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Promoting informed health choices: the long and winding road

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Introduction

When health professionals intervene in the lives of others, their actions sometimes inadvertently do more harm than good. The same risk is true for legislators or individuals making health choices. Informed health choices can increase the probability that patients benefit, that is that the wanted intervention effects will outweigh unwanted effects. For this reason, all health policies and practices should be informed by the best available evidence of intervention effects.

In this commentary, we consider some of the challenges that confront those promoting the evaluation of the effects of health interventions to inform health choices. By 'health choice' we mean any action that individuals or groups can choose to take in the belief that it will protect or improve their health or the health of others. 'Health interventions' include everything from dietary, device, surgical or pharmaceutical interventions for individuals to policies for population health.

We are not trying to cover everything that goes into making informed choices in this commentary. We focus particularly on the evaluation of the effects of health interventions. People make health choices based largely on what they believe will happen because of their choices (the expected effects). For informed health choices, reliable information about the probability of those effects is essential, but not sufficient. Other types of research are also important, as is efficiency, equity, and inclusivity. However, it is not possible to make informed judgements about efficiency and equity without reliable information about the effects of a health choice.

Our interest in informed health choices began in the 1970s. It started with raising questions about the opinions of authorities. This led to collaborating to help address some of the challenges considered in this commentary. Brief accounts of how we came to question authority and to recognise the need to collaborate can be found in Supplemental Appendix 1.

This is an abridged version of a longer commentary published in the James Lind Library.[1] It is based on discussions we had over several months, our experience, and feedback from colleagues. In Supplemental Appendix 1, we address how our experience may have affected this commentary. This, together with the references we cite, may help those bothering to reflect on our opinions to decide what to believe or do.

People have recognised for hundreds of years some of the problems we address. Some illustrative examples are outlined in Figure 1. However, over the past five decades, awareness of these problems and efforts to address them have increased dramatically. Illustrative examples of this can be found in Supplemental Appendix 2. There has been astonishing progress towards making informed health choices a reality.

To get to where we are today has been a long and winding road, and we still have a long way to go. For example, in 1987, Cynthia Mulrow showed that review articles in major medical journals were not using systematic, explicit methods to reduce the risk of being misled by bias or the play of chance.[4] There has since been an explosion in the production and publication of systematic reviews, but there is unnecessary and confusing duplication of effort.[5–8] Access to high-quality reviews is also limited, partly because of poor communication and pay walls.[9,10] For these and other reasons, many health choices still are not informed by high-quality, up-to-date systematic reviews.[7,8,11]

The fundamental problem underlying poorly informed health choices is uncritical reliance on poorly informed opinions. Often, authorities (and others) express strong opinions about the effects of interventions without being explicit about the basis for their opinions, or cherry-picking evidence. Those opinions influence choices without people questioning their basis. In the current political environment, with increasing authoritarianism and massive amounts of misinformation, this is particularly important for all kinds of interventions, not just healthcare interventions.[12–14]

Figure 1. Illustrative examples of promoting evaluation of the effects of health interventions to inform health choices dating back to the fifth century BCE.*

As early as 400 BCE Hippocrates stressed that a competent researcher must ensure that his starting point is knowledge of what has already been discovered, and Socrates questioned authority, including his own (Plato, *Apology* 21c – 21d).

More than a millennium ago, in the 9th century CE, Al-Razi (Rhazes) recognized that comparisons are needed to evaluate the effects of interventions, and for centuries people have recognised that in unbiased comparisons of interventions, like must be compared with like. For example, in 1364, Francisco Petrarca proposed an experiment to assess whether people would be better off avoiding rather than seeking medical treatment. In 1648, Jean-Baptiste van Helmont proposed casting lots to decide which patients should be treated by orthodox physicians with bloodletting and purging, and which by him without these treatments.

The *James Lind Library* contains hundreds of reports of using prospective allocation to reduce the risk of comparison groups being biased, published as early as 1575 (by Ambroise Paré) and during the 1800s and early 1900s.

In 1812 Frances Burney described in excruciating detail her experience undergoing mastectomy for breast cancer without anaesthesia, highlighting adverse consequences of a poorly informed decision by physicians and the lack of patient participation in decision-making.

