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FEATURE

STATISTICS BEHIND THE HEADLINES

Have there been 13 000 needless deaths at 14 NHS trusts?

David Spiegelhalter examines the latest media outrage over excess hospital deaths and concludes that most of the media (and parliament) seem incapable of understanding that half of all trusts will always have above-expected mortality

David Spiegelhalter *Winton professor for the public understanding of risk, University of Cambridge*

Before the release of the recent Keogh report into 14 NHS hospital trusts in England with apparently high mortality,[1] the *Sunday Telegraph* and other newspapers reported that "13,000 died needlessly at 14 worst NHS trusts."[2]

And yet the Keogh report, when published in July, was notable for its careful thoroughness and said nothing whatsoever about numbers of deaths. Indeed, when discussing the use of measures of mortality such as the standardised hospital mortality indicator (SHMI) and hospital standardised mortality ratio (HSMR), Keogh said: "It is clinically meaningless and academically reckless to use such statistical measures to quantify actual numbers of avoidable deaths. Robert Francis himself said: 'It is in my view misleading and a potential misuse of the figures to extrapolate from them a conclusion that any particular number, or range of numbers of deaths were caused or contributed to by inadequate care'."[1]

So where did the "13,000" come from? It is the difference between the observed and "expected" number of deaths in the 14 trusts between 2005 and 2012. The *Telegraph* claims this number is based on research by Professor Brian Jarman, one of the Keogh team, and the numbers can be derived from data on the HSMR available on Jarman's website.[3] It should have been fairly predictable that such a briefing to journalists would be misleadingly reported, but it is unclear who carried it out. Lord Hunt, the Labour peer, has accused the government.[4]

Keogh is reported by a blogger to have distanced himself from these numbers in an email: "Not my calculations, not my views. Don't believe everything you read, particularly in some newspapers."[5]

What are the SHMI and the HSMR?

The 14 trusts examined by Keogh were selected as being outliers for either the SHMI, produced by the Health and Social Care Information Centre,[6] or the HSMR, produced by the Dr Foster Unit at Imperial College,[7] which Professor Jarman heads. Each of these indicators uses patient-specific information to calculate an overall "expected" number of deaths if the trust matched the national average performance. Dividing the observed number of deaths by the expected gives the index.

The main differences lie in the coverage (HSMR only considers around 80% of deaths), definition of death (in hospital mortality for HSMR; all cause, 30 day mortality for SHMI), coding for palliative care (included in HSMR, not by SHMI), and the definition of "outliers" (SHMI is more stringent).[8]

The two indices often come up with different conclusions and do not necessarily correlate with Keogh's findings: for example, of the first three trusts investigated, Basildon and Thurrock was a high outlier on SHMI but not on HSMR for 2011-12[9] (and was put on special measures), Blackpool was a high outlier on both (no action), and Burton was high on HSMR but not on SHMI (special measures). Keogh emphasised "the complexity of using and interpreting aggregate measures of mortality, including HSMR and SHMI. The fact that the use of these two different measures of mortality to determine which trusts to review generated two completely different lists of outlier trusts illustrates this point."[1] It also suggests that many trusts that were not high on either measure might have had issues revealed had they been examined.

What does "higher than expected" mortality mean anyway?

Just as it says, "higher than expected" mortality means the observed number of deaths is greater than expected. The crucial fact is that both the SHMI and HSMR are standardised to recent national performance, and so we would expect at any time that around half of all trusts would have "higher than expected" mortality, just by chance variability around an average. Indeed, for the SHMI between January 2012 and December 2012, 56% of trusts (80/142) had above expected mortality.[10] It would be absurd to label all these as outliers, and yet a *BBC News* item claims that: "Outliers are trusts which have a

d.spiegelhalter@statslab.cam.ac.uk

higher-than-expected number of deaths."[11] It is enough to make a statistician sob.

Using the definition used for the HSMR, the same SHMI indicator identifies 20% of trusts (29/142) as "high outliers," whereas the SHMI's own definition generates only 8% (11/142), a somewhat more plausible figure.

The difference between the observed and expected number of deaths has been called "excess deaths," a term used in the Bristol Royal Infirmary inquiry: as the head of that statistical team, I deeply regret this use as it so readily translates, whether through ignorance or mendacity, into "needless deaths."

So what about the "1200 needless deaths" at Mid-Staffs? A recent *BBC News* story claims: "Data shows there were between 400 and 1200 more deaths than would have been expected between 2005 and 2008."[12] But there are no published data that show this, as fully discussed in the first Francis report.[13]

Like the "1200" at Mid-Staffs, "13,000" threatens to become a "zombie statistic"—one that will not die in spite of repeated demolition.

What can be done?

Keogh has commissioned the development of "a new national indicator on avoidable deaths in hospitals, measured through the introduction of systematic and externally audited case note reviews."[1] Meanwhile, since most of the media and parliament seem incapable of understanding that half of all trusts will have above expected mortality, I would recommend following the Keogh data packs and referring always to potential outliers as "above expected range," with a clear definition of what this means. And avoid saying what this translates to in terms of numbers of deaths.

