Evidence-Based Practice

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Abstract

Evidence-based practice (EBP) is an approach that aims to improve the process through which high-quality scientific research evidence can be obtained and translated into the best practical decisions to improve health. The interprofessional model of EBP emphasizes shared decision-making within the context of the most important advances of the various health professions. The model depicts three data streams that are integrated in the decision-making process: evidence, resources, and patient characteristics. Health professionals can play several different roles in the EBP process, including primary researchers, systematic reviewers, and clinicians. Carrying out the EBP process involves five steps, including Ask, Acquire, Appraise, Apply, and Analyze and Adjust. A new generation of research designs, such as the Sequential Multiphased Adaptive Randomized Trial, has been put forward to develop treatment algorithms that optimally capture the Apply, Analyze and Adjust steps of the EBP process.

Definition

Evidence-based practice (EBP) is an approach that aims to improve the process through which high-quality scientific research evidence can be obtained and translated into the best practical decisions to improve health. Research findings derived from the systematic collection of data through observation and experiment, as well as the formulation of questions and testing of hypotheses comprise the evidence supporting practice. EBP harmonizes the standards used to conduct, report, evaluate, and distribute research results so as to increase their application to practice and policy. EBP also involves the use of conscientious and explicit decision-making that integrates consideration of the best available research evidence, client characteristics (including preferences), and resources. Best available research is defined as contextually relevant and best in quality, according to consensually accepted scientific standards for different types of questions. Practical decisions relevant to EBP often involve the selection of an assessment or intervention. While professionals practicing evidence-based medicine (EBM) often need to choose among treatments involving drugs or devices, those practicing evidence-based behavioral medicine (EBBM) usually make selections among nondrug and nondevice behavioral or psychosocial interventions.

History of EBP

The origins of EBP are usually dated to 1910, when the American Medical Association and the Carnegie Foundation commissioned Abraham Flexner, a research scholar at the Carnegie Foundation for the Advancement of Teaching, to survey American and Canadian medical schools. The Flexner Report, as it was called, represented a major effort to reform medical education by placing it on a scientific foundation. Flexner surveyed 155 medical schools and severely criticized the training offered by many of them. His findings revealed that most medical schools offered lax clinical training, a curriculum not based on science, and a motivation that promoted profit rather than public service (Flexner, 1910). The Flexner Report established an educational quality standard that many of the existing medical schools could not meet. Therefore, more than half of all medical schools closed by 1935 (Beck, 2004). This report is widely regarded as the start of the EBM movement.

A second main catalyst for the EBM movement came from Archibald Cochrane, a British epidemiologist who aimed to establish a rational, systematic basis for determining what treatments should be covered by health care (Cochrane, 1972). Cochrane argued that because resources for health care are inevitably limited, it is essential that scarce dollars be allocated only for procedures of demonstrated worth. He argued that randomized controlled trials (RCTs) offer the most unbiased, reliable method to evaluate the effectiveness of treatments, warranting their placement at the top of a hierarchy of evidence. Accordingly, findings from high-quality RCTs are given greater credence than those from observational studies, case studies, and expert opinion when determining whether a treatment is effective. Followers of Cochrane's work subsequently established the Cochrane Collaboration (www.cochrane.org), a worldwide network that tracks, critically appraises, and synthesizes results of RCTs, publishing their findings online.

In the 1990s, a group of clinical epidemiologists working at Canada's McMaster University under the direction of David Sackett and Gordon Guyatt spearheaded the third initiative that catalyzed the EBM movement. This group's mission was to close the research-to-practice gap by encouraging physicians to engage in lifelong learning about new research findings (Sackett and Rosenberg, 1995a,b). The McMaster group was motivated by evidence that health professionals primarily implement treatment practices learned during training but neglect new and often more efficacious treatments that emerged subsequently (Isaacs and Fitzgerald, 1999). To change this habit, the McMaster group developed methods for health professionals to find, assess, and apply research results. However, the group encountered resistance from health professionals who believed that exclusive practice based upon

research findings devalued clinical expertise and experience (Haynes et al., 1996). To overcome this perceived slight against practicing clinicians, Guyatt et al. (1992) renamed the approach 'evidence-based medicine' in place of 'scientific medicine.' In this newest model, EBM was presented as an approach that tied together and utilized research, patient characteristics, and expertise to formulate best treatment practice, as opposed to relying solely on research findings (Haynes et al., 1996; Sackett et al., 1996).

