

Evidence-Based Public Health: A Fundamental Concept for Public Health Practice

Ross C. Brownson,¹ Jonathan E. Fielding,² and Christopher M. Maylahn³

¹Prevention Research Center in St. Louis, George Warren Brown School of Social Work, Department of Surgery and Alvin J. Siteman Cancer Center, Washington University School of Medicine, Washington University in St. Louis, St. Louis, Missouri 63110; email: rbrownson@wustl.edu

²Los Angeles Department of Health Services, Los Angeles, California 90012; School of Public Health, University of California, Los Angeles, California 90095-1772; email: jfieldin@ucla.edu

³Office of Public Health Practice, New York State Department of Health, Albany, New York 12237; email: cmm05@health.state.ny.us

Annu. Rev. Public Health 2009. 30:175–201

First published online as a Review in Advance on January 14, 2009

The *Annual Review of Public Health* is online at publhealth.annualreviews.org

This article's doi:
10.1146/annurev.publhealth.031308.100134

Copyright © 2009 by Annual Reviews.
All rights reserved

0163-7525/09/0421-0175\$20.00

Key Words

disease prevention, evidence-based medicine, intervention, population-based

Abstract

Despite the many accomplishments of public health, a greater attention to evidence-based approaches is warranted. This article reviews the concepts of evidence-based public health (EBPH), on which formal discourse originated about a decade ago. Key components of EBPH include making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned. Three types of evidence have been presented on the causes of diseases and the magnitude of risk factors, the relative impact of specific interventions, and how and under which contextual conditions interventions were implemented. Analytic tools (e.g., systematic reviews, economic evaluation) can be useful in accelerating the uptake of EBPH. Challenges and opportunities (e.g., political issues, training needs) for disseminating EBPH are reviewed. The concepts of EBPH outlined in this article hold promise to better bridge evidence and practice.

INTRODUCTION

Public health research and practice are credited with many notable achievements, including much of the 30-year gain in life expectancy in the United States over the twentieth century (124). A large part of this increase can be attributed to provision of safe water and food, sewage treatment and disposal, tobacco use prevention and cessation, injury prevention, control of infectious diseases through immunization and other means, and other population-based interventions (34).

Despite these successes, many additional opportunities to improve the public's health remain. To achieve state and national objectives for improved population health, more widespread adoption of evidence-based strategies has been recommended (19, 57, 64, 109, 119). Increased focus on evidence-based public health (EBPH) has numerous direct and indirect benefits, including access to more and higher-quality information on what works, a higher likelihood of successful programs and policies being implemented, greater workforce productivity, and more efficient use of public and private resources (19, 77, 95).

Ideally, public health practitioners should always incorporate scientific evidence in selecting and implementing programs, developing policies, and evaluating progress (23, 107). Society pays a high opportunity cost when interventions that yield the highest health return on an investment are not implemented (55). In practice, intervention decisions are often based on perceived short-term opportunities, lacking systematic planning and review of the best evidence regarding effective approaches. These concerns were noted two decades ago when the Institute of Medicine determined that decision making in public health is often driven by "crises, hot issues, and concerns of organized interest groups" (p. 4) (82). Barriers to implementing EBPH include the political environment and deficits in relevant and timely research, information systems, resources, leadership, and the required competencies (4, 7, 23, 78).

It is difficult to estimate how widely evidence-based approaches are being applied. In a survey of 107 U.S. public health practitioners, an estimated 58% of programs in their agencies were deemed evidence-based (i.e., using the most current evidence from peer-reviewed research) (51). This finding in public health settings appears to mirror the use of evidence-based approaches in clinical care. A random study of adults living in selected metropolitan areas within the United States found that 55% of overall medical care was based on what is recommended in the medical literature (108). Thacker and colleagues (159) found that the preventable fraction (i.e., how much of a reduction in the health burden is estimated to occur if an intervention is carried out) was known for only 4.4% of 702 population-based interventions. Similarly, cost-effectiveness data are reported for a low proportion of public health interventions.

Several concepts are fundamental to achieving a more evidence-based approach to public health practice. First, we need scientific information on the programs and policies that are most likely to be effective in promoting health (i.e., undertake evaluation research to generate sound evidence) (14, 19, 45, 77). An array of effective interventions is now available from numerous sources including the *Guide to Community Preventive Services* (16, 171), the *Guide to Clinical Preventive Services* (2), *Cancer Control PLANET* (29), and the *National Registry of Evidence-Based Programs and Practices* (142). Second, to translate science to practice, we need to marry information on evidence-based interventions from the peer-reviewed literature with the realities of a specific real-world environment (19, 69, 96). To do so, we need to better define processes that lead to evidence-based decision making. Finally, wide-scale dissemination of interventions of proven effectiveness must occur more consistently at state and local levels (91). This article focuses particularly on state and local public health departments because of their responsibilities to assess public health problems, develop appropriate programs

or policies, and assure that programs and policies are effectively implemented in states and local communities (81, 82).

We review EBPH in four major sections that describe (a) relevant background issues, including concepts underlying EBPH and definitions of evidence; (b) key analytic tools to enhance the adoption of evidence-based decision making; (c) challenges and opportunities for implementation in public health practice; and (d) future issues.

EVOLUTION OF THE TENETS OF EVIDENCE-BASED PUBLIC HEALTH

Formal discourse on the nature and scope of EBPH originated about a decade ago. Several authors have attempted to define EBPH. In 1997, Jenicek defined EBPH as the “conscientious, explicit, and judicious use of current best evidence in making decisions about the care of communities and populations in the domain of health protection, disease prevention, health maintenance and improvement (health promotion)” (84). In 1999, scholars and practitioners in Australia (64) and the United States (23) elaborated further on the concept of EBPH. Glasziou and colleagues posed a series of questions to enhance uptake of EBPH (e.g., “Does this intervention help alleviate this problem?”) and identified 14 sources of high-quality evidence (64). Brownson and colleagues described a six-stage process by which practitioners can take a more evidence-based approach to decision making (19, 23). Kohatsu and colleagues broadened earlier definitions of EBPH to include the perspectives of community members, fostering a more population-centered approach (96). In 2004, Rychetnik and colleagues summarized many key concepts in a glossary for EBPH (141). There appears to be a consensus among investigators and public health leaders that a combination of scientific evidence and values, resources, and context should enter into decision making (**Figure 1**) (19, 119, 141, 151, 152).

In summarizing these various attributes of EBPH, key characteristics include

- Making decisions using the best available peer-reviewed evidence (both quantitative and qualitative research),
- Using data and information systems systematically,
- Applying program-planning frameworks (that often have a foundation in behavioral science theory),
- Engaging the community in assessment and decision making,
- Conducting sound evaluation, and
- Disseminating what is learned to key stakeholders and decision makers.

Accomplishing these activities in EBPH is likely to require a synthesis of scientific skills, enhanced communication, common sense, and political acumen.

Defining Evidence

At the most basic level, evidence involves “the available body of facts or information indicating whether a belief or proposition is true or valid” (85). The idea of evidence often derives from legal settings in Western societies. In law, evidence comes in the form of stories, witness accounts, police testimony, expert opinions, and forensic science (112). For a public health professional, evidence is some form of data—including epidemiologic (quantitative) data, results of program or policy evaluations, and qualitative data—for uses in making judgments or decisions (**Figure 2**). Public health evidence is usually the result of a complex cycle of observation, theory, and experiment (114, 138). However, the value of evidence is in the eye of the beholder (e.g., usefulness of evidence may vary by stakeholder type) (92). Medical evidence includes not only research but characteristics of the patient, a patient’s readiness to undergo a therapy, and society’s values (122). Policy makers seek out distributional consequences (i.e., who has to pay, how much, and who benefits) (154), and in practice settings, anecdotes sometimes trump empirical data (26). Evidence is usually imperfect and, as noted by Muir Gray, “[t]he absence of excellent evidence does not make evidence-based decision making

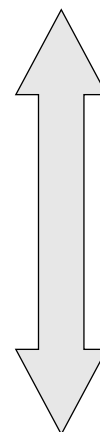


Figure 1

Domains that influence evidence-based decision making [from Spring et al. (151, 152)].

- Scientific literature in systematic reviews
- Scientific literature in one or more journal articles
- Public health surveillance data
- Program evaluations
- Qualitative data
 - Community members
 - Other stakeholders
- Media/marketing data
- Word of mouth
- Personal experience

Objective



Subjective

Figure 2

Different forms of evidence. Adapted from Chambers & Kerner (37).

Table 1 Comparison of the types of scientific evidence

Characteristic	Type One	Type Two	Type Three
Typical data/relationship	Size and strength of preventable risk—disease relationship (measures of burden, etiologic research)	Relative effectiveness of public health intervention	Information on the adaptation and translation of an effective intervention
Common setting	Clinic or controlled community setting	Socially intact groups or community wide	Socially intact groups or community wide
Example	Smoking causes lung cancer	Price increases with a targeted media campaign reduce smoking rates	Understanding the political challenges of price increases or targeting media messages to particular audience segments
Quantity	More	Less	Less
Action	Something should be done	This particular intervention should be implemented	How an intervention should be implemented

impossible; what is required is the best evidence available not the best evidence possible” (119).

Several authors have defined types of scientific evidence for public health practice (Table 1) (19, 23, 141). Type 1 evidence defines the causes of diseases and the magnitude, severity, and preventability of risk factors and diseases. It suggests that “something should be done” about a particular disease or risk factor. Type 2 evidence describes the relative impact of specific interventions that do or do not improve health, adding “specifically, this should be done” (19). There are different sources of Type 2 evidence (Table 2). These categories build on work from Canada, the United Kingdom, Australia, the Netherlands, and the United States on how to recast the strength of evidence, emphasizing the weight of evidence and a wider range of considerations beyond efficacy. We define four categories within a typology of scientific evidence for decision making: evidence-based, efficacious, promising, and emerging interventions. Adherence to a strict hierarchy of study designs may reinforce an inverse evidence law by which interventions most likely to influence whole populations (e.g., policy change) are least valued in an evidence matrix emphasizing randomized designs (125, 127). Type 3 evidence (of which we have the least) shows how and under which contextual conditions interventions were implemented and how they were received, thus

informing “how something should be done” (141). Studies to date have tended to overemphasize internal validity (e.g., well-controlled efficacy trials) while giving sparse attention to external validity (e.g., the translation of science to the various circumstances of practice) (62, 71).

Understanding the context for evidence.