Competing interests: I have read and understood the BMJ Group policy on declaration of interests and declare the following interests: I headed the statistical team at the Bristol Royal Infirmary Inquiry, acted as a statistical adviser to the Healthcare Commission between 2003 and 2008, and contributed to the development of statistical methods for performance assessment, including those now used for the SHMI indicator.

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FEATURE

STATISTICS BEHIND THE HEADLINES

Are you 45% more likely to die in a UK hospital rather than a US hospital?

David Spiegelhalter is frustrated by the recent headlines that English patients are more likely to die in hospital than US citizens

David Spiegelhalter *Winton professor for the public understanding of risk*

University of Cambridge, Cambridge, UK

On 11 September *Channel 4 News* carried lengthy and uncritical coverage of work by Brian Jarman comparing hospital mortality in seven Western countries between 2004 and 2012. The headline claims were that English "health service patients are 45% more likely to die in hospital than in the US,"[1] which was the leading (and only named) country of the seven being compared.

This was followed by newspaper coverage including claims that "A patient in England was five times as likely to die of pneumonia and twice as likely to die of septicaemia compared to similar patients in the US."[2]

The basis of these claims was questioned on Twitter and in online articles, and blogs, particularly as neither the data nor the methods were publicly available—it is perhaps notable that the BBC's website did not cover the story at all. To his credit, Jarman responded with a torrent of robust tweets and provided links to files with some limited details of the methods and results.[3]

Health systems differ

Nevertheless, it is frustratingly difficult to assess the evidence for his conclusions because of lack of information about the data, methods, hospitals, and even countries involved. Jarman seems to have pooled routinely collected, individual level data on hospital discharges from the seven countries, used in-hospital mortality as an outcome, and fitted a common prediction model using age, sex, emergency or elective admission, comorbidity score and diagnosis using the Agency for Healthcare Research and Quality clinical classification system, which is based on ICD-9 codes.[4] This enabled him to calculate an expected mortality risk for a hospital's admissions and so obtain a hospital standardised mortality ratio (HSMR) for each hospital.

Criticism has been focused on the comparison with the US. Indeed, in the document provided to *Channel 4 News*,[5] Jarman acknowledges that the US "has lower life expectancy and higher infant mortality rates" than the UK and "there is a disincentive for poorer people to be admitted" (it is notable that this international HSMR, unlike the UK version, does not adjust for deprivation). In addition, the comparability of coding can be questioned because of the known practice of "up-coding" in the US to increase reimbursement[6] and possibly different use of terms such as pneumonia and sepsis.

There also seem to be wide international differences in discharge policies before death—a recent study estimated that 78% of deaths in Japan occur in hospital, compared with 56% in England and Wales, 45% in the US, and 34% in the Netherlands.[7] This will have an important effect on in-hospital mortality—other countries may rapidly move patients into intermediate care facilities, an option that is not readily available in the UK. Jarman himself observed in 2004 that "In-hospital death rates are 4.9% in the US compared with 9.3% in England, suggesting that people are more likely to die out of hospital in the United States"[8]—a similar finding to his current analysis but with a rather different emphasis. Given that there is also general scepticism about the HSMR methodology, my personal inclination is to take little notice of the overall comparison with the US.

Over-reliance on the media

Jarman is clearly passionate about improving the NHS and has been frustrated at the lack of interest that has been taken in his analyses over the years. This has led him to a personal crusade, sidelining the usual routes of scientific papers and worthy reports by committees and to make direct contacts with the media. However, just as with the previous *Telegraph* story about "13 000 needless deaths" (currently subject to an investigation by the Press Complaints Commission after it received two complaints, one from me),[9] he seems to trust the media to report his caveats. They almost invariably fail to do so.

We are entering the era of "big data" and, although you can't help but be impressed at anyone who does logistic regressions

d.spiegelhalter@statslab.cam.ac.uk

with 21 000 000 observations, this is a fine example of when size is not everything—rather, we need data that are fit for the purpose of comparing what would happen to a similar patient were they admitted to different hospitals worldwide.

And unless big also means open data, it is impossible for outside observers to verify the analysis and interpretation, especially when the stories are trumpeted by media with an apparent vested interest in running down the NHS. This inevitably breeds suspicion and scepticism.

Of course, it would be deluded to deny there are serious problems in aspects of the NHS, or that we could not learn from good evidence of improved outcomes for comparable patients, and the culture of safety that exists in the best hospitals in the US and elsewhere. Channel 4 featured the Mayo hospital in Arizona as an example, and ventures such as Risky Business have been pressing these issues for years.[10] The recent Berwick report into patient safety proclaimed that "The NHS in England can become the safest health care system in the world."[11] But that this would "require unified will, optimism, investment, and change." If it takes this kind of publicity to bring these issues to increased prominence and contribute towards a cultural shift, then we should not complain.

But this was an exercise in closed data, and I remain sceptical about the specific statistical claims.

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