Quantifying the benefits and harms of various preventive health activities

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Background and objective
It is helpful for general practitioners (GPs) and their patients to understand the amount of health benefit expected from different preventive activities to enable a thoughtful choice of which to adopt first. The aim of this article is to illustrate how it might be possible to quantify the mortality benefit for cancer screening, quitting smoking, losing weight and treating lipids, which are preventive activities from The Royal Australian College of General Practitioners' (RACGP's) *Guidelines for preventive activities in general practice* (Red Book).

Methods
A sample of common preventive activities was taken, with an outcome for each selected for fair comparison, and benefits and harms were estimated.

Results
For a man aged 50 years, the benefit in terms of reduced risk of dying is greatest for quitting smoking (at 24 fewer deaths/1000/decade), which is approximately 10 times the benefit of lowering lipids in a man with metabolic syndrome and about 50 times greater than from participating in regular colorectal cancer screening. Benefits for women are generally lower, as their baseline risk is lower.

Discussion
It is feasible to quantify the benefits of some preventive activities, although estimating them is not straightforward and requires several assumptions. Nevertheless, extending estimates such as these to the items in the RACGP's Red Book would assist GPs and their patients' preventive activity prioritisation.

IN AUSTRALIAN general practice, preventive health activities are usually undertaken opportunistically – that is, they are additional to other reasons for attending – rather than in annual health checks, which do not lead to reduction in mortality.[1] Opportunistic prevention involves addressing individual preventive activities that have good evidence of benefit. To assist general practitioners (GPs), these activities have been formalised in the recommendations of The Royal Australian College of General Practitioners' (RACGP's) *Guidelines for preventive activities in general practice* (Red Book), a collection of 32 preventive activities for adults and 24 for children.[2]

As all of the preventive activities in the Red Book are beneficial, the large number of activities presents a problem. Naturally, not every patient can adopt all of them, and the question of which to choose is also influenced by factors such as competing health priorities and the patient's interest or capacity. Which should be selected in the brief time afforded by opportunistic prevention? When a preventive activity is being considered, it seems sensible to initially choose one (or more) that has the greatest net absolute health benefit, remembering that some preventive activities are also potentially harmful (such as from overdiagnosis and downstream overtreatment). Adding other health tasks can contribute to treatment burden and result in fewer health tasks being undertaken,[3] particularly for patients with multimorbidity. This leads to the question: how **should** GPs and patients prioritise which tasks to undertake?

The absolute risk difference of any benefit (or harm) is more important than the relative risk difference because it adjusts for the prevalence of the disease. A small relative risk difference in a prevalent disease may be more important than a large relative difference in a rare one.[4] If the benefits and harms of each preventive activity were ranked in the Red Book using a single consistent metric, then GPs could assist patients to compare a few options and rationally consider how these options align with patients' preferences, values and circumstances.

In this article, we explore the feasibility of such an approach and show an example of how this might be done.

Methods

We selected a sample of commonly adopted preventive activities. For each, we selected an outcome that would enable a fair comparison between them, then estimated their benefits and harms.

Choosing outcomes

Ideally, outcomes would estimate the mortality as well as morbidity gains and losses attributable to each preventive activity. One metric that combines these is the quality-adjusted life year (QALY), used to compare health outcomes caused by different diseases. However, most patients are not familiar with this measure. Moreover, harms are more difficult to quantify for some diseases, which makes

comparisons vulnerable to inaccuracy. Accordingly, we have chosen to simplify the outcome to include quantification of mortality, and only list other benefits and harms to facilitate discussion.

Choosing the best study type

Good evidence for preventive activities comes from meta-analyses of randomised trials, which we have used where possible. For preventive activities where these are not available (eg smoking cessation has never been tested in a randomised trial with mortality as an outcome), we quantified the evidence for benefit from observational cohort studies.

Estimating the size of the benefit

The benefit of a preventive activity depends on factors such as the patient's baseline risk of the disease and the risk reduction from adopting the preventive activity. Baseline risk varies by several demographic variables, including age and sex. To simplify the estimates, we restricted the analysis to a single age group (50 years of age). The absolute benefits and harms at different ages are different, although the relative values will be similar. Most preventive activities, including cancer screening, are recommended for people at average risk; for these items, the baseline is the general population risk. But for other preventive activities, such as stopping smoking, the patient's baseline risk is increased, which we estimated by partitioning the general population mortality risk by exposure status. For example, the overall mortality rate for Australian men aged 50 years is 432/100,000/year, which can be partitioned into 380 for non-smokers and 691 for smokers (on the basis of a smoking prevalence of 17% and relative risk of 1.82).[5]

Some interventions have benefits that are continuous outcomes; one example is body weight, which has benefits per five body mass index (BMI) units (kg/m^2) of reduction. However, to complicate our estimates, the benefits from reducing a risk factor are rarely as large as never having had the risk factor. To adjust for this, we used a two-stage process: first applying the results of observational studies to establish the degree of risk, then applying results from follow-up studies (randomised trials when available) to estimate the degree of benefit from the preventive activity (Table 1).

Results

For some common preventive activities, we were able to calculate estimates of the mortality benefits in a format that invites comparison (Table 1). The range of estimates of mortality benefits varied considerably, as did the nature of the harms (although these were not quantified).

For example, the benefits of attending mammography screening for a woman aged 50 years are about 0.5 deaths avoided for every 1000 women undergoing screening for a decade; by contrast, reducing weight to consequently reduce BMI from 35 to 30 kg/m^2 results in 12 fewer deaths over a decade for every 1000 women. The potential harms from each of the two preventive activities are very different.