By the end of the 1950s there was growing recognition of the use of random allocation to reduce the risk of comparison groups being biased with respect to prognosis and responsiveness to the interventions.

1941 Joseph Bell, in an exceptionally clearly written report of his trial of whooping cough vaccine, reported his use of random sampling numbers to generate unbiased comparison groups.

1948 The UK Medical Research Council's report of a controlled trial of streptomycin for pulmonary tuberculosis was a methodological landmark because it provided detailed information about the trial, and in particular, the steps taken to prevent foreknowledge of treatment assignments.

1952 William Silverman published the first of many randomized trials in neonatology. "He played a role in North America that was equal to or even beyond that of Sir Austin Bradford Hill in the UK in terms of introducing randomised trials. Silverman carried out trials in areas where the overwhelming opinion was what was going on was correct. It took an enormous amount of courage to carry out these trials." [2]

1955 Thomas Chalmers , one of the most vocal promoters of randomized trials, published a detailed report of a trial that found no evidence that the prolonged bed rest that was commonly prescribed for hepatitis at the time promoted recovery. [3] He suggested that inadequately evaluated new treatments should only be used in randomised trials until their effects became known.

1959 By the end of the 1950s, the UK Medical Research Council had accumulated substantial experience of designing, running, analysing and reporting controlled trials. Austin Bradford Hill was invited to plan and chair a meeting in Vienna in 1959 to report this experience.

*Additional important events in the history of evaluations of interventions can be found in A Timeline of Fair Tests of Treatments in the James Lind Library.

Other problems using evaluations of the effects of health interventions to inform policies and practice include:

- inadequate consideration of the harmful effects of intervention
- biased evaluations of intervention effects
- conflicts of interest
- biased reporting of research
- deficient reporting of research
- deficient reviews
- ineffective and inefficient peer review
- failure to keep reviews up to date
- unnecessary duplication of effort
- misinformation
- limited access to trustworthy information about the effects of policies and practices
- gaps between evidence-based recommendations and professional practice
- inadequately informed policymaking
- lack of patient and public participation in decision-making.

Collaboration is needed to address all these challenges. Like the importance of thinking critically about opinions, collaboration and collective action are more important than ever, given the many challenges facing humanity. These include massive inequities, pandemics, antimicrobial resistance, unsustainable use of resources, and climate change.

Uncritical reliance on inadequately informed opinions

Researchers, doctors, pundits, influencers and other authorities often disagree about the effects of interventions. This may be because their opinions are not routinely informed by systematic reviews. People frequently consider: Who expressed the opinion? How strong is their opinion? And how much experience do they have? The answers to these questions do not always provide a trustworthy basis for judging the reliability of opinions.

Improving the extent to which health choices are informed requires enabling people to avoid uncritical reliance on inadequately informed opinions. This depends on developing, evaluating, and implementing effective interventions to enable people to question the basis for opinions about the effects of interventions.

Inadequate consideration of harmful effects of intervention

Almost all health interventions have unwanted effects that must be weighed against potential desired effects. These include individual treatments, but also public health interventions and educational interventions.[15,16] Poor reporting of harms makes this weighing up difficult. Findings that suggest benefits tend to be emphasised, while potential harms are downplayed or ignored.[17,18] Moreover, reliable evidence of harmful effects, especially long-term harms, often lags behind evidence of beneficial effects.[17,19,20]

Added to these deficits, press releases for research reports are often designed to attract favourable media attention, and news reports of those studies do the same.[21] Most news reports about health interventions mention at least one benefit, but fewer than half mention or adequately discuss harms.[22] Patients and health professionals tend to overestimate the benefits and underestimate the harms of health interventions.[23–25]

Improving the chances that wanted intervention effects outweigh unwanted effects will depend on researchers, health professionals, policymakers, patients and the public ensuring that harmful effects are adequately measured, reported and considered.

