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# Estimating cancer survival – improving accuracy and relevance

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1. Cancer Council Queensland

With the number of people diagnosed with cancer increasing globally each year, the role of accurate and relevant indicators of the effectiveness of current management strategies at a population level is crucial for governments, policy makers, clinicians and planners as they seek to allocate and prioritise scarce resources and appropriately understand the changing burden of cancer. One such indicator is cancer survival.

One of the more common survival concepts is net survival, or the mortality that is specifically associated with a cancer diagnosis. It is generally estimated using either cause-specific survival or relative survival. Cause-specific survival considers only those deaths coded as due to cancer, which can be limited due to the difficulty of ascertaining a single cause of death for an individual. While the most preferred method in population-based registries is relative survival, its interpretation is poorly understood and standard methods of calculation are typically open to error.

In theory, relative survival compares the all-cause mortality rates among a cancer cohort to the all-cause mortality rate among the population without cancer. However, in practice it is typically calculated using population life tables in the denominator which includes the cancer cohort. Recent studies in Sweden<sup>1</sup> and Canada<sup>2</sup> have demonstrated that this introduces bias by over-estimating the relative survival, particularly when the mortality rate among the cancer cohort is high. While for most practical purposes this bias is negligible, for all cancers combined and some common cancers (notably prostate cancer), the bias was considered sufficiently high to warrant adjustment of the population mortality to exclude people with cancer.<sup>1,2</sup> This adjustment can be done simply,<sup>1</sup> but does require cancer-specific mortality information in the population by age. To our knowledge this bias has not been assessed or reported in an Australian context; however, we have

found that unpublished data from the Queensland Cancer Registry are consistent with those international studies.

A second factor is the impact of the changing distribution of age or cancer types as the time after diagnosis increases or between time periods or states/countries. Similar to age-standardised incidence rates, weights such as the International Cancer Survival Standard,<sup>3</sup> can be used to increase the comparability of relative survival estimates over time and between jurisdictions. Also, adjusting combined cancer survival estimates for cancer type can account for the different mix of cancers over time or between age groups as younger people are predominately diagnosed with cancers generally having good survival (melanoma, thyroid and testicular cancer).

When comparing survival across ethnic or social groups, relative survival requires ethnic or social-group specific population life tables.<sup>4,5</sup> This requirement has until recently limited its application for cancer survival among Indigenous Australians,<sup>6</sup> and led to the calculation of ethnic-specific lifetables for New Zealand.<sup>7</sup>

While the optimal method of calculating relative survival is to standardise by age (and potentially cancer type when combining cancers), using appropriate life tables and to adjust population mortality files by excluding people with cancer, these methodological changes will require systematic implementation by relevant jurisdictions across Australia to prevent further compromising comparability. While the changes are not difficult to implement in standard statistical packages, they will require a widespread appreciation among the producers of these statistics for the need to change and a willingness to incorporate and communicate these changes to the end-users.

Regardless of the method of calculation, the interpretation of relative survival remains difficult. Relative survival estimates net survival in the hypothetical situation where a

person cannot die of anything other than the cancer of interest. While this is not reflective of the real world, it does have the advantage of being independent of background mortality, at least in theory, thus allowing comparisons to be made across age, time and countries where the background mortality can differ substantially between groups.

However, when relative survival estimates are reported in the media, reports and even many research publications, the 'hypothetical scenario' caveat is typically discarded from the description, using phrases such as 'x% of cancer patients survived for five years'. Alternatively, many just state that '5-year relative survival was x%' without further elaboration, nicely circumventing the issue and leaving it up to the reader to interpret the reported estimate.

As far as we are aware, there is still no agreed upon standard about how best to describe relative survival estimates, with current descriptions ranging from the correct (rarely) to the potentially misleading or incorrect (more commonly). This is understandable, because most authors of scientific and more general publications would not want to include the caveat 'in a hypothetical but implausible world where people only die of cancer' to every reported survival estimate.

This hypothetical world interpretation doesn't hold a lot of intuitive appeal for persons who live in the real world, because for them it only provides part of the picture. The link between the hypothetical and real world is missing; that is, how likely it is for the general population to survive five years, given that this information is used as the denominator in the calculation of relative survival estimates.

