Translating research for evidence-based public health: key concepts and future directions

Lucie Rychetnik,[1] Adrian Bauman,[2] Rachel Laws,[2] Lesley King,[2] Chris Rissel,[2] Don Nutbeam,[3] Stephen Colagiuri,[2] Ian Caterson[2]

[1]School of Public Health, University of Sydney, Sydney, New South Wales, Australia
[2]Prevention Research Collaboration, Boden Institute of Obesity, Nutrition, Exercise & Eating Disorders, University of Sydney, Sydney, New South Wales, Australia
[3]University of Southampton, Southampton, UK

Correspondence to
Dr Lucie Rychetnik, School of Public Health, University of Sydney, Sydney, Australia; lucie.rychetnik@sydney.edu.au

Accepted 27 March 2012
Published Online First 8 May 2012

ABSTRACT

Applying research to guide evidence-based practice is an ongoing and significant challenge for public health. Developments in the emerging field of 'translation' have focused on different aspects of the problem, resulting in competing frameworks and terminology. In this paper the scope of 'translation' in public health is defined, and four related but conceptually different 'translation processes' that support evidence-based practice are outlined: (1) reviewing the transferability of evidence to new settings, (2) translation research, (3) knowledge translation, and (4) knowledge translation research. Finally, an integrated framework is presented to illustrate the relationship between these domains, and priority areas for further development and empirical research are identified.

INTRODUCTION

The generation and deployment of research evidence for public health is an evolving field. Much has been achieved in the development of applied research for building, appraising and synthesising evidence but bridging the 'gap' between this and the complexities of policy and practice is an ongoing challenge. Solutions have been proposed under the broad concept of research-to-practice 'translation', but developments have focused on different aspects of the problem and give rise to competing frameworks and terminology. We outline the scope of 'translation' in public health and define four related but distinct translation processes that support evidence-based practice: (1) reviewing the transferability of evidence between settings, (2) translation research, (3) knowledge translation, and (4) knowledge translation research. Finally, we present an integrated framework to illustrate the relationship between these domains, and identify priority areas for further development and empirical research.

BACKGROUND

The foundations of evidence-based public health are built on a solid tradition of evaluation that emphasises clear, measurable objectives.[1–3] Recent developments have been influenced by clinical epidemiology and evidence-based medicine, which have informed the now well-established characteristics of evidence-based practice, that is, reliance on research of programme effectiveness, explicit criteria to appraise evidence, and use of systematic reviews of intervention benefits and harms.[4–7]

The obstacles to implementing evidence-based practice may be attributed to many factors,[5 8] but even if one overcomes political, institutional and individual barriers there remain many challenges related to the nature of public health itself. Public health is by definition an applied, intervention focused endeavour.[7] Public health intervention effectiveness is influenced by characteristics of the intervention, its implementation, the target setting or population, and prevailing social, economic and policy contexts.[9–12] The interactions must be understood to determine whether evidence from one setting is relevant or valuable for policy and practice decisions elsewhere. Evidence of intervention effectiveness often comes from small-scale studies with selected target groups and a limited range of settings, and the suitability, practicality and cost for population-wide dissemination are unknown.[13–15] Finally, programmes that are implemented based on evidence of efficacy often fail to achieve anticipated population outcomes.[16] It is apparent that evidence from primary effectiveness research and systematic reviews requires 'translation' into real-world policy and practice.

'TRANSLATING' EVIDENCE FOR APPLICATION TO POLICY AND PRACTICE

Translation is derived from the Latin *translatio* meaning 'to carry across' and is the source of the term 'transfer'.[17] Translation also refers to communicating meaning from one language to another, where the art is to achieve equivalence rather than a literal copy. This is important because at the heart of evidence-based practice is the fundamental principle that evidence derived from an intervention in one setting may be applied elsewhere, though to do so is likely to require skilled translation. This concept is represented in figure 1: that is, a programme evaluation derived from one context feeds into a body of evidence derived from multiple contexts, which is reviewed as evidence for application in another new context.

This assumption about the potential transfer of evidence to new settings has been a key point of examination and debate because of the complexity and the social, structural and political character of population-level interventions.[11 18 19] Questions relating to the translation of evidence can be summarised in four overlapping domains outlined in box 1.