Type 3 evidence derives from the context of an intervention (141). Although numerous authors have written about the role of context in informing evidence-based practice (32, 60, 77, 90, 92, 93, 140, 141), there is little consensus on its definition. When moving from clinical interventions to population-level and policy interventions, context becomes more uncertain, variable, and complex (49). One useful definition of context highlights information needed to adapt and implement an evidence-based intervention in a particular setting or population (141). The context for Type 3 evidence specifies five overlapping domains (Table 3). First, characteristics of the target population for an intervention are defined such as education level and health history (104). Next, interpersonal variables provide important context. For example, a person with a family history of cancer might be more likely to undergo cancer screening. Third, organizational variables should be considered. For example, whether an agency is successful in carrying out an evidence-based

Table 2 Typology for classifying interventions by level of scientific evidence

Category	How established	Considerations for the level of scientific evidence	Data source examples
Evidence-based	Peer review via systematic or narrative review	Based on study design and execution External validity Potential side benefits or harms Costs and cost-effectiveness	<i>Community Guide</i> Cochrane reviews Narrative reviews based on published literature
Effective	Peer review	Based on study design and execution External validity Potential side benefits or harms Costs and cost-effectiveness	Articles in the scientific literature Research-tested intervention programs (123) Technical reports with peer review
Promising	Written program evaluation without formal peer review	Summative evidence of effectiveness Formative evaluation data Theory-consistent, plausible, potentially high-reach, low-cost, replicable	State or federal government reports (without peer review) Conference presentations
Emerging	Ongoing work, practice-based summaries, or evaluation works in progress	Formative evaluation data Theory-consistent, plausible, potentially high-reaching, low-cost, replicable Face validity	Evaluability assessments ^a Pilot studies NIH CRISP database Projects funded by health foundations

^aA preevaluation activity that involves an assessment is an assessment prior to commencing an evaluation to establish whether a program or policy can be evaluated and what might be the barriers to its evaluation (145).

program will be influenced by its capacity (e.g., a trained workforce, agency leadership) (51, 77). Fourth, social norms and culture are known to shape many health behaviors. Finally, larger political and economic forces affect context. For example, a high rate for a certain disease may influence a state’s political will to address the issue in a meaningful and systematic way. Particularly for high-risk and understudied populations, there is a pressing need for evidence on contextual variables and ways of adapting programs and policies across settings and population subgroups. Contextual issues are being addressed more fully in the new realist review, which is a systematic review process that seeks to examine not only whether an intervention works but also how interventions work in real-world settings (134).

Triangulating evidence. Triangulation involves the accumulation of evidence from a variety of sources to gain insight into a particular topic (164) and often combines quantitative and qualitative data (19). It generally uses multiple

methods of data collection and/or analysis to determine points of commonality or disagreement (47, 153). Triangulation is often beneficial because of the complementary nature of information from different sources. Although quantitative data provide an excellent opportunity to determine how variables are related for large numbers of people, these data provide little understanding of why these relationships exist. Qualitative data, on the other hand, can help provide information to explain quantitative findings, or what has been called “illuminating meaning” (153). One can find many examples of the use of triangulation of qualitative and quantitative data to evaluate health programs and policies including AIDS-prevention programs (50), occupational health programs and policies (79), and chronic disease prevention programs in community settings (66).

Audiences for EBPH

There are four overlapping user groups for EBPH (56). The first includes public health

practitioners with executive and managerial responsibilities who want to know the scope and quality of evidence for alternative strategies (e.g., programs, policies). In practice, however, public health practitioners frequently have a relatively narrow set of options. Funds from federal, state, or local sources are most often earmarked for a specific purpose (e.g., surveillance and treatment of sexually transmitted diseases, inspection of retail food establishments). Still, the public health practitioner has the opportunity, even the obligation, to carefully review the evidence for alternative ways to achieve the desired health goals. The next user group is policy makers at local, regional, state, national, and international levels. They are faced with macrolevel decisions on how to allocate the public resources of which they are stewards. This group has the additional responsibility of making policies on controversial public issues. The third group is composed of stakeholders who will be affected by any intervention. This includes the public, especially those who vote, as well as interest groups formed to support or oppose specific policies, such as the legality of abortion, whether the community water supply should be fluoridated, or whether adults must be issued handgun licenses if they pass background checks. The final user group is composed of researchers on population health issues, such as those who evaluate the impact of a specific policy or program. They both develop and use evidence to answer research questions.

Similarities and Differences between EBPH and Evidence-Based Medicine

The concept of evidence-based practice is well established in numerous disciplines including psychology (136), social work (58), and nursing (115). It is probably best established in medicine. The doctrine of evidence-based medicine (EBM) was formally introduced in 1992 (53). Its origins can be traced back to the seminal work of Cochrane that noted many medical treatments lacked scientific effectiveness (41). A basic tenet of EBM is to deempha-

Table 3 Contextual variables for intervention design, implementation, and adaptation

Category	Examples
Individual	Education level
	Basic human needs ^a
	Personal health history
Interpersonal	Family health history
	Support from peers
	Social capital
Organizational	Staff composition
	Staff expertise
	Physical infrastructure
	Organizational culture
Sociocultural	Social norms
	Values
	Cultural traditions
	History
Political and economic	Political will
	Political ideology
	Lobbying and special interests
	Costs and benefits

^aBasic human needs include food, shelter, warmth, safety (104).

size unsystematic clinical experience and place greater emphasis on evidence from clinical research. This approach requires new skills, such as efficient literature searching and an understanding of types of evidence in evaluating the clinical literature (73). The literature on EBM has grown rapidly, contributing to the formal recognition of EBM. Using the search term “evidence-based medicine” there were 0 citations in 1991, rising to 4040 citations in 2007 (Figure 3). Even though the formal terminology of EBM is relatively recent, its concepts are embedded in earlier efforts such as the Canadian Task Force for the Periodic Health Examination (28) and the *Guide to Clinical Preventive Services* (167).

Important distinctions can be made between evidence-based approaches in medicine and public health. First, the type and volume of evidence differ. Medical studies of pharmaceuticals and procedures often rely on randomized controlled trials of individuals, the most

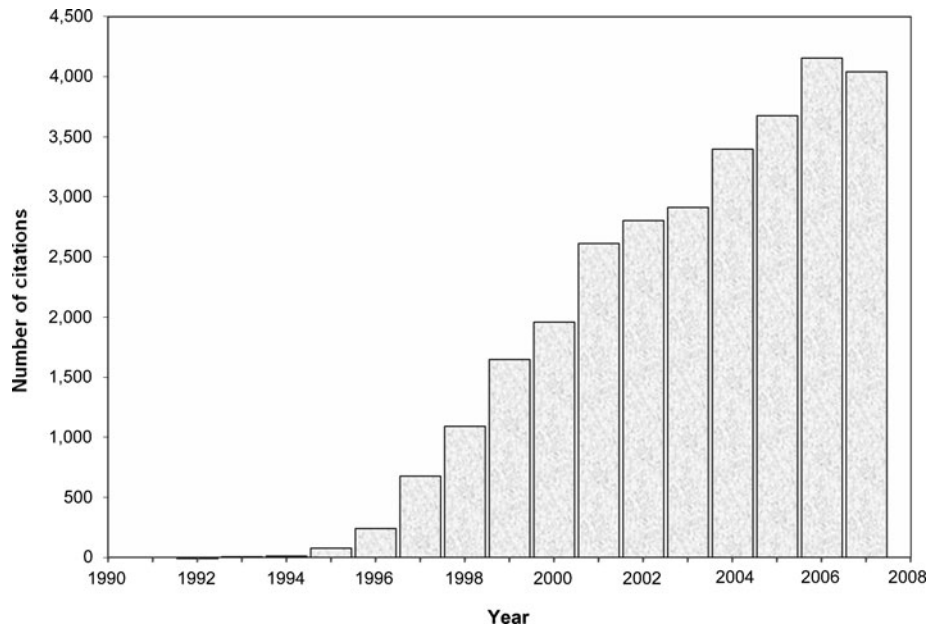


Figure 3

Citations for evidence-based medicine.

scientifically rigorous of epidemiologic studies. In contrast, public health interventions usually rely on cross-sectional studies, quasi-experimental designs, and time-series analyses. These studies sometimes lack a comparison group and require more caveats when interpreting the results. Over the past 50 years, there have been more than one million randomized controlled trials of medical treatments (157). Many fewer studies have been performed on the effectiveness of public health interventions (19, 128) because they are difficult to design, and often results derive from natural experiments (e.g., a state adopting a new policy compared with other states). EBPH has borrowed the term intervention from clinical disciplines, insinuating specificity and discreteness. However, in public health, we seldom have a single “intervention,” but rather a program that involves a blending of several interventions within a community. Large community-based trials can be more expensive to conduct than randomized experiments in a clinic. Population-based studies generally require a longer time

period between intervention and outcome. For example, a study on the effects of smoking cessation on lung cancer mortality would require decades of data collection and analysis. Contrast that with treatment of a medical condition (e.g., an antibiotic for symptoms of pneumonia), which is likely to produce effects in days or weeks, or even a surgical trial for cancer with endpoints of mortality within a few years.

The formal training of persons working in public health is much more variable than that in medicine or other clinical disciplines (161). Unlike medicine, public health relies on a variety of disciplines, and there is not a single academic credential that certifies a public health practitioner, although efforts to establish credentials (via an exam) are now underway. Fewer than 50% of public health workers have any formal training in a public health discipline such as epidemiology or health education (166). This higher level of heterogeneity means that multiple perspectives are involved in a more complicated decision-making process. It also suggests

that effective public health practice places a premium on routine, on-the-job training.

ANALYTIC TOOLS AND APPROACHES TO ENHANCE THE UPTAKE OF EBPH

Several analytic tools and planning approaches can help practitioners answer questions such as the following:

- What is the size of the public health problem?
- Are there effective interventions for addressing the problem?
- What information about the local context and this particular intervention is helpful in deciding its potential use in the situation at hand?
- Is a particular program or policy worth doing (i.e., is it better than alternatives?), and will it provide a satisfactory return on investment, measured in monetary terms or in health impacts?

Public Health Surveillance

Public health surveillance is a critical tool for those using EBPH. This process involves the ongoing systematic collection, analysis, and interpretation of specific health data, closely integrated with the timely dissemination of these data to those responsible for preventing and controlling disease or injury (158). Public health surveillance systems should be able to collect and analyze data, disseminate data to public health programs, and regularly evaluate the effectiveness of the use of the disseminated data (160). For example, documentation of the prevalence of elevated levels of lead (a known toxicant) in blood in the U.S. population was used as the justification for eliminating lead from paint and then gasoline and for documenting the effects of these actions (5). In tobacco control, agreement on a common metric for tobacco use enabled comparisons across the states and an early recognition of the doubling and

then tripling of the rates of decrease in smoking in California after passage of its Proposition 99 (163), as well as a subsequent quadrupling of the rate of decline in Massachusetts compared with the other 48 states (11).