EBM to EBBM

To evaluate interventions besides drugs or devices, health professionals in the behavioral sciences also needed a standard to evaluate behavioral treatments. The first entity to take on this task of conceptualizing EBBM was the Society of Behavioral Medicine's EBBM Committee. Established in 2000 with support from the National Institutes of Health (NIH) Office of Behavioral and Social Science Research (OBSSR) under Acting Director, Peter Kaufmann, the first EBBM Committee, first chaired by Karina Davidson, defined its scope to include behavioral interventions that prevent disease, promote health and adherence to treatment, or change biological determinants of behavioral conditions (Davidson et al., 2003). Initially, this committee familiarized behavioral medicine researchers with the Consolidated Standards of Reporting Trials (CONSORT) guidelines that encourage comprehensive, transparent reporting of RCTs in medical journals (Schulz et al., 2010). This effort was one of many that led behavioral science journals to adopt the CONSORT guidelines for publishing clinical trials. Among the first behavioral science journals to adopt CONSORT were *Annals of Behavioral Medicine*, *Health Psychology*, *International Journal of Behavioral Medicine*, and the *Journal of Consulting and Clinical Psychology*. The EBBM committee also addressed other weaknesses in the quality of behavioral clinical trials, especially with regard to the analytic approach. Numerous behavioral treatment trials were found to have analyzed data only from those who completed the final assessment in a clinical trial or who experienced a full dose of treatment (Pagoto et al., 2009; Spring et al., 2007). Since then, use of the intent-to-treat policy has increasingly become normative in behavioral science, such that data from all randomized participants are included in study analyses according to the condition to which they were assigned.

EBBM Evolves to EBBP, and Then to EBP

By 2006, the US health-care crisis was in full swing. With it came the need for a better, more integrated system of care that addressed mental as well as physical health for the sick and prevention for the well. The only way to accomplish all of this was by the coordinated efforts of an interprofessional team. It became clear that the EBBM approach needed to be upgraded to include all health professionals. Thus, OBSSR sponsored the Council on Evidence-Based Behavioral Practice (EBBP), chaired by Bonnie Spring, and its scientific and clinician advisory boards. The composition of the Council and the Boards was determinedly interprofessional, combining representatives from medicine, nursing, psychology, social work, public health, and information sciences (www.ebbp.org). The Council's first task was to formulate a conceptual model that could accommodate the diverse historic traditions as well as the individual- and population-level behavioral interventions that different health professions implement.

Initially, the conceptual model for EBM emphasized only a single parameter: research (Sackett et al., 1996). Later, the EBM model expanded to include other considerations such as clinical experience and specific patient needs. The EBM definition stated that: "evidence-based medicine requires the integration of the best research evidence with clinical expertise and the patient's unique values and circumstances" (Strauss et al., 2005). EBBM expanded upon EBM by adding nondrug, nondevice treatments. EBBP went one step further by consolidating across different disciplinary frameworks for EBP. The goal was to develop a conceptual model that could be shared by a more diverse interprofessional health-care team, whose members all require core competency in EBP (Greiner and Knebel, 2003). This shared EBP model supports jointly held vocabulary, foundational assumptions, and practice principles that unite the team of professionals in medicine, nursing, psychology, social work, public policy, and information sciences. A unified EBP eliminates the need to have separate models for different disciplines (Satterfield et al., 2009; Spring and Hitchcock, 2009).

Interprofessional Model of EBP

The interprofessional model of EBP (**Figure 1**) emphasizes shared decision-making within the context of the most important advances of the various health professions, including those mentioned above. The model depicts three data streams that are integrated in the decision-making process: evidence, resources, and patient characteristics. The interprofessional EBP model is grounded in an ecological framework that emphasizes the importance of considering environmental and organizational spheres when conceptualizing the problem and designing a course of treatment.