Biased evaluations of intervention effects

The use of randomised trials to evaluate the effects of interventions has increased dramatically.[8] But many evaluations (both randomised and non-randomised) do not take adequate steps to reduce the risk of bias.[26,27]

When there are important uncertainties about the effects of health interventions, they should ideally be evaluated in well-designed randomised trials. The trials need to be large enough to yield reliable estimates of effects on important outcomes. As the Australian economist and politician Andrew Leigh writes at the end of his book describing randomised trials of all types of interventions: '*If we let our curiosity roam free, we might be surprised how much we can learn about the world, one coin toss at a time*'.[28]

Because resources are limited, it is vital to identify important uncertainties about the effects of interventions and then set priorities for evaluations that minimise the risk of bias. Collaboration among research funders, research institutions, researchers, policymakers, patients and the public can help do this.[29]

Conflicts of interest

In addition to wanting to help people, people may have other interests in promoting a particular intervention, for example, to make money. They may promote an intervention by exaggerating its benefits, ignoring potential harms, cherry-picking which information is used, or making exaggerated or false claims. Conversely, people may object to an intervention for a range of reasons, such as cultural practices.

Most research on funding bias (conflicting interests of funders) and conflicts of interest of researchers and authors of reviews or guidelines is devoted to evaluating the prevalence, nature and effects of disclosing conflicts of interest.[30,31] While disclosure policies are ubiquitous, those policies are not consistently designed, implemented, or enforced. Disclosure alone is insufficient. It is not particularly effective in mitigating the undesirable consequences of conflicts of interest.[30] Effective strategies are needed to assess whether an interest constitutes a conflict of interest, and to better manage conflicts of interest.[32] There is also a need to identify and reduce incentives that contribute to distorting the conduct, reporting and interpretation of research.[33,34]

Biased reporting of research

Many evaluations of the effects of interventions are not published,[35–37] and outcomes are sometimes selectively reported in research reports.[37–41] Those outcomes that are published are more likely to report favourable results. Consequently, relying only on published reports sometimes results in overestimating the wanted effects of interventions and underestimating unwanted effects.

The International Committee of Medical Journal Editors (ICMJE) adopted a policy in 2004 to mitigate bias resulting from selective reporting of research.[42] The policy requires, as a condition of consideration for publication, registration of trials in a trial registry. In 2006, the World Health Organization established the International Clinical Trials Registry Platform to link trial registries to ensure a single point of access and unambiguous

identification of trials, and to establish standards for trial registries.[43] These and other initiatives have helped accurately document non-publication, but biased reporting of evaluations of interventions remains a problem. Better understanding and evaluation of solutions is needed. This will require the collaboration of research funders,[44] industry and regulators,[45–47] trial registries, journal editors,[42] research institutions,[48] systematic review authors[46,49–51] and researchers.[52]

Deficient reporting of research

For people to be able to critically appraise research, the research must be clearly and completely reported. Recognition of inadequacies in the reporting of research dates back at least 50 years.[53] In 1996, two groups working independently to address this problem collaborated to create the first Consolidated Standards of Reporting Trials (CONSORT) statement in 1996. The statement is a checklist of items that should be included in reports of randomised trials, which has been updated three times since 1996.[54] The original Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) statement for reporting protocols for randomised trials was published in 2013.[55] Major updates of the CONSORT and SPIRIT guidelines were published in five major medical journals in 2025.[54,55]

Other deficiencies in reporting research have been recognised, and many other checklists for reporting research have been developed subsequently. This includes checklists to improve the reporting of descriptions of interventions,[56,57] systematic reviews[58] and guidelines.[59] EQUATOR (the Enhancing the QUAlity and Transparency Of health Research network) was officially launched in 2008 as a global collaborative initiative. Its objective is to improve the value and reliability of published health research by promoting transparent and accurate reporting and wider use of evidence-based reporting guidelines.[60]

The first formal Outcome Measures in Rheumatology (OMERACT) conference was convened in 1992 to address deficiencies in the measurement and reporting of outcomes in randomised trials of interventions for people with autoimmune and musculoskeletal diseases.[61,62] In 2010, the Core Outcome Measures in Effectiveness Trials (COMET) initiative was launched.[63,64] It promotes the development and use of core outcome sets to improve the measurement and reporting of outcomes for trials in all specific areas of health or health care.

