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Building Capacity for Evidence-Based Public Health: Reconciling the Pulls of Practice and the Push of Research

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Keywords

capacity building, context, evidence-based interventions, external validity, implementation, practice-based evidence

Abstract

Timely implementation of principles of evidence-based public health (EBPH) is critical for bridging the gap between discovery of new knowledge and its application. Public health organizations need sufficient capacity (the availability of resources, structures, and workforce to plan, deliver, and evaluate the preventive dose of an evidence-based intervention) to move science to practice. We review principles of EBPH, the importance of capacity building to advance evidence-based approaches, promising approaches for capacity building, and future areas for research and practice. Although there is general agreement among practitioners and scientists on the importance of EBPH, there is less clarity on the definition of evidence, how to find it, and how, when, and where to use it. Capacity for EBPH is needed among both individuals and organizations. Capacity can be strengthened via training, use of tools, technical assistance, assessment and feedback, peer networking, and incentives. Modest investments in EBPH capacity building will foster more effective public health practice.

INTRODUCTION

The gap between discovery of new research findings and their application in public health and policy settings is extensive in time lapse, completeness, and fidelity (86, 100). Timely implementation of evidence-based interventions (EBIs) is critical to bridge this chasm and to improve population health (71). A vast array of EBIs is now available in systematic reviews such as the *Guide to Community Preventive Services* (known as the *Community Guide*; <https://www.thecommunityguide.org/>). Systematic reviews summarize large bodies of research and provide decision makers (practitioners, policy makers) a useful array of EBIs from which to prioritize resources and plan programs (17, 63). Yet multiple lines of inquiry show that EBIs are not being disseminated or implemented effectively (86). In two surveys of US public health departments, an estimated 58–64% of programs and policies were reported as evidence-based (55, 67). Participants in a European public health training program reported that 56% of programs were evidence-based (67). These findings compare closely across these regions (North America, Europe) and with studies of the use of EBIs in clinical settings (122, 134) (see the sidebar titled Terms and Definitions for more description of key terms used throughout this article).

TERMS AND DEFINITIONS

Administrative evidence-based practices: agency (health department)- and work unit-level structures and activities that are positively associated with performance measures (e.g., achieving core public health functions, carrying out evidence-based interventions)

Capacity: the availability of resources, structures, and workforce to deliver the preventive dose of an evidence-based intervention

Capacity building: activities (e.g., training, technical assistance) that build durable resources and enable the recipient setting or community to deliver an evidence-based intervention

Dissemination: an active approach of spreading evidence-based interventions to the target audience via determined channels using planned strategies

Evidence-based intervention: public health practices and policies that have been shown to be effective based on evaluation research. Often, lists of evidence-based interventions are identified through systematic reviews, but they sometimes need adaptation to unique or varied settings, populations, or circumstances

Evidence-based public health (or evidence-based decision making): defined by several key characteristics that include making decisions based on evidence-based interventions; using data and information systems systematically; applying program planning frameworks; engaging the community in assessment and decision making; conducting sound evaluation; and disseminating what is learned to key stakeholders and decision makers

Evidence-informed decision making: the process of distilling and disseminating the best available evidence from research, context, and experience (political, organizational) and using that evidence to inform and improve public health practice and policy. The term “evidence-informed public health” is often used in Australia and Canada

External validity: the degree to which findings from a study or set of studies can be generalized to and relevant for populations, settings, and times other than those in which the original studies were conducted

Practice-based evidence: the process of deriving or determining the effectiveness and implementation of evidence-based interventions from evaluation in real-world practice experience rather than or in addition to highly controlled research studies

Investigating these gaps leads to several key findings: (a) Practitioners underuse EBIs (90, 91); (b) passive approaches for disseminating EBIs are largely ineffective because dissemination does not happen spontaneously (15, 120); (c) stakeholder involvement in the research or evaluation process (so-called practice-based evidence that responds to the pull of practitioners) is likely to enhance dissemination (79, 80, 84, 87, 96, 98, 177); (d) theory and planning frameworks are useful to guide the uptake of EBIs (170); and (e) capacity-building approaches in health-related settings (public health, medical care, policy) should be time-efficient; consistent with organizational climate, culture, and resources; and aligned with the needs and skills of staff members (21, 118).

Putting evidence to use in public health or other settings requires sufficient capacity (i.e., the availability of resources, structures, and workforce to recognize and deliver the preventive dose of an EBI) (92, 179) and the adaptation of highly controlled research-based practices to fit the varied circumstances and populations in which they would be applied. Capacity is a determinant of performance; that is, greater capacity is linked with higher public health impact (21, 137, 159). Conceptually, capacity is the ability of a public health agency to provide or perform essential public health services. It requires skills in evaluating the quality (strength), quantity (weight), and applicability of evidence. Capacity building for EBPH is essential at all levels of public health, from national or international standards to agency-level practices. Yet how capacity is operationalized, built, and maintained is less straightforward, and relatively little is known about how to tailor capacity-building approaches to practitioners' needs (119).

Capacity-building efforts are often aimed at improving the use of scientific evidence in day-to-day public health practice [so called evidence-based public health (EBPH) (21) or evidence-informed public health (5, 40, 83)]. Much of the early research on EBPH focused on barriers to the uptake of EBIs. Studies have focused on public health practitioners' personal (e.g., lack of skills) and organizational challenges (e.g., lack of incentives or resources) in utilizing EBIs. There is a strong correlation between the perception of organizational leadership or priority for evidence-based practices and use of research to inform program adoption and implementation among practitioners (22, 50, 101).

The overarching purposes of this review are to aid practitioners in building organizational-level capacity and to assist researchers conducting participatory research in identifying gaps in the literature in need of inquiry. Our review contains four major sections, which describe (a) the historical evolution and key principles of EBPH; (b) the importance of capacity building for EBPH; (c) promising approaches for capacity building; and (d) future issues for research and practice.

WHY EVIDENCE-BASED PUBLIC HEALTH MATTERS

Numerous reviews from teams on multiple continents have described the importance and core elements of EBPH (4, 21, 27, 36, 108, 110, 124, 127, 144). Many of the principles of EBPH have their historical precedents in the seminal work of Archie Cochrane, who noted in the early 1970s that many medical treatments lacked scientific effectiveness (41). The philosophical origins of evidence-based medicine extend as far back as nineteenth-century Paris (156), whereas a more formal doctrine and set of highly structured processes were described in the 1990s (61, 156). The basic tenet of evidence-based medicine is to de-emphasize unsystematic clinical experience and place greater emphasis on evidence from clinical research, especially randomized controlled trials. This approach requires new skills, such as efficient literature searching and an understanding of types and quality of evidence in evaluating the clinical literature (89). Even though the formal terminology of evidence-based medicine is relatively recent, its concepts are embedded in earlier efforts such as the *Canadian Task Force for the Periodic Health Examination* (34) and the *Guide to Clinical Preventive Services* (174).

Building on concepts of evidence-based medicine, formal discourse on the nature and scope of EBPH originated about two decades ago. In 1997, Jenicek (107) 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)” (p. 190). The emphasis was less on randomized controlled trial evidence because public health made such research less feasible in many settings or conditions. Though widely and variously taught in schools of public health as an implicit step in planning public health programs and policy in earlier years, in 1999, scholars and practitioners in Australia (72) and the United States (28) elaborated further on the concept of EBPH. Glasziou and Longbottom (72) 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. Brownson and colleagues (21, 28) described a multistage process by which practitioners can take a more evidence-based approach to decision making. Rychetnik and colleagues (155) summarized many key concepts in a glossary for EBPH. Across this body of literature, there is a consensus that evidence-based decision making requires not only scientific evidence, but also consideration of values, resources, and context (21, 140, 155, 157).

It is important to maintain both a practitioner-oriented and a stakeholder-oriented focus in concepts of EBPH. The concise definition proposed by Kohatsu (115) puts a stronger focus on participatory decision making: “[E]vidence-based public health is the process of integrating science-based interventions with community preferences to improve the health of populations” (p. 419). Particularly in Canada and Australia, the term evidence-informed decision making is commonly used (5, 184), in part, to emphasize that public health decisions are based on research but also require consideration of political and organizational factors (176). In a similar vein, Green (79, 80) has argued that we need to focus not only on evidence-based practice but also on practice-based evidence. In the *Community Guide*, an estimated 54% of studies reviewed were practice-based, which was defined mainly by whether participants were allocated to intervention and comparison conditions in their natural settings. Most of the practice-based studies occurred in community settings (175). To achieve a stronger practice orientation, besides more consistent evaluation of programs, we need research that responds better to practitioners’ needs and circumstances (e.g., practice-based research networks) (80), funding mechanisms that evaluate natural experiments (26), and reliance on so-called “tacit knowledge” or “colloquial evidence” (pragmatic information based on direct experience and action in practice) (116, 162). Among practitioners, the general concepts and importance of EBPH are well accepted; there is less clarity on the definition of evidence, how to find it, how to use it (8), and how to weight the variations among types or sources of evidence, recognizing that decisions should be based not just on the strength of evidence, but also on the weight of evidence (83). These observations highlight the need for clarity in the criteria for sufficient and appropriate evidence to catalyze action as well as capacity-building activities for both those sponsoring the intervention and the target organizations and populations.

The Need to Understand When Evidence Is Sufficient for Action

An ongoing challenge for public health practitioners involves determining when scientific evidence is sufficient for action, and when it is appropriate for some settings or problems or populations, whether it is sufficient for the ones at hand. Many of the key considerations are discussed in detail elsewhere (21, 65, 78). Advances in public health research are generally incremental, suggesting the need for intervention as a body of literature accumulates and single studies are not definitive. When evaluating a body of literature and determining a course of action, an excellent starting point for EBIs is a systematic review (e.g., the *Community Guide*, Cochrane reviews). Every public

health team should have a staff member with the skills to evaluate the quality and quantity of evidence along with the ability to translate this assessment into options for intervention in the particular problem, setting, population, and circumstances faced.