Best Research Evidence

Evidence refers to research findings from the systematic collection of data through observation and experiment grounded in

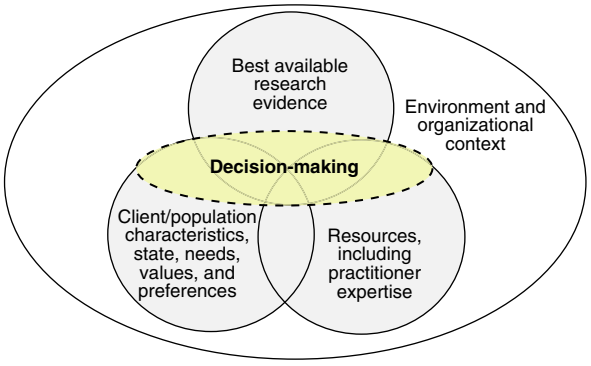

Figure 1 Interprofessional model of EBP.

the formulation of questions and hypothesis testing. That, which is deemed best research evidence is contingent on the particular question that needs to be addressed (Sackett and Wennberg, 1997). A question concerning etiology or prognosis, for example, is optimally answered through a longitudinal cohort research study design. On the other hand, a question about efficacy and effectiveness of treatments benefits from an RCT that is less susceptible to bias and error. Treatment-based questions can be addressed particularly well with the systematic review, which synthesizes the findings from multiple RCTs (Oxford Center for Evidence-Based Medicine, 2001). Recent interest in personalized care has generated interest in contextualized research evidence that is uniquely applicable to a particular patient and practice context (Weaver et al., 2005; Westfall et al., 2007). This has led to a resurgence of interest in the single-case experimental design (Dallery et al., 2013), which some representations of the evidence hierarchy place at the top of the evidence pyramid (Figure 2).

Resources

Resources refer to the skills and infrastructure that are required to provide EBPs. Resources needed to deliver treatments include physical, technological, financial, and personnel assets (e.g., office space, technological support, insurance reimbursement, and expert health professionals trained in an evidence-based treatment). Additional resources may include institutional endorsement by higher administration and agreement from other system components to make a treatment available.

The interprofessional EBP model breaks down clinician expertise into four categories of skill: assessment skills, EBP process skills, communication and collaboration skills, and engagement and intervention skills.

1. *Assessment skills* refer to the appraisal of patient characteristics, problems, values and expectations, and environmental factors.
2. *EBP process skills* are defined by competency in carrying out the steps of the EBP process: ask well-formulated questions, acquire best available research evidence, appraise quality and relevance of evidence, apply evidence, analyze change, and adjust treatment accordingly.

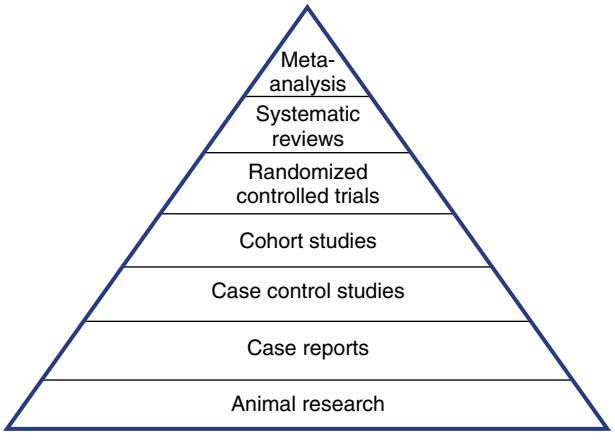

Figure 2 Evidence hierarchy.

3. *Communication and collaboration skills* involve the capacity to convey information clearly and appropriately. Further, they include the ability to listen, observe, adjust, and negotiate in order to achieve an agreed-upon treatment plan.
4. *Engagement and intervention skills* entail proficiency at motivating interest, constructive involvement, and positive change from individuals, groups, organizations, communities, and other entities affected by health decisions.

A recent development in EBP is resource-sensitive practice guidelines that review evidence for appropriate practice recommendations given an available level of resources (cf Fried and Krabshuis, 2008). Resource-sensitive guidelines enable decision-makers to appraise the level of intervention intensity that optimizes the available degree of accessible infrastructure, human capital, and financial resources.

Patient Characteristics

Patient characteristics are a key set of contextualizing factors. They include individual attributes such as state and trait variation in condition, needs, history of treatment response, values, and preferences that all influence whether a treatment is well matched to a particular patient. When deciding whether available research evidence is relevant to a given individual, health professionals need to assess the comparability between patient and study population. Tailoring surface aspects of the treatment can enhance its acceptability to the patient, so long as modifications do not stray so far from fidelity to core treatment elements that treatment loses its effectiveness (National Cancer Institute, 2006).