Reporting guidelines and core outcome sets have been widely disseminated and endorsed, but there remain important inadequacies in reporting research.[65–67] There is a wide range of strategies that research funders, editors and peer reviewers, academic and research institutions could currently use to improve adherence to reporting guidelines, but little evidence of the effects of those strategies.[68–70]

Deficient reviews

Reviews that fail to use systematic methods may yield biased or imprecise estimates of the effects of interventions. Unsystematic searches mean good studies may not be found, and poor selection or appraisal of identified studies may lead to bias. Finally, the synthesis of the results of the included studies may be inadequate or inappropriate.[71]

Hundreds of systematic reviews are published every week now.[5,8] There are about 9500 Cochrane reviews, and over 500,000 systematic reviews in the Epistemonikos database.[72] However, most reviews are still not systematic, and many systematic reviews have serious flaws.[6,7] While there have been slow improvements, there is a need for ongoing collaboration among organisations such as the Cochrane Collaboration, the Campbell Collaboration, and the International Collaboration for the Automation of Systematic Reviews to improve the efficient and effective production of systematic reviews.

Automation tools have the potential to improve the speed and efficiency of systematic review production, their accuracy, and to keep them up to date.[73] However, caution is needed as evaluations show mixed results with the potential to decrease, as well as increase, accuracy and only for some review steps.[74] Those tools that have been shown to be helpful remain underused. Improved and automated review methods can also help improve the quality of reviews. But the methods used in systematic reviews have become increasingly complex – sometimes too complex.[75] To paraphrase a quote attributed to Albert Einstein: ‘The methods used in systematic reviews should be made as simple as possible, but not simpler.’

Ineffective and inefficient peer review

Journals rely on peer review to ensure the quality of the research they publish, and decisions about which research proposals are funded rely heavily on peer review.[76–78] However, peer review is highly variable, inconsistent and often flawed.[77,79–82] There is little evidence of the effects of peer review on the quality of published research evidence,[83,84] and very little evidence on the effects of peer review of proposals for research funding.[76,77] For the most part, it is done by volunteers, few of whom have formal training, and they commonly miss major errors. For example, the British Medical Journal (BMJ) sent three papers, each of which had nine major methodological

errors inserted, to about 600 peer reviewers.[84,85] On average, the peer reviewers detected about one-third of the errors in each paper. In addition, peer reviewers fail to detect or comment on spin.[86]

A systematic review published in 2007 found only 28 comparative studies of the effects of processes in editorial peer review.[83] The same year, another systematic review found only 10 comparative studies of the effects of grant-giving peer review processes.[76] A more recent review found 83 studies of innovations to improve the effectiveness and efficiency of peer review of health research funding. The studies had important limitations, but many innovations appear promising and warrant further evaluation.[78]

Strategies that work are needed to improve the effectiveness and efficiency of peer review.

Failure to keep reviews up to date

A landmark study by Eliot Antman and colleagues, published in 1992, compared the results of cumulative meta-analyses of treatments for myocardial infarction with the recommendations of clinical experts writing (unsystematic) review articles and textbook chapters.[87] They showed that research had continued long after robust estimates of treatment effects had accumulated, and that recommendations had overlooked strong, existing evidence from randomised trials, both of beneficial and of lethal effects of treatments.

An analysis of 50 reports including over 1500 cumulative meta-analyses of health intervention studies was published 22 years later, in 2014.[88] This analysis showed *'that, had researchers assessed systematically what was already known, some beneficial and harmful effects of treatments could have been identified earlier and might have prevented the conduct of the new trials. This would have led to the earlier uptake of effective health and social care interventions in practice, less exposure of trial participants to less effective treatments, and reduced waste resulting from unjustified research.'*

'Living systematic reviews' are continually updated analyses, incorporating relevant new evidence as it becomes available.[89] Although this has been described as a novel approach to updating systematic reviews, it is like the approach that was used by The *Oxford Database of Perinatal Trials* (ODPT), first published electronically in 1988. ODPT became the *Cochrane Pregnancy and Childbirth Database* and was the pilot for the *Cochrane Database of Systematic Reviews*.[90–92] What's more recent is identifying a subset of reviews for which this approach is appropriate and the use of automation to assist with some systematic review tasks. These include searching, eligibility assessment, identification and retrieval of full-text reports, extraction of data, and risk of bias assessment.[93]

