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Evidence-based medicine: a brief historical analysis of conceptual landmarks and practical goals for care

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Abstract

Evidence-based medicine (EBM) is intended to improve the efficiency and quality of health services provided to the population and reduce the operational costs of prevention, treatment, and rehabilitation; the objective of EBM is to identify relevant issues and promote the social applicability of conclusions. This article underscores the importance of EBM in modern clinical teaching and social practices from the contributions of Archibald Cochrane and David Sackett to the development and dissemination of this paradigm in care and education during the twentieth century. EBM has helped broaden discussions on the relationships between teaching and medical practice, and has taken on an important role in curriculum reforms and training models and practices in health care.

Keywords: evidence-based medicine; effectiveness; efficiency; Archibald Cochrane (1909-1988); David Sackett (1934-2015).



How can contradictions and potential conflicts between good clinical care and a variety of approaches and scientific discoveries be minimized? How can we encourage “evidence-based” medical education without undermining the doctor/patient relationship? How can humanization and effectiveness be combined in health care? Around the world these questions have concerned physicians, managers, and researchers for decades, leading to heated debates on the importance of social practices in the health sciences.

Within the real-world context of health systems, professionals make decisions based on their experience and training, which can be crucial to the patient’s clinical progress. The process of clinical decision making requires careful and (as much as possible) impartial analysis of scientific research outcomes. It involves, at least on a rhetorical level, respect for the patient’s preferences; preferences and choices should be adequately clarified, along with the circumstances of treatment, by verifying the stage of disease and the resources available at the point of care in order to ensure a higher probability of benefits (Savi, Silva, 2009). Health care professionals should consequently be able to make decisions related to the applicability of scientific knowledge to an individual patient or a given clinical scenario, to guide interventions and seek efficient and effective results.

In terms of practice, the quality of evidence to be identified, evaluated, interpreted, and integrated into the patient’s reality is fundamental in the clinic, particularly evidence about the validity of diagnostic testing, predictive power of prognostic markers, and effectiveness of therapeutic and preventive procedures. In this aspect, critical sensibility, professional experience, and clinical expertise are also relevant.

In the educational dimension, facing the health problems that affect populations in rich as well as poor countries requires the training of socially responsible and politically aware professionals who are able to engage in ongoing training and education. This process of continuing education must be efficient not only from a technological point of view, but in developing interpersonal skills based on humanitarian and ethical principles in order to respond to the various demands generated by the transition from the pattern of disease, demographic changes, and problems arising from poverty and social inequalities. The theme of social responsibility and interpersonal skills has been recognized as crucial for training health professionals in Brazil, as pointed out by Nobre, Bernardo, and Jatene (2004, p.222): “everything begins with a good doctor/patient relationship, in the attention the professional provides to the patient ... Hence the need for strong training ... that meets the needs of interpersonal communication. In a society that favors individual responsibilities at the expense of the structural causes of illness, communication, dialog, and educational issues play a central role in care.”¹

In the late twentieth century, the articulation of these principles led to the evidence-based medicine (EBM) movement, from the anxieties and needs health professionals (mainly physicians) had experienced personally as well as political movements to organize universal health systems, many in response to the widespread demand for changes in professional training. Efforts were made to boost the efficiency and quality of health services rendered to the population and to reduce the operating costs of prevention, treatment, and rehabilitation. From the beginning, EBM has helped broaden the discussion about relationships between the teaching and practice of medicine, and taken a prominent role

in post-war curriculum reform, and its influences on training models and modern health care practices are significantly visible.

Historically, the roots of EBM go back to the movement to consolidate England's health systems with the establishment of the National Health System (NHS), championed by the Scottish physician Archibald Cochrane, who was a pioneer in clinical epidemiology, the microeconomics of health, and "person-centered medicine." And EBM as we know it today in Canada was structured during the 1980s and 1990s to promote improvements in health care and extensive reforms in medical education, within the context of the celebrated Lalonde Report, led by the epidemiologist and physician David Sackett. From the 1990s, EBM soon achieved global reach, particularly through the International Clinical Epidemiology Network (INCLLEN), with support from consistent, large-scale investments by the Rockefeller Foundation (White, 1991), and the Cochrane Collaboration, an international movement founded in 1993 by Iain Chalmers to share scientifically validated clinical data (Clarke, Chalmers, 2018).