FOUR TRANSLATION PROCESSES

Responses to the questions in box 1 have included proposals for an expanded typology of evidence and revised standards for evidence reporting and appraisal.[12 20 21] Other developments are in areas of 'translation research' and 'knowledge translation',[22]

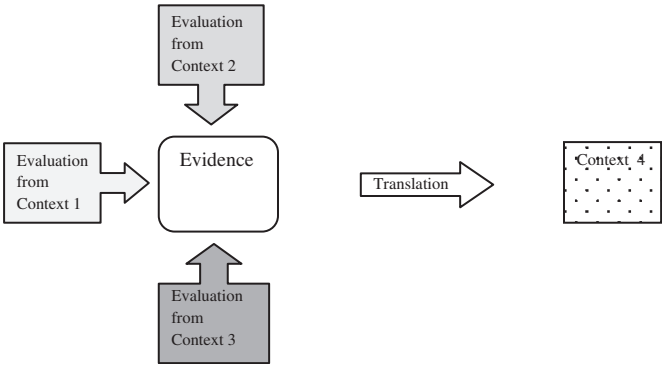

Figure 1 Evidence-based practice relies on the potential to transfer evidence between contexts.

but there are significant variations in how these terms are used.[23 24] We seek to clarify and distinguish four related but conceptually different 'translation' processes that support evidence-based public health and address questions of transferability from different perspectives. The four processes are defined below, with further explanation and examples of each provided:

1. *Reviewing evidence* to assess *transferability* of the findings: reviewing evidence derived from studies of intervention effectiveness to examine the transferability of the reported findings (ie, to real-life, new settings, different populations, or scaled-up policies and programmes); an important step in translating effective interventions to broader policy and practice.
2. Empirical applied research focused on formal replication and dissemination of effective programmes in new settings or populations, and which examines what factors enhance or limit the transferability of evidence (*translation research*).
3. Adoption of strategies to optimise the uptake and use of research findings to inform evidence-based policy and practice (*knowledge translation*).
4. Empirical research of knowledge translation processes, including developing and testing knowledge translation strategies (*knowledge translation research*).

Box 1 Questions related to the translation of evidence

Experimental to real-life: that is, are the findings from a programme that was delivered and evaluated under experimental or research conditions (efficacy studies) transferable to 'real life'?

Setting to setting: that is, are the findings from an evaluation conducted in a particular social and political context (effectiveness studies) transferable to other contexts? For example, transferring the findings about an indigenous youth employment and social inclusion programme developed in a large city to a rural and remote area.

Population to population: that is, are the findings from a programme conducted with one population transferable to other populations? For example, transferring the findings about an effective smoking cessation programme developed for one migrant population to other populations living in the same city.

Small-scale to large-scale: that is, are the findings from a localised or small-scale programme transferable to large population-wide (scaled-up) policies and programmes?

REVIEWING EVIDENCE TO ASSESS TRANSFERABILITY OF THE FINDINGS

Glasgow *et al*'s RE-AIM model addressed the problem of translation by highlighting the importance of examining the population impact of an intervention, and provided tools to assess whether programmes with demonstrated efficacy are likely to achieve population-wide effectiveness, and comparable outcomes.[16] Building on the idea that the impact of a programme is the product of its *efficacy* (positive and negative outcomes) and *reach* (measures of participation and characteristics of participants), RE-AIM added dimensions of *adoption* (proportion and representativeness of settings that adopt the programme), *implementation* (whether programme delivery occurred as intended in real world settings) and *maintenance* (degree to which programme is sustained over time).[16] The model was particularly useful for considering whether outcomes of experimental or small-scale programmes could be reproduced in real-life and population-wide settings, but it did not elaborate on the intervention adaptations that may be required.

Other guides for reviewing evidence on public health interventions have incorporated expanded criteria for translating evidence to new settings.[12 25 26] In reviews conducted in the context of policy and practice decisions, such assessments of transferability are performed comparing how and where the evidence of effectiveness was derived, to how and where it is to be applied. A number of dimensions may be considered, including the transferability of the programme delivery system, as well as of programme results.[9 26]

The adequacy of the reporting of translation-relevant data[27] about interventions has also been incorporated into systematic reviews.[21 28 29] It is important to note that while structured review guides exist, final judgements about the potential translation of evidence are interpretative, and rely on local knowledge as well as descriptive details provided in the research. Reporting interventions has tended to be poor; a problem that will be addressed by wider application of guidelines for transparent reporting.[30 31] Conclusions from reviewing evidence can only reflect the data that are available, and cannot redress evidence gaps.

