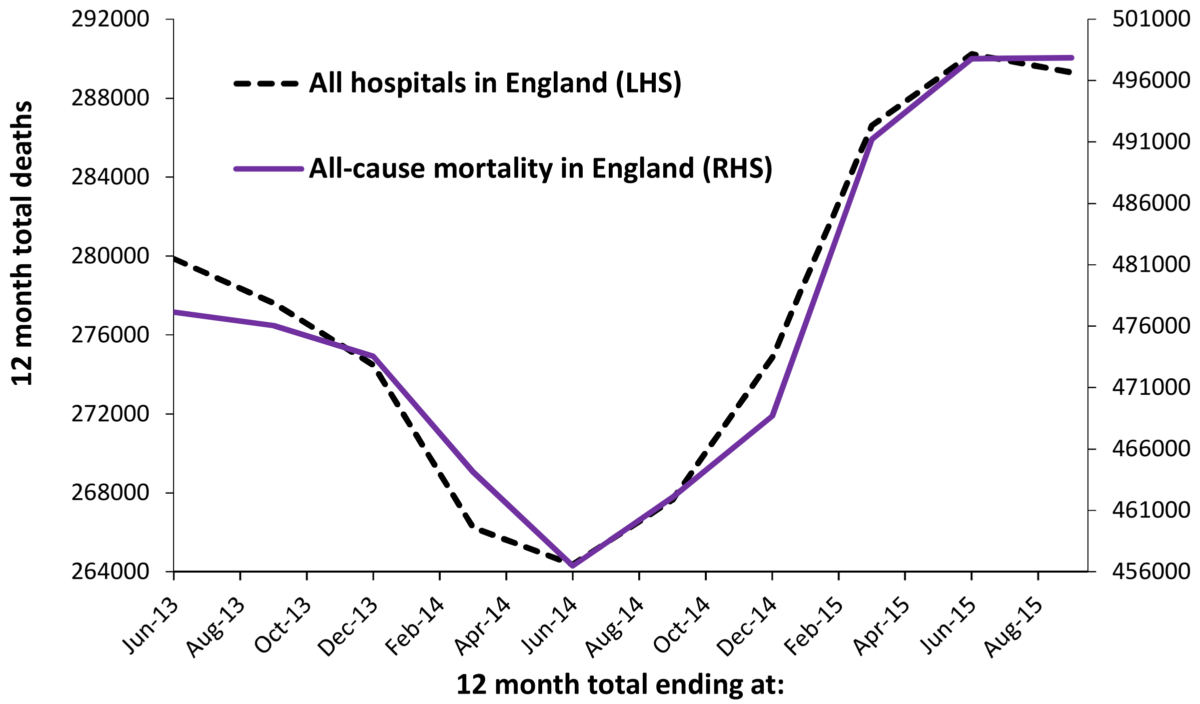
For the past 7 years BJHCM has run a series of articles demonstrating that A&E attendances, medical admissions and all-cause mortality are following highly unusual trends, which are reminiscent of a series of very large-scale infectious outbreaks, i.e. both the numerator and denominator in any form of hospital standardised mortality calculation (HSMR) are subject to powerful forces which are poorly understood (Jones 2015c), and can therefore lead to unexpected outcomes.

Figure 1: Total deaths for patients admitted to hospital and all-cause mortality in England



Footnote: Data on hospital deaths including death within 30 days of discharge is from the Health & Social Care Information Centre (HSCIC) website http://www.hscic.gov.uk/SHMI, while monthly all-cause mortality by district of residence is from the Office for National Statistics (ONS) website http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/monthlyfiguresondeathsregisteredbyareaofusualresidence

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The Summary Hospital-level Mortality Indicator (SHMI) is a variant of HSMR which includes death within 30 days of discharge as well as in-hospital deaths. Other key differences have been discussed elsewhere (Jones 2015b). The great weakness of any methodology claiming to predict the 'expected' number of hospital deaths is that it may have omitted some unknown but vitally important factor (Jones 2015b).