Systematic Reviews and Evidence-Based Guidelines

Systematic reviews are syntheses of comprehensive collections of information on a particular topic (see examples in **Table 4**). Reading a good review can be one of the most efficient ways to become familiar with state-of-the-art research and practice on many specific topics in public health (80, 117, 121). The use of explicit, systematic methods (i.e., decision rules) in reviews limits bias and reduces chance effects, thus providing more reliable results upon which to make decisions (132). One of the most useful sets of reviews for public health interventions is the *Guide to Community Preventive Services* (the *Community Guide*) (120, 171), which provides an overview of current scientific literature through a well-defined, rigorous method in which available studies themselves are the units of analysis. The *Community Guide* seeks to answer the following: (a) Which interventions have been evaluated, and what have been their effects? (b) Which aspects of interventions can help *Guide* users select from among the set of interventions of proven effectiveness? And finally, (c) What might this intervention cost, and how do these costs compare with the likely health impacts?

Several authors have provided checklists for assessing the quality of a systematic review article (**Table 5**) (74, 88, 131). A good systematic review should allow the practitioner to understand the local contextual conditions necessary for successful implementation (168).

Economic Evaluation

Economic evaluation is an important component of evidence-based practice (65). It can provide information to help assess the relative value

Table 4 Examples of systematic reviews and evidence-based guidelines

Title	Description	Web site
<i>Guide to Community Preventive Services</i>	The <i>Guide to Community Preventive Services</i> (the <i>Community Guide</i>) summarizes what is known about the effectiveness, economic efficiency, and feasibility of population-based interventions. The Task Force on Community Preventive Services makes recommendations for the use of various interventions on the basis of evidence gathered in the rigorous and systematic scientific reviews of published studies conducted by the review teams of the Community Guide. The findings from the reviews are published in peer-reviewed journals and are also made available on the Web site.	http://www.thecommunityguide.org
<i>Guide to Clinical Preventive Services</i>	The U.S. Preventive Services Task Force (USPSTF) conducts rigorous and systematic reviews of the scientific evidence for the effectiveness of a broad range of clinical preventive services, including screening, counseling, and preventive medications. The mission of the USPSTF is to evaluate the benefits of individual services on the basis of age, gender, and risk factors for disease; make recommendations about which preventive services should be incorporated routinely into primary medical care and for which populations; and identify a research agenda for clinical preventive care.	http://www.ahrq.gov/clinic/prevenix.htm
Cochrane Collaboration	The Cochrane Collaboration is an international organization dedicated to making up-to-date, accurate information about the effects of health care readily available. It produces and disseminates systematic reviews of health care interventions and promotes the search for evidence in the form of clinical trials and other studies of interventions. The Cochrane Collaboration was founded in 1993 and named after the British epidemiologist Archie Cochrane. The major product of the Collaboration is the Cochrane Database of Systematic Reviews, which is published quarterly as part of the Cochrane Library.	http://www.cochrane.org/
Cochrane Public Health Group	The Cochrane Public Health Group (PHRG), formerly the Health Promotion and Public Health Field, aims to work with contributors to produce and publish Cochrane reviews of the effects of population-level public health interventions. The PHRG undertakes systematic reviews of the effects of public health interventions to improve health and other outcomes at the population level, not those targeted at individuals. Thus, it covers interventions seeking to address macroenvironmental and distal social environmental factors that influence health. In line with the underlying principles of public health, these reviews seek to have a significant focus on equity and aim to build the evidence to address the social determinants of health.	http://www.ph.cochrane.org/
Center for Reviews and Dissemination	The Center for Reviews and Dissemination (CRD) is part of the National Institute for Health Research and is a department of the University of York. CRD, which was established in 1994, is one of the largest groups in the world engaged exclusively in evidence synthesis in the health field. CRD undertakes systematic reviews evaluating the research evidence on health and public health questions of national and international importance.	http://www.york.ac.uk/inst/crd/index.htm
Campbell Collaboration	The Campbell Collaboration, named after Donald Campbell, was founded on the principle that systematic reviews on the effects of interventions will inform and help improve policy and services. The Collaboration strives to make the best social science research available and accessible. Campbell reviews provide high-quality evidence of what works to meet the needs of service providers, policy makers, educators and their students, professional researchers, and the general public. Areas of interest include crime, justice, education, and social welfare.	http://www.campbellcollaboration.org/

Annu. Rev. Public Health 2009.30:175-201. Downloaded from www.annualreviews.org. Access provided by 78.162.87.58 on 03/21/22. For personal use only.

Table 5 Checklist for evaluating the methodologic quality of a systematic review. Adapted from Kelsey et al. (88), Oxman et al. (131), Guyatt & Rennie (74), and Briss et al. (16, 17)

What are the methods?

- Are decision rules for the systematic review explicit, transparent, and clearly described?
- Do the methods account for study design?
- Is study execution considered?

Are the results valid?

- Were the results similar from study to study?
- How precise were the results?
- Do the pooled results allow me to examine subgroup differences?
- Did the review explicitly address a focused and answerable question?
- On the basis of the search process, is it likely that important, relevant studies were missed?
- Were the primary studies of high methodologic quality?
- Were assessments of studies reproducible?
- Can a causal association be inferred from the available data?

How can I apply the results to population health and/or patient care?

- How can I best interpret the results to apply them to the populations that I serve in my public health agency or to the care of patients in my practice?
 - Were all outcomes of clinical and public health importance considered?
 - Are the benefits worth the costs and potential risks?
 - Did the authors provide explicit consideration of external validity?
-

of alternative expenditures on public health programs and policies. In cost-benefit analysis, all the costs and consequences of the decision options are valued in monetary terms. More often, the economic investment associated with an intervention is compared with the health impacts, such as cases of disease prevented or years of life saved. This technique, cost-effectiveness analysis (CEA), can suggest the relative value of alternative interventions (i.e., health return on dollars invested) (65). CEA has become an increasingly important tool for researchers, practitioners, and policy makers. However, relevant data to support this type of analysis are not always available, especially for possible public policies designed to improve health (26, 30).

Health Impact Assessment

Health impact assessment (HIA) is a relatively new method that seeks to estimate the probable impact of a policy or intervention in nonhealth sectors, such as agriculture, transportation, and economic development, on population health (76). Some HIAs have focused on ensuring the involvement of relevant stakeholders in the de-

velopment of a specific project. This latter approach, the basis of environmental impact assessment required by law for many large place-based projects, is similar to the nonregulatory approach that has been adopted for some HIAs. Overall, HIA, in both its forms, has been gaining acceptance as a tool because of mounting evidence that social and physical environments are important determinants of population health and health disparities. It is now being used to help assess the potential effects of many policies and programs on health status and outcomes (44, 89, 118).

Recently, Dannenberg and colleagues (46) reviewed 27 HIAs completed in the United States from 1999 to 2007. Topics studied ranged from policies about living wages and after-school programs to projects about power plants and public transit. Within this group of 27 HIAs, an excellent illustration is the assessment of a Los Angeles living wage ordinance (43). Researchers used estimates of the effects of health insurance and income on mortality to project and compare potential mortality reductions attributable to wage increases and changes in health insurance status among workers covered

HIA: health impact assessment

by the Los Angeles City living wage ordinance (43). Estimates demonstrated that the health insurance provisions of the ordinance would have a much larger health benefit than the wage increases, thus providing valuable information for policy makers who may consider adopting living wage ordinances in other jurisdictions or modifying existing ordinances.

Participatory Approaches

Participatory approaches that actively involve community members in research and intervention projects (31, 70, 83) show promise in engaging communities in EBPH (96). Practitioners, academicians, and community members collaboratively define issues of concern, develop strategies for intervention, and evaluate the outcomes. This approach relies on stakeholder input (72), builds on existing resources, facilitates collaboration among all parties, and integrates knowledge and action that hopefully will lead to a fair distribution of the benefits of an intervention or project for all partners (83, 99). Stakeholders, or key players, are individuals or agencies that have a vested interest in the issue at hand (150). In the development of health policies, for example, policy makers are especially important stakeholders (144). Stakeholders should include those who would potentially receive, use, and benefit from the program or policy being considered. In particular, three groups of stakeholders are relevant (36):

1. Those involved in program operations, such as sponsors, coalition partners, administrators, and staff;
2. Those served or affected by the program, including clients, family members, neighborhood organizations, and elected officials; and
3. Primary users of the evaluation—that is, people who are in a position to do or decide something regarding the program.

Participatory approaches may also present challenges in adhering to EBPH principles, especially in reaching agreement on which approaches are most appropriate for addressing a particular health problem (75).

DISSEMINATION AND IMPLEMENTATION OF EBPH

Although the concept of EBPH is likely to resonate with most public health professionals, the dissemination and implementation (D&I) of effective intervention strategies remains a significant challenge (61, 67). Drawing on experience in clinical practice, D&I of evidence-based clinical guidelines using passive methods (e.g., publication of consensus statements in professional journals, mass mailings) has been largely ineffective, resulting in only small changes in the uptake of a new practice (10), and single-source prevention messages are generally ineffective (100).

Effective D&I of an evidence-based program often calls for time-efficient approaches, ongoing training, and placement of high organizational value on research-informed practice (48). Furthermore, translation of research to practice among organizations, practitioner groups, or the general public is likely to occur in stages (139), suggesting that the decision to adopt, accept, and utilize an innovation in EBPH is a process rather than a single act.

Active Ingredients

EBPH relies on the transferability of evidence about effective interventions to new community settings. Practitioners need to identify the most important components or “active ingredients” of an intervention. The active ingredients of an effective intervention are the essential elements that produce the desired results. The concept of active ingredients in clinical interventions is exemplified by mental health interventions (116) and smoking cessation counseling (87). This is analogous to the concept of best processes needed when generalizing research to other populations, places, and times (68). Understanding these essential factors and how the context for a proposed replication may differ from the original is critical. Often, constraints require some modification of the original intervention. In these situations there is an inherent tension between fidelity (maintaining

the original program design) and reinvention (changes needed for replication or adoption in a new setting or for a different population) (9).

Organizational Culture

EBPH often relies on strong advocates of the evidence or evidence champions, who are willing to challenge the status quo within an organization and promote new ways of making decisions. Governmental institutions, including public health agencies, are key users of EBPH, yet they are not known for their organizational or budgetary flexibility. These agencies are typically bound to rigid civil service and union-bargained requirements about how staff can be hired, remunerated, evaluated, and terminated, as well as how money can be spent. As an example, in Los Angeles County, the pay scale for nutritionists and health educators is so low that it is very difficult to attract even entry-level individuals. Once hired by the county, they are often attracted to higher-paying administrative positions that do not use their primary expertise.