TRANSLATION RESEARCH: BUILDING BETTER EVIDENCE FOR EVIDENCE-BASED PRACTICE

Translation research refers to empirical approaches that build a new type of evidence; one in which the process of translation is formally tested by studying the replication and dissemination of programmes previously shown to be effective. Translation research seeks to determine what aspects of an evaluated programme must be reproduced or modified, so that reported outcomes can be achieved in different settings, populations or on a larger scale. This definition builds on the well established idea that there are different types or stages of intervention research, which include efficacy, effectiveness and dissemination research.[32–34] As an example, building evidence for health promotion has been described as a six-stage research process.[35] We apply these stages, with minor modification, to delineate and define translation research (see figure 2).

The first two stages, *problem definition* (stage 1) and *solution generation* (stage 2), relate to programme development; and *intervention testing* (stage 3) represents process and impact evaluation to determine programme efficacy or effectiveness. *Intervention replication* (stage 4) refers to subsequent studies in which effective programmes are adapted for other settings to

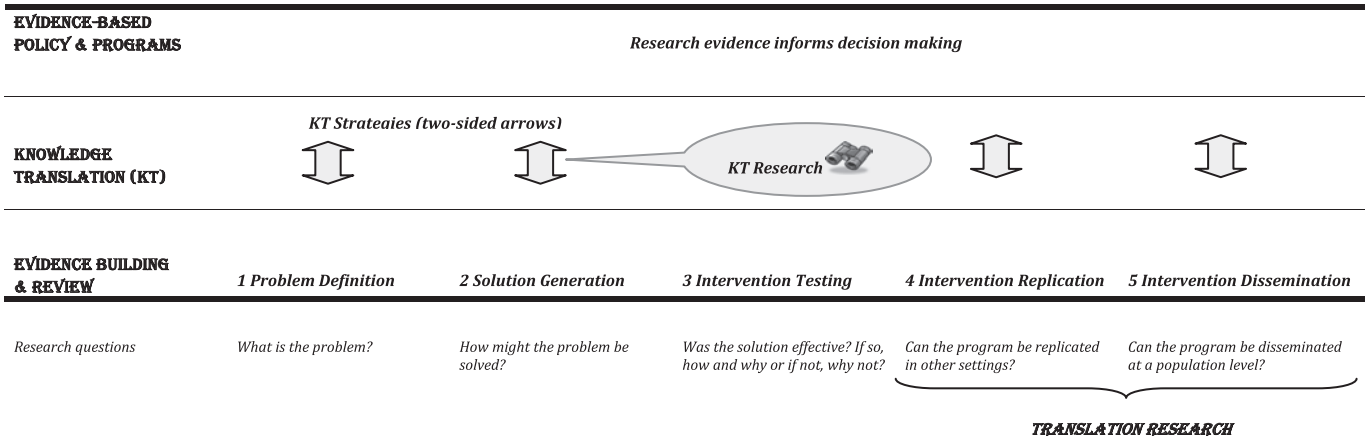

Figure 2 Translation processes to support evidence-based policy and practice.

determine if (and how) similar outcomes can be reproduced in different places or populations. Finally, *dissemination research* (stage 5) focuses on the up-scaling of a programme to a population-level, seeking to maximise the public health benefits of interventions which have been shown to be effective in specific settings and have been successfully replicated. Dissemination research examines whether real population outcomes can be achieved.

We define *translation research* as studies that focus on the replication and dissemination of interventions, that is, the evidence building stages 4 and 5 above. This definition is more precise than other uses of the term. For example, translation research in clinical settings includes all 'bench-to-bedside' stages of research from laboratory research to clinical treatments, as well as the translation of clinical research into clinical practice.[23 24] Rabin *et al* define translation research as the study of effectiveness and dissemination.[22] We seek to further distinguish between effectiveness research (intervention testing, stage 3) and *translation research*; and define the latter as research to *empirically* examine and test whether evidence of programme effectiveness can be translated to new settings (stage 4, replication research[36–38]), and to a larger scale (stage 5, dissemination research[39]).