The evolution of 'living guideline recommendations' is linked to that of 'living systematic reviews'. Studies have documented how quickly practice recommendations need updating.[94–96] Collaboration between 'living systematic reviews' and 'living guideline' teams is needed,[97] and digital tools can facilitate keeping practice recommendations up to date.[98–100]

Unnecessary duplication of effort

Plans for randomised trials should use systematic reviews to avoid conducting new trials that are unnecessary (and thus probably unethical).[101,102] Cumulative meta-analyses have shown that new trials might have been recognised as unjustified had a systematic review informed plans for new trials.[87,88]

Many published systematic reviews duplicate other reviews on the same topic without adding anything important.[7,103,104] In addition, some duplicate reviews are discordant and confusing.[105] Some intentional replication of systematic reviews by different teams might be useful (WHO often commissions duplicate reviews for very important topics). However, for many topics, duplication is a waste of resources.

Pressure on academics to publish contributes to unnecessary duplication. Many institutions base promotion and tenure on publication quantity, rather than quality. When income and professional advancement depend on publication output, systematic review authors may choose to publish a review, even if it duplicates another review unnecessarily.

To help avoid unintended and unnecessary duplication of systematic reviews, review authors should register protocols for their reviews, and they should search for other systematic reviews and review protocols on the same topic before undertaking a new review.[106]

Misinformation

Mass media are a source of health information for many people. Researchers have studied and criticised the quality of health information in the mass media for at least five decades. A systematic review of 44 studies of the quality of health news found that many news reports gave an unbalanced and oversimplified picture of the potential consequences of health interventions.[22]

Over the past three decades, people have been increasingly using the internet and social media to seek and share health information.[13,107] Several systematic reviews have found high prevalences of poor-quality online health information and misinformation.[13,107–110]

The creation and dissemination of trustworthy information about the effects of health interventions can help to mitigate the adverse effects of misinformation.[9,10,13] Fact-checking and automated detection of health misinformation could also help. However, there is limited evidence of the effects of these and other interventions.[13,111–113]

Artificial Intelligence (AI) could potentially help to reduce inequalities in access to evidence-based health information by facilitating equitable access to trustworthy information.[114,115] However, AI can also generate and worsen the spread of misinformation.

Eliminating misinformation is a worthy but Sisyphean task. In addition, teaching people to think critically about health claims and choices (including when and where to find trustworthy information) is essential.

Limited access to trustworthy information about the effects of policies and practices

To make informed decisions about interventions, patients and the public, health professionals and policymakers need information about effects based on the best available research evidence.[9] Those communicating evidence-based information about the effects of health interventions should make it easy for readers to quickly assess the relevance of the information. For each important outcome, they should help their target audience to understand the size of the beneficial and harmful effects and how sure we can be about those, presented in ways that avoid misleading. They should help their target audience to put information about the effects of interventions in context and to understand why the information is trustworthy.

There is an abundance of health information on the internet, but it is hard to find trustworthy information that is explicitly based on systematic reviews.[10,116] Patients and the public are unlikely to critically appraise the information that they find, and most are unlikely to understand the key concepts people need to understand to assess claims about the effects of health care.[117]

Clinicians frequently have questions about the care of patients in their practice.[118] Roughly half of the questions are never pursued. This picture has been stable over time despite the broad availability of online evidence resources that can answer these questions. It may be difficult for health professionals to find the best available evidence due to time constraints, lack of access to user-friendly, up-to-date, evidence-based resources, or lack of the skills needed to find and appraise up-to-date, evidence-based recommendations or systematic reviews.

Evidence-based textbooks that are kept up to date can help. However, the costs of these resources are passed along to the consumer, limiting access for many health professionals. In addition, a plethora of cheap, low-quality imitations may further limit access. The label 'evidence-based' is sometimes applied to resources that simply reference the medical literature (and may not even do that), regardless of how old or unsystematic they may be.