An organizational climate that supports changes is required for innovation (148). Rigid personnel systems often make it difficult to effectively implement new programs and keep up with rapidly evolving technology. For example, in many health agencies, there are no suitable job classifications for a health economist or for a Web designer, making it virtually impossible to hire at competitive salaries. Relatively secure employment and attractive rewards for long-term service (e.g., pensions, other retirement benefits) also tend to attract individuals who value job security more than the excitement of new ideas and approaches. Within a hierarchical bureaucracy, few incentives exist to press superiors for changes in programs or approaches even when the evidence is compelling. This self-selecting candidate pool and stable employment environment often result in the attitude that the key to a successful career is to stay under the radar to avoid possible negative performance evaluations or jeopardize advancement opportunities. In short, unlike in some private-

sector organizations that encourage risk taking and provide substantial monetary rewards for success, most public-sector organizations have a culture that discourages out of the box thinking and entrepreneurship (42).

The tendency to continue doing what has been done in the past is a powerful impediment to change. In many bureaucracies, when change occurs, it is usually in small incremental steps (130). Continuing past practices requires less effort than working through all the implications of a different approach based on newer evidence. Public health agency staff who propose new policies or programs can encounter opposition from colleagues who may feel threatened by the unfamiliar or from supervisors who feel a challenge to their authority to decide on program directions.

Leadership

The attitude toward EBPH among agency leadership is important because it helps to determine the organizational culture and use of finite resources. In a survey of 152 city and county health departments in the United States, one of the main predictors of strong public health system performance was the attention of organizational leadership to the science base, quality, and performance (143). However, even public health leaders who understand and embrace EBPH have challenges in choosing and implementing innovative approaches. How should they choose priority opportunities for programs and policies among all those recommended based on evidence reviews? As in clinical medicine (102), there are more recommendations than are practical for any department to introduce. Which criteria should leaders consider when selecting among options? Some worthy considerations include population-attributable disease/illness burden, preventable fraction, relative cost-effectiveness, skills of key staff, prior experience with other approaches, opportunities for leverage through partnerships with other stakeholders, and consistency with an agency's strategic plan, goals, and objectives.

Political Challenges

Having good scientific evidence is often insufficient to convince policy makers (e.g., Congress, state governors, boards of county supervisors, city councils) to initiate changes based on EBPH (39, 40). Researchers rely on experimental and observational studies to test specific hypotheses in a deliberate and systematic way (94, 97), and their influence derives from having specialized knowledge. However, policy making happens quickly and is built on generalized knowledge and demands from stakeholders (10, 40). Policy makers have to sell, argue, advocate, and get reelected in light of their available political capital (26). The evidence for a particular action does not necessarily lead to policy change (3, 147). Public health agencies often face obstacles from other stakeholders in proposing or implementing new evidence-based practices.

Programmatic and policy changes often result in winners and losers who can be at odds in the EBPH process (1). A contractor who financially supports an elected decision maker may have more clout than the agency, regardless of its merits. Public health agencies, because of their mission to improve the population's health, often seek to advance measures that expand the power and reach of government, raising objections from those who want less government. For example, in the debates surrounding public smoking ban proposals, public health agencies were forced to combat arguments that the smoking bans were simply a way for the government to limit personal freedoms. Overcoming this resistance often requires that public health leaders create coalitions of partners that extend well beyond public health.

The prevailing political ideology may be contrary to what science recommends, such as for water fluoridation or needle exchange programs. In other cases, those without a background in scientific methods may be skeptical that a systematic review process yields a better idea of what to do about a problem and may simply follow advice of a trusted individual, even when the trusted advice contradicts the best available evidence (98). Lack of skill in forming coalitions of partners who support a particular

EBPH intervention can also reduce the likelihood of convincing policy makers to act.

Public health leaders occasionally encounter situations in which the political will to implement a particular intervention exists before there is evidence to support it. A prime example is the Drug Abuse Resistance Education (D.A.R.E.) program, which is the most widely used school-based drug use prevention program in the United States, reaching more than 70% of elementary school children (52). The program costs ~\$130 per student (in 2004 dollars) to implement. Systematic reviews of methodologically sound D.A.R.E. program evaluations have shown the program to be ineffective (169).

Funding Challenges

Another challenge to implementing EBPH is the need to adhere to the requirements of the funding agencies. Most public health funding at all levels of government is categorical and restricted with respect to how the money may be spent. This was described over a decade ago as "hardening of the categories" (170) and limits the flexible use of funds to implement new evidence-based programs. Public health leaders are beginning to recognize the benefits to program integration and have articulated principles to enhance integration efforts (149). In addition, appropriating legislation or voter initiatives may contain explicit language about restrictions, which is in turn often influenced by key stakeholders. For example, in California, no more than 20% of funding coming from voter-initiated Proposition 99 can be used for antitobacco education in schools and communities (15). We are not aware of any legislation or executive branch guidance that limits expenditures to evidence-based recommendations or that requires that these expenditures be used whenever available. However, more governmental agencies appear to be referencing the best sources of evidence-based recommendations, including the *Community Guide* (171), as important inputs into the state and local planning processes (21).

Workforce Training Needs and Approaches

Strengthening EBPH competencies needs to take into account the diverse education and training backgrounds of the workforce. The emphasis on principles of EBPH is not uniformly taught in all the disciplines represented in the public health workforce. For example, a public health nurse is likely to have had less training than an epidemiologist in how to locate the most current evidence and interpret alternatives. A recently graduated health educator with an MPH is more likely to have gained an understanding of the importance of EBPH than an environmental health specialist holding a bachelor's degree. Probably fewer than 50% of public health workers have any formal training in a public health discipline such as epidemiology or

health education (166). Even fewer of these professionals have formal graduate training from a school of public health or other public health program. Currently, it appears that few public health departments have made continuing education about EBPH mandatory.

Although the formal concept of EBPH is relatively new, the underlying skills are not. For example, reviewing the scientific literature for evidence or evaluating a program intervention are skills often taught in graduate programs in public health or other academic disciplines and are building blocks of public health practice. The most commonly applied framework in EBPH is probably that of Brownson and colleagues (Figure 4), which uses a seven-stage process (19, 22, 51). The process used in applying this framework is nonlinear and entails numerous



Figure 4

Training approach for evidence-based public health (19, 22).

iterations (165). Competencies for more effective public health practice are becoming clearer (12, 13, 59). For example, to carry out the EBPH process, the skills needed to make evidence-based decisions require a specific set of competencies (Table 6).

To address these and similar competencies, EBPH training programs have been developed in the United States for public health professionals in state health agencies (6, 51), local health departments, and community-based organizations (105, 106), and similar programs have been developed in other countries (22, 129, 133). Some programs show evidence of effectiveness (51, 106). The most common format uses didactic sessions, computer labs, and scenario-based exercises taught by a faculty team with expertise in EBPH. The reach of these training programs can be increased by emphasizing a train-the-trainer approach (22). Other formats have been used including Internet-based self-study (101, 105), CD-ROMs (20), distance and distributed learning networks, and targeted technical assistance. Training programs may have greater impact when delivered by change agents, who are perceived as experts yet share common characteristics and goals with trainees (137). A commitment from leadership and staff to life-long learning is also an essential ingredient for success in training (38).

Implementation of training to address EBPH competencies should take into account principles of adult learning. These issues were recently articulated by Bryan and colleagues (27), who highlighted the need to (a) know why the audience is learning; (b) tap into an underlying motivation to learn by the need to solve problems; (c) respect and build on previous experience; (d) design learning approaches that match the background and diversity of recipients; and (e) actively involve the audience in the learning process.

Cultural and Geographic Differences

The tenets of EBPH have largely been developed in a western, European-American con-

text (111, 113). The conceptual approach arises from the epistemological underpinnings of logical positivism (156), which finds meaning through rigorous observation and measurement. This is reflected in a professional preference among clinicians for research designs such as the randomized controlled trial. In addition, most studies in the EBPH literature are academic-based research, usually with external funding for well-established investigators. In contrast, in developing (110) countries and in impoverished areas of developed countries, the evidence base for how best to address common public health problems is often limited, even though the scope of the problem may be enormous. Cavill compared evidence-based interventions across countries, showing that much of the evidence base in several areas is limited to empirical observations (33). Even in more developed countries (including the United States), information published in peer-reviewed journals or data available through Web sites and official organizations may not adequately represent all populations of interest.

THE FUTURE

The United States spends nearly \$30 billion annually on health-related research (126). A small portion of these expenditures is dedicated to research relevant to the practice of public health. Nonetheless, evidence for addressing a number of priority public health problems now exists. Unfortunately, the translation from research to clinical or community applications often occurs only after a delay of many years (8, 19, 91). Accelerating the production of new evidence and the adoption of evidence-based interventions to protect and improve health requires several actions.

Expanding the Evidence Base

The growing literature on the effectiveness of preventive interventions in clinical and community settings (2, 171) does not provide equal coverage of health problems. For example, the evidence base on how to increase immunization

Table 6 Competencies in evidence-based public health. Adapted from Brownson et al. (18)

Category	Domain ^a	Level ^b	Competency
1. Community input	C	B	Understand the importance of obtaining community input before planning and implementing evidence-based interventions.
2. Etiologic knowledge	E	B	Understand the relationship between risk factors and diseases.
3. Community assessment	C	B	Understand how to define the health issue according to the needs and assets of the population/community of interest.
4. Partnerships at multilevels	P/C	B	Understand the importance of identifying and developing partnerships to address the issue with evidence-based strategies at multiple levels.
5. Development of a concise statement of the issue	EBP	B	Understand the importance of developing a concise statement of the issue to build support for it.
6. Grant writing need	T/T	B	Recognize the importance of grant-writing skills including the steps involved in the application process.
7. Literature searching	EBP	B	Understand the process for searching the scientific literature and summarizing search-derived information on the health issue.
8. Leadership and evidence	L	B	Recognize the importance of strong leadership from public health professionals regarding the need and importance of evidence-based public health interventions.
9. Role of behavioral science theory	T/T	B	Understand the role of behavioral science theory in designing, implementing, and evaluating interventions.
10. Leadership at all levels	L	B	Understand the importance of commitment from all levels of public health leadership to increase the use of evidence-based interventions.
11. Evaluation in plain English	EV	I	Recognize the importance of translating the impacts of programs or policies in language that can be understood by communities, practice sectors, and policy makers.
12. Leadership and change	L	I	Recognize the importance of effective leadership from public health professionals when making decisions in the midst of ever-changing environments.
13. Translating evidence-based interventions	EBP	I	Recognize the importance of translating evidence-based interventions to unique real-world settings.
14. Quantifying the issue	T/T	I	Understand the importance of descriptive epidemiology (concepts of person, place, time) in quantifying the public health issue.
15. Developing an action plan for program or policy	EBP	I	Understand the importance of developing a plan of action that describes how the goals and objectives will be achieved, which resources are required, and how responsibility of achieving objectives will be assigned.
16. Prioritizing health issues	EBP	I	Understand how to choose and implement appropriate criteria and processes for prioritizing program and policy options.
17. Qualitative evaluation	EV	I	Recognize the value of qualitative evaluation approaches including the steps involved in conducting qualitative evaluations.
18. Collaborative partnerships	P/C	I	Understand the importance of collaborative partnerships between researchers and practitioners when designing, implementing, and evaluating evidence-based programs and policies.
19. Non-traditional partnerships	P/C	I	Understand the importance of traditional partnerships as well as those that have been considered nontraditional such as those with planners, departments of transportation, and others.
20. Systematic reviews	T/T	I	Understand the rationale, uses, and usefulness of systematic reviews that document effective interventions.