While the effect upon increased medical admissions has been discussed elsewhere (Jones 2015c) this analysis will concentrate upon the trends in death. In this respect Figure 1 shows the trend in death associated with hospital admission (SHMI-deaths) and all-cause mortality in England. Note that SHMI is calculated using 12 month periods which increment quarterly and all-cause mortality has therefore been calculated in the same way. Also note that because both lines are running 12 month totals, a sudden step-like increase in deaths will show up as a ramp with the true magnitude of the step-change only seen in the total 12 months later, i.e. whatever happened just after June 2014 led to an unexplained and large step-increase in deaths.

Hospital deaths include any person dying within 30 days of discharge and this roughly adds a further 20% on top of in-hospital deaths. My own analysis indicates that death within 30 days of discharge is too permissive, and death within 3 days of discharge is probably a better measure. Hence whatever is measured by SHMI-deaths may be an overestimate.

However, the main point is that both follow an almost identical trajectory. The apparent slight difference between the two lines is simply due to deaths within 30 days of discharge being assigned to the month of discharge. Interestingly the step-increase revealed in Figure 1 has a magnitude of +9.9% for SHMI-deaths and +9.1% for all-cause mortality. The increase in SHMI-deaths cannot explain the increase in all-cause mortality since it only accounts for 63% of the step-increase in all-cause mortality. Clearly hospital deaths are simply tracking whatever is causing the overall change in all-cause mortality, i.e. SHMI is not measuring anything fundamental to hospital care.

It has also been determined that the rise and fall in deaths behaves like an infectious outbreak, i.e. there is spatiotemporal spread of a relatively difficult to transmit presumed infectious agent (Jones 2015a,c, 2016b). Hence Figure 1 picks up the tail end of an outbreak in 2012 and the initiation of an outbreak in 2014, both of which are part of a much longer series of these events which can be traced back to the 1950's (Jones 2015c).

The concept of spatial spread is explored in Table 1 where the 12 month period containing the minimum (highlighted in green) and maximum number of deaths (highlighted in red) is shown for a selection of larger NHS Trusts. Initiation of the 2014 event is seen to occur in the interval between Mar-14 to Dec-14. Initiation occurs after the minimum in the running 12 month total, resulting from the step-down following the previous event. In a running total a step-change in deaths will normally result in the minimum and maximum being 12 months apart, however the use of quarterly rather than monthly increments can lead to slight distortions in this effect.

As can be seen greatest number of initiations occur from Jun-14 to Sep-14, termed synchrony, i.e. the degree to which an outbreak initiates at the same time across different spatial areas (He and Stone 2002). This clustering in time is referred to as in-phase behaviour, however there is some evidence for what is called anti-phase behaviour, i.e. initiation at the mid-point in the cycle of outbreaks rather than near the start. Anti-phase behaviour also being a characteristic of those infectious outbreaks which occur at regular intervals (Terletskaia-Ladwig 2005, Zhang et al 2007).