The Key Role of EBPH in Accreditation and Certification Efforts

A national voluntary accreditation program for public health agencies in the United States, established in 2007 through the Public Health Accreditation Board (PHAB), has direct and indirect effects on EBPH (14). The accreditation process intersects with EBPH on at least three levels. First, the prerequisites for accreditation—a community health assessment, a community health improvement plan, and an agency strategic plan—are key elements of EBPH (21). Second, the process is based on the assertion that if a public health agency meets certain standards and measures, then quality and performance (i.e., EBPH) will be enhanced. Third, domain 10 of the PHAB process states, “Identify and use the best available evidence for making informed public health practice decisions” (150, p. 219). Successfully accomplishing the standards and measures under domain 10 involves using EBIs from such sources as the *Community Guide*, having access to research expertise, and disseminating the data and implications of research to appropriate audiences. Similarly, certification of practitioners, such as the examinations for Certified Health Education Specialists and for public health practitioners have built-in test questions on EBIs. In addition, the rapid growth in number of schools and programs in public health puts growing pressure on them to hire faculty without experience in public health, leading to calls encouraging, if not requiring, faculty to have periodic rotations in practice or policy settings (33, 81, 82).

Understanding the Disconnect Between Evidence Generators and Evidence Users

For public health practitioners to apply the latest scientific evidence, they need to be connected all along the research production-to-application pipeline and not just to the end of it (8, 80). Research-based evidence serves many public health functions, including assuring the public and policy makers of the scientific grounding of advice, selection of EBIs, needs assessment, evaluation, and grant writing (101). Several factors are likely to affect the use of research evidence and practice-based research, including its perceived importance, accessibility of the latest research, and methods of obtaining or receiving and challenging the latest evidence for its applicability in a given setting and population. Although multiple studies show that public health practitioners value evidence-based decision making, access to the latest research information is sometimes limited. For example, Harris and colleagues (94) found that only 46% of state public health practitioners use journals in their day-to-day work and that lack of access is a major barrier to journal use. Journal access is a particular barrier for those without university library privileges. Open access publishing and online summaries of research reviews are obvious solutions to this limitation, and more journals are offering and moving toward open access, including the *Annual Review of Public Health*.

Perhaps the biggest challenge lies in the disconnect between how researchers disseminate their findings and how practitioners learn about the latest evidence (**Table 1**). Academic journals and conferences are by far the most common methods by which researchers disseminate their work (18, 135); however, among local and state public health practitioners in the United States, webinars and workshops are the most frequently selected methods by which to learn about research (64, 101). In qualitative research in Ontario, Dobbins and colleagues (51) found that public health decision makers value systematic reviews, short summaries of research, and clear statements of implications for practice.

Table 1 Preferred methods for disseminating or learning about the latest research-based evidence, United States

Method	Researchers % ^a (rank) ^b	Local practitioners % ^a (rank) ^c	Local practitioners % ^a (rank) ^d	State practitioners % ^a (rank) ^e
Academic journals	100 (1)	35 (3)	33 (4)	50 (2)
Academic conferences	92.5 (2)	24 (5)	22 (5)	17.5 (6)
Reports to funders	68 (3)	0	0	0
Press releases	62 (4)	0	12.5 (7)	0
Seminars or workshops	61 (5)	50 (1)	53 (1)	59 (1)
Face-to-face meetings with stakeholders	53 (6)	15 (7)	11 (6)	15 (7)
Media interviews	51 (7)	0	1 (9)	0
Policy briefs	26 (8)	24 (5)	17 (6)	30 (4)
Email alerts	22 (9)	46 (2)	34 (3)	40 (3)
Professional associations	Not applicable	30 (4)	48 (2)	24.5 (5)

^aThe percentage is determined for any method ranked as one of the top three choices.

^bBased on a study of US public health researchers ($n = 266$) (18, 135).

^cBased on a study of US local public health department employees ($n = 147$) (101).

^dBased on a study of US local public health department employees ($n = 849$) (64).

^eBased on a study of US state public health department employees ($n = 596$) (101).

WHY CAPACITY BUILDING MATTERS

While capacity building is recognized as a core activity for furthering EBPH (104), it is also recognized that capacity building is multifaceted and is often a difficult concept to define [e.g., more than 80 distinct characteristics of capacity building have been identified (163)] (73, 118). Capacity building is often described more precisely within the business and management literature than in the health literature (73). Across diverse disciplines, capacity building involves intentional, coordinated, and mission-driven efforts aimed at strengthening the activities, management, and governance of agencies to improve their performance and impact (43, 73). In public health, capacity building can be broad, crossing programmatic (or organizational) silos, or can be specific to a particular topic area such as cancer prevention (136), nutrition (169), maternal and child health (46), and HIV prevention (48) or to the professional specializations in performing their tasks identified by certification or licensing requirements (148).

Capacity for Evidence-Based Public Health

Capacity for EBPH is needed among individuals and among work units and whole organizations (112). These multiple groups should benefit from having reciprocal relationships, i.e., individuals shape organizations and organizations support the development of individuals (**Figure 1**) (140). Success in achieving evidence-based decision making is achieved both by building the skills and competencies of individuals (e.g., capacity to carry out a program evaluation) (21, 23, 128) and by taking actions in multiple levels of organizations (e.g., achieving a climate and culture that supports innovation, recording and providing feedback on performance, making rewards for performance public). Capacity alone is a necessary but insufficient prerequisite for improving population health; sustained change in public health is driven by many additional factors, including selection of EBIs, the policy and political environments, funding, and public support for improvements in population health (125, 166). Recent data from US state health departments suggest that individual-level capacity may be easier to change than organizational-level capacity (19).

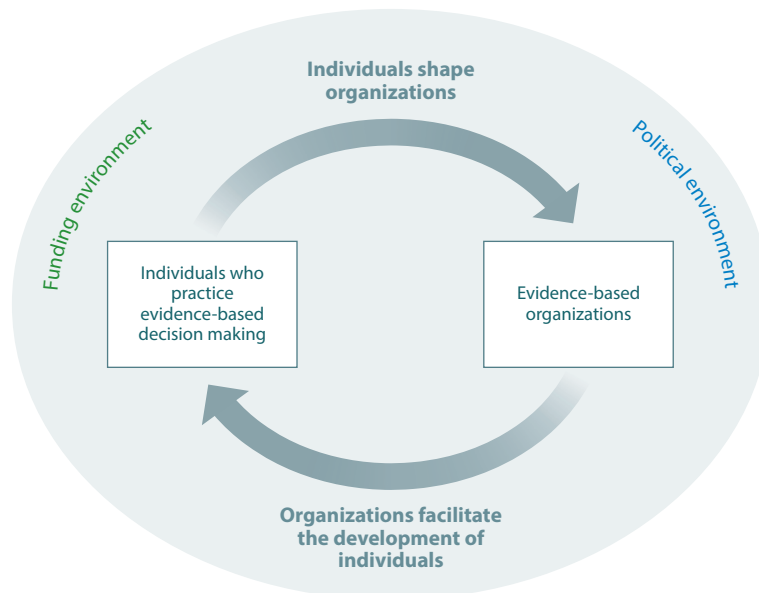


Figure 1

The interrelationships between individuals and organizations in supporting evidence-based decision making. Figure adapted with permission from Muir Gray (140).

Theory to Guide Capacity Building

Evidence from a variety of fields, including public health, has found that interventions that use health behavior theories are more effective than are those that lack a basis in theory because a theory-based model can provide a way to guide the search for evidence on interventions and processes needed to change intermediate variables (such as behavior) leading to the long-term health outcome (68, 79, 138). A theory is a set of interrelated concepts, definitions, and propositions that present a systematic view of events by specifying relations among variables in order to explain and predict events (69) and to impute potential interventions for which evidence can be sought (86).

There are few reviews of theories that are specific to capacity building among public health practitioners. In perhaps the most exhaustive summary, Leeman and colleagues (119) used an iterative process to review 24 capacity-building theories for their salient variations (i.e., how complexity and uncertainty influence the uptake of EBIs). Several practice contexts are particularly important across the theories for capacity building. First, the practice-setting, decision-making structures (hierarchy, climate, and culture) influence EBI adoption. Second, an organization's capacity to innovate is crucial in EBI uptake and is related to strong leadership, a learning environment, and a track record with innovation. These characteristics help us inform the How of capacity building, described later in this review.

Lessons from Community-Level Efforts

Although the focus of this review is primarily on settings at the organizational (agency) level, a considerable literature exists on capacity building in community settings. This literature has covered numerous aspects, including the core domains for defining community capacity (e.g., participation and leadership, social capital, community values) (74, 85, 163); methods of measuring

community capacity (121); participatory evaluation in community settings (32, 35); and coalition building as a means to enhance community capacity (76). Several elements and challenges from these community-based studies inform our review of capacity in public health practice: (a) Capacity building is informed by the broader concepts from community development; (b) with lack of agreement on the core concepts underlying community capacity building, measurement is lacking; and (c) building and cultivating leadership are among the most important aspects of capacity.

Barriers to Capacity Building

The gap between research and practice underscores the need to understand the barriers to uptake of EBIs (119). Several studies have reported practitioners' personal and institutional barriers to utilizing EBIs. Lack of time, inadequate funding, inability to analyze and interpret evidence, and absence of cultural and managerial support are among the most commonly cited barriers (50, 52, 55, 103, 114, 132). In a national survey of public health practitioners in the United States, absence of incentives within the organization was the largest barrier to evidence-based decision making (103), including the inevitable disincentive of time required for locating and studying evidence sources, which delays the launch of programs or services. Other studies have found a strong correlation between the perception of institutional priority and the expectation of documentation for evidence-based practices and actual use of research to inform program adoption and implementation (22, 50). Therefore, it is important to recognize that uptake of EBIs is not likely to succeed in an environment that is not explicitly supportive of innovation or is protective of the status quo (161). At an individual level, US practitioners who lacked skills to develop EBIs were likely to have had a lower level of education, suggesting that some personal barriers are modifiable through training (103). To overcome barriers, capacity-building approaches need to involve the target population (practitioners) in development of training and evidence-based approaches and take into account numerous contextual variables (e.g., resources, incentives, values) (70, 119).