(Continued)

Table 6 (Continued)

Category	Domain ^a	Level ^b	Competency
21. Quantitative evaluation	EV	I	Recognize the importance of quantitative evaluation approaches including the concepts of measurement validity and reliability.
22. Grant-writing skills	T/T	I	Demonstrate the ability to create a grant, including an outline of the steps involved in the application process.
23. Role of economic evaluation	T/T	A	Recognize the importance of using economic data and strategies to evaluate costs and outcomes when making public health decisions.
24. Creating policy briefs	P	A	Understand the importance of writing concise policy briefs to address the issue using evidence-based interventions.
25. Evaluation designs	EV	A	Comprehend the various designs useful in program evaluation with a particular focus on quasi-experimental (nonrandomized) designs.
26. Transmitting evidence-based research to policy makers	P	A	Understand the importance of developing creative ways to transmit what we know works (evidence-based interventions) to policy makers to gain interest, political support, and funding.

^aC, community-level planning; E, etiology; P/C, partnerships and collaboration; EBP, evidence-based process; T/T, theory and analytic tools; L, leadership; EV, evaluation; P, policy.

^bB, beginner; I, intermediate; A, advanced.

levels is much stronger than how to prevent HIV infection or reduce alcohol abuse. A greater investment of resources to expand the evidence base is therefore essential. Even where we have interventions of proven effectiveness, the populations in which they have been tested often do not include subpopulations with the greatest disease and injury burden. Expanding the evidence base requires reliance on well-tested conceptual frameworks, especially those that pay close attention to D&I. For example, RE-AIM helps program planners and evaluators to pay explicit attention to Reach, Efficacy/Effectiveness, Adoption, Implementation, and Maintenance (63, 86).

Overcoming Barriers to Dissemination and Implementation

More knowledge is needed on effective mechanisms to translate evidence-based practice to public health settings. Several important questions deserve answers:

- Why have some types of evidence languished while others have been quickly adopted?
- Which D&I strategies appear to be most cost-effective?

- How can funding agencies accelerate the replication and adaptation of evidence-based interventions in a variety of settings and populations?
- Which specific processes best integrate community health assessment and improvement activities into health system planning efforts?
- How can we harness new tools, such as the Internet, to improve intervention effectiveness and dissemination?
- Which changes in organizational culture that promote innovation and adoption of EBPH are feasible?
- How can we increase attention on external validity in the production and systematic reviews of evidence?

Engaging Leadership

As noted earlier, leadership is essential to promote adoption of EBPH as a core part of public health practice (143). This includes an expectation that decisions will be made on the basis of the best science, the needs of the target population, and what will work locally. In some cases, additional funding may be required; however, in many circumstances, not having the will to change (rather than dollars) is the major

impediment. Use of EBPH should be incorporated as part of performance reviews for key public health personnel and as part of explicit goals and objectives for all program directors.

Expanding Training Opportunities

More practitioner-focused training is needed on the rationale for EBPH: how to select interventions, how to adapt them to particular circumstances, and how to monitor their implementation. The Task Force on Workforce Development has recommended that the essential public health services (35) be used as a framework to build the basic cross-cutting and technical competencies required to address public health problems. As outlined in this article, we would supplement this recommendation by including an EBPH framework and competencies (18, 19). Because many of the health issues needing urgent attention in local communities will require the involvement of other organizations (e.g., nonprofit groups, hospitals, employers), their participation in training efforts is essential.

Enhancing Accountability for Public Expenditures

Public funds should be targeted to support evidence-based strategies. Grants made by public health agencies to outside organizations should contain language explicitly requiring use of such strategies, when they exist, to justify expenditure of funds. Although the science base for many topics is still evolving, it is irresponsible not to use existing evidence when designing and implementing proven public health interventions. Evaluations of such efforts can thus contribute to a better understanding of what works in different settings. At the same time, the adoption of EBPH by the public health system as a whole and its impact on the community's health should be tracked. A central criterion in the accreditation of public health departments, soon to be implemented (162), must be the use of best evidence in every effort to improve health and health equity.

Understanding How to Use EBPH Better to Address Disparities

To what degrees do specific evidence-based approaches reduce disparities while improving overall current and/or future health? For many interventions, there is not a clear answer to this question. Despite the Healthy People 2010 goal of eliminating health disparities, recent data show large and growing differences in disease burden and health outcomes between high- and low-income groups (54). Most of the existing intervention research has been conducted among higher-income populations, and programs focusing on eliminating health disparities have often been short-lived (146). Yet, in both developed and developing countries, poverty is strongly correlated with poor health outcomes (155). When enough evidence exists, systematic reviews should focus specifically on interventions that show promise in eliminating health disparities (103, 135). Policy interventions hold the potential to influence health determinants more broadly and could significantly reduce the growing disparities across a wide range of health problems (24).

CONCLUSION

The successful implementation of EBPH in public health practice is both a science and an art. The science is built on epidemiologic, behavioral, and policy research showing the size and scope of a public health problem and which interventions are likely to be effective in addressing the problem. The art of decision making often involves knowing which information is important to a particular stakeholder at the right time. Unlike solving a math problem, significant decisions in public health must balance science and art because rational, evidence-based decision making often involves choosing one alternative from among a set of rational choices. By applying the concepts of EBPH outlined in this article, decision making and, ultimately, public health practice can be improved.

SUMMARY POINTS

1. To achieve state and national objectives for improved population health, more widespread adoption of evidence-based strategies is recommended.
2. Key components of evidence-based public health (EBPH) include making decisions on the basis of the best available, peer-reviewed evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned.
3. Three types of evidence focus on the causes of diseases and the magnitude of risk factors, the relative impact of specific interventions, and how and under which contextual conditions interventions were implemented.
4. Evidence is imperfect, and practitioners should seek the best evidence available not the best evidence possible.
5. Audiences for EBPH are public health practitioners, policy makers, stakeholders affected by a health issue, and researchers.
6. Several important distinctions between EBPH and evidence-based medicine include the volume of evidence, study designs used to inform research and practice, the setting or context in which the intervention is applied, and the training and certification of professionals.
7. Numerous analytic tools and approaches that can enhance the greater use of EBPH include public health surveillance, systematic reviews, economic evaluation, health impact assessment, and participatory approaches.
8. To increase the dissemination and implementation of EBPH in practice settings (e.g., health departments), several important issues should be considered: organizational culture, the role of leadership, political challenges, funding challenges, workforce training needs, culture, and geographic differences. Any of these could justify or demand some adaptation of evidence-based interventions to fit contextual conditions.

DISCLOSURE STATEMENT

C.M. has received nominal payment as a consultant to the St. Louis University School of Public Health.

ACKNOWLEDGMENTS

This work was partially funded through the Centers for Disease Control and Prevention award U48 DP00060 (Prevention Research Centers Program) and the National Association of Chronic Disease Directors. The authors appreciate input from Dr. C. Tracy Orleans of the Robert Wood Johnson Foundation and Dr. Laura Brennan-Ramirez of Transtria LLC.

LITERATURE CITED

1. Abney G. 1988. Lobbying by the insiders: parallels of state agencies and interest groups. *Public Adm. Rev.* 48:911–17

2. Agency for Healthc. Res. and Quality. 2005. *Guide to Clinical Preventive Services, 3rd Ed.*, Period. Updates. Agency for Healthc. Res. and Quality
3. Almeida C, Bascolo E. 2006. Use of research results in policy decision-making, formulation, and implementation: a review of the literature. *Cad. Saude Publica* 22(Suppl.):S7–19; discussion S20–33
4. Anderson J. 1999. “Don’t confuse me with facts. . .”: evidence-based practice confronts reality. *Med. J. Aust.* 170:465–66
5. Annett JL, Pirkle JL, Makuc D, Neese JW, Bayse DD, Kovar MG. 1983. Chronological trend in blood lead levels between 1976 and 1980. *N. Engl. J. Med.* 308:1373–77
6. Baker E, Brownson R, Dreisinger M, McIntosh L, Karamchic A. 2008. Examining the role of training in evidence-based public health: a qualitative study in the United States. *Health Promot. Practice*. In press
7. Baker EL, Potter MA, Jones DL, Mercer SL, Cioffi JP, et al. 2005. The public health infrastructure and our nation’s health. *Annu. Rev. Public Health* 26:303–18
8. Balas EA. 1998. From appropriate care to evidence-based medicine. *Pediatr. Ann.* 27:581–84
9. Bauman LJ, Stein RE, Ireys HT. 1991. Reinventing fidelity: the transfer of social technology among settings. *Am. J. Community Psychol.* 19:619–39
10. Bero LA, Jadad AR. 1998. How consumers and policy makers can use systematic reviews for decision making. In *Systematic Reviews. Synthesis of Best Evidence for Health Care Decisions*, ed. C Mulrow, D Cook, pp. 45–54. Philadelphia, PA: Am. Coll. Phys.
11. Biener L, Harris JE, Hamilton W. 2000. Impact of the Massachusetts tobacco control programme: population based trend analysis. *BMJ* 321:351–54
12. Birkhead GS, Davies J, Miner K, Lemmings J, Koo D. 2008. Developing competencies for applied epidemiology: from process to product. *Public Health Rep.* 123(Suppl. 1):67–118
13. Birkhead GS, Koo D. 2006. Professional competencies for applied epidemiologists: a roadmap to a more effective epidemiologic workforce. *J. Public Health Manag. Pract.* 12:501–4
14. Black BL, Cowens-Alvarado R, Gershman S, Weir HK. 2005. Using data to motivate action: the need for high quality, an effective presentation, and an action context for decision-making. *Cancer Causes Control* 16(Suppl. 1):15–25
15. Breslow L, Johnson M. 1993. California’s Proposition 99 on tobacco, and its impact. *Annu. Rev. Public Health* 14:585–604
16. Briss PA, Brownson RC, Fielding JE, Zaza S. 2004. Developing and using the *Guide to Community Preventive Services*: lessons learned about evidence-based public health. *Annu. Rev. Public Health* 25:281–302
17. Briss PA, Zaza S, Pappaioanou M, Fielding J, Wright-De Aguero L, et al. 2000. Developing an evidence-based *Guide to Community Preventive Services*—methods. The Task Force on Community Preventive Services. *Am. J. Prev. Med.* 18:35–43
18. Brownson R, Ballew P, Kittur N, Elliott M, Haire-Joshu D, et al. 2009. Developing competencies for training practitioners in evidence-based cancer control. *J. Cancer Educ.* In press
19. Brownson RC, Baker EA, Leet TL, Gillespie KN. 2003. *Evidence-Based Public Health*. New York: Oxford Univ. Press
20. Brownson RC, Ballew P, Brown KL, Elliott MB, Haire-Joshu D, et al. 2007. The effect of disseminating evidence-based interventions that promote physical activity to health departments. *Am. J. Public Health* 97:1900–7
21. Brownson RC, Ballew P, Dieffenderfer B, Haire-Joshu D, Heath GW, et al. 2007. Evidence-based interventions to promote physical activity: what contributes to dissemination by state health departments. *Am. J. Prev. Med.* 33:S66–73; quiz S4–8
22. Brownson RC, Diem G, Grabauskas V, Legetic B, Potemkina R, et al. 2007. Training practitioners in evidence-based chronic disease prevention for global health. *Promot. Educ.* 14:159–63
23. Brownson RC, Gurney JG, Land G. 1999. Evidence-based decision making in public health. *J. Public Health Manag. Pract.* 5:86–97
24. Brownson RC, Haire-Joshu D, Luke DA. 2006. Shaping the context of health: a review of environmental and policy approaches in the prevention of chronic diseases. *Annu. Rev. Public Health* 27:341–70
25. Brownson RC, Petitti DB, eds. 1998. *Applied Epidemiology: Theory to Practice*. New York: Oxford Univ. Press