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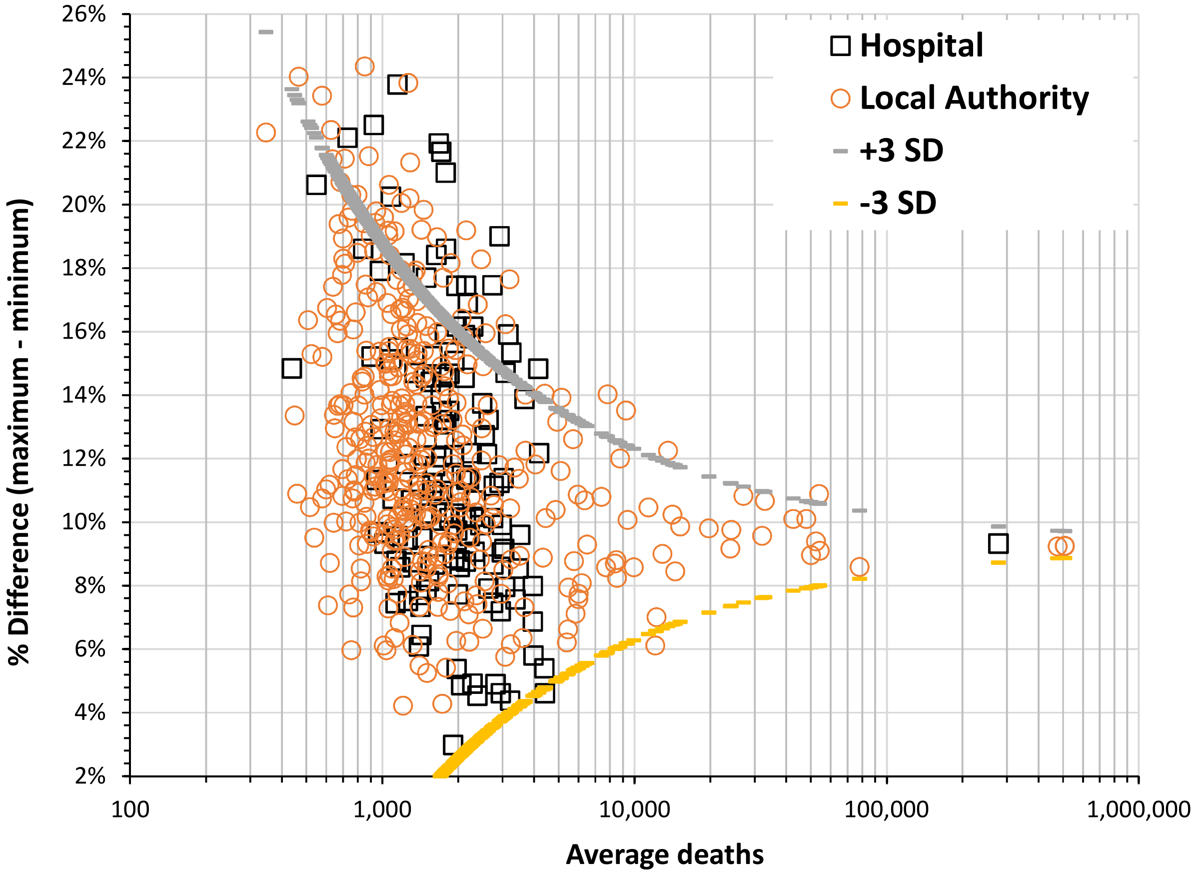
Figure 2: Difference between maximum and minimum deaths over the 12 month periods ending Sep-13 to Sep-15 seen in English hospitals and all-cause mortality in English Local Authorities and regions.



By way of explanation an outbreak of something like influenza would see a spike increase in deaths (rather than the step-increase seen here) and the synchrony of onset between hospitals would be much closer in time. Hence we are dealing with a 'novel' type of infectious event.

Finally Figure 2 explores the issues of spatial heterogeneity - one area being affected worse than another (Greene et al 2006), and the effect of size (number of deaths). A log scale has been used to facilitate visualisation across a range of sizes. The data points at the far right hand side cover the whole of England. The variation or heterogeneity increases as size reduces due to the effect of Poisson randomness and the underlying small-area spatial spread (Jones 2015a).

Deaths in English Local Authorities (LAs) were compared over the same time period as the SHMI data. As can be seen both SHMI-deaths and all-cause mortality in English local authority areas lay overlaid on each other, i.e. they are both reflecting the same causative factor which leads to high heterogeneity.

Hence some hospitals (and CCGs) are affected far worse than others and carry a disproportionate burden of the additional costs associated with enhanced levels of both medical admissions and end-of-life care during these seemingly infectious events.

