Cancer survival statistics for every hospital: do they make any sense?

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Words: 1,418

Keywords: cancer survival, population-based, cancer registry, hospital-specific, health policy

Does it make sense to publish cancer survival statistics for every hospital, every year, as has been proposed?[1] We think not.

Population-based cancer survival figures, derived from cancer registry data on all cancer patients living in a defined region, have been used to highlight geographic, socio-economic and international inequalities in survival for many years. Such survival figures have underpinned every national cancer strategy in the UK since 1995,[2,3] and trends in survival have been used to evaluate the impact of those strategies.[4]

Unlike hospital-specific survival figures, population-based figures include *all* cancer patients. They are unbiased, and they take precise account of the risk of death from causes other than cancer, allowing survival from the cancer to be compared between populations. They are thus ideal for evaluating trends in survival, and for regional[5] and international comparisons.[6]

Persistent inequalities in survival have led politicians to demand survival estimates for ever-smaller geographies, such as the 209 Clinical Commissioning Groups in England (CCGs, population 65,000-880,000). However, producing survival estimates for every CCG that are sufficiently robust to be interpreted for managerial purposes, year on year, is extremely difficult, even for the most common cancers.[7] It can be done for 1-year but not 5-year survival, and it requires modelling the entire national dataset of several million cancer patients diagnosed over more than 10 years.

Failure to distinguish between hospital-specific and population-based survival figures has led the Department of Health and NHS England to demand routine production of hospital survival figures, to judge the performance of every health service "provider" (a single hospital, or a group of hospitals that provide cancer services). It has even been suggested that hospital-specific cancer survival statistics should be produced every year, for each type of cancer, and for each stage at diagnosis, as a way of informing "patient choice".[1] A proposal to that effect was removed from the 2015 cancer strategy[3] only at a very late stage.

We argue that provider-level survival statistics cannot be usefully interpreted for surveillance of hospital performance. They are prone to referral bias and to random fluctuation due to small numbers; they may lead to spurious comparisons and inappropriate management decisions, and they do not support patient choice. The fact that over a million people have opted out from the use of their health data other than for their own clinical management (http://digital.nhs.uk/catalogue/PUB20527) will introduce bias and further undermine the utility of such statistics. We outline some alternatives.

Annual snapshots of outcome data cannot be safely interpreted in isolation. The Association of Coloproctology of Great Britain and Ireland publishes such performance data for individual colorectal surgeons, such as the 90-day mortality of each surgeon's patients after planned surgery, but the caveats for patients should give pause for thought:

- "the results this year will not tell us the real situation and will not be completely accurate for some surgeons";
- "very few [surgeons] do a sufficient number [of procedures], even over the four-year period, for these data to allow reliable comparison between surgeons";
- "some data may be accurate but other data are not correct and require further verification"; and finally
- "[it is] hard to identify one surgeon as being in charge in one operation" [because surgeons work in teams]

Quite so.

Readmission rates, and 30-day or 90-day mortality rates, are short-term outcome measures that may relate to a single surgeon or hospital, but fair comparisons require adjustment for case-mix, and sufficient numbers to produce statistically robust results.[8] One consequence could be misplaced confidence where evidence of poor performance is not strong, which can be interpreted as reflecting adequate performance. By contrast, population-based outcome measures, such as 1-, 5- or 10-year survival, reflect the overall effectiveness of the health service in managing all cancer patients in the longer term. Variation in such metrics cannot generally be ascribed to a single surgeon or hospital, or a single component of the quality of care.

It is not straightforward to assign a cancer patient to a particular hospital for survival analyses. Should it be the hospital where surgery is done, or where radiotherapy is carried out, or the specialised hospital to which those patients with complex problems may be transferred? Specialised hospitals may appear to confer higher survival if they see few patients for palliative care. Conversely, they may appear to confer lower survival if they treat many patients with late-stage disease, or complications, despite offering the best treatment. This selection process ("referral bias") can lead to misleading comparisons of survival between hospitals.

At the heart of the problem is the amount of data available for analysis. Most hospitals will see too few patients for robust survival estimation. Even for the most common cancers (breast and prostate), the average number of new patients seen every year in each hospital is below 300, and below 50 for the less common cancers. In many hospitals, those numbers will be even lower. The numbers are smaller still for each age group and sex (Table 1). Age-standardisation would be impossible. Producing survival statistics for each cancer, every year, for each hospital, further sub-divided by stage at diagnosis, would be even less useful: many sub-groups would not contain even one patient. Hospitals cannot be reliably rated, or compared with other hospitals, using statistics based on such small numbers of patients.