26. Brownson RC, Royer C, Ewing R, McBride TD. 2006. Researchers and policymakers: travelers in parallel universes. *Am. J. Prev. Med.* 30:164–72
27. Bryan RL, Kreuter MW, Brownson RC. 2008. Integrating adult learning principles into training for public health practice. *Health Promot Pract.* In press
28. Can. Task Force on the Period. Health Exam. 1979. The periodic health examination. Canadian Task Force on the Periodic Health Examination. *Can. Med. Assoc. J.* 121:1193–254
29. Cancer Control PLANET. 2008. *Cancer Control PLANET. Links resources to comprehensive cancer control.* Atlanta, GA: Natl. Cancer Inst./Cent. Dis. Control Prev./Am. Cancer Soc./Subst. Abuse Mental Health Serv./Agency for Healthc. Res. Quality
30. Carande-Kulis VG, Maciosek MV, Briss PA, Teutsch SM, Zaza S, et al. 2000. Methods for systematic reviews of economic evaluations for the *Guide to Community Preventive Services*. Task Force on Community Preventive Services. *Am. J. Prev. Med.* 18:75–91
31. Cargo M, Mercer SL. 2008. The value and challenges of participatory research: strengthening its practice. *Annu. Rev. Public Health* 29:325–50
32. Castro FG, Barrera M Jr, Martinez CR Jr. 2004. The cultural adaptation of prevention interventions: resolving tensions between fidelity and fit. *Prev. Sci.* 5:41–45
33. Cavill N, Foster C, Oja P, Martin BW. 2006. An evidence-based approach to physical activity promotion and policy development in Europe: contrasting case studies. *Promot. Educ.* 13:104–11
34. Cent. Dis. Control Prev. 1993. *Public Health in the New American Health System. Discussion Paper.* Atlanta, GA: Cent. Dis. Control Prev.
35. Cent. Dis. Control Prev. 1999. *CDC Taskforce on Public Health Workforce Development.* Atlanta, GA: Cent. Dis. Control Prev.
36. Cent. Dis. Control Prev. 1999. Framework for program evaluation in public health. *MMWR* 48:1–40
37. Chambers D, Kerner J. 2007. Closing the gap between discovery and delivery. In *Dissemination and Implementation Research Workshop: Harnessing Science to Maximize Health.* Rockville, MD: Natl. Inst. Health
38. Chambers LW. 1992. The new public health: do local public health agencies need a booster (or organizational “fix”) to combat the diseases of disarray? *Can. J. Public Health* 83:326–28
39. Choi BC. 2005. Twelve essentials of science-based policy. *Prev. Chronic. Dis.* 2:A16
40. Choi BC, Pang T, Lin V, Puska P, Sherman G, et al. 2005. Can scientists and policy makers work together? *J. Epidemiol. Community Health* 59:632–37
41. Cochrane A. 1972. *Effectiveness and Efficiency: Random Reflections on Health Services.* London: Nuffield Provincial Hospital Trust
42. Cohen S, Eimicke W. 1996. *Understanding and applying innovation strategies in the public sector.* Presented at Annu. Natl. Conf. Am. Soc. Public Admin., 57th, Atlanta, Ga.
43. Cole B, Shimkhada R, Morgenstern H, Kominski G, Fielding J, Wu S. 2005. Projected health impact of the Los Angeles City living wage ordinance. *J. Epidemiol. Commun. Health* 59:645–50
44. Cole BL, Wilhelm M, Long PV, Fielding JE, Kominski G, Morgenstern H. 2004. Prospects for health impact assessment in the United States: new and improved environmental impact assessment or something different? *J. Health Polit. Policy Law* 29:1153–86
45. Curry S, Byers T, Hewitt M, eds. 2003. *Fulfilling the Potential of Cancer Prevention and Early Detection.* Washington, DC: Natl. Acad. Press
46. Dannenberg AL, Bhatia R, Cole BL, Heaton SK, Feldman JD, Rutt CD. 2008. Use of health impact assessment in the U.S.: 27 case studies, 1999–2007. *Am. J. Prev. Med.* 34:241–56
47. Denzin NK. 1970. *The Research Act in Sociology.* London, UK: Butterworth
48. Dobbins M, Cockerill R, Barnsley J, Ciliska D. 2001. Factors of the innovation, organization, environment, and individual that predict the influence five systematic reviews had on public health decisions. *Int. J. Technol. Assess. Health Care* 17:467–78
49. Dobrow MJ, Goel V, Upshur RE. 2004. Evidence-based health policy: context and utilisation. *Soc. Sci. Med.* 58:207–17
50. Dorfman LE, Derish PA, Cohen JB. 1992. Hey girlfriend: an evaluation of AIDS prevention among women in the sex industry. *Health Educ. Q.* 19:25–40

51. Dreisinger M, Leet TL, Baker EA, Gillespie KN, Haas B, Brownson RC. 2008. Improving the public health workforce: evaluation of a training course to enhance evidence-based decision making. *J. Public Health Manag. Pract.* 14:138–43
52. Drug Policy Found. 2003. *Public Policy: Youth Drug Education/The D.A.R.E. Program*. Washington, DC: Drug Policy Found.
53. Evidence-Based Med. Work. Group. 1992. Evidence-based medicine. A new approach to teaching the practice of medicine. *JAMA* 17:2420–25
54. Ezzati M, Friedman AB, Kulkarni SC, Murray CJ. 2008. The reversal of fortunes: trends in county mortality and cross-county mortality disparities in the United States. *PLoS Med.* 5:e66
55. Fielding JE. 2001. Where is the evidence? *Annu. Rev. Public Health* 22:v–vi
56. Fielding JE. 2003. Foreword. In *Evidence-Based Public Health*, ed. RC Brownson, EA Baker, TL Leet, KN Gillespie, pp. v–vii. New York: Oxford Univ. Press
57. Fielding JE, Briss PA. 2006. Promoting evidence-based public health policy: Can we have better evidence and more action? *Health Aff. (Millwood)* 25:969–78
58. Gambrell E. 2003. Evidence-based practice: sea change or the emperor’s new clothes? *J. Social Work Educ.* 39:3–23
59. Gebbie K, Merrill J, Hwang I, Gupta M, Btoush R, Wagner M. 2002. Identifying individual competency in emerging areas of practice: an applied approach. *Qual. Health Res.* 12:990–99
60. Glasgow RE. 2008. What types of evidence are most needed to advance behavioral medicine? *Ann. Behav. Med.* 35:19–25
61. Glasgow RE, Emmons KM. 2007. How can we increase translation of research into practice? Types of evidence needed. *Annu. Rev. Public Health* 28:413–33
62. Glasgow RE, Green LW, Klesges LM, Abrams DB, Fisher EB, et al. 2006. External validity: We need to do more. *Ann. Behav. Med.* 31:105–8
63. Glasgow RE, Vogt TM, Boles SM. 1999. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am. J. Public Health* 89:1322–27
64. Glasziou P, Longbottom H. 1999. Evidence-based public health practice. *Aust. N. Z. J. Public Health* 23:436–40
65. Gold MR, Siegel JE, Russell LB, Weinstein MC. 1996. *Cost-Effectiveness in Health and Medicine*. New York: Oxford Univ. Press
66. Goodman RM, Wheeler FC, Lee PR. 1995. Evaluation of the Heart to Heart Project: lessons from a community-based chronic disease prevention project. *Am. J. Health Promot.* 9:443–55
67. Green L, Ottoson J, Hiatt R, Garcia C. 2009. Diffusion, dissemination and implementation of evidence-based public health. *Annu. Rev. Public Health* 30:151–74
68. Green LW. 2001. From research to “best practices” in other settings and populations. *Am. J. Health Behav.* 25:165–78
69. Green LW. 2006. Public health asks of systems science: To advance our evidence-based practice, can you help us get more practice-based evidence? *Am. J. Public Health* 96:406–9
70. Green LW, George MA, Daniel M, Fankish CJ, Herbert CJ, et al. 1995. *Review and Recommendations for the Development of Participatory Research in Health Promotion in Canada*. Vancouver, BC: R. Soc. Can.
71. Green LW, Glasgow RE. 2006. Evaluating the relevance, generalization, and applicability of research: issues in external validation and translation methodology. *Eval. Health Prof.* 29:126–53
72. Green LW, Mercer SL. 2001. Can public health researchers and agencies reconcile the push from funding bodies and the pull from communities? *Am. J. Public Health* 91:1926–29
73. Guyatt G, Cook D, Haynes B. 2004. Evidence based medicine has come a long way. *BMJ* 329:990–91
74. Guyatt G, Rennie D, eds. 2002. *Users’ Guides to the Medical Literature. A Manual for Evidence-Based Clinical Practice*. Chicago, IL: Am. Med. Assoc. Press. 706 pp.
75. Hallfors D, Cho H, Livert D, Kadushin C. 2002. Fighting back against substance abuse: Are community coalitions winning? *Am. J. Prev. Med.* 23:237–45
76. Harris P, Harris-Roxas B, Harris E, Kemp L. 2007. *Health Impact Assessment: A Practical Guide*. Sydney, Aust. Cent. Health Equity Train., Res. Eval. (CHETRE)
77. Hausman AJ. 2002. Implications of evidence-based practice for community health. *Am. J. Community Psychol.* 30:453–67