Patient preferences are a singular type of contextualizing variable. Although patient preferences are a particularly vital part of shared decision-making, they are the least developed aspect of the EBP model. Shared decision-making is grounded in the empowering of patients to self-manage their health and health care. Two preconditions for shared decision-making exist. The first is departure from a paternalistic model of care in which the clinician makes decisions on the patient's behalf. The second is adoption of a culturally informed model of care, whereby health professionals assist patients in clarifying their own values and treatment preferences.

Health Professionals' Roles in EBP

Health professionals can play several different roles in the EBP process (Figure 3).

First, they can be primary researchers who directly contribute to forming the evidence base. Primary researchers not only develop new treatments, but also design, conduct, analyze, and report research that evaluates the efficacy and effectiveness of interventions. Ideally, they will conduct RCTs to evaluate whether a treatment works. If, however, time and resources are insufficient to conduct an RCT, primary researchers may use alternative designs such as an intermittent time series.

A second role that health professionals can play is that of systematic reviewers, whereby they act as evidence synthesizers. They aggregate primary research to analyze and interpret synthesized findings that can be accessed and used efficiently

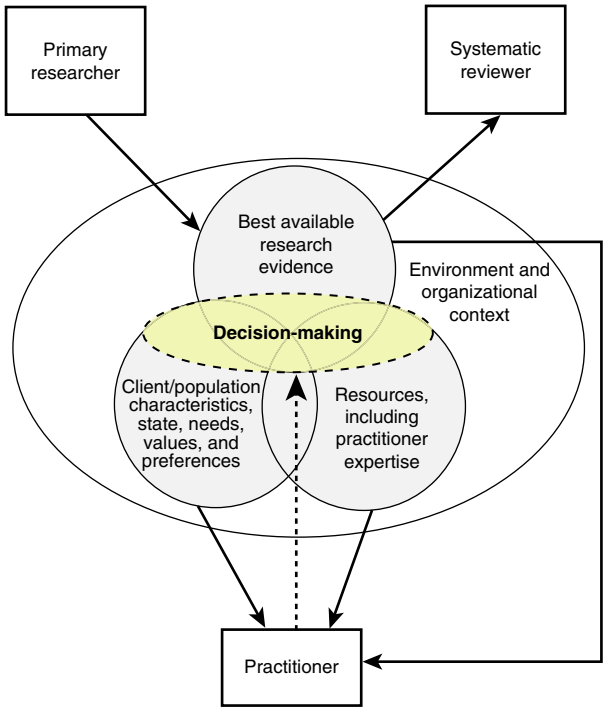

Figure 3 Roles of health professionals in the EBP model.

by health professionals. The role of the systematic reviewer is particularly critical within the EBP framework due both to the rapid proliferation of the scientific literature and health professionals' limited time to remain comprehensively informed of new research. The EBP system is made possible because systematic reviewers collect and analyze the full body of new and old studies that address clinically relevant questions. Systematic reviewers then disseminate their findings to health professionals in the form of succinct summaries that offer EBP recommendations for practicing clinicians.

Systematic review methodology includes a series of steps, including the formulation of a structured PICOT question that specifies the target population (P), candidate intervention (I) to be evaluated, comparator (C) intervention, patient outcome (O) of interest, and over what time frame (T) the outcome is to be assessed. After formulating the PICOT question, the systematic reviewer develops a comprehensive and unbiased protocol whose objective is to identify research that addresses the question. Once the relevant studies have been acquired, a decision about whether to include them in the review can be made relative to protocol entry and exclusion criteria. Included studies are then critically appraised for methodological quality, and their data extracted and synthesized to reach an answer to the question at hand. Synthesis is sometimes performed quantitatively, if the included interventions and study designs are sufficiently homogeneous; alternatively, synthesis can be performed qualitatively. Increasingly, systematic reviews constitute a requisite basis for EBP guidelines and health policies.

The third role that health professionals can play is that of the clinician. Assuming one of the most complex and challenging roles in EBP, the clinician extracts and uses data from each of the three EBP circles. Unlike the primary researcher or systematic reviewer, the clinician interacts directly with the two circles of the EBP model that concern patient characteristics and resource considerations. Additionally, health professionals are research consumers in that they access research evidence and assess its quality and relevance for the patient and context at hand. Secondary, synthesized, critically preappraised evidence sources, such as systematic reviews or EBP guidelines on www.guidelines.gov are intentionally designed to give the busy health professional a way to efficiently find the best research-tested answer to the most commonly asked practice questions. In some circumstances, however, available systematic reviews and treatment guidelines may not provide an answer, requiring the clinician to search the primary literature to identify relevant research. To enhance the simplicity of the clinician's complex job, the five-step EBP process delineates a recommended series of steps that health professionals can follow to address each of the three circles of the EBP model.