Ranked bar charts, a common form of comparison, can lead to incorrect judgments about year-on-year performance, because they do not take account of the precision of each survival estimate.[9] Even among 34 Cancer Networks, which covered populations of around 2 million, breast cancer survival rankings could change markedly from year to year, due to the small numbers of deaths (Figure 1).[5] Even in these larger populations, at least three years of data are required to obtain more robust survival estimates.

Funnel plots provide a good alternative. Data points outside the control limits (the funnel) indicate variation beyond what would be expected by chance, while taking due account of precision.[9] Funnel plots may still be used to compare some outcome measures for hospitals, but the data then need to be adjusted for other factors; and to recognise persistent outliers for which performance really needs investigating, we must examine time series, not just a single year in which the estimate for a hospital happens to fall outside an arbitrary threshold. Providers with consistently poor performance (e.g. the black triangle in Figure 2) can then be followed up with in-depth investigation.

We may obtain more insight into the variability of cancer survival from mixed effects models.[10] If we analyse patient data that include hospital characteristics (e.g. the presence of a multi-disciplinary team, or small caseload), we can ascertain whether a certain characteristic is associated with lower survival. The results can identify *categories* of hospitals for which a problem appears to exist, and for which a wider policy change may therefore be required. Such analyses avoid inappropriately stigmatising individual hospitals. They also avoid the issue of small numbers by grouping hospitals with similar features. They emphasise the

importance of factors that may be associated with poor survival, such as poor completeness of data on stage at diagnosis, or limited access to radiotherapy, thus pointing the way to policies designed to improve outcomes. Instead of “naming and shaming” a local hospital based on a single year's data, which can cause lasting and inappropriate damage to public confidence, this approach may help identify and correct deficits across the health service as a whole.

The attraction of cancer survival statistics for every hospital may be strong, but responsible policy-makers will resist it.

Cancer patient survival metrics are of great importance to most patients, and we may intuitively feel that comparing cancer survival between hospitals will allow us to identify hospitals that are in trouble, and to hold up the “best-performing” providers as exemplars of good practice. Population-based survival estimates are relevant for policy-makers, because they provide an overview of the effectiveness of the health-care system, so it may seem appealing to compare hospital-specific survival estimates – but they are not the same.

League tables may be considered politically desirable to inform “patient choice”,[1] but it is not helpful to publish league tables in which providers or areas are ranked every year, and for the spotlight to fall on those where performance appears to be outside expectation. Information that is inaccurate, misleading or uninterpretable is of no use to patients or healthcare planners.

The goal is to support long-term improvement in cancer survival. Outcome measures are indicators of performance, not proof of failure. Serious attempts to improve hospital performance should be based on deeper insight than a tabloid headline.

References

1. Dixon A, Robertson R, Appleby J, Burge P, Devlin N, Magee H. Patient choice: how patients choose and how providers respond. London: Kings Fund, 2010.
2. Expert Advisory Group on Cancer. A policy framework for commissioning cancer services (Calman-Hine report). London: Department of Health, 1995.
3. Independent Cancer Taskforce. Achieving world-class cancer outcomes: a strategy for England 2015-2020. London: NHS England, 2015.
4. Rachet B, Maringe C, Nur U, et al. Population-based cancer survival trends in England and Wales up to 2007: an assessment of the NHS cancer plan for England. *Lancet Oncol* 2009; **10**: 351-69.
5. Ellis L, Rachet B, Coleman MP. Cancer survival indicators by Cancer Network: a methodological perspective. *Health Statistics Quarterly* 2007; **Winter**: 36-41.
6. Allemani C, Weir HK, Carreira H, et al. Global surveillance of cancer survival 1995-2009: analysis of individual data for 25,676,887 patients from 279 population-based registries in 67 countries (CONCORD-2). *Lancet* 2015; **385**: 977–1010.
7. Quaresma M, Coleman MP, Rachet B. Cancer survival indicators for Clinical Commissioning Groups in England: feasibility study. London: Department of Health, 2013.
8. Walker K, Neuburger J, Groene O, Cromwell DA, Van der Meulen J. Public reporting of surgeon outcomes: low numbers of procedures lead to false complacency. *Lancet* 2013; **382**(9905): 1674-7.
9. Spiegelhalter DJ. Funnel plots for comparing institutional performance. *Stat Med* 2005; **24**: 1185-202.
10. Seppä K, Hakulinen T, Läärä E. Regional variation in relative survival—quantifying the effects of the competing risks of death by using a cure fraction model with random effects. *Journal of the Royal Statistical Society: Series C (Applied Statistics)* 2014; **63**(1): 175-90.