Complex, Multilevel Challenges

Systems thinking is needed to address our most vexing public health issues (49, 79, 164). The need for systems approaches is grounded in the knowledge that public health problems (e.g., violence, mental illness, substance abuse, infectious and chronic diseases) have complex upstream causes that are multilevel, interrelated, and closely linked with social determinants (a group of highly interrelated social and economic factors that create inequities in income, education, housing, and employment). Solutions are often policy dependent because policies have the largest impact on population health outcomes (62). However, 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 or systems change) are least valued in an evidence hierarchy that emphasizes randomized designs (77, 83, 109, 141, 142).

New skills are often needed to identify and implement EBIs that are multilevel and policy oriented and take into account a complex set of system-level factors. Studies in cancer control show that public health practitioners are less equipped to address systems-level interventions than are client-oriented EBIs (60). The capacities and skills needed among practitioners for implementing complex interventions cut across and go beyond traditional specializations of public health training (e.g., epidemiology, environmental health, health education) to other areas, including systems thinking, new methods of communication, and policy analysis.

PROMISING APPROACHES FOR BUILDING CAPACITY

On the basis of the current literature, we describe the core components of capacity-building efforts and how these elements can be operationalized.

The What of Capacity Building

Capacity-building efforts have many components. One set of targets involves broader, macrolevel determinants (20). Many of these macrolevel determinants of performance are less modifiable, closely connect to policy or governance, and may take years to change (e.g., may be connected to a political party in power or a funding mechanism for public health agencies).

For this review, we focus on microlevel determinants of capacity. Some have called these administrative evidence-based practices (A-EBPs), which are agency-level (health department) and work unit-level structures and activities that are positively associated with performance measures (e.g., achieving core public health functions, carrying out EBIs) (20). Evidence-based interventions are often the objects of capacity-building activities. These are interventions with proven efficacy and effectiveness and, defined broadly, may include programs, practices, processes, policies, and guidelines (152). These often involve complex interventions (e.g., multilevel interventions) whereby the core intervention components and their relationships involve multiple settings, audiences, and approaches (88, 97).

Across several reviews, core elements (domains) of A-EBPs appear to be particularly important: (a) leadership, (b) organizational climate and culture, (c) partnerships, (d) workforce development, and (e) financial processes (Table 2). These domains, described in detail below, are particularly useful targets for quality improvement efforts because they are modifiable in a shorter time frame than are the macrolevel determinants (12, 20, 54, 57).

Leadership is the most common element across all reviews because it is essential in promoting adoption of EBPH as a core part of public health practice (13, 29, 186). Recent research shows a number of actions from leaders in public health agencies that may increase the use of scientific information in decision making (101). These actions include direct supervisor expectations for EBPH use and performance evaluation based partially on EBPH principles (101).

The climate and culture within an agency are associated with employee attitudes, motivation, and performance (2). On the basis of reviews from the fields of organizational behavior, implementation science, public administration, and public health, high-performing agencies require the creation of an organizational environment conducive to EBPH and implementation of innovations (3). Climate is how employees rate perceptions of the extent to which their use of a specific innovation (e.g., an EBI) is rewarded, supported, and expected within an organization (113). Culture is what makes that organization unique among all others (e.g., productive relationships between leaders and subordinates) (1). Activities to support EBPH in organizations include ready access to high-quality information, employee perception that management supports innovation, and management teams that encourage communication and collaboration.

The domain on partnerships builds in part on extensive literature in participatory research (35). It also acknowledges that much of the progress in public health requires local actions with partners outside the health sector (e.g., schools, social services, urban planners, law enforcement). Activities to build and maintain partnerships include aligning mission and vision statements and colearning with partners.

A commitment to workforce development is an essential element of capacity building in public health practice (11, 58). One of the core domains for accreditation of public health agencies covers the need for a competent workforce (150). To achieve high levels of competency, numerous actions are warranted, including training in quality improvement and EBPH, access to ongoing technical

Table 2 Modifiable administrative evidence-based practice applications

Capacity-building domain	Core elements	Sample activities to build capacity	Time frame for modification ^a
Leadership	Skills and background of leaders Values and expectations of leaders Participatory decision making	Training (e.g., leadership/management and employee training in EBPH) Peer networking (e.g., leaders and middle managers seek and incorporate employee input)	Short to medium
Organizational climate and culture	Support for innovation Learning orientation Access and free flow of information	Tools (e.g., 360° employee performance reviews geared toward evidence-based practices; access to high-quality information) Assessment and feedback (e.g., employees perceive that management supports innovation, direct supervisor expects EBPH use, performance evaluation is based partially on EBPH principles). Incentives (e.g., recognition for using EBPH principles)	Short
Partnerships	Interorganizational relationships Vision and mission of partnerships	Peer networking (e.g., build and/or enhance partnerships with schools, hospitals, community organizations, social services, private businesses, universities, law enforcement; communities of practice)	Medium
Workforce development	Employee on-the-job training Access to technical assistance	Training (e.g., in-service training in quality improvement or evidence-based decision making, skills-based training in organization and systems change, training aligned with essential services and usual job responsibilities) Technical assistance (e.g., access and use of knowledge brokers ^b) Assessment and feedback (e.g., use of process improvement activities including accreditation, performance assessment)	Short
Financial processes	Allocation and expenditure of resources	Tools (e.g., outcomes-based contracting) Incentives (e.g., contracts to incentivize the use of EBPH principles)	Medium

Abbreviations: EBPH, evidence-based public health.

^aTime frame definitions: short = less than 1 year; medium = 1–3 years.

^bA knowledge broker is defined as a masters-trained individual available for technical assistance (173).

assistance [e.g., knowledge brokers (173)], and the promotion of process improvement activities (e.g., accreditation) that build the workforce.

Finally, financial processes are critical for progress in public health. When public health agencies spend more per capita, measurable improvements are shown, particularly in lower-resource communities (133). Yet in the current funding environment, public health is often a zero- (or shrinking) sum game—a loss of funding results in a loss in population benefit (181). Policy interventions are often useful in a limited-resource environment insofar as they have significant impact without high cost. Processes in the financial domain may include reliance on diverse funding sources or outcomes-based contracting.

Several factors, both at individual and organizational levels, appear to influence the use of A-EBPs at the local level. Among the five A-EBP domains, local health departments in the United States generally scored lowest for organizational climate and culture (mean for the domain = 50%)

and highest for partnerships (mean for the domain = 77%) (29). Two national studies have shown that A-EBPs are far less likely to be used by local health departments with jurisdictions of less than 25,000 persons (3–4 times less likely to apply A-EBPs than health departments with jurisdictions of 500,000 persons or more) (29, 59). This lack of engagement by smaller jurisdictions highlights the challenges encountered by rural health departments, which often face a double disparity (i.e., higher rates of risk factors coupled with limited capacity) (95).

The How of Capacity Building

More challenging and less grounded in the scientific literature than the What of capacity building is the How of capacity building (118, 119, 146). In determining the optimal approaches for capacity building, one must understand the push–pull process, in which the potential adopter of an EBI must be receptive to a wide array of choices (pull), and, at the same time, there must be a systematic effort provided to the adopter to enhance the implementation of the EBI (push) (45, 85, 118, 143). The mismatch between push and pull is illustrated in **Table 1**. Too often, capacity-building efforts have been built around pushing out research-based evidence without accounting for the pull of practitioners, policy makers, or community members or accounting for key contextual variables (e.g., resources, needs, culture, capacity) (78, 80).

In responding to the demand from communities for more help from universities and agencies in their communities in their public health problem-solving efforts, the pull of the stakeholders seeking EBIs will compete to some extent with the push of the universities or funders for particular EBIs that they deem most appropriate (85). This struggle was illustrated in the early period of the AIDS epidemic when the pull of activists was far ahead of the push of researchers and government agencies (66). Reconciling these conflicting perceptions of needs and appropriate solutions can become a source of training and experience for the public health agency or university providing technical assistance to community groups thereby strengthening their capacity to meet other community groups' needs more effectively with contextually appropriate EBIs. This engagement is even more so if the partnership involves evaluation of the interventions to produce practice-based evidence.

Building on several reviews [particularly those from Leeman and colleagues (118, 119)] (20, 44, 48, 117), we describe six approaches for capacity building that show evidence of effectiveness in building capacity for EBPH [particularly supporting adoption and implementation of EBIs (118)] (see examples in **Table 2**). Some scholars label these approaches broadly as knowledge translation strategies (117); others focus on aspects of the EBPH process, such as reinvention, adaptation, and integration (86). Training involves organized education or skill-building sessions for a group of practitioners (e.g., in-service training). On the push side, the largest number of studies have evaluated the impact of various training programs for EBPH (**Table 3**) (52, 118, 166). Many of these programs show evidence of effectiveness (e.g., increased capacity, improved skills, development of new partnerships). However, many of the evaluations of these training programs are posttest only and lack comparison groups. Training on EBPH for public health professionals should employ principles of adult learning (e.g., respect and build on previous experience, actively involve the audience in learning) (31). The reach of these training programs can be increased by employing a train-the-trainer approach (182). Tools are media or technology resources used in planning, implementing, and evaluating EBPH-related activities (105). For example, the Public Health Foundation has assembled a series of online tools for improving performance (<http://www.phf.org/resourcestools/Pages/default.aspx>). Scholars in public health services and systems research have developed an online tool for assessing agency progress in achieving A-EBPs (151). Technical assistance is the provision of interactive, individualized education and skill building, which often seeks to solve a specific problem. For example, knowledge brokers

Table 3 Summary of selected empirical studies on capacity building for evidence-based (or evidence-informed) public health