The Five Steps of EBP

Carrying out the EBP process involves five steps (Figure 4):

Step 1: Ask patient-oriented, well-formulated questions about the health status and contexts of individuals, communities, or populations.

Step 2: Acquire the best available evidence to answer the questions.

Step 3: Appraise the evidence critically for validity and applicability to the problem at hand.

Step 4: Apply the evidence by engaging in collaborative health decision-making with the affected individual(s) and/or group(s). Implement the health practice. Appropriate decision-making integrates the context, values, and preferences of the individual, community, or population. It also integrates available resources, including professional expertise.

Step 5: Analyze the new health practice and adjust practice accordingly. Evaluate implications for future decision-making, disseminate the results, and identify new informational needs.

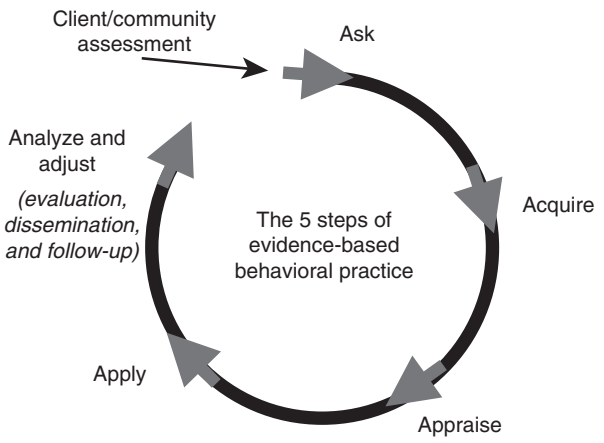

Figure 4 The 5As approach of EBP.

Competencies

Ask

EBP health professionals ask important, practice-relevant questions. They know how to translate their information needs into well-formulated, answerable questions. Further, they differentiate among various types of practical questions, including assessment, intervention, prognosis, harm, cost-effectiveness, and seek the best type(s) of evidence to answer each kind of question.

Acquire

EBP health professionals answer their questions by efficiently and effectively searching for the best available evidence. Specifically, EBP health professionals understand how to seek answers to their questions by accessing clinical guidelines and systematic reviews of research on health procedures. They know the difference between primary and secondary (synthesized) research evidence, and can translate questions into efficient search plans. They can use available technology and information systems to stay up-to-date regarding research relevant to their questions.

Appraise

EBP health professionals critically appraise evidence based on its quality and applicability to the specific population and circumstances at hand. When evaluating research on interventions, it is important to consider both internal and external validity. Internal validity represents the extent to which research was designed and conducted in a way that enables change to be causally attributed to the intervention as opposed to extraneous variables. External validity reflects whether characteristics of the research population or intervention context can be generalized to the current population, interventionist, or circumstances. Applicability refers to the clinician's judgment vis-à-vis the fit of the evidence with the circumstances.

In terms of specific competencies, EBP health professionals know the strengths and weaknesses of different kinds of research evidence for answering different kinds of health questions. They can evaluate the quality and strength of primary research evidence based on study design and execution. They understand how to synthesize research evidence and how to evaluate the quality and strength of evidence in systematic reviews and practice guidelines. They can identify gaps in evidence that suggest future research. Finally, they evaluate the applicability of the evidence for a particular individual, community, or population.

Apply

Finding the best available research evidence is one thing. Applying it is more complex in EBP, because it requires shared decision-making between health professionals and those affected by an intervention. The aim of the shared decision-making is to arrive at an action plan that balances the applicable evidence, the resources available to implement the best practice, and how the values and preferences of those affected influence the acceptability of the practice.

Analyze and Adjust

EBP health professionals participate in continuous quality improvement. After initiating an intervention that aggregate research suggests is evidence based, the clinician analyzes change and adjusts intervention accordingly. As such, the adaptation of interventions to changing individuals in changing contexts over time is at the core of EBP's transition between the Apply and the Analyze and Adjust. In other words, one initially applies the best 'one size fits all' treatment based on systematic review or aggregate evidence. Subsequently, the adaptation of treatment becomes individualized based on the person's own unique response to the sequence of offered treatments.