Discussion

Different approaches to analysis might yield different estimates; however, we think the accuracy is sufficient for comparisons, particularly when the differences are as much as a factor of 10. We have not quantified harms, which would be possible for only some of these interventions. The risk for an individual patient will be influenced by additional risk factors such as family history, health behaviours and age, so the estimates in Table 1, being for a patient with no other risk factors, are just a starting point for discussion. If the sample patient with a BMI of 30 kg/m^2 also has a family history of cardiovascular disease, the benefit from weight loss will be greater.

Nevertheless, this provides a possible way for GPs to encourage patients to consider a range of preventive activities and prioritise those that suit their concerns, expectations and preferences with respect to the expected benefits and possible harms. These benefits must also be weighed against the feasibility of the activities and the achievability of change for each patient. For example, it may be easier for a woman to choose mammography over an attempt to lose weight.

We hope this paper, despite its limitations, small number of examples and single age group, stimulates discussion about the issue of prioritising preventive health activities, the need to discuss such an approach with patients on the basis of the benefits and harms of each, and involves patients in the decision making.

To extend the estimates to all the activities in the RACGP Red Book would require refinement of the methods, and suggests the possibility of designing and testing decision support tools to support GPs to have such discussions with their patients.

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Table 1. Estimated benefits and harms for a patient aged 50 years with no other risk factors

Preventive activity	Mortality benefits Reduction in expected deaths per 1000 people per decade (95% confidence intervals)	Examples of other benefits (not complete list)	Examples of harms (not a complete list)
Being invited for regular mammography*	Female: 0.5 (0.1, 1.1) fewer breast cancer deaths	• Reassurance for those with negative screening results • Early detection may lead to less invasive surgery	• Anxiety with false positives (requiring rescreening) = 70/1000[6] • Overdiagnosis = 4.4/1000[7] and overtreatment, which may include mastectomy
Participating in regular faecal occult blood testing (FOBT; biennial, ≥2 rounds)†	Male: 0.5 (0.3, 0.6) fewer bowel cancer deaths Female: 0.3 (0.2, 0.4) fewer bowel cancer deaths	• Reassurance for those with negative screening results • Early detection may lead to less invasive surgery	• Risk of perforation during colonoscopy among patients with a positive FOBT result • Risk of overdiagnosis
Quitting smoking (for patients who smoke 20 cigarettes/day)‡	Male: 24.2 (18.0, 30.0) fewer deaths Female: 15.4 (11.5, 19.4) fewer deaths	• Fewer hospital admissions • Save money • Increase in fitness	• Short-term withdrawal symptoms • Weight change
Weight loss (reduction in body mass index [BMI] from 35 to 30 kg/m^2)§	Male: 19.7 (17.3, 21.6) fewer deaths Female: 11.8 (10.4, 12.0) fewer deaths	• Lower risk of developing osteoarthritis • Fewer hospital admissions • Reduced cancer incidence	
Lipid lowering with a statin in a male with metabolic syndrome‖	2.1 (1.4, 2.5) fewer deaths	• Less cardiovascular disease morbidity (such as from myocardial infarction, heart failure) • Better quality of life without heart disease	• Observational studies suggests an extra 12 cases of diabetes per 1000 per decade
Lipid lowering with a statin in a female with metabolic syndrome‖	0.7 (0.5, 0.8) fewer deaths	• As for men	• As for men

**Meta-analysis shows a 14% risk reduction from mammography.[8] We applied this to the Australian breast cancer–specific mortality for women aged 50–59 years from General Record of Incidence of Mortality (GRIM) data. This estimate is for being invited to screening; the benefit from participating in screening will be higher, probably by 20%,[9] so the true value may be 0.6 per 1000 per decade.*

†A Cochrane review showed a 25% reduction in colorectal cancer mortality.[10] Applying this risk reduction to the observed colorectal cancer–specific mortality from the GRIM books was done separately for men and women since the baseline risk is gender-specific.

‡A study of the entire New Zealand population[11] shows that the mortality risk from being a smoker has lessened over recent decades. The later result from 1996 to 1999 for non-Maori people, after adjustment for age and socioeconomic status, was a risk ratio for all-cause mortality of 1.82 for men and 1.99 for women. The risk reduction from quitting is derived from a Danish cohort[12] with nearly 20,000 people followed for 15 years. The relative risk for those who quit smoking was 0.65 (95% confidence interval: 0.56, 0.74); no mortality benefit was seen in the people who reduced the number of cigarettes smoked but did not quit.

§The average BMI of people in NSW as reported by the 45 and Up Study[13] is 26.7 kg/m^2, so a person at BMI 35 is 8.3 kg/m^2 above the average. A systematic review[14] shows the mortality risk slope for obesity flattens out with increasing age. For all-cause mortality the risk is 1.37 per five BMI units for people aged <59 years. At a BMI of 35 kg/m^2, the relative risk for all-cause mortality is 1.69. The estimated benefit is based on the untested assumption that losing weight is equally beneficial to not gaining weight.

‖The GRIM books report that the cardiovascular disease (CVD) mortality for patients aged 50–59 years in Australia in 2015 was 94.8 for men and 31.3 for women per 100,000 per year. The prevalence of metabolic syndrome in Australia by the International Diabetes Federation definition is 30.7% in the AusDiab[15] population survey in 1999–2000, and the relative risk for cardiovascular death for those with metabolic syndrome is 2.40.[16] This allows partitioning of the CVD mortality risk for men of 66/100,000/year for those without metabolic syndrome, and 159/100,000/year for those with metabolic syndrome. Applying the risk reduction from the Cholesterol Trialists Collaboration[17] of 0.87 for those on a statin gives 2.07 deaths averted per 1000 men treated per decade. The use of statins for prevention is based on overall CVD risk rather than on just a lipid estimation, so we have used a candidate patient with metabolic syndrome rather than a stated lipid value.

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