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Table 1: Quarterly 12 month totals of hospital deaths (within 30 days of discharge) for a selection of the largest hospitals – point for maximum and minimum deaths highlighted

Hospital	Jun-13	Sep-13	Dec-13	Mar-14	Jun-14	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15
All hospitals in England	279857	277622	274491	266243	264366	267647	274869	286629	290234	289318
Leicester	4498	4457	4483	4357	4327	4307	4337	4451	4446	4511
Heart of England	4505	4428	4447	4271	4268	4316	4272	4428	4450	4497
North Midlands	4250	4225	4238	3998	3910	3990	4064	4304	4419	4418
Leeds	3982	3991	3981	3842	3832	3810	3891	3991	4070	4126
East Kent	3844	3856	3932	3917	3866	3896	3923	4065	4112	4116
Pennine	4102	4036	3928	3903	3904	3871	3981	3984	4010	4044
Barts	3600	3666	3568	3539	3492	3439	3661	3810	3874	3947
United Lincolnshire	3538	3532	3465	3364	3386	3362	3494	3661	3700	3672
Sheffield Teaching	3531	3550	3466	3422	3300	3298	3410	3486	3594	3574
Norfolk & Norwich	3154	3183	3144	3046	3035	3074	3273	3484	3531	3533
Hull & E Yorks	3331	3331	3314	3281	3261	3289	3370	3453	3516	3510
Frimley Health	3072	3061	3059	2982	2971	3022	3146	3336	3413	3473
Northumbria	3158	3063	3033	2886	2849	2929	3066	3263	3302	3239
Oxford	3254	3285	3251	3213	3198	3144	3173	3193	3200	3218
Royal Free	3244	3224	3117	2956	2822	2727	2691	2741	2782	2794
Derby	2965	2989	3072	3012	2991	3054	3028	3140	3209	3175
Barking, Havering	3163	3099	3043	2903	2851	2889	3059	3195	2999	2999
York	3095	3030	2999	2913	2940	2950	2993	3148	3182	3192
County Durham	3139	3075	2975	2883	2870	2904	2891	3009	2990	2957
Portsmouth	3077	3076	3000	2850	2823	2809	2897	3050	3066	3104
Western Sussex	2930	2917	2863	2756	2758	2846	2913	3061	3084	3030
Mid Yorkshire	2895	2904	2925	2855	2866	2863	2958	3050	3056	3067
Gloucestershire	2970	2935	2982	2867	2914	2922	2952	3003	2975	2924
Coventry	2691	2627	2661	2667	2637	2723	2852	2897	2935	2933
Worcestershire	2709	2734	2731	2695	2689	2656	2736	2848	2861	2895
Southampton	2853	2879	2881	2791	2806	2781	2776	2819	2790	2743
South Tees	2867	2818	2734	2599	2589	2634	2677	2798	2865	2856
Doncaster	2807	2763	2746	2651	2634	2668	2735	2824	2839	2804
East Sussex	2771	2793	2749	2574	2471	2444	2511	2687	2682	2703
Newcastle	2541	2523	2477	2549	2511	2512	2607	2738	2769	2793
East Lancashire	2658	2621	2599	2536	2524	2553	2631	2728	2732	2698

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As discussed above in Figure 2, the percentage difference between the maximum and minimum increases as size (number of deaths) gets smaller. The effect of size partly arises due to the relatively slow spread of the agent (Jones 2015a); however it explains why some LAs and hospitals appear to lie above the 99.9% confidence interval (+3 standard deviations).

Once again the architects of SHMI failed to realise that there is positive over-dispersion associated with smaller size (at least during the time of each outbreak), and smaller hospitals will be sometimes incorrectly flagged as outliers. These and other methodological difficulties with HSMR and SHMI (Girling et al 2012, Freemantle et al 2013, Baines et al 2014, Hogan et al 2015), explain why the government is shifting the focus away from HSMR and SHMI to the audit of in-hospital deaths as a means of detecting true instances of poor care.

In conclusion, the rise and fall in hospital deaths (along with numerous other indicators of poor health) display all the classic characteristics for the presence of an infectious outbreak (Jones 2015c, 2016a,b). Due to the profound effect of this agent on death, HSMR and SHMI are therefore unlikely to be detecting the absence of good care, except perhaps for clear and persistent outliers. Sadly, it would appear that no government agency is prepared to (publically) admit that the UK may have a huge infectious public health issue.

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