Methodological and Practical Challenges

Despite the past decades' great strides toward acceptance and full implementation of EBP, continued *barriers* remain. Rigorously designed research studies are expensive and take time to complete. Often, research findings are simply lacking or insufficient to provide a basis for policy and practice decisions. Gaps in the existing evidence base are especially noteworthy in areas of nondrug treatment interventions and preventive care (Maciosek et al., 2006; Moyer et al., 2005). The U.S. Preventive Services Task Force (USPSTF) was created by the U.S. Department of Health and Human Services in 1984 to address this challenge. *The Guide to Clinical Preventive Services*, which appraises systematic reviews of research graded on its evidence quality was created to allow governing bodies to identify effective evidence-based preventive services (Woolf and Atkins, 2001). The evidence reviewed in the current *Guide* provides the basis for all preventive services mandated by the Affordable Care Act to be covered by insurance without copays. Even so, the evidence about many preventive care practices earns a grade of 'i' for insufficient evidence. As such, the state of the science too often fails to accommodate the demands of policy-makers and health professionals.

Some have gone so far as to challenge the utility and relevance of RCTs as the gold standard research design for evaluating intervention effectiveness. Beyond the expense and duration of RCTs, other criticisms allege an overemphasis on internal validity (freedom from bias) over external validity (sample representativeness, generalizability) (Altman et al., 2001). Other challenges are that RCT designs are sometimes not feasible to implement when, for example, policy-makers or communities decline to accept potential random assignment to a control condition.

Another ongoing tension is that some clinicians chafe under the perceived restrictions that EBP imposes on professional autonomy. While they may appreciate research-tested practices as useful tools, they regard treatment as something of an art form and prefer being given the creative license to try out and develop novel treatment tactics. Additionally, health professionals may lack training in EBP. Although many training programs train students in the use of specific evidence-based treatments, few educate students on the EBP process and steps (Gambrill, 2007a). Discussions are just beginning regarding the best timing and configuration for EBP in the training curriculum (Jenson, 2007) and optimal teaching techniques (Gambrill, 2007b; Sackett et al., 2000).

Emerging Directions

The methods and standards of EBP are now given in health care. Establishing and disseminating an evidence base for behavioral treatments alongside medical treatments is necessary to make them accessible to patients. Providing access is, in turn, essential to achieve patient-centered care because a majority of patients express a preference for behavioral over medical treatments (e.g., Raue and Schulberg, 2007). Systematic reviews and treatment guidelines that include behavioral treatments are needed, particularly because most health insurers now require these EBP components as prerequisites for treatments to become covered practices.

Currently, most evidence-based behavioral treatments resemble evidence-based medical treatments in taking the form of a single, best 'one size fits all' intervention. However, few clinicians believe that one-size treatment fits all. More often clinicians practice by applying a sequence of interventions that they adapt over time depending upon the patient's response. A common protocol is to begin with a best modal practice, evaluate response, and then adapt or change treatment in the case of insufficient response or nonresponse. The sequence of decision rules about how to titrate and adjust treatment contingent upon patient response has been called a treatment algorithm or operational guideline. The algorithm represents a strategy that links together particular treatments that have research support, a strategy about what treatment should be tried first, and a set of tactics or decision rules about what treatment to try next in the case of treatment failure. Like a specific treatment, an algorithm that links together a sequence of research-tested interventions can itself be tested and proven by research to be an efficacious strategy, as compared to a fixed treatment or an alternative treatment algorithm. An example of adaptive treatments that showed efficacy in clinical trials is the Action to Control Cardiovascular Risk in Diabetes trial (e.g., Sullivan et al., 2013). Moreover, once validated, such operational treatment guidelines can be programmed into electronic health records or mobile devices to provide guidance and decision support to clinicians about how to choose the next step in treatment. Approaches like the operational guideline capture both the Apply and the Analyze and Adjust steps of the EBP process. A new generation of research designs, such as the Sequential MultiPhased Adaptive Randomized Trial (SMART) has been put forward to develop such treatment algorithms (e.g., Almirall et al., 2012). We expect these new adaptive interventions to become the EBP wave of the future.

See also: Applied Social Research, History of; Behavioral Economics, History of; Health Education and Health Promotion; Implementation Science; Policy Analysis; Prevention Research; Science and Politics: Value Neutrality.

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Relevant Websites

www.ebbp.org – Evidence-Based Behavioral Practice (EBBP) project.
www.cochrane.org – The Cochrane Collaboration.
www.guidelines.gov – National Guideline Clearinghouse.