First author/year	Location	Setting	Capacity-building approach	Type of evaluation	Findings
Ramos/ 2002 (153)	US–Mexico border	CBOs serving Hispanics	Cooperative training approach to build skills in HIV/AIDS prevention; three-part train-the-trainer approach	Quantitative process and outcome evaluation with data collected at 3 time points (program staff in 42 agencies)	The training program increased the infrastructure capacity and program development in CBOs; collaboration among agencies was increased
MacLean/ 2003 (130)	Nova Scotia, Canada	Provincial, municipal, and CBOs engaged in health, education, and recreation	Partnership (multilevel partnerships) and organizational development (technical support, action research, community activation) for heart health promotion	Mixed-method with prepost 5-year follow-up (20 organizations) and 5 qualitative instruments	New partnerships were developed; 18 community initiatives were implemented; organizational changes were documented including policy changes, funding reallocations, and enhanced knowledge and practices
Barron/ 2007 (9)	Allegheny County, PA, United States	Local public health agency	Action planning after use of the Local Public Health System Performance Assessment Instrument	Case study (2 years prepost)	The assessment process and action planning led to organizational change in the ability to carry out 10 essential services; the assessment tool fostered cross-program communication
Dreisinger/ 2008 (55)	United States	State and local public health agencies	2.5- or 3.5-day in-person training course (9 modules) in EBPB	Quantitative follow-up survey ($n = 107$)	90% of participants used course information to inform decision making; improved abilities to communicate with coworkers and read reports
Horton/ 2008 (99)	Yukon, Canada	Health education workers	Capacity-building instruction to support first aid, food safety, and health promotion	Qualitative follow-up individual and focus group interviews ($n = 21$)	Themes showed ways in which health educators build on strengths; focuses on issues of immediate importance to the community; key individual and community-level capacity-building outcomes
Baker/ 2009 (6)	United States	State and local public health agencies	2.5- or 3.5-day in-person training course (9 modules) in EBPB	Qualitative follow-up (open-ended) interviews	Course beneficial for those without a public health background; provides a common knowledge base for staff; support from leaders is crucial for furthering EBPB
Lloyd/ 2009 (126)	Australia (New South Wales)	Senior health promotion staff	2-day train-the-trainer course focused on EBP content and skill	Quantitative follow-up survey ($n = 50$)	Significant improvements in EBP knowledge and skills; incorporated knowledge into practice; key barriers identified (resources, staff movement, organizational change, insufficient)

(Continued)

Table 3 (Continued)

First author/year	Location	Setting	Capacity-building approach	Type of evaluation	Findings
Peirson/ 2012 (147)	Ontario, Canada	Local public health unit	Implementation of strategic plan that included a significant focus on EIDM	Qualitative case study including interviews and focus groups (<i>n</i> = 70 respondents) and review of 137 documents	A series of critical organizational-level success factors covered 7 domains: leadership, organizational structure, human resources, organizational culture, knowledge management, communication, and change management
Gibbert/ 2013 (67)	United States and Europe	National, state, and local public health agencies; NGOs	3.5–4.5-day in-person training course (9 modules) in EBPH	Mixed-method with 2 parts: course prepost (<i>n</i> = 393) and follow-up (<i>n</i> = 358)	Significant prepost improvement in knowledge, skill, and ability; high levels of use of EBPH course materials; use of materials differed by location and agency type; qualitative responses provided multiple options for course improvement
Pettman/ 2013 (149)	Australia	State and local public health agencies; NGOs	Short course on EIPH (5 domains)	Mixed-method course pre- (<i>n</i> = 45), post (<i>n</i> = 59), 6-month follow-up (<i>n</i> = 38)	Course objectives continually met and exceeded; improvements across several domains of EIPH such as asking answerable questions, literature searching, critical appraisal
Yost/ 2014 (183)	Ontario, Canada	Health professionals involved in decision making	5-day workshop on EIDM knowledge, skills, and behaviors	Mixed method with 2 parts: longitudinal survey (<i>n</i> = 40 at baseline) and qualitative interviews (<i>n</i> = 8)	Significant prepost increase in knowledge and skills; no significant improvement in EIDM behaviors; interviews identified perceived barriers to and facilitators of participation in continuing education
Jacobs/ 2014 (104)	Four US states (Michigan, North Carolina, Ohio, Washington)	Local public health agencies	2.5-day train-the-trainer course (9 modules) in EBPH	Quantitative, quasi-experimental (prepost) survey (<i>n</i> = 82 participants; <i>n</i> = 214 controls)	Course participants reported greater increases in availability and decreases in skill gaps compared with controls; course benefits included becoming better leaders and making scientifically informed decisions
Mainor/ 2014 (131)	United States (43 states and the District of Columbia)	Mainly state public health program managers	5-day training conducted over a 7-year period in obesity prevention	Quantitative course prepost (<i>n</i> = 303) and 6-month follow-up (<i>n</i> = 229)	High course ratings for quality and relevance; at least 70% reported self-confidence in performing competencies; majority of participants at follow-up reported completing at least 1 activity from action planning

(Continued)

Table 3 (Continued)

First author/year	Location	Setting	Capacity-building approach	Type of evaluation	Findings
Schuchter/2015 (160)	United States	National and local public health agencies; NGOs; universities	4 different trainings, ranging from 1.5 to 11.5 days in health impact assessment	Qualitative follow-up (open-ended) interviews (<i>n</i> = 48)	Training objectives were met; case studies were beneficial; new collaborations were developed; trainees disseminated what they had learned
Hardy/2015 (93)	Pueblo City-County, CO	Local public health agency	3-day EBPH training, formalized language in personnel policies and strategic plan	Mixed method with 2 parts: longitudinal survey (<i>n</i> = 74 at baseline) and qualitative interviews (<i>n</i> = 11)	At posttest, attitudes toward EBPH were improved, more resources were allocated, greater access to EBPH information was achieved. Skills were improved in developing EBIs and communicating with policy makers
Jaskiewicz/2015 (106)	Chicago, IL	CBOs serving minority communities	1-day workshop, technical assistance, 3 webinars to build capacity in healthy food access	Qualitative interviews with project staff	Training and materials provided by the project increased staff confidence in working with food stores; individualized project support was particularly useful; leadership support and staff time were limitations to project success
Yarber/2015 (182)	Four US states (Indiana, Colorado, Nebraska, Kansas)	State and local public health agencies	3.5-day train-the-trainer course (9 modules) in EBPH	Quantitative follow-up survey (<i>n</i> = 144)	78% of respondents indicated that the course allowed them to make more scientifically informed decisions; utilization of materials was high whether the course was taught by original trainers or state-based trainers
Sauaia/2016 (158)	Colorado	6 area health agencies (CBOs)	2-day training featuring local data, sources of EBIs, hands-on activities	Quantitative short-term (<i>n</i> = 94) and follow-up surveys (<i>n</i> = 26)	Significant improvement in knowledge in core content areas and accomplishment of self-proposed organizational goals, grant applications/awards and several community-academic partnerships
Yost/2016 (185)	Canada and other parts of the world	Multiple sectors at multiple levels of government	Webinar series to promote use of a registry of EIDM methods and tools	Quantitative follow-up survey (<i>n</i> = 434) and Google Analytics	22 webinars have reached 2,048 people; webinars were a valuable strategy for enhancing EIDM by increasing awareness of the registry and intentions to use the tools
Morshed/2017 (139)	Nebraska	State and local public health agencies	6 online modules featuring scenario-based learning	Quantitative, quasi-experimental (prepost) survey (<i>n</i> = 123 participants; <i>n</i> = 201 controls)	Significant improvement in skills among participants without advanced degrees; no improvement for participants with advanced degrees

Abbreviations: CBO, community-based organizations; EBI, evidence-based interventions; EBPH, evidence-based practice; EBPH, evidence-based public health; EIDM, evidence-informed decision making; EIPH, evidence-informed public health; NGO, nongovernmental organization.

(generally masters-level individuals providing one-on-one technical assistance) show evidence of effectiveness for organizations that perceive their setting to place little value on EBPH (1). Assessment and feedback involves providing data-based feedback on EBPH-related performance [e.g., evaluation of performance based on EBPH use (101)]. On the pull side, peer networking involves bringing practitioners together to learn from each other via in-person or distance methods. Networking is sometimes achieved through communities of practice that support EBPH, which show promise in the use of analytic tools (10). Incentives are financial compensation and in-kind resources to incentivize progress or build capacity in EBPH. For example, in the largest local public health agency in Canada, leaders used criteria-based resource allocation to shift funds from lower-priority to higher-priority areas (75).

CHALLENGES AND OPPORTUNITIES FOR RESEARCH AND PRACTICE

This section briefly describes a set of challenges in public health that take into account issues raised in this review, current priorities in public health, the body of available evidence, how the evidence is applied across various settings, and broader macrolevel changes (30, 58). While these examples are not exhaustive, they illustrate the vast array of capacity-related issues faced by public health practitioners currently and in the coming years as well as areas for practice-based research.

Recognize that Leadership Matters

As noted previously in this review, leadership is essential to promote adoption of EBPH principles as a core part of public health practice. This component includes an expectation that decisions will (a) be made on the basis of the best science (use of EBIs), (b) fit the needs of the target population, (c) be realistic given the resources available, and (d) plan for evaluation early in the life cycle of a program or policy. In some cases, additional funding may be required, but in many circumstances not having the will (rather than the dollars) to change is the major impediment. Recent practice-based research shows at least three actions from leaders in public health agencies that may increase the use of scientific information in decision making. These include participatory decision making, accessing and sharing information widely, and encouragement to use EBPH (36, 93, 101).

Measure the Important Variables

A public health adage is “what gets measured, gets done” (172). Successful progress in capacity building will require the development of practical measures of outcomes that are both reliable and valid yet are brief enough to be used by busy public health practitioners. One of the greatest needs among public health practitioners involves learning how to better assess organizational capacity (60). Most existing measures focus on ultimate outcomes, such as changes in health status. Previous reviews have shown that most existing measures of capacity have not been adequately tested for reliability and predictive validity (37, 56, 178). There are, however, examples of practical tools for tracking organizational capacity in the United States (154) and in developing regions (16). It is feasible for a mid-sized local health department to use these tools to measure A-EBPs and take action on the basis of this assessment (93).

Agree On Capacity Standards

The National Academy of Medicine (formerly the Institute of Medicine) has called for a minimum set of services that no health department should be without (42). These cover both foundational

capabilities (e.g., policy development capacity, quality improvement) and basic programs (e.g., mainly categorical programs: maternal and child health promotion, communicable disease control, chronic disease prevention). The A-EBPs fit most closely with the foundational capabilities and provide baseline data and a reliable method for measuring administrative and management capacity.

Embrace Policy and Complexity

Complex, multilevel, policy-focused, and policy-supported interventions are often the most effective in improving population health indicators (39, 62). To achieve progress by furthering evidence-based policy, researchers need to use the best available evidence and expand the role of researchers and practitioners to communicate evidence packaged appropriately for various policy audiences (policy makers and advocacy groups). New skills are needed to embrace more fully complexity, such as systems thinking for practice and systems methods for research (e.g., agent based modeling, social network analysis). These tools allow us to describe more effectively the dynamic processes at work, to map social and organizational relationships, to identify feedback mechanisms, and to forecast future system behavior (129), especially as applied to the particular population, circumstances, and participating parties (79).