Authors' contributions

MM drafted the paper, MQ, JP, EM and BR read drafts of the paper and added contributions, MPC conceived the idea for the paper and drafted it.

Conflict of interest statements

None declared

Funding

MM is funded by an Early Diagnosis Award from Cancer Research UK to the Cancer Policy Programme at the London School of Hygiene and Tropical Medicine (award number C7923/A18348). The funders had no role in the writing of this comment.

Ethics

Not applicable

Appendix

Table 1: Number of new cancer patients in England in 2014‡, and average annual number of new patients likely to be seen in each of 154 acute hospitals* with one of four common cancers, by age and sex

Cancer		New patients	Age in years <15	15-39	40-49	50-59	60-69	70-79	80+
Breast (F)	England	46,085	0	1,874	6,733	9,857	11,519	8,580	7,522
	per hospital	**299**	**0**	**12**	**44**	**64**	**75**	**56**	**49**
Prostate	England	39,741	1	7	467	4,183	13,448	14,309	7,326
	per hospital	**258**	**0**	**0**	**3**	**27**	**87**	**93**	**48**
Non-Hodgkin lymphoma (M)	England	6,448	66	332	435	911	1,611	1,811	1,282
	per hospital	**42**	**0**	**2**	**3**	**6**	**10**	**12**	**8**
Non-Hodgkin lymphoma (F)	England	5,172	20	222	330	663	1,240	1,447	1,250
	per hospital	**34**	**0**	**1**	**2**	**4**	**8**	**9**	**8**
Pancreas (M)	England	4,071	1	37	157	460	1,066	1,289	1,061
	per hospital	**26**	**0**	**0**	**1**	**3**	**7**	**8**	**7**
Pancreas (F)	England	4,009	1	40	99	365	842	1,226	1,436
	per hospital	**26**	**0**	**0**	**1**	**2**	**5**	**8**	**9**

Sources:

*http://www.nhsconfed.org/resources/key-statistics-on-the-nhs for number of acute hospitals in 2014

‡http://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/datasets/cancerregistrationstatisticscancerregistrationstatisticsengland for cancer incidence

Cancer (ICD-10 code): breast (C50); prostate (C61); non-Hodgkin lymphoma (C82-C85); pancreas (C25)

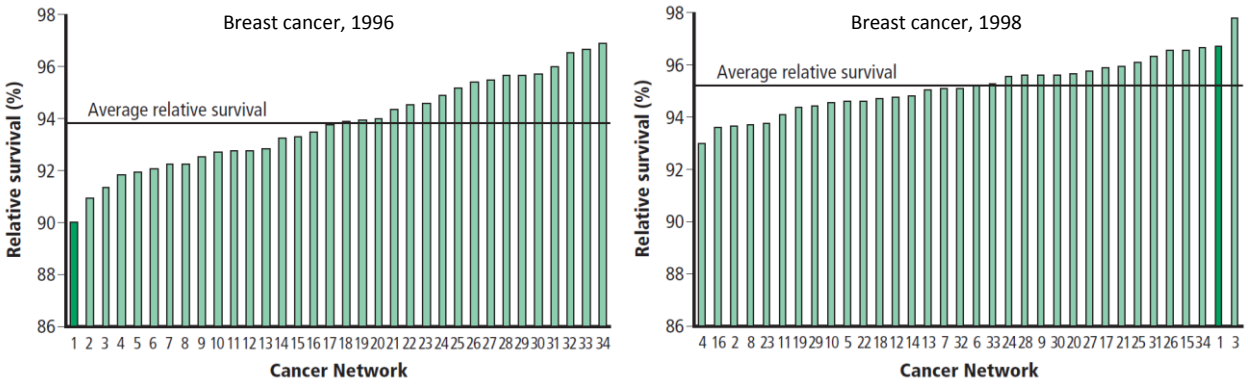

Figure 1: One-year relative survival for breast cancer in 34 Cancer Networks in 1996 and 1998. The Cancer Network in a darker colour moved from the lowest ranking to almost the highest ranking within two years.