KNOWLEDGE TRANSLATION: APPLYING STRATEGIES TO INCREASE THE USE OF EVIDENCE IN POLICY AND PRACTICE

It is also important to distinguish between 'translation research' and 'knowledge translation research', but to do so we must first define 'knowledge translation' itself. 'Knowledge translation' is an umbrella term for strategies adopted to increase the impact of research on policy and practice decisions.[40] The Canadian Institutes of Health Research define knowledge translation as a 'dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge to improve health…'.[41] Knowledge translation strategies are underpinned by a 'knowledge-to-action framework', which distinguishes between knowledge creation and the application of that knowledge in policy and practice settings.[42] This relies on an active interface between research and policy or practice, which may be embodied in persons, such as knowledge mentors or knowledge brokers, or entire knowledge translation agencies with supporting systems, structures and incentives.[43–46] Importantly, there is emergent understanding of knowledge translation as a two-way process of exchange between the worlds of research and practice.[47]

KNOWLEDGE TRANSLATION RESEARCH: EMPIRICALLY TESTING AND EVALUATING KNOWLEDGE TRANSLATION STRATEGIES

Knowledge translation research is that which empirically examines the relative value and effectiveness of alternative knowledge translation approaches, models and strategies. Knowledge translation research may address baseline questions on whether and how evidence informs policy and practice, what research is being used, by whom, and how it is used.[48] Knowledge translation research also considers factors that support or hinder the use of research, either by practitioners or in the context of policy development. Finally knowledge translation research evaluates the actual impact (if any) of adopted knowledge translation strategies. For example, a large cluster randomised trial of knowledge translation strategies in local government is currently underway in Australia.[49] Thus the primary aim of knowledge translation research is to empirically determine optimal strategies for effective knowledge translation and to describe its impact on policy and practice. This is a new and rapidly developing field and knowledge translation research must also focus on developing and testing new research methods, tools and measures.[50 51]

To assist in delineating the translation processes, the integrated framework is presented in figure 2.

AN INTEGRATED FRAMEWORK OF TRANSLATION TO SUPPORT EVIDENCE-BASED PRACTICE

The framework in figure 2 maps the different translation processes that have been discussed. Short definitions of the terms used in this framework are also provided in box 2. 'Evidence building and review' (bottom row) refers to the types of research required for evidence-based policy and practice, including primary evaluations of programme effectiveness and 'translation research' to empirically test programme replication and dissemination. The bottom row also includes evidence reviews, which incorporate appraisal of the potential transferability of research. To date these reviews are mostly of effectiveness studies, using expanded criteria to examine potential translation of the findings to real policy and practice. Reviews of evidence transferability will become more empirically grounded as more 'translation research' becomes available.

The top row in figure 2, 'evidence-based policy and programmes', represents the output of translating evidence into practice, where evidence informs policy and practice decisions. 'Knowledge translation' in the middle row represents the

Box 2 Translation processes to support evidence-based practice; definitions of terms

Evidence building and review: Stages of evaluation research that generate evidence for evidence-based practice. Evidence building includes studies of intervention effectiveness (stage 3) and 'translation research' defined below (stages 4 and 5). Reviewing evidence includes appraisal of potential *transferability* of findings from intervention effectiveness studies.

Translation research: *Research* that empirically examines and tests the translation of effective programmes in new settings and populations (replication) and on a larger scale in whole populations (dissemination). Translation research refers to evidence building stages 4 and 5.

Knowledge translation: *Strategies* and *systems* that actively promote and enhance the application of all research evidence in evidence-based policy and practice. Knowledge translation represents the active *interface* between evidence building and review, and evidence-based policy and practice.

Knowledge translation research: *Research* that *empirically* examines and evaluates the relative value and effectiveness of knowledge translation approaches, models, systems and strategies. Therefore it is research that is conducted *within* the active interface between evidence building and review, and evidence-based policy and practice.

Evidence-based policy and practice: Policies and programmes that are explicitly informed by research evidence. This evidence may be derived from all stages of evidence-building and review, including effectiveness research, *translation research* on the replication and dissemination of programmes, as well as *knowledge translation research* on strategies to support the application of evidence.

interface between evidence-based policy and practice (above) and evidence building and review (below). The knowledge translation strategies, bringing together the domains above and below, are indicated by the two-sided arrows in the middle row. 'KT research' (knowledge translation research) produces the evidence that is generated within that interface, as the knowledge translation strategies are empirically tested and evaluated.

This framework is intended to assist with the delineation of concepts rather than to reflect the complexities of the real world. It also articulates an 'ideal' scenario in which effective programmes are ready for population-wide dissemination after their transferability has been tested in replication studies (stage 4). Factors that contribute to the success, or otherwise, of population-wide dissemination are revealed in stage 5. In reality, of course, evidence-building is more organic than the stages described, and there are numerous social, political, organisational and resource influences on policy and practice.[52] Therefore programmes may be implemented directly at the point of solution generation (stage 2) and skip other evidence-building stages because an immediate public health policy or programme response is required (such as the initial public health response to HIV/AIDS). Examination of actual decision making may also reveal little overlap between the domains of evidence and practice. Such a framework can enable us to more clearly map the status of the evidence for a specific policy or programme; to identify what evaluations have been done, what (if any) translation research was conducted, and what evidence was used to inform (if at all) current policy and practice. It also provides a basis for discussing what knowledge translation strategies are in place to support evidence-based practice, and how such strategies could be further developed and evaluated.