78. Haynes B, Haines A. 1998. Barriers and bridges to evidence based clinical practice. *BMJ* 317:273–76
79. Hugentobler M, Israel BA, Schurman SJ. 1992. An action research approach to workplace health: integrating methods. *Health Educ. Q.* 19:55–76
80. Hutchison BG. 1993. Critical appraisal of review articles. *Can. Fam. Physician* 39:1097–102
81. Inst. of Med. 2003. *The Future of the Public's Health in the 21st Century*. Washington, DC: Natl. Acad. Press
82. Inst. Med. Comm. for the Study of the Fut. Public Health. 1988. *The Future of Public Health*. Washington, DC: Natl. Acad. Press
83. Israel BA, Schulz AJ, Parker EA, Becker AB. 1998. Review of community-based research: assessing partnership approaches to improve public health. *Annu. Rev. Public Health* 19:173–202
84. Jenicek M. 1997. Epidemiology, evidence-based medicine, and evidence-based public health. *J. Epidemiol. Commun. Health* 7:187–97
85. Jewell EJ, Abate F, eds. 2001. *The New Oxford American Dictionary*. New York: Oxford Univ. Press
86. Jilcott S, Ammerman A, Sommers J, Glasgow RE. 2007. Applying the RE-AIM framework to assess the public health impact of policy change. *Ann. Behav. Med.* 34:105–14
87. Kelley K, Bond R, Abraham C. 2001. Effective approaches to persuading pregnant women to quit smoking: a meta-analysis of intervention evaluation studies. *Br. J. Health Psychol.* 6:207–28
88. Kelsey JL, Pettitt DB, King AC. 1998. Key methodologic concepts and issues. See Ref. 25, pp. 35–69
89. Kemm J. 2001. Health impact assessment: a tool for healthy public policy. *Health Promot. Int.* 16:79–85
90. Kemm J. 2006. The limitations of 'evidence-based' public health. *J. Eval. Clin. Pract.* 12:319–24
91. Kerner J, Rimer B, Emmons K. 2005. Introduction to the special section on dissemination: dissemination research and research dissemination: How can we close the gap? *Health Psychol.* 24:443–46
92. Kerner JF. 2008. Integrating research, practice, and policy: What we see depends on where we stand. *J. Public Health Manag. Pract.* 14:193–98
93. Kerner JF, Guirguis-Blake J, Hennessy KD, Brounstein PJ, Vinson C, et al. 2005. Translating research into improved outcomes in comprehensive cancer control. *Cancer Causes Control* 16(Suppl. 1):27–40
94. Koepsell TD, Weiss NS. 2003. *Epidemiologic Methods. Studying the Occurrence of Illness*. New York: Oxford Univ. Press
95. Kohatsu ND, Melton RJ. 2000. A health department perspective on the *Guide to Community Preventive Services*. *Am. J. Prev. Med.* 18:3–4
96. Kohatsu ND, Robinson JG, Torner JC. 2004. Evidence-based public health: an evolving concept. *Am. J. Prev. Med.* 27:417–21
97. Last JM, ed. 2001. *A Dictionary of Epidemiology*. New York: Oxford Univ. Press. 196 pp.
98. Lavis JN, Robertson D, Woodside JM, McLeod CB, Abelson J. 2003. How can research organizations more effectively transfer research knowledge to decision makers? *Milbank Q.* 81:221–48, 171–72
99. Leung MW, Yen IH, Minkler M. 2004. Community based participatory research: a promising approach for increasing epidemiology's relevance in the 21st century. *Int. J. Epidemiol.* 33:499–506
100. Lewin Group I. 2001. *Factors Influencing Effective Dissemination of Prevention Research Findings by the Department of Health and Human Services. Final Report*. Washington, DC: Lewin Group
101. Linkov F, LaPorte R, Lovalekar M, Dodani S. 2005. Web quality control for lectures: Supercourse and Amazon.com. *Croat. Med. J.* 46:875–78
102. Maciosek MV, Coffield AB, Edwards NM, Flottemesch TJ, Goodman MJ, Solberg LI. 2006. Priorities among effective clinical preventive services: results of a systematic review and analysis. *Am. J. Prev. Med.* 31:52–61
103. Masi CM, Blackman DJ, Peek ME. 2007. Interventions to enhance breast cancer screening, diagnosis, and treatment among racial and ethnic minority women. *Med. Care Res. Rev.* 64:195S–242
104. Maslov A. 1943. A theory of human motivation. *Psychol. Rev.* 50:370–96
105. Maxwell ML, Adily A, Ward JE. 2007. Promoting evidence-based practice in population health at the local level: a case study in workforce capacity development. *Aust. Health Rev.* 31:422–29
106. Maylahn C, Bohn C, Hammer M, Waltz E. 2008. Strengthening epidemiologic competencies among local health professionals in New York: teaching evidence-based public health. *Public Health Rep.* 123:35–43

107. McGinnis JM. 2001. Does proof matter? Why strong evidence sometimes yields weak action. *Am. J. Health Promot.* 15:391–96
108. McGlynn EA, Asch SM, Adams J, Keesey J, Hicks J, et al. 2003. The quality of health care delivered to adults in the United States. *N. Engl. J. Med.* 348:2635–45
109. McMichael C, Waters E, Volmink J. 2005. Evidence-based public health: What does it offer developing countries? *J. Public Health (Oxf.)* 27:215–21
110. McQueen D. 2000. *Strengthening the evidence base for health promotion*. Presented at Global Conf. Health Promot. Health Promot.: Bridging the Equity Gap, 5th, Mexico
111. McQueen D. 2007. Evidence and theory. Continuing debates on evidence and effectiveness. In *Global Perspectives on Health Promotion Effectiveness*, ed. D McQueen, C Jones, pp. 281–303. New York, NY: Springer
112. McQueen DV. 2001. Strengthening the evidence base for health promotion. *Health Promot. Int.* 16:261–68
113. McQueen DV. 2002. The evidence debate. *J. Epidemiol. Community Health* 56:83–84
114. McQueen DV, Anderson LM. 2001. What counts as evidence? Issues and debates. In *Evaluation in Health Promotion: Principles and Perspectives*, ed. Rootman, pp. 63–81. Copenhagen, Denmark: World Health Organ.
115. Melnyk BM, Fineout-Overholt E, Stone P, Ackerman M. 2000. Evidence-based practice: the past, the present, and recommendations for the millennium. *Pediatr. Nurs.* 26:77–80
116. Miller CL, Druss BG, Rohrbaugh RM. 2003. Using qualitative methods to distill the active ingredients of a multifaceted intervention. *Psychiatr. Serv.* 54:568–71
117. Milne R, Chambers L. 1993. Assessing the scientific quality of review articles. *J. Epidemiol. Community Health* 47:169–70
118. Mindell J, Sheridan L, Joffe M, Samson-Barry H, Atkinson S. 2004. Health impact assessment as an agent of policy change: improving the health impacts of the mayor of London's draft transport strategy. *J. Epidemiol. Community Health* 58:169–74
119. Muir Gray JA. 1997. *Evidence-Based Healthcare: How to Make Health Policy and Management Decisions*. New York/Edinburgh: Churchill Livingstone
120. Mullen PD, Ramirez G. 2006. The promise and pitfalls of systematic reviews. *Annu. Rev. Public Health* 27:81–102
121. Mulrow CD. 1987. The medical review article: state of the science. *Ann. Intern. Med.* 106:485–88
122. Mulrow CD, Lohr KN. 2001. Proof and policy from medical research evidence. *J. Health Polit. Policy Law* 26:249–66
123. Natl. Cancer Inst. 2008. *Research-tested intervention programs (RTIPs)*. Atlanta, GA: Natl. Cancer Inst./Cent. Dis. Control Prev./Am. Cancer Soc./Subst. Abuse Mental Health Serv./Agency for Healthc. Res. Quality
124. Natl. Cent. for Health Stat. 2000. *Health, United States, 2000 With Adolescent Health Chartbook*. Hyattsville, MD: Cent. Dis. Control Prev., Natl. Cent. Health Stat.
125. Nutbeam D. 2003. How does evidence influence public health policy? Tackling health inequalities in England. *Health Promot. J. Aust.* 14:154–58
126. Off. of Manag. and Budget. 2008. *Budget: Department of Health and Human Services*. Washington, DC: Exec. Off. Pres.
127. Ogilvie D, Egan M, Hamilton V, Petticrew M. 2005. Systematic reviews of health effects of social interventions: 2. Best available evidence: How low should you go? *J. Epidemiol. Community Health* 59:886–92
128. Oldenburg BF, Sallis JF, French ML, Owen N. 1999. Health promotion research and the diffusion and institutionalization of interventions. *Health Educ. Res.* 14:121–30
129. Oliver KB, Dalrymple P, Lehmann HP, McClellan DA, Robinson KA, Twose C. 2008. Bringing evidence to practice: a team approach to teaching skills required for an informationist role in evidence-based clinical and public health practice. *J. Med. Libr. Assoc.* 96:50–57
130. Oliver TR. 2006. The politics of public health policy. *Annu. Rev. Public Health* 27:195–233
131. Oxman AD, Cook DJ, Guyatt GH. 1994. Users' guides to the medical literature. VI. How to use an overview. Evidence-Based Medicine Working Group. *JAMA* 272:1367–71