Turn Data into Policy-Relevant Stories

Thomas (Tip) O’Neill, the former Speaker of the US House of Representatives, made famous the phrase “All politics is local.” Evidence becomes more relevant to policy makers when it involves a local example (a story), often describing some type of direct impact on one’s local community, family, or constituents. Research is beginning to present data on contextual issues and the importance of narrative communication in the form of story. The premises for this line of research are that storytelling makes messages personally relevant, that motivation is gauged by personal susceptibility, and that practical information is provided. Policy makers cite the impact on “real people” as one of the most important factors in increasing the coverage and relevance of research (165). New skills in this area can build on advice on how to construct an effective policy brief (53, 167).

Prepare for New Threats

Processes in EBPH need to take stock of the maturity of the evidence base, including the availability of EBIs. For example, for well-established public health issues with a well-established evidence base (e.g., tobacco, immunizations), the issue is often one of selection and implementation of EBIs. For an emerging infectious disease that has newly appeared in a population (e.g., SARS, Zika), however, a set of EBIs may not be available. These situations call for other EBPH-related processes such as strengthening surveillance efforts or capacity building to support the physical infrastructure (e.g., laboratories, research facilities) and personnel for outbreak investigation and medical follow-up. An example of emerging conflicts in applying the established evidence base is the emergence of a competing method of reducing tobacco smoking with e-cigarette use. The EBI science base for population tobacco control is well established but still not entirely successful with smoking cessation or with preventing youth from taking up a nicotine habit. E-cigarettes are being promoted as a solution to the first of these (smoking cessation) but might be introducing more young users to nicotine addiction.

Fix the Broken Connections

The public health research enterprise does a great deal of dissemination—but not necessarily effective dissemination (25). As this review illustrates, researchers are often successful in connecting with other researchers rather than linking with the most important receptor sites for their scholarship (practitioners and policy makers). There are vast opportunities for dissemination research to better understand how to improve research–practice connections. Perhaps more importantly, we need new skills and approaches for balancing the push/pull between research and practice. Meeting these needs may involve working with new disciplines (e.g., communications or marketing experts) and crossing professional boundaries (e.g., researchers becoming more involved with advocacy or professional groups). Working in public health practice may improve dissemination skills among researchers. For example, in a national study from the United States, public health researchers with practice or policy experience were 4.4 times more likely to report good or excellent dissemination skills (171). Practice-based evidence, including case examples of action outside the health sector (79, 80), will help in developing practical approaches for multisectoral action to bridge the research–practice divide (7, 145, 164). Cross-cutting approaches that address health equity may be effective in breaking down disease- and risk factor–specific silos (47, 180).

Find and Fill the Biggest Skill Gaps

A summary of four US surveys of state and local public health practitioners identified three skills where the gaps in capacity are largest between importance and availability: economic evaluation, communication of research to policy makers, and adaptation of interventions from one setting or population to another (102). The shortage of economic data has also been observed in England (114). The deficits in capacity are often larger in developing countries and in smaller (often rural) health departments (29, 57, 168). To address these gaps, agencies need to leverage more effectively the existing resources and build community partnerships to share resources (38).

Reduce the Imbalance Between Internal Versus External Validity

Those who develop and disseminate public health guidelines have placed a premium on internal validity, too often giving short shrift to external validity (83). For EBPH practitioners, the generalizability of an EBI from one population and setting to another, the core concept of external validity, is an essential ingredient (77). The issues in external validity often relate to context for an intervention (123); for example, what factors need to be taken into account when an internally valid program or policy is implemented in a different setting or with a different population subgroup? How does one balance the concepts of fidelity and adaptation/reinvention? If the adaptation process changes the original EBI to such an extent that the original efficacy data may no longer apply, then the program may be viewed as a new intervention under very different contextual conditions. Green (78) has recommended that the implementation of evidence-based approaches (“best practices”) involves careful consideration of the “best processes” needed when generalizing evidence to alternate populations, places, and times (e.g., what makes evidence useful and applicable to settings, populations, or circumstances other than those in which the controlled trial evidence was generated).

SUMMARY AND CONCLUSION

Successful application of EBPH principles in public health settings requires a combination of science, art, and timing. The science is built on epidemiologic, behavioral, and policy research showing the size and scope of a public health problem and available EBIs. The art of decision

making often involves knowing which information is important to a particular stakeholder at the right time [often when a policy window is open (111)].

With an abundance of public health research showing the need for action, why is the translation of science into practice and policy so slow? The ever-expanding knowledge from dissemination and implementation science is beginning to provide lessons to speed up the translation of science to application (24, 86). We need new approaches for disseminating research, an increased emphasis on practice-based evidence, and a greater focus on external validity, all of which will help us to understand whether EBPH approaches work, for whom, why, and at what cost.

Across the diverse literature reviewed in this article, it is apparent that a one-size-fits-all approach for improving public health capacity is unlikely to be effective. Efforts to build capacity in public health practice have probably focused too much on simply whether EBIs are or are not being used, which puts the entire onus on the practitioners who often find that the published evidence does not fit their population or circumstances. This approach, while easier to measure and to cast blame on the receivers rather than the research sources, reviewers, and disseminators, overlooks the context and complex processes of decision making that are central to EBPH. Modest investments in the training and capacity-building activities that we have outlined will likely lead to greater use of EBIs, more effective public health practice, and, ultimately, improvements in population health and reductions in health inequality.

SUMMARY POINTS

1. Sufficient capacity in the form of resources, structures, and workforce is needed to further the production and use of evidence in public health settings.
2. The uptake of evidence-based public health can be accelerated by a stronger focus on practice-based evidence; skills in evaluating the applicability, quality, and quantity of evidence; public health accreditation; and the disconnect between evidence generators and evidence users.
3. Capacity for EBPH involves a reciprocal relationship between individuals and organizations: Individuals shape organizations and organizations support the development of individuals.
4. A set of new skills is often needed to identify and implement evidence-based interventions that are multilevel and policy oriented and take into account a complex group of system-level factors.
5. The What of capacity building involves a core set of attributes across five domains: (a) leadership, (b) organizational climate and culture, (c) partnerships, (d) workforce development, and (e) financial processes.
6. The How of capacity building must be receptive to a wide array of choices (pull) from practitioners and not only to the push of researchers, thus involving a core set of activities: (a) training, (b) use of tools, (c) technical assistance, (d) assessment and feedback, (e) peer networking, and (f) incentives.
7. Going forward, capacity building needs to focus on several core issues: leadership, measurement, capacity standards, the nexus of policy and complexity, data-based stories for policy change, readiness for new public health threats, effective dissemination, skill gaps, and external validity.

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LITERATURE CITED

1. Aarons G, Moullin J, Ehrhart M. 2018. The role of organizational processes in dissemination and implementation research. See Ref. 24, pp. 121–42
2. Aarons GA, Ehrhart MG, Farahnak LR, Sklar M. 2014. Aligning leadership across systems and organizations to develop a strategic climate for evidence-based practice implementation. *Annu. Rev. Public Health* 35:255–74
3. Allen P, Brownson RC, Duggan K, Stamatakis KA, Erwin PC. 2012. The makings of an evidence-based local health department: identifying administrative and management practices. *Front. Public Health Serv. Syst. Res.* 1:2
4. Armstrong R, Doyle J, Lamb C, Waters E. 2006. Multi-sectoral health promotion and public health: the role of evidence. *J. Public Health* 28:168–72
5. Armstrong R, Pettman TL, Waters E. 2014. Shifting sands—from descriptions to solutions. *Public Health* 128:525–32
6. Baker EA, Brownson RC, Dreisinger M, McIntosh LD, Karamehic-Muratovic A. 2009. Examining the role of training in evidence-based public health: a qualitative study. *Health Promot. Pract.* 10:342–48
7. Barr V, Pedersen S, Pennock M, Rootman I. 2008. *Health Equity Through Intersectoral Action: An Analysis of 18 Country Case Studies*. Ottawa: Public Health Agency Can., World Health Organ.
8. Barr-Walker J. 2017. Evidence-based information needs of public health workers: a systematized review. *J. Med. Libr. Assoc.* 105:69–79
9. Barron G, Glad J, Vukotich C. 2007. The use of the National Public Health Performance Standards to evaluate change in capacity to carry out the 10 essential services. *J. Environ. Health* 70:29–31, 63
10. Barwick MA, Peters J, Boydell K. 2009. Getting to uptake: Do communities of practice support the implementation of evidence-based practice? *J. Can. Acad. Child Adolesc. Psychiatry* 18:16–29
11. Beaglehole R, Dal Poz MR. 2003. Public health workforce: challenges and policy issues. *Hum. Resour. Health* 1:4
12. Beitsch LM, Leep C, Shah G, Brooks RG, Pestronk RM. 2010. Quality improvement in local health departments: results of the NACCHO 2008 survey. *J. Public Health Manag. Pract.* 16:49–54
13. Bekemeier B, Grembowski D, Yang Y, Herting JR. 2012. Leadership matters: local health department clinician leaders and their relationship to decreasing health disparities. *J. Public Health Manag. Pract.* 18:E1–10
14. Bender K, Halverson PK. 2010. Quality improvement and accreditation: What might it look like? *J. Public Health Manag. Pract.* 16:79–82
15. Bero LA, Grilli R, Grimshaw JM, Harvey E, Oxman AD, Thomson MA. 1998. Closing the gap between research and practice: an overview of systematic reviews of interventions to promote the implementation of research findings. The Cochrane Effective Practice and Organization of Care Review Group. *BMJ* 317:465–68