A more real-world picture of survival is provided by crude survival. Crude survival uses the same calculation mechanism as relative survival in terms of comparing the cohort all-cause mortality with the population all-cause mortality. While net survival ignores competing causes of death, crude survival accommodates them. This reflects the real world scenario that people can die of either their diagnosed cancer or another cause. Crude survival also has the advantage over other methods of incorporating competing risks in that it calculates the estimates from the relative survival framework by partitioning the survival expectations rather than requiring cause of death data.<sup>8</sup>

As an illustration, we provide survival data from the Queensland Cancer Registry (Figure

1a). The relative survival estimates for all ages combined suggests that, in a hypothetical world where the only cause of death is cancer, 70% of patients survived their cancer five years after diagnosis. However, this ignores competing causes of death, and has the potential to be interpreted as 70% of patients are alive after five years. When competing causes of death are accounted for, 63% of all patients were alive after five years, 29% died from their cancer and 8% from other causes. With population mortality being low among younger people, the relative and crude survival estimates in this age group are very similar (Figure 1a). For older people, however, there are marked differences, with the estimate of surviving five years in the hypothetical world being 50% (relative survival), while in the real world, after considering competing causes of death, it is 36% (crude survival). The changing scenarios in prognosis by age at diagnosis can be communicated pictorially (Figure 1b).

We suggest that the oft-used interpretation of 'x% of cancer patients survive for five years' leaves too much unsaid. In situations that do not lend themselves to using the phrase 'hypothetical world', we recommend that

relative survival estimates be described in the context of a ratio, with cancer patients being x% as likely (or 100-x% less likely) to survive five years than the general population. Since it is independent of background mortality, this ratio can be correctly used to compare the impact of a diagnosis of cancer across national and international population groups where background mortality differs. Crude survival estimates, in contrast, should be used to describe survival outcomes in more real life terms, incorporating the risks of both cancer-related and non-cancer deaths in the prognostic outcomes, while understanding that these estimates will vary depending on the background mortality.

We raise these concepts in the hope of motivating efforts to increase the accuracy and understanding of population-based survival estimates as well as increasing their relevance to clinicians, health planners, media, support workers and cancer patients in Australia and New Zealand. It is also important to note that appropriate communication of information about cancer prognosis should not rely on one measure alone. There are an increasing suite of prognostic measures now available, including

loss of life expectancy due to cancer,<sup>9</sup> survival outcomes conditional on previous survival,<sup>10</sup> proportion of cancer patients considered cured,<sup>11</sup> and avoidable or postponable deaths, some of which have been applied to Australian or New Zealand data.<sup>12,13</sup> Not only is it important that these range of measures continue to be reported in these contexts, but that they be calculated, interpreted and communicated appropriately.

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Figure 1a: Net (1-relative survival) and crude cumulative probability of death for all cancers combined, Queensland, 2009-2013, 15-89 years.

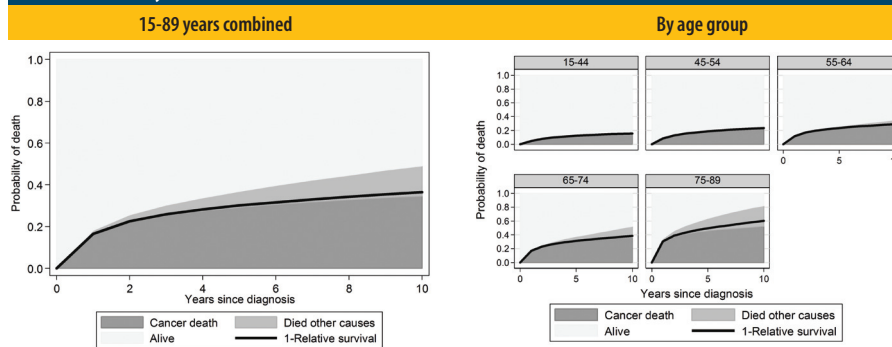
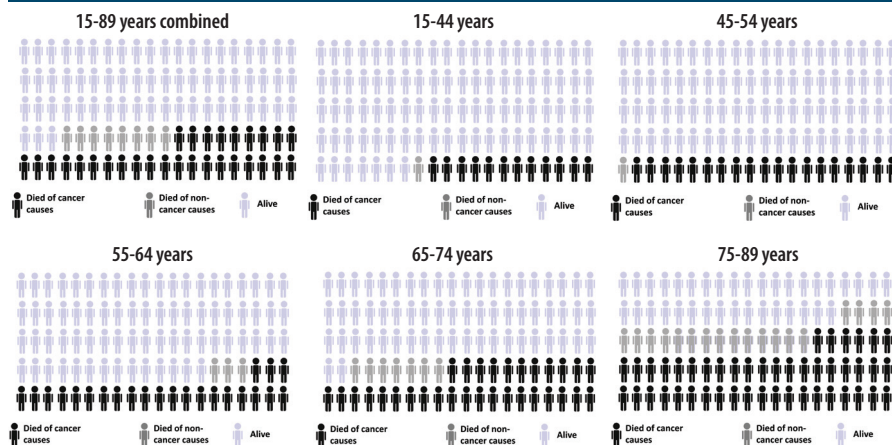


Figure 1b: Five-year crude probability of death for all cancers combined by cause of death, Queensland, 2009-2013, by age group at diagnosis.



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