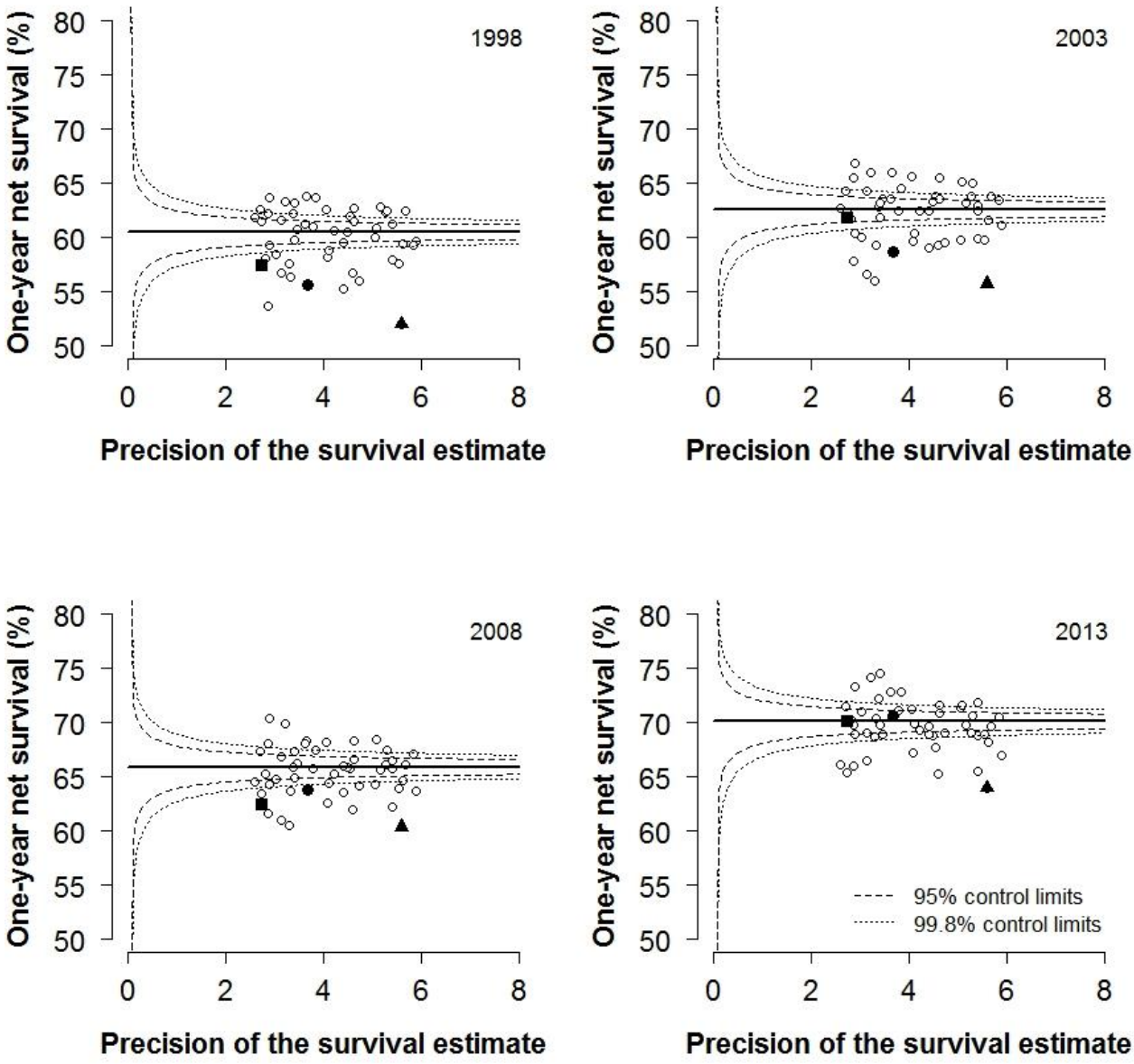

Figure 2: Funnel plots showing an illustration of one-year net survival for all cancers combined in 50 small geographical areas, for years 1998, 2003, 2008 and 2013