16. Bishai D, Sherry M, Pereira CC, Chicumbe S, Mbofana F, et al. 2016. Development and usefulness of a district health systems tool for performance improvement in essential public health functions in Botswana and Mozambique. *J. Public Health Manag. Pract.* 22:586–96
17. 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
18. Brownson R. 2013. *Research translation and public health services & systems research*. Presented at Keeneland Conf. Public Health Serv. Syst. Res., April 8–11, Lexington, KY. http://publichealthsystems.org/sites/default/files/uploads/docs/PHSSR_Keeneland_Conference_2013.pdf
19. Brownson RC, Allen P, Jacob RR, deRuyter A, Lakshman M, et al. 2017. Controlling chronic diseases through evidence-based decision making: a group-randomized trial. *Prev. Chronic Dis.* 14:170326
20. Brownson RC, Allen P, Duggan K, Stamatakis KA, Erwin PC. 2012. Fostering more-effective public health by identifying administrative evidence-based practices: a review of the literature. *Am. J. Prev. Med.* 43:309–19
21. Brownson RC, Baker EA, Deshpande AD, Gillespie KN. 2018. *Evidence-Based Public Health*. New York: Oxford Univ. Press. 3rd ed.
22. 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 S74–78
23. Brownson RC, Ballew P, Kittur ND, Elliott MB, Haire-Joshu D, et al. 2009. Developing competencies for training practitioners in evidence-based cancer control. *J. Cancer Educ.* 24:186–93
24. Brownson RC, Colditz GA, Proctor EK, eds. 2018. *Dissemination and Implementation Research in Health: Translating Science to Practice*. New York: Oxford Univ. Press. 2nd ed.
25. Brownson RC, Eyler AA, Harris JK, Moore JB, Tabak RG. 2018. Getting the word out: new approaches for disseminating public health science. *J. Public Health Manag. Pract.* <https://doi.org/10.1097/PHH.0000000000000673>
26. Brownson RC, Diez Roux AV, Swartz K. 2014. Commentary: Generating rigorous evidence for public health: the need for new thinking to improve research and practice. *Annu. Rev. Public Health* 35:1–7
27. Brownson RC, Fielding JE, Maylahn CM. 2009. Evidence-based public health: a fundamental concept for public health practice. *Annu. Rev. Public Health* 30:175–201
28. Brownson RC, Gurney JG, Land G. 1999. Evidence-based decision making in public health. *J. Public Health Manag. Pract.* 5:86–97
29. Brownson RC, Reis RS, Allen P, Duggan K, Fields R, et al. 2014. Understanding administrative evidence-based practices: findings from a survey of local health department leaders. *Am. J. Prev. Med.* 46:49–57
30. Brownson RC, Samet JM, Bensyl DM. 2017. Applied epidemiology and public health: Are we training the future generations appropriately? *Ann. Epidemiol.* 27:77–82
31. Bryan RL, Kreuter MW, Brownson RC. 2009. Integrating adult learning principles into training for public health practice. *Health Promot. Pract.* 10:557–63
32. Butterfoss FD. 2006. Process evaluation for community participation. *Annu. Rev. Public Health* 27:323–40
33. Calleson DC, Jordan C, Seifer SD. 2005. Community-engaged scholarship: Is faculty work in communities a true academic enterprise? *Acad. Med.* 80:317–21
34. Can. Task Force Period. Health Exam. 1979. The periodic health examination. Canadian Task Force on the Periodic Health Examination. *Can. Med. Assoc. J.* 121:1193–254
35. Cargo M, Mercer SL. 2008. The value and challenges of participatory research: strengthening its practice. *Annu. Rev. Public Health* 29:325–50
36. Chatterji M, Green LW, Kumanyika S. 2014. L.E.A.D.: a framework for evidence gathering and use for the prevention of obesity and other complex public health problems. *Health Educ. Behav.* 41:85–99
37. Chaudoir SR, Dugan AG, Barr CH. 2013. Measuring factors affecting implementation of health innovations: a systematic review of structural, organizational, provider, patient, and innovation level measures. *Implement Sci.* 8:22
38. Chen LW, Jacobson J, Roberts S, Palm D. 2012. Resource allocation and funding challenges for regional local health departments in Nebraska. *J. Public Health Manag. Pract.* 18:141–47

39. Chokshi DA, Stine NW. 2013. Reconsidering the politics of public health. *JAMA* 310:1025–26
40. Ciliska D, Thomas H, Buffett C. 2008. *An Introduction to Evidence-Informed Public Health and a Compendium of Critical Appraisal Tools for Public Health Practice*. Hamilton, ON: Natl. Collab. Cent. Methods Tools. <http://www.nccmt.ca/uploads/media/media/0001/01/b331668f85bc6357f262944f0aca38c14c89c5a4.pdf>
41. Cochrane A. 1972. *Effectiveness and Efficiency: Random Reflections on Health Services*. London: Nuffield Prov. Hosp. Trust
42. Comm. Public Health Strateg. Improve Health. 2012. *For the Public's Health: Investing in a Healthier Future*. Washington, DC: Natl. Acad. Press. <https://doi.org/10.17226/13268>
43. Create the Future. 2016. *Capacity building overview*. Revis. June 20, Create the Future, Milwaukee, WI. http://www.createthefuture.com/capacity_building.htm
44. Crisp BR, Swerissen H, Duckett SJ. 2000. Four approaches to capacity building in health: consequences for measurement and accountability. *Health Promot. Int.* 15:99–107
45. Curry SJ. 2000. Organizational interventions to encourage guideline implementation. *Chest* 118:40S–46
46. Dawson A, Brodie P, Copeland F, Rumsey M, Homer C. 2013. Collaborative approaches towards building midwifery capacity in low income countries: a review of experiences. *Midwifery* 30:391–402
47. Dean HD, Fenton KA. 2013. Integrating a social determinants of health approach into public health practice: a five-year perspective of actions implemented by CDC's National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. *Public Health Rep.* 128(Suppl. 3):5–11
48. Dean HD, Myles RL, Spears-Jones C, Bishop-Cline A, Fenton KA. 2014. A strategic approach to public health workforce development and capacity building. *Am. J. Prev. Med.* 47:S288–96
49. Diez Roux AV. 2011. Complex systems thinking and current impasses in health disparities research. *Am. J. Public Health* 101:1627–34
50. 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
51. Dobbins M, Jack S, Thomas H, Kothari A. 2007. Public health decision-makers' informational needs and preferences for receiving research evidence. *Worldviews Evid.-Based Nurs.* 4:156–63
52. Dodson EA, Baker EA, Brownson RC. 2010. Use of evidence-based interventions in state health departments: a qualitative assessment of barriers and solutions. *J. Public Health Manag. Pract.* 16:E9–15
53. Dodson EA, Eyer AA, Chalifour S, Wintrobe CG. 2012. A review of obesity-themed policy briefs. *Am. J. Prev. Med.* 43:S143–48
54. Drabczyk A, Epstein P, Marshall M. 2012. A quality improvement initiative to enhance public health workforce capabilities. *J. Public Health Manag. Pract.* 18:95–99
55. 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
56. Emmons KM, Weiner B, Fernandez ME, Tu SP. 2012. Systems antecedents for dissemination and implementation: a review and analysis of measures. *Health Educ. Behav.* 39:87–105
57. Erwin PC. 2008. The performance of local health departments: a review of the literature. *J. Public Health Manag. Pract.* 14:E9–18
58. Erwin PC, Brownson RC. 2017. Macro trends and the future of public health practice. *Annu. Rev. Public Health* 38:393–412
59. Erwin PC, Harris JK, Smith C, Leep CJ, Duggan K, Brownson RC. 2014. Evidence-based public health practice among program managers in local public health departments. *J. Public Health Manag. Pract.* 20:472–80
60. Escoffery C, Hannon P, Maxwell AE, Vu T, Leeman J, et al. 2015. Assessment of training and technical assistance needs of Colorectal Cancer Control Program grantees in the U.S. *BMC Public Health* 15:49
61. Evid.-Based Med. Work. Group. 1992. Evidence-based medicine. A new approach to teaching the practice of medicine. *JAMA* 268:2420–25
62. Fielding JE. 2013. Health education 2.0: the next generation of health education practice. *Health Educ. Behav.* 40:513–19

63. Fielding JE, Briss PA. 2006. Promoting evidence-based public health policy: Can we have better evidence and more action? *Health Aff.* 25:969–78
64. Fields RP, Stamatakis KA, Duggan K, Brownson RC. 2015. Importance of scientific resources among local public health practitioners. *Am. J. Public Health* 105(Suppl. 2):S288–94
65. Fink A. 2013. *Evidence-Based Public Health Practice*. Thousand Oaks, CA: Sage
66. France D. 2016. *How to Survive a Plague: The Inside Story of How Citizens and Science Tamed AIDS*. New York: Knopf
67. Gibbert WS, Keating SM, Jacobs JA, Dodson E, Baker E, et al. 2013. Training the workforce in evidence-based public health: an evaluation of impact among US and international practitioners. *Prev. Chronic Dis.* 10:E148
68. Glanz K, Bishop DB. 2010. The role of behavioral science theory in development and implementation of public health interventions. *Annu. Rev. Public Health* 31:399–418
69. Glanz K, Rimer BK, Viswanath K, eds. 2015. *Health Behavior and Health Education: Theory, Research, and Practice*. San Francisco: Jossey-Bass
70. Glasgow RE, Marcus AC, Bull SS, Wilson KM. 2004. Disseminating effective cancer screening interventions. *Cancer* 101:1239–50
71. Glasgow RE, Vinson C, Chambers D, Khoury MJ, Kaplan RM, Hunter C. 2012. National Institutes of Health approaches to dissemination and implementation science: current and future directions. *Am. J. Public Health* 102:1274–81
72. Glasziou P, Longbottom H. 1999. Evidence-based public health practice. *Aust. N. Z. J. Public Health* 23:436–40
73. Goldberg J, Bryant M. 2012. Country ownership and capacity building: the next buzzwords in health systems strengthening or a truly new approach to development? *BMC Public Health* 12:531
74. Goodman RM, Speers MA, McLeroy K, Fawcett S, Kegler M, et al. 1998. Identifying and defining the dimensions of community capacity to provide a basis for measurement. *Health Educ. Behav.* 25:258–78
75. Graham JR, Mackie C. 2016. Criteria-based resource allocation: a tool to improve public health impact. *J. Public Health Manag. Pract.* 22:E14–20
76. Granner ML, Sharpe PA. 2004. Evaluating community coalition characteristics and functioning: a summary of measurement tools. *Health Educ. Res.* 19:514–32
77. Green L, Nasser M. 2018. Furthering dissemination and implementation research: the need for more attention to external validity. See Ref. 24, pp. 301–16
78. Green LW. 2001. From research to “best practices” in other settings and populations. *Am. J. Health Behav.* 25:165–78
79. 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
80. Green LW. 2008. Making research relevant: If it is an evidence-based practice, where’s the practice-based evidence? *Fam. Pract.* 25(Suppl. 1):i20–24
81. Green LW. 2016. Reflections on government service rotations by an academic health education professional. *Health Educ. Behav.* 43:11–16
82. Green LW. 2016. Turnstile careers between academia and practice. *Pedagogy Health Promot.* 2:221–38
83. 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
84. Green LW, Glasgow RE, Atkins D, Stange K. 2009. Making evidence from research more relevant, useful, and actionable in policy, program planning, and practice: slips “twixt cup and lip.” *Am. J. Prev. Med.* 37:S187–91
85. 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
86. Green LW, Ottoson JM, Garcia C, Hiatt RA. 2009. Diffusion theory and knowledge dissemination, utilization, and integration in public health. *Annu. Rev. Public Health* 30:151–74
87. Greene JC. 1987. Stakeholder participation in evaluation design: Is it worth the effort? *Eval. Progr. Plan.* 10:379–94
88. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. 2004. Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Q.* 82:581–629