While aspects of the translation processes presented in this paper have been described in other models and theories, our framework seeks to provide a conceptual map to illustrate how the processes fit together. For example, the evidence-building stages build on previous linear-based models of research to practice.[53–56] There is also literature describing adoption into practice of intervention innovations,[56–59] which was mostly derived from Diffusion of Innovation theory.[60] Other models describe how effective interventions are adapted to different settings and populations,[61–63] that is, moving from evidence building stage 3 to stage 4. The emerging field of knowledge translation has also added theories and models for promoting the uptake of knowledge.[64–68] In presenting the integrated framework in this paper we seek to provide orientation and clarification of this developing literature. It is also a means to mapping areas for further research and development.

TRANSLATION DOMAINS FOR FURTHER RESEARCH AND DEVELOPMENT

There is scope for research and development in each of the translation processes described above. Much public health intervention research describes programmes developed within the bounds of scientific peer-reviewed funding allocations. Such evaluations are designed to maximise internal validity and minor modifications may be tested in similar settings. These studies can be pooled or summarised to produce evidence reviews, but often this is done without an appraisal of transferability. Thus, while based on good underpinning theory, optimal study designs and systematic processes, this evidence does not automatically indicate the suitability of an intervention for different settings or different populations. The challenge is to further develop frameworks to rate transferability,[12 69] and empirically test the validity of such ratings in policy and practice settings to determine the best criteria to judge the relevance of research.

A focus on population level outcomes requires more study of how to implement effective programmes in different settings and on a larger scale. This will rely on funding allocations to the fourth (replication) and fifth (dissemination) stages of evidence, and continued development of relevant frameworks and methodologies, including observational and ethnographic approaches in process evaluation. This work entails trialling new research-comparable ways to observe programmes in different settings, measure programme uptake and reach, and examine adaptation for wide-scale delivery of a programme. It includes evaluating the impacts of alternative approaches to replication and dissemination research; that is, do different models result in different outcomes; and if so, which has the highest acceptability and cost-effectiveness? Factors that lead to effective scaling-up of interventions are not well understood; for example, how do different organisational structures impact on programme delivery? Do methods of delivery influence effectiveness and cost-effectiveness? What is the cost structure for implementing programmes across multiple settings and for monitoring performance?

Finally, in the growth area of investigating the knowledge translation interface there are encouraging signs, with funding bodies allocating resources to this area—that is, for innovations in knowledge translation research. The Australian National Health and Medical Research Council has recently funded a Centre for Informing Policy in Health with Evidence from Research (CIPHER) that will conduct knowledge translation

What is already known on this subject

- There is a growing literature on research-to-practice 'translation' but it has focused on different aspects of the problem and given rise to competing models and terminology.
- An overview is needed of foundational concepts, different translation processes, and how these align to support evidence-based practice.

What this study adds

- The overview and integrated framework presented here distinguishes different types of research evidence and the translation processes required to support evidence-based practice.
- It enables decision makers to map the evidence for a given policy or programme; that is, to identify what type of evaluations have been done, including translation research, and which of this evidence (if any) informed current policy and practice.
- It highlights the knowledge translation interface of evidence-based practice, and that 'translation' strategies must also be researched and evaluated.

research, and develop and test specific knowledge translation research methods and tools.[70] In addition to the knowledge translation research questions outlined earlier, more foundational work is needed to understand public health policy processes, and programme adoption, from sociological, historical and anthropological perspectives. Empirical investigations should be conducted and compared across different jurisdictions of public health policy and practice. It is important to understand programmes informed by evidence-based reviews, as well as implications of potentially premature programme dissemination. Case study research would help to understand these occurrences and inform evidence-based practice.

The common theme of these future directions is the growing overlap of building and applying evidence. While early stages of intervention development and testing are often conducted in a research-focused paradigm, to achieve population impact, policies and programmes must be implemented in real-world situations, and often in larger-scale settings than the original studies may have permitted. If the described translation processes both generate and employ more policy-and-practice-relevant evidence,[71] the 'gap' between research and practice will become less relevant.