132. Oxman AD, Guyatt GH. 1993. The science of reviewing research. *Ann. N. Y. Acad. Sci.* 703:125–33; discussion 33–34
133. Pappaioanou M, Malison M, Wilkins K, Otto B, Goodman RA, et al. 2003. Strengthening capacity in developing countries for evidence-based public health: the data for decision-making project. *Soc. Sci. Med.* 57:1925–37
134. Pawson R, Greenhalgh T, Harvey G, Walshe K. 2005. Realist review—a new method of systematic review designed for complex policy interventions. *J. Health Serv. Res. Policy* 10(Suppl 1):21–34
135. Peek ME, Cargill A, Huang ES. 2007. Diabetes health disparities: a systematic review of health care interventions. *Med. Care Res. Rev.* 64:101S–56
136. Presidential Task Force on Evidence-Based Practice. 2006. Evidence-based practice in psychology. *Am. Psychol.* 61:271–85
137. Proctor EK. 2004. Leverage points for the implementation of evidence-based practice. *Brief Treat. Crisis Interv.* 4:227–42
138. Rimer BK, Glanz DK, Rasband G. 2001. Searching for evidence about health education and health behavior interventions. *Health Educ. Behav.* 28:231–48
139. Rogers EM. 2003. *Diffusion of Innovations*. New York: Free Press
140. Rychetnik L, Frommer M, Hawe P, Shiell A. 2002. Criteria for evaluating evidence on public health interventions. *J. Epidemiol. Community Health* 56:119–27
141. Rychetnik L, Hawe P, Waters E, Barratt A, Frommer M. 2004. A glossary for evidence based public health. *J. Epidemiol. Community Health* 58:538–45
142. SAMHSA. 2008. *SAMHSA's National Registry of Evidence-Based Programs and Practices*. Washington, DC: US Dep. Health Hum. Serv. Subst. Abuse Mental Health Serv. Admin.
143. Scutchfield FD, Knight EA, Kelly AV, Bhandari MW, Vasilescu IP. 2004. Local public health agency capacity and its relationship to public health system performance. *J. Public Health Manag. Pract.* 10:204–15
144. Sederburg WA. 1992. Perspectives of the legislator: allocating resources. *MMWR* 41(Suppl.):37–48
145. Shadish W, Cook T, Leviton L. 1995. *Foundations of Program Evaluation: Theories of Practice*. Newbury Park, CA: Sage
146. Shaya FT, Gu A, Saunders E. 2006. Addressing cardiovascular disparities through community interventions. *Ethn. Dis.* 16:138–44
147. Shulock N. 1999. The paradox of policy analysis: If it is not used, why do we produce so much? *J. Policy Anal. Manage.* 18:226–44
148. Simpson DD. 2002. A conceptual framework for transferring research to practice. *J. Subst. Abuse Treat.* 22:171–82
149. Slonim AB, Callaghan C, Daily L, Leonard BA, Wheeler FC, et al. 2007. Recommendations for integration of chronic disease programs: Are your programs linked? *Prev. Chronic Dis.* 4:A34
150. Soriano FI. 1995. *Conducting Needs Assessments. A Multidisciplinary Approach*. Thousand Oaks, CA: Sage
151. Spring B. 2007. OBSSR award supports training in evidence-based behavioral practice. *Outlook: Q. Newsl. Soc. Behav. Med.* Winter, p. 10
152. Spring B, Walker B, Brownson R, Mullen E, Newhouse R, et al. 2008. *Definition and competencies for evidence-based behavioral practice*. White paper prepared by the Council on Evidence-Based Behav. Pract., Northwestern Univ., Chicago, IL
153. Steckler A, McLeroy KR, Goodman RM, Bird ST, McCormick L. 1992. Toward integrating qualitative and quantitative methods: an introduction. *Health Educ. Q.* 19:1–8
154. Sturm R. 2002. Evidence-based health policy versus evidence-based medicine. *Psychiatr. Serv.* 53:1499
155. Subramanian SV, Belli P, Kawachi I. 2002. The macroeconomic determinants of health. *Annu. Rev. Public Health* 23:287–302
156. Suppe F. 1977. *The Structure of Scientific Theories*. Urbana, IL: Univ. Ill. Press
157. Taubes G. 1996. Looking for the evidence in medicine. *Science* 272:22–24
158. Thacker SB, Berkelman RL. 1988. Public health surveillance in the United States. *Epidemiol. Rev.* 10:164–90
159. Thacker SB, Ikeda RM, Giesecker KE, Mendelsohn AB, Saydah SH, et al. 2005. The evidence base for public health informing policy at the Centers for Disease Control and Prevention. *Am. J. Prev. Med.* 29:227–33

160. Thacker SB, Stroup DF. 2006. Public health surveillance. See Ref. 25, pp. 30–67
161. Tilson H, Gebbie KM. 2004. The public health workforce. *Annu. Rev. Public Health* 25:341–56
162. Tilson HH. 2008. Public health accreditation: progress on national accountability. *Annu. Rev. Public Health* 29:xv–xxii
163. Tobacco Educ. Res. Oversight Comm. Calif. 2006. *Toward a tobacco-free California, 2006–2008: confronting a relentless adversary, a plan for success.* <http://www.cdph.ca.gov/services/boards/teroc/Documents/TEROCMasterPlan06-08.pdf>
164. Tones K. 1997. Beyond the randomized controlled trial: a case for ‘judicial review.’ *Health Educ. Res.* 12:i–iv
165. Tugwell P, Bennett KJ, Sackett DL, Haynes RB. 1985. The measurement iterative loop: a framework for the critical appraisal of need, benefits and costs of health interventions. *J. Chronic Dis.* 38:339–51
166. Turnock BJ. 2001. *Public Health: What It Is and How It Works.* Gaithersburg, MD: Aspen. 354 pp.
167. U.S. Prev. Services Task Force. 1989. *Guide to Clinical Preventive Services: An Assessment of the Effectiveness of 169 Interventions.* Baltimore: Williams & Wilkins
168. Waters E, Doyle J. 2002. Evidence-based public health practice: improving the quality and quantity of the evidence. *J. Public Health Med.* 24:227–29
169. West SL, O’Neal KK. 2004. Project D.A.R.E. outcome effectiveness revisited. *Am. J. Public Health* 94:1027–29
170. Wiesner PJ. 1993. Four diseases of disarray in public health. *Ann. Epidemiol.* 3:196–98
171. Zaza S, Briss PA, Harris KW, eds. 2005. *The Guide to Community Preventive Services: What Works to Promote Health?* New York: Oxford Univ. Press



Contents

Epidemiology and Biostatistics

- Adaptive Designs for Randomized Trials in Public Health
*C. Hendricks Brown, Thomas R. Ten Have, Booil Jo, Getachew Dagne,
Peter A. Wyman, Bengt Muthén, and Robert D. Gibbons* 1
- Social Epidemiology. Social Determinants of Health in the United
States: Are We Losing Ground?
Lisa F. Berkman 27
- The Behavioral Risk Factors Surveillance System: Past, Present,
and Future
Ali H. Mokdad 43
- Geographic Life Environments and Coronary Heart Disease:
A Literature Review, Theoretical Contributions, Methodological
Updates, and a Research Agenda
Basile Chaix 81
- Health Effects of Arsenic and Chromium in Drinking Water:
Recent Human Findings
Allan H. Smith and Craig M. Steinmaus 107
- Evidence-Based Public Health: A Fundamental Concept for Public
Health Practice
Ross C. Brownson, Jonathan E. Fielding, and Christopher M. Maylahn 175
- Prioritizing Clinical Preventive Services: A Review and Framework
with Implications for Community Preventive Services
*Michael Maciosek, Ashley B. Coffield, Nichol M. Edwards, Thomas J. Flottemesch,
and Leif I. Solberg* 341

Environmental and Occupational Health

- Gene by Environment Interaction in Asthma
Stephanie J. London and Isabelle Romieu 55

Geographic Life Environments and Coronary Heart Disease: A Literature Review, Theoretical Contributions, Methodological Updates, and a Research Agenda <i>Basile Chaix</i>	81
Health Effects of Arsenic and Chromium in Drinking Water: Recent Human Findings <i>Allan H. Smith and Craig M. Steinmaus</i>	107
Health Effects of Combat: A Life-Course Perspective <i>Barry S. Levy and Victor W. Sidel</i>	123
Potential Health Impact of Nanoparticles <i>Tian Xia, Ning Li, and Andre E. Nel</i>	137
Public Health Practice	
Diffusion Theory and Knowledge Dissemination, Utilization, and Integration in Public Health <i>Lawrence W. Green, Judith M. Ottoson, César García, and Robert A. Hiatt</i>	151
Evidence-Based Public Health: A Fundamental Concept for Public Health Practice <i>Ross C. Brownson, Jonathan E. Fielding, and Christopher M. Maylath</i>	175
Public Health Certification <i>Kristine M. Gebbie</i>	203
Health Communication in the Latino Community: Issues and Approaches <i>John P. Elder, Guadalupe X. Ayala, Deborah Parra-Medina, and Gregory A. Talavera</i>	227
The Delivery of Public Health Interventions via the Internet: Actualizing Their Potential <i>Gary G. Bennett and Russell E. Glasgow</i>	273
Social Environment and Behavior	
A Crisis in the Marketplace: How Food Marketing Contributes to Childhood Obesity and What Can Be Done <i>Jennifer L. Harris, Jennifer L. Pomeranz, Tim Lobstein, and Kelly D. Brownell</i>	211
Health Communication in the Latino Community: Issues and Approaches <i>John P. Elder, Guadalupe X. Ayala, Deborah Parra-Medina, and Gregory A. Talavera</i>	227
School-Based Interventions for Health Promotion and Weight Control: Not Just Waiting on the World to Change <i>D.L. Katz</i>	253

The Delivery of Public Health Interventions via the Internet: Actualizing Their Potential <i>Gary G. Bennett and Russell E. Glasgow</i>	273
Social Epidemiology. Social Determinants of Health in the United States: Are We Losing Ground? <i>Lisa F. Berkman</i>	27
The Behavioral Risk Factors Surveillance System: Past, Present, and Future <i>Ali H. Mokdad</i>	43
Diffusion Theory and Knowledge Dissemination, Utilization, and Integration in Public Health <i>Lawrence W. Green, Judith M. Ottoson, César García, and Robert A. Hiatt</i>	151
Health Services	
Cost-Sharing: A Blunt Instrument <i>Dablia K. Remler and Jessica Greene</i>	293
Extreme Makeover: Transformation of the Veterans Health Care System <i>Kenneth W. Kizer and R. Adams Dudley</i>	313
Prioritizing Clinical Preventive Services: A Review and Framework with Implications for Community Preventive Services <i>Michael V. Maciosek, Ashley B. Coffield, Nichol M. Edwards, Thomas J. Flottemesch, and Leif I. Solberg</i>	341
Quality-Based Financial Incentives in Health Care: Can We Improve Quality by Paying For It? <i>Douglas A. Conrad and Lisa Perry</i>	357
The Contribution of Hospitals and Health Care Systems to Community Health <i>Stephen M. Shortell, Pamela K. Washington, and Raymond J. Baxter</i>	373
Untangling Practice Redesign from Disease Management: How Do We Best Care for the Chronically Ill? <i>Katie Coleman, Soeren Mattke, Patrick J. Perrault, and Edward H. Wagner</i>	385
Indexes	
Cumulative Index of Contributing Authors, Volumes 21–30	409
Cumulative Index of Chapter Titles, Volumes 21–30	414

Errata

An online log of corrections to *Annual Review of Public Health* chapters may be found at <http://publhealth.annualreviews.org/>