89. Guyatt G, Cook D, Haynes B. 2004. Evidence based medicine has come a long way. *BMJ* 329:990
90. Hannon PA, Fernandez ME, Williams RS, Mullen PD, Escoffery C, et al. 2010. Cancer control planners' perceptions and use of evidence-based programs. *J. Public Health Manag. Pract.* 16:E1-8
91. Hannon PA, Maxwell AE, Escoffery C, Vu T, Kohn M, et al. 2013. Colorectal Cancer Control Program grantees' use of evidence-based interventions. *Am. J. Prev. Med.* 45:644-48
92. Hanusaik N, Sabiston CM, Kishchuk N, Maximova K, O'Loughlin J. 2014. Association between organizational capacity and involvement in chronic disease prevention programming among Canadian public health organizations. *Health Educ. Res.* 30:206-22
93. Hardy AK, Nevin-Woods C, Proud S, Brownson RC. 2015. Promoting evidence-based decision making in a local health department, Pueblo City-County, Colorado. *Prev. Chronic Dis.* 12:140507
94. Harris JK, Allen P, Jacob RR, Elliott L, Brownson RC. 2014. Information-seeking among chronic disease prevention staff in state health departments: use of academic journals. *Prev. Chronic Dis.* 11:140201
95. Harris JK, Beatty K, Leider JP, Knudson A, Anderson BL, Meit M. 2016. The double disparity facing rural local health departments. *Annu. Rev. Public Health* 37:167-84
96. Harris JR, Cheadle A, Hannon PA, Forehand M, Lichiello P, et al. 2012. A framework for disseminating evidence-based health promotion practices. *Prev. Chronic Dis.* 9:110081
97. Hawe P, Shiell A, Riley T. 2004. Complex interventions: How "out of control" can a randomised controlled trial be? *BMJ* 328:1561
98. Honeycutt S, Hermstad A, Carvalho ML, Arriola KRJ, Ballard D, et al. 2017. Practice to evidence: using evaluability assessment to generate practice-based evidence in rural south Georgia. *Health Educ. Behav.* 44:454-62
99. Horton JE, MacLeod ML. 2008. The experience of capacity building among health education workers in the Yukon. *Can. J. Public Health* 99:69-72
100. Inst. Med. 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: Natl. Acad. Press
101. Jacob RR, Allen PM, Ahrendt LJ, Brownson RC. 2017. Learning about and using research evidence among public health practitioners. *Am. J. Prev. Med.* 52:S304-8
102. Jacob RR, Baker EA, Allen P, Dodson EA, Duggan K, et al. 2014. Training needs and supports for evidence-based decision making among the public health workforce in the United States. *BMC Health Serv. Res.* 14:564
103. Jacobs JA, Dodson EA, Baker EA, Deshpande AD, Brownson RC. 2010. Barriers to evidence-based decision making in public health: a national survey of chronic disease practitioners. *Public Health Rep.* 125:736-42
104. Jacobs JA, Duggan K, Erwin P, Smith C, Borawski E, et al. 2014. Capacity building for evidence-based decision making in local health departments: scaling up an effective training approach. *Implement Sci.* 9:124
105. Jacobs JA, Jones E, Gabella BA, Spring B, Brownson RC. 2012. Tools for implementing an evidence-based approach in public health practice. *Prev. Chronic Dis.* 9:110324
106. Jaskiewicz L, Dombrowski R, Massuda Barnett G, Mason M, Welter C. 2015. Training local organizations to support healthy food access: results from a year-long project. *Community Dev. J.* 51:285-301
107. Jenicek M. 1997. Epidemiology, evidence-based medicine, and evidence-based public health. *J. Epidemiol.* 7:187-97
108. Jirawattanapaisal T, Kingkaew P, Lee TJ, Yang MC. 2009. Evidence-based decision-making in Asia-Pacific with rapidly changing health-care systems: Thailand, South Korea, and Taiwan. *Value Health* 12(Suppl. 3):S4-11
109. Kessler R, Glasgow RE. 2011. A proposal to speed translation of healthcare research into practice: Dramatic change is needed. *Am. J. Prev. Med.* 40:637-44
110. Kiefer L, Frank J, Di Ruggiero E, Dobbins M, Manuel D, et al. 2005. Fostering evidence-based decision-making in Canada: examining the need for a Canadian population and public health evidence centre and research network. *Can. J. Public Health* 96:11-40 following 200
111. Kingdon JW. 2010. *Agendas, Alternatives, and Public Policies. Update Edition, With an Epilogue On Health Care*. New York: Pearson

112. Kislov R, Waterman H, Harvey G, Boaden R. 2014. Rethinking capacity building for knowledge mobilisation: developing multilevel capabilities in healthcare organisations. *Implement Sci.* 9:166
113. Klein KJ, Sorra JS. 1996. The challenge of innovation implementation. *Acad. Manag. Rev.* 21:1055–80
114. Kneale D, Rojas-Garcia A, Raine R, Thomas J. 2017. The use of evidence in English local public health decision-making: a systematic scoping review. *Implement. Sci.* 12:53
115. Kohatsu ND, Robinson JG, Torner JC. 2004. Evidence-based public health: an evolving concept. *Am. J. Prev. Med.* 27:417–21
116. Kothari A, Rudman D, Dobbins M, Rouse M, Sibbald S, Edwards N. 2012. The use of tacit and explicit knowledge in public health: a qualitative study. *Implement. Sci.* 7:20
117. LaRocca R, Yost J, Dobbins M, Ciliska D, Butt M. 2012. The effectiveness of knowledge translation strategies used in public health: a systematic review. *BMC Public Health* 12:751
118. Leeman J, Calancie L, Hartman MA, Escoffery CT, Herrmann AK, et al. 2015. What strategies are used to build practitioners' capacity to implement community-based interventions and are they effective?: a systematic review. *Implement Sci.* 10:80
119. Leeman J, Calancie L, Kegler MC, Escoffery CT, Herrmann AK, et al. 2017. Developing theory to guide building practitioners' capacity to implement evidence-based interventions. *Health Educ. Behav.* 44:59–69
120. Lehoux P, Denis JL, Tailliez S, Hivon M. 2005. Dissemination of health technology assessments: identifying the visions guiding an evolving policy innovation in Canada. *J. Health Polit. Policy Law* 30:603–41
121. Lempa M, Goodman RM, Rice J, Becker AB. 2008. Development of scales measuring the capacity of community-based initiatives. *Health Educ. Behav.* 35:298–315
122. Levine DM, Linder JA, Landon BE. 2016. The quality of outpatient care delivered to adults in the United States, 2002 to 2013. *JAMA Intern. Med.* 176:1778–90
123. Leviton LC. 2017. Generalizing about public health interventions: a mixed-methods approach to external validity. *Annu. Rev. Public Health* 38:371–91
124. Liang Z, Howard PF, Leggat SG, Murphy G. 2012. A framework to improve evidence-informed decision-making in health service management. *Aust. Health Rev.* 36:284–89
125. Liverani M, Hawkins B, Parkhurst JO. 2013. Political and institutional influences on the use of evidence in public health policy. A systematic review. *PLOS ONE* 8:e77404
126. Lloyd B, Rychetnik L, Maxwell M, Nove T. 2009. Building capacity for evidence-based practice in the health promotion workforce: evaluation of a train-the-trainer initiative in NSW. *Health Promot. J. Aust.* 20:151–54
127. Lorenc T, Tyner EF, Petticrew M, Duffy S, Martineau FP, et al. 2014. Cultures of evidence across policy sectors: systematic review of qualitative evidence. *Eur. J. Public Health* 24:1041–47
128. Luck J, Yoon J, Bernell S, Tynan M, Alvarado CS, et al. 2015. The Oregon Public Health Policy Institute: building competencies for public health practice. *Am. J. Public Health* 105:1537–43
129. Luke D, Morshed A, McKay V, Combs T. 2018. Systems science methods in dissemination and implementation research. See Ref. 24, pp. 157–73
130. MacLean DR, Farquharson J, Heath S, Barkhouse K, Latter C, Joffres C. 2003. Building capacity for heart health promotion: results of a 5-year experience in Nova Scotia, Canada. *Am. J. Health Promot.* 17:202–12
131. Mainor A, Leeman J, Sommers J, Heiser C, Gonzales C, et al. 2014. A systematic approach to evaluating public health training: the obesity prevention in public health course. *J. Public Health Manag. Pract.* 20:647–53
132. Maylahn C, Bohn C, Hammer M, Waltz EC. 2008. Strengthening epidemiologic competencies among local health professionals in New York: teaching evidence-based public health. *Public Health Rep.* 123:35–43
133. Mays GP, Smith SA. 2011. Evidence links increases in public health spending to declines in preventable deaths. *Health Aff.* 30:1585–93
134. 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