Acknowledgements This paper was prepared under the auspice of a Capacity Building Infrastructure Grant (CBIG 2010-2013) to the Prevention Research Collaboration from NSW Health. The authors wish to thank CBIG Chief Investigators Tim Gill and Louise Baur for their comments on the draft paper.

Contributors LR, AB, RL, LK, CR, DN, SC and IC contributed to the conception of the article, and made substantial contributions to drafting and/or revising it critically for important intellectual content. All of the named authors have given approval of the final version.

Funding This work was partly supported by a Capacity Building Infrastructure Grant (CBIG 2010-2013) from the New South Wales (NSW) Department of Health, Australia.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1. **Green L,** Lewis F. *Measurement and Evaluation in Health Education and Health Promotion*. Palo Alto, CA: Mayfield Pub. Co, 1986.
2. **Nutbeam D.** Evaluating health promotion; progress, problems and solutions. *Health Promot Int* 1998;**13**:27—44.
3. **Hawe P,** Degeling D, Hall J. *Evaluating Health Promotion: A Health Worker's Guide*. Sydney: MacLennan & Petty, 1990.
4. **Briss PA,** Zaza S, Pappaianou M, *et al*. Developing an evidence-based guide to community preventive services—methods. *Am J Prev Med* 2000;**18**:35—43.
5. **Brownson RC,** Baker AE, Leet TL, *et al*. *Evidence-Based Public Health*. 2nd edn. Oxford: Oxford University Press, 2011.
6. **Brownson RC,** Fielding JE, Maylahn CM. Evidence-based public health: a fundamental concept for public health practice. *Annu Rev Public Health* 2009;**30**:175—201.
7. **Rychetnik L,** Hawe P, Waters E, *et al*. A glossary for evidence based public health. *J Epidemiol Community Health* 2004;**58**:538—45.
8. **Leicester G.** The seven enemies of evidence-based policy. *Public Money Manag* 1999;**19**:5—7.
9. **Glasgow RE,** Emmons KM. How can we increase translation of research into practice? Types of evidence needed. *Annu Rev Public Health* 2007;**28**:413—33.
10. **Hawe P,** Shiell A, Riley T, *et al*. Methods for exploring implementation variation and local context within a cluster randomised community intervention trial. *J Epidemiol Community Health* 2004;**58**:788—93.
11. **Green LW.** From research to 'best practices' in other settings and populations. *Am J Health Behav* 2001;**25**:165—78.
12. **Green LW,** Glasgow RE. Evaluating the relevance, generalization, and applicability of research: issues in external validation and translation methodology. *Eval Health Prof* 2006;**29**:126—53.
13. **Antikainen I,** Ellis R. A RE-AIM evaluation of theory-based physical activity interventions. *J Sport Exerc Psychol* 2011;**33**:198—214.
14. **Livingstone MBE,** McCaffrey TA, Rennie KL. Childhood obesity prevention studies: lessons learned and to be learned. *Public Health Nutr* 2006;**9**:1121—9.
15. **Zechmeister I,** Kilian R, McDaid D. Is it worth investing in mental health promotion and prevention of mental illness? A systematic review of the evidence from economic evaluations. *BMC Public Health* 2008:8.
16. **Glasgow RE,** Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am J Public Health* 1999;**89**:1322—7.
17. **Ayto J.** *Dictionary of Word Origins*. London: Bloomsbury Publishing, 1990.
18. **Raphael D.** The question of evidence in health promotion. *Health Promot Int* 2000;**15**:355—67.
19. **Rychetnik L,** Frommer M, Hawe P, *et al*. Criteria for evaluating evidence on public health interventions. *J Epidemiol Community Health* 2002;**56**:119—27.
20. **Macdonald G,** Veen C, Tones K. Evidence for success in health promotion: suggestions for improvement. *Health Educ Res* 1996;**11**:367—76.
21. **Waters E,** Hall BJ, Armstrong R, *et al*. Essential components of public health evidence reviews: capturing intervention complexity, implementation, economics and equity. *J Public Health* 2011;**33**:462—5.
22. **Rabin BA,** Brownson RC, Haire-Joshu D, *et al*. A glossary for dissemination and implementation research in health. *J Public Health Manag* 2008;**14**:117—23.
23. **Westfall JM,** Mold J, Fagman L. Practice-based research—"Blue Highways" on the NIH roadmap. *JAMA* 2007;**297**:403—6.
24. **Woolf SH.** The meaning of translation research and why it matters. *JAMA* 2008;**299**:211—13.
25. **Rychetnik L,** Frommer M. *A Schema for Evaluating Evidence on Public Health Interventions*. Melbourne: National Public Health Partnership, 2002.
26. **Wang S,** Moss JR, Hiller HE. Applicability and transferability of interventions in evidence-based public health. *Health Promot Int* 2005;**21**:76—83.
27. **Klesges LM,** Dzewaltowski DA, Glasgow RE. Review of external validity reporting in childhood obesity prevention research. *Am J Prev Med*. 2008;**34**:216—23.
28. **Egan M,** Bambra C, Petticrew M, *et al*. Reviewing evidence on complex social interventions: appraising implementation in systematic reviews of the health effects of organisational-level workplace interventions. *J Epidemiol Community Health* 2009;**63**:4—11.
29. **Rabin BA,** Glasgow RE, Kerner JF, *et al*. Dissemination and implementation research on community-based cancer prevention: a systematic review. *Am J Prev Med* 2010;**38**:443—56.
30. **Des Jarlais DC,** Lyles C, Crepaz N, *et al*. Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement. *Am J Public Health* 2004;**94**:361—6.
31. **Armstrong R,** Waters E, Moore L, *et al*. Improving the reporting of public health intervention research: advancing TREND and CONSORT. *J Public Health* 2008;**30**:103—9.
32. **Flay B.** Efficacy and effectiveness trials (and other phases of research) in the development of health promotion programs. *Prev Med* 1986;**15**:451—74.
33. **Glasgow R,** Lichtenstein E, Marcus A. Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. *Am. J Public Health* 2003;**93**:1261—7.
34. **Sorensen G,** Emmons K, Hunt MK, *et al*. The implications of the results of community intervention trials. *Annu Rev Public Health* 1998;**19**:379—416.
35. **Nutbeam D,** Bauman A. *Evaluation in a Nutshell: a Practical Guide to the Evaluation of Health Promotion Programs*. 1 edn. Sydney: McGraw Hill, 2006.