Gaps between evidence-based recommendations and professional practice

Underuse of effective interventions and overuse of interventions that are more likely to cause harm than good are common.[119,120] The size of gaps between evidence-based recommendations and clinical practice varies widely.[121–125] For example, a systematic review of inappropriate practice in Canada found a median proportion of inappropriate care of 30%. Underuse was more frequent (median 44%) than overuse (median 14%).[121] A review of studies in the U.S. found that about 50% of people received recommended preventive care.[122] None of the studies reported a percentage of people receiving contraindicated preventive care. An average of 70% of patients received recommended acute care, and 30% received contraindicated acute care. For chronic conditions, 60% received recommended care and 20% received contraindicated care. A review of studies of quality of care in general practice in the UK, Australia, and New Zealand found that in almost all the included studies, care did not attain the standards set out in national guidelines or by researchers.[123]

Over the past three decades, increased attention has been given to the need to narrow the gap between research and practice,[126–128] but important gaps remain. Many initiatives to close gaps are narrowly focused and short term. Hence, ongoing collaborative efforts are needed to continually reduce those gaps. This includes addressing barriers to improvements and evaluating the effects of implementation interventions.

Inadequately informed policymaking

Substantial sums of money are invested each year in public programmes and policies. For most of these, little is known about their effects, including whether public programmes and policies can fulfil their primary objectives. Furthermore, what is known is often not used to inform policy decisions.[129] Because public resources are limited, it is important to use them effectively, efficiently and equitably.

When making decisions about public programmes, good intentions and plausible theories are not enough. Research evidence, values, political considerations, and judgements are all needed for well-informed decisions. However, decisions are often made without systematic or transparent access and appraisal of relevant research evidence and without an adequate evaluation of intended and unintended effects of policies or programmes.

Evidence-informed policymaking aims to ensure that decision-making is well-informed by the best available research evidence.[130] It is characterised by systematic and transparent access to, and appraisal of, evidence as

an input into the policymaking process. While the overall process of policymaking may not be systematic and transparent, within that, systematic processes should be used to ensure that relevant research is identified, appraised and used appropriately. To ensure that others can examine what research evidence was used to inform policy decisions, as well as the judgements made about the evidence and its implications, the processes should be transparent.

Four key principles underlie fair processes: reporting, reasonableness, revision and regulation.[131] In a fair process, the reasons for a decision are transparent and clearly reported. There are no secret deals or hidden motives. The reasons and evidence used to justify a decision must be reasonable. That is, they must adhere to agreed-upon principles. If someone feels a decision is mistaken or unfair, there should be a way to challenge it, and the process should allow for revision if better reasons or evidence come up. To ensure that the process is fair, it must be regulated, and the regulations must be enforced.

Increased attention has been given to the need to evaluate the impacts of health policies and for using systematic reviews to inform health policy.[132–137] However, few governments have in place fair processes that ensure that policy decisions are informed by systematic reviews of relevant research. And few governments have processes that ensure that the effects of implementing policies are evaluated when there are important uncertainties.

Lack of patient and public participation in decision-making

Funders' decisions about research priorities for evaluating the effects of interventions should reflect the needs of the end users: patients, carers and clinicians. There are marked differences between the types of treatments prioritised for evaluation by patients, carers and clinicians and those currently being evaluated by researchers.[138] Inclusive participation of patients and clinicians in priority setting processes could help to address this.[29]

Patients' decisions about their care should allow involvement to the extent they want. A reason for this is that people vary greatly in the importance they attribute to outcomes,[139,140] and patients may value the pros and cons of an intervention differently than their physician.[141] Most patients prefer sharing decisions with their doctors.[142] Yet, few health care providers consistently attempt to facilitate patient involvement, and even fewer adjust care to patient preferences.[143] Decision aids can help, but few decision aids are currently used in clinical practice.[144]

Involving patients and the public in the development of clinical guidance has increased in recent decades. But there is little research to inform decisions about how to do this.[145–147]

The International Conference on Primary Health Care, meeting in Alma-Ata in 1978, declared that people have the right and duty to participate individually and collectively in the planning and implementation of their health care.[148] In addition to being a democratic right, inclusive participation in deliberative and decision-making processes has the potential to improve the quality of the judgements and decisions that are made, build trust, improve adherence and help to ensure transparency and accountability.[149]

Public engagement may also help to ensure that important uncertainties are identified and addressed.[150] However, participation without clear objectives may anger participants and fail to benefit the policymaking process or outcomes. Poorly planned and implemented participation can create mistrust, waste people's time, and undermine future attempts to engage the public.[151]