135. McVay AB, Stamatakis KA, Jacobs JA, Tabak RG, Brownson RC. 2016. The role of researchers in disseminating evidence to public health practice settings: a cross-sectional study. *Health Res. Policy Syst.* 14:42
136. Meissner HI, Bergner L, Marconi KM. 1992. Developing cancer control capacity in state and local public health agencies. *Public Health Rep.* 107:15–23
137. Meyer AM, Davis M, Mays GP. 2012. Defining organizational capacity for public health services and systems research. *J. Public Health Manag. Pract.* 18:535–44
138. Mitchell SA, Fisher CA, Hastings CE, Silverman LB, Wallen GR. 2010. A thematic analysis of theoretical models for translational science in nursing: mapping the field. *Nurs. Outlook* 58:287–300
139. Morshed AB, Ballew P, Elliott MB, Haire-Joshu D, Kreuter MW, Brownson RC. 2017. Evaluation of an online training for improving self-reported evidence-based decision-making skills in cancer control among public health professionals. *Public Health* 152:28–35
140. Muir Gray JA. 2009. *Evidence-Based Healthcare: How to Make Decisions about Health Services and Public Health*. New York/Edinburgh: Churchill Livingstone Elsevier
141. Nutbeam D. 2003. How does evidence influence public health policy? Tackling health inequalities in England. *Health Promot. J. Aust.* 14:154–58
142. 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
143. Orleans CT, Barker DC, Kaufman NJ, Marx JF. 2000. Helping pregnant smokers quit: meeting the challenge in the next decade. *Tob. Control.* 9(Suppl. 3):III6–11
144. Orton L, Lloyd-Williams F, Taylor-Robinson D, O’Flaherty M, Capewell S. 2011. The use of research evidence in public health decision making processes: systematic review. *PLOS ONE* 6:e21704
145. Paradis G, Hamelin A-M, Malowany M, Levy J, Rossignol M, et al. 2017. The University–Public Health Partnership for Public Health Research Training in Quebec, Canada. *Am. J. Public Health* 107:100–4
146. Parmelli E, Flodgren G, Schaafsma ME, Baillie N, Beyer FR, Eccles MP. 2011. The effectiveness of strategies to change organisational culture to improve healthcare performance. *Cochrane Database Syst. Rev.* CD008315
147. Peirson L, Ciliska D, Dobbins M, Mowat D. 2012. Building capacity for evidence informed decision making in public health: a case study of organizational change. *BMC Public Health* 12:137
148. Petersen DJ, Kurz RS. 2013. Progress in public health certification. *J. Public Health Manag. Pract.* 19:492
149. Pettman TL, Armstrong R, Jones K, Waters E, Doyle J. 2013. Cochrane update: building capacity in evidence-informed decision-making to improve public health. *J. Public Health* 35:624–27
150. Public Health Accredit. Board. 2014. *Public Health Accreditation Board Standards and Measures*. Ver. 1.5. Alexandria, VA: Public Health Accredit. Board. http://www.phaboard.org/wp-content/uploads/PHABSM_WEB_LR1.pdf
151. Public Health Serv. Syst. Res. Public Health Practice-Based Res. Netw. 2015. *Administrative evidence-based practices assessment tool*. Public Health Serv. Syst. Res. Public Health Practice-Based Res. Netw., Lexington, KY. <http://tools.publichealthsystems.org/tools/tool?name=Administrative%20Evidence-Based%20Practices%20Assessment%20Tool&view=about&id=134>
152. Rabin BA, Brownson RC, Kerner JF, Glasgow RE. 2006. Methodologic challenges in disseminating evidence-based interventions to promote physical activity. *Am. J. Prev. Med.* 31:S24–34
153. Ramos RL, Ferreira-Pinto JB. 2002. A model for capacity-building in AIDS prevention programs. *AIDS Educ. Prev.* 14:196–206
154. Reis RS, Duggan K, Allen P, Stamatakis KA, Erwin PC, Brownson RC. 2014. Developing a tool to assess administrative evidence-based practices in local health departments. *Front. Public Health Serv. Syst. Res.* 3(3). <https://doi.org/10.13023/FPHSSR.0303.02>
155. 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
156. Sackett DL, Rosenberg WMC, Muir Gray JA, Haynes RB, Richardson WS. 1996. Evidence based medicine: what it is and what it isn’t. *BMJ* 312:71–72
157. Satterfield JM, Spring B, Brownson RC, Mullen EJ, Newhouse RP, et al. 2009. Toward a transdisciplinary model of evidence-based practice. *Milbank Q.* 87:368–90

158. Sauaia A, Tuitt NR, Kaufman CE, Hunt C, Ledezma-Amorosi M, Byers T. 2016. Project TEACH: a capacity-building training program for community-based organizations and public health agencies. *J. Public Health Manag. Pract.* 22:298–300
159. Schenck AP, Meyer AM, Kuo TM, Cilenti D. 2015. Building the evidence for decision-making: the relationship between local public health capacity and community mortality. *Am. J. Public Health* 105(Suppl. 2):S211–16
160. Schuchter J, Rutt C, Satariano WA, Setod E. 2015. Building capacity for health impact assessment: training outcomes from the United States. *Environ. Impact Assess. Rev.* 50:190–95
161. Scullion PA. 2002. Effective dissemination strategies. *Nurse Res.* 10:65–77
162. Sharma T, Choudhury M, Kaur B, Naidoo B, Garner S, et al. 2015. Evidence informed decision making: the use of “colloquial evidence” at NICE. *Int. J. Technol. Assess. Health Care* 31:138–46
163. Simmons A, Reynolds RC, Swinburn B. 2011. Defining community capacity building: Is it possible? *Prev. Med.* 52:193–99
164. Smith K. 2013. *Beyond Evidence-Based Policy in Public Health. The Interplay of Ideas.* Hampshire, UK: Palgrave MacMillan
165. Sorian R, Baugh T. 2002. Power of information: closing the gap between research and policy. When it comes to conveying complex information to busy policy-makers, a picture is truly worth a thousand words. *Health Aff.* 21:264–73
166. Sosnowy CD, Weiss LJ, Maylahn CM, Pirani SJ, Katagiri NJ. 2013. Factors affecting evidence-based decision making in local health departments. *Am. J. Prev. Med.* 45:763–68
167. Stamatakis KA, McBride TD, Brownson RC. 2010. Communicating prevention messages to policy makers: the role of stories in promoting physical activity. *J. Phys. Act. Health* 7(Suppl. 1):S99–107
168. Sullivan R, Purushotham AD. 2011. Avoiding the zero sum game in global cancer policy: beyond 2011 UN high level summit. *Eur. J. Cancer* 47:2375–80
169. Swanepoel E, Fox A, Hughes R. 2014. Practitioner consensus on the determinants of capacity building practice in high-income countries. *Public Health Nutr.* 18:1898–905
170. Tabak RG, Khoong EC, Chambers DA, Brownson RC. 2012. Bridging research and practice: models for dissemination and implementation research. *Am. J. Prev. Med.* 43:337–50
171. Tabak RG, Stamatakis KA, Jacobs JA, Brownson RC. 2014. What predicts dissemination efforts among public health researchers in the United States? *Public Health Rep.* 129:361–68
172. Thacker SB. 2007. Public health surveillance and the prevention of injuries in sports: What gets measured gets done. *J. Athl. Train* 42:171–72
173. Traynor R, DeCorby K, Dobbins M. 2014. Knowledge brokering in public health: a tale of two studies. *Public Health* 128:533–44
174. US Prev. Serv. Task Force. 1989. *Guide to Clinical Preventive Services: An Assessment of the Effectiveness of 169 Interventions.* Baltimore: Williams & Wilkins
175. Vaidya N, Thota AB, Proia KK, Jamieson S, Mercer SL, et al. 2017. Practice-based evidence in Community Guide Systematic Reviews. *Am. J. Public Health* 107:413–20
176. Viehbeck SM, Petticrew M, Cummins S. 2015. Old myths, new myths: challenging myths in public health. *Am. J. Public Health* 105:665–69
177. Wandersman A, Duffy J, Flaspohler P, Noonan R, Lubell K, et al. 2008. Bridging the gap between prevention research and practice: the interactive systems framework for dissemination and implementation. *Am. J. Community Psychol.* 41:171–81
178. Weiner BJ, Amick H, Lee SY. 2008. Conceptualization and measurement of organizational readiness for change: a review of the literature in health services research and other fields. *Med. Care Res. Rev.* 65:379–436
179. WHO (World Health Organ.) Reg. Off. Eur. 2007. *Countrywide Integrated Noncommunicable Diseases Intervention (CINDI) Programme. Report of the 23rd Annual Meeting of CINDI Programme Directors, Banff, Canada, 16–17 October 2006.* Copenhagen: WHO Reg. Off. Eur. http://www.euro.who.int/__data/assets/pdf_file/0016/240361/E91093.pdf
180. Wiesner PJ. 1993. Four diseases of disarray in public health. *Ann. Epidemiol.* 3:196–98
181. Willard R, Shah GH, Leep C, Ku L. 2012. Impact of the 2008–2010 economic recession on local health departments. *J. Public Health Manag. Pract.* 18:106–14

182. Yarber L, Brownson CA, Jacob RR, Baker EA, Jones E, et al. 2015. Evaluating a train-the-trainer approach for improving capacity for evidence-based decision making in public health. *BMC Health Serv. Res.* 15:547
183. Yost J, Ciliska D, Dobbins M. 2014. Evaluating the impact of an intensive education workshop on evidence-informed decision making knowledge, skills, and behaviours: a mixed methods study. *BMC Med. Educ.* 14:13
184. Yost J, Dobbins M, Traynor R, DeCorby K, Workentine S, Greco L. 2014. Tools to support evidence-informed public health decision making. *BMC Public Health* 14:728
185. Yost J, Mackintosh J, Read K, Dobbins M. 2016. Promoting awareness of key resources for evidence-informed decision-making in public health: an evaluation of a webinar series about knowledge translation methods and tools. *Front. Public Health* 4:72
186. Yousefi Nooraie R, Lohfeld L, Marin A, Hanneman R, Dobbins M. 2017. Informing the implementation of evidence-informed decision making interventions using a social network analysis perspective; a mixed-methods study. *BMC Health Serv. Res.* 17:122



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