36. **Stewart AL,** Mills KM, Sepsis PG, *et al*. Evaluation of CHAMPS, a physical activity promotion program for older adults. *Ann Behav Med* 1997;**19**:353—61.
37. **Hooker SP,** Seavey W, Weidmer CE, *et al*. The California active aging community grant program: translating science into practice to promote physical activity in older adults. *Ann Behav Med* 2005;**29**:155—65.
38. **Stewart AL,** Gillis D, Grossman M, *et al*. Diffusing a research-based physical activity promotion program for seniors into diverse communities: CHAMPS III. *Preventing Chronic Dis* 2006;**3**:A51.
39. **Elliot DL,** Kerry KS, Moe EL, *et al*. The IGNITE (investigation to guide new insight into translational effectiveness) trial: protocol for a translational study of an evidenced-based wellness program in fire departments. *Implement Sci* 2010;**5**:73.
40. **Armstrong R,** Waters E, Roberts H, *et al*. The role and theoretical evolution of knowledge translation and exchange in public health. *J Public Health* 2006;**28**:1—6.
41. The Canadian Institutes of Health Research. Knowledge Translation—definition. http://www.cihr-irsc.gc.ca/e/39033.html (accessed 1 Mar 2011).
42. **Straus S,** Tetroe J, Graham I. Defining knowledge translation. *Can Med Assoc J* 2009;**181**:165—8.
43. **Armstrong R,** Waters E, Crockett B, *et al*. The nature of evidence resources and knowledge translation for health promotion practitioners. *Health Promot Int* 2007;**22**:254—60.
44. **Lomas J.** The in-between world of knowledge brokering. *Br Med J* 2007;**334**:129—32.
45. **Straus S,** Graham I, Taylor M, *et al*. Development of a mentorship strategy: a knowledge translation case study. *J Contin Educ Health Prof* 2008;**28**:117—22.
46. **Ward VL,** House AO, Hamer S. Knowledge brokering: exploring the process of transferring knowledge into action. *BMC Health Serv Res* 2009;**9**:12.
47. **Gravois LR,** Garvin T. Moving from information transfer to information exchange in health and health care. *Soc Sci Med* 2003;**56**:449—64.
48. **Dobrow MJ,** Goel V, Lemieux-Charles L, *et al*. The impact of context on evidence utilization: a framework for expert groups developing health policy recommendations. *Soc Sci Med* 2006;**63**:1811—24.
49. **Waters E,** Armstrong R, Swinburn B, *et al*. An exploratory cluster randomised controlled trial of knowledge translation strategies to support evidence-informed decision-making in local governments (the KT4LG study). *BMC Public Health* 2011;**11**:34.
50. **National Collaborating Centre for Methods and Tools.** *Knowledge Translation Methods And Tools For Public Health*. Canada: The Registry of Methods and Tools. http://www.nccmt.ca/registry/index-eng.html (accessed 18 May 2011).
51. **Grimshaw JM,** Zwarenstein M, Tetroe JM, *et al*. Looking inside the black box: a theory-based process evaluation alongside a randomised controlled trial of printed educational materials (the Ontario printed educational message, OPEM) to improve referral and prescribing practices in primary care in Ontario, Canada. *Implement Sci* 2007;**2**:38.
52. **Brownson RC,** Chriqui JF, Stamatakis KA. Understanding evidence-based public health policy. *Am. J Public Health* 2009;**99**:1576—83.
53. **Greenwald P,** Cullen JW. The new emphasis in cancer control. *J Natl Cancer Inst* 1985;**74**:543—51.