Recognition of the importance of patient and public participation in research, systematic reviews, clinical practice guidelines, clinical decision-making, and health policymaking has grown in recent decades. However, participation is limited in practice and policy, and there is little evidence of the effects of strategies to facilitate participation.[152–163]

The way forward

Addressing the multifaceted challenges in medicine, public health, research and science increasingly demands the pooling of diverse expertise, resources and perspectives. There has been increasing recognition of the power of focused collaborative endeavours, such as the Human Genome Project, the Cochrane and Campbell Collaborations, collaborations fostered by the Oxford Clinical Trials Service Unit, and other collaborations referred to in this commentary.[164] An analysis of nearly 20 million research articles and over two million patents found a clear global trend towards team science across all scientific disciplines.[165] Teams now also produce the exceptionally high-impact research, even where that distinction was once the domain of solo authors. Since the foundation of the World Health Organization in 1948, the world has experienced public health challenges that have required international collaborations to improve health around the world.[166]

Although there have been dramatic improvements in the design, implementation and use of health research evidence to inform policy and practice, there are still problems that need to be addressed. In Table 1, we suggest key challenges that need to be addressed by research funders, publishers, academic institutions, healthcare providers, governments and collaborations that aim to promote informed health

Table 1. Key challenges for research funders, publishers, academic institutions, healthcare providers, governments and collaborations that aim to promote informed health choices.

Who	Key challenges that need to be addressed
Research funders	• Strengthen inclusive participation in setting priorities and peer review of grant applications • Adopt and enforce evidence-based research policies[102] • Support evaluations of the effects of interventions to address the problems considered in this commentary
Publishers	• Improve the effectiveness and efficiency of journal peer review • Strengthen the identification and management of conflicts of interest • Assess the effects of registered reports,[172] post-publication peer review,[173] and other publishing models[33] to improve the quality of and access to research evidence
Academic institutions	• Change how researchers are evaluated from rewarding quantity and competition to rewarding quality, relevance, and collaboration[33,34] • Reclaim publication from commercial publishers that are making large profits by using unpaid researchers and charging high fees[33] • Design, evaluate, and implement effective strategies to foster critical thinking from primary school through to higher education and beyond
Healthcare providers	Take responsibility and be accountable for implementing learning health systems to[174–176] • Reduce gaps between evidence-based recommendations and professional practice • Ensure patient and public participation in clinical and health service decisions • Conduct research to reduce important uncertainties about the effects of clinical and implementation interventions
Governments	• Take responsibility and be accountable for addressing the same key challenges as other research funders and healthcare providers • Support non-commercial, open access publication and dissemination of trustworthy information about the effects of policies and practices • Adopt and implement fair processes with inclusive public participation to ensure that ○ Policy decisions are informed by systematic reviews of relevant research and ○ The effects of implementing policies are evaluated when there are important uncertainties
Collaborations	Researchers, editors, health professionals, policymakers, patients and the public need to collaborate within and across organisations and networks to • Persuade research funders, publishers, academic institutions, healthcare providers and governments to take responsibility and be accountable for addressing the key challenges noted above • Prepare, update and disseminate high-quality systematic reviews and guidelines, and reduce unnecessary duplication of effort • Identify, prioritise and reduce important uncertainties about how to address the problems discussed in this commentary

choices. More specific recommendations that overlap with these suggestions have been made elsewhere.[27,67,101,167–171]

In Figure 2, we suggest a framework linking together the way forward and the challenges we have discussed in this commentary with using evaluations of the effects of interventions to inform health choices.