54. **Logan J,** Graham ID. Toward a comprehensive interdisciplinary model of health care research use. *Sci Commun* 1998;**20**:227—46.
55. **Mercy JA,** Rosenberg ML, Powell KE, *et al*. Public health policy for preventing violence. *Health Aff (Millwood)* 1993;**12**:7—29.
56. **Wandersman A,** Duffy J, Flaspohler P, *et al*. Bridging the gap between prevention research and practice: the interactive systems framework for dissemination and implementation. *Am J Community Psychol* 2008;**41**:171—81.
57. **Durlak JA,** DuPre EP. Implementation matters: a review of research on the influence of implementation on program outcomes and the factors affecting implementation. *Am J Community Psychol* 2008;**41**:327—50.
58. **Greenhalgh T,** Robert G, Macfarlane F, *et al*. Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Q* 2004;**82**:581—629.
59. **Mendel P,** Meredith LS, Schoenbaum M, *et al*. Interventions in organizational and community context: a framework for building evidence on dissemination and implementation in health services research. *Adm Policy Ment Health* 2008;**35**:21—37.
60. **Rogers E.** *Diffusion of Innovations*. 5th edn. New York: Free Press, 2003.
61. **Bowen SA,** Saunders RP, Richter DL, *et al*. Assessing levels of adaptation during implementation of evidence-based interventions: introducing the Rogers-Rutten framework. *Health Educ Behav* 2010;**37**:815—30.
62. **McKleroy VS,** Galbraith JS, Cummings B, *et al*. Adapting evidence-based behavioral interventions for new settings and target populations. *AIDS Educ Prev* 2006;**18** (4 Suppl A):59—73.
63. **Wingood GM,** DiClemente RJ. The ADAPT-ITT model: a novel method of adapting evidence-based HIV interventions. *J Acquir Immune Defic Syndr* 2008;**47**(Suppl 1): S40—6.
64. **Jacobson N,** Butterill D, Goering P. Development of a framework for knowledge translation: understanding user context. *J Health Serv Res Policy* 2003;**8**:94—9.
65. **Liyanage C.** Knowledge communication and translation—a knowledge transfer model. *J Knowledge Manag* 2009;**13**:118—31.
66. **Majdzadeh R,** Sadighi J, Nejat S, *et al*. Knowledge translation for research utilization: design of a knowledge translation model at Tehran University of Medical Sciences. *J Contin Educ Health Prof* 2008;**28**:270—7.
67. **Palmer D,** Kramlich D. An introduction to the multisystem model of knowledge integration and translation. *Adv Nurs Sci* 2011;**34**:29—38.
68. **Pronovost PJ,** Berenholtz SM, Needham DM. Translating evidence into practice: a model for large scale knowledge translation. *Br Med J* 2008;**337**:963—5.
69. **Milat AJ,** King L, Bauman AE, *et al*. The concept of scalability: increasing the scale and potential adoption of health promotion interventions into policy and practice. *Health Promot Int* 2012. doi:10.1093/heapro/dar097 First published online: January 12, 2012.
70. **National Health and Medical Research Council.** *Hearts, Minds And Everything In Between—New Centres Of Research Excellence Ministerial Media Release*. Australian Government, 2010. http://www.nhmrc.gov.au/node/30299 (accessed 18 May 2011).
71. **Redman S,** Stickney B, Mitchell J. Policy-relevant population health research. *NSW Public Health Bull* 2011;**22**:1—2.