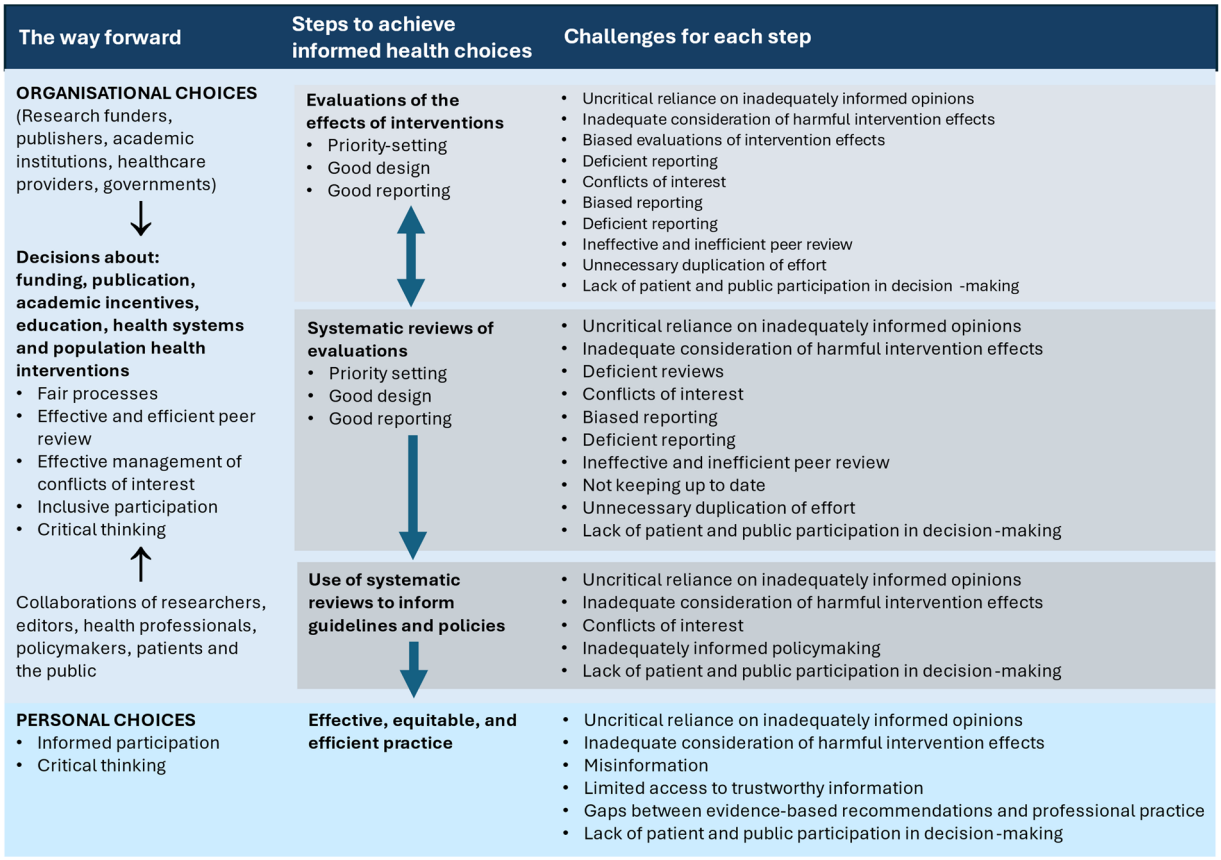
Conclusion

We have come a long way over the past four decades, but we still have a long way to go. Ongoing collaborative efforts are needed to ensure that the effects of interventions are evaluated when there are important uncertainties about their effects. Efforts are also needed to ensure that systematic reviews of the effects of interventions are used to inform policy and practice. Questioning authority and thinking critically about the basis for opinions has been at the heart of the progress made, and it is essential for continued progress. This includes questioning the basis for the opinions we have expressed in this commentary.

There is joy as well as power in collaboration. To paraphrase what Dave Sackett wrote in the preface to the first edition of the *Cochrane Collaboration Handbook*,[177] the emphasis on collaboration is not simply a sentimental comment on the 'generosity of spirit' of those who become involved (although this spirit certainly makes collaboration a pleasure). The shared will to collaborate is a precondition for efficient improvement in the use of research to inform policy and practice and ensuring that interventions are likely to do more good than harm.

In summary, '*good intentions and plausible theories are insufficient for selecting policies and practices for*

Figure 2. Framework for promoting evaluation of the effects of health interventions to inform health choices.



protecting, promoting and restoring health. Humility and uncertainty are preconditions for unbiased assessments of the effects of the prescriptions and proscriptions of policy makers and practitioners'. 'The interests of the public will be served more responsibly and ethically when research designed to reduce the likelihood that we will be misled by bias and the play of chance has become an expected element of professional and policy making practice, not an optional add-on'.[178]

Declarations

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