Cochrane and Sackett were both charismatic personalities who profoundly influenced the formation of scientific boards, managers, and politicians concerned with the quality of medical interventions around the world, establishing the importance of scientific evidence in decision making about patient care to assess the effectiveness of treatments, alongside physician experience (constructed in a scientific and structured manner) and patient preferences. As intellectual leaders, both placed the patient at the center of the discussion in terms of diagnosis, treatment, and the effects of applying technology in clinical practice, emphasizing the importance of life history and clinical findings in making health care decisions.

The goal of this text is to evaluate two connected themes that run through the institutional movement known as EBM: on the one hand, as a mode of care in clinical practice guided by scientific knowledge, and on the other hand, as a model of training characterized by "problem-based learning" (PBL), especially in medical education. To better appreciate the context and symbolic aspects of this important movement, we will first discuss some of the defining elements of so-called scientific medicine, the foundation of techno-sciences applied to modern-day health practices. We will then briefly present the lives and work of Archie Cochrane and David Sackett, emphasizing their contributions to the development and dissemination of this new paradigm for care and training. Finally, we will discuss current debates on evidence-based practice (EBP, an expanded term used in the literature to include other health areas) to determine changes in clinical practice and improvements in the quality of care and assistance provided to patients and their families.

Medical practices and scientific knowledge: dialogs and controversies

The advent of bacteriological research immediately led to refutations of old theories about the cause of disease, which included appeals to various deities, evil spirits, moral constitution, and spontaneous generation. Proto-ecological concepts such as miasmas and climate conditions held on for some time, as they advocated a naturalistic framework for understanding causation. Throughout the nineteenth century, medicine began to invest in

the experimental sciences, with the laboratory as a parameter for activities. New discoveries in physiology, bacteriology, microbiology, pathology, and biochemistry are now accepted as explanations for the morbid phenomena of the human body (Pauli, White, 1998; Pauli, White, McWhinney, 2000). This period is marked by the reorientation of scientific concepts and the creation and dissemination of new fields of knowledge. Within this context, the sciences of bacteriology and immunology, which were new at that time, came to strengthen not only clinical practice but also the concept of prevention. Research in the field of infectious diseases resulted in the emergence of new and more effective prevention measures including vaccination. Vaccines and immune sera were produced for a significant number of diseases: typhoid, tuberculosis, yellow fever, polio, diphtheria, and tetanus, as well as snakebite. Alongside improvements in health and living conditions, and as modes of transmission and the means of reproduction of specific vectors were identified, disease control strategies were developed and implemented and caused indicators of mortality to drop rapidly. Control of smallpox, malaria, yellow fever, and other “tropical” diseases in the ports of colonized countries revealed intense pragmatism, as well as ties between public health and essentially scientific areas of the medical sciences. Meanwhile, collective considerations were present in the sanitation efforts that were already underway at the beginning of the twentieth century, in campaigns such as those by Oswaldo Cruz in Rio de Janeiro (Castro Santos, 1985).

The discovery of pathogenic microorganisms and the initial success of technologies to treat and control infectious diseases represented an undeniable strengthening of organicist medicine. The most prevalent diseases at that time, which were infectious, favored the hegemony of this train of thought or interpretative explanation. Epidemiological studies in specific populations gradually gained ground in bacteriology laboratories, with research on the most prevalent and virulent infectious diseases (White, 1991).

The final decades of the nineteenth century and early twentieth century were marked by proposals for educational reform in western medicine, based on pedagogical and didactic assumptions that emphasized changing the curricula for the practice of medicine. After the 1910 publication of the Flexner Report, a critical investigation of medical education in the United States and Canada, changes were proposed to seek a new perspective for academic and vocational guidance that could connect scientific knowledge on health and disease through an expanded biological foundation. According to White (1991), after the Flexner reform, these proposed changes in medical training, particularly those related to the practice of medicine, were accompanied by changes in medical school curricula. This expanded the reach of objectives that were congruent with the social reality to a certain extent, and paved the way for clinical decisions related to care that could impact diagnoses or treatment.

In the early twentieth century, basic knowledge of communicable diseases grew very rapidly, monopolizing the advancement of epidemiological knowledge and directing it toward the processes of transmission, control, and prevention of the epidemics that were prevalent at that time. Teaching the (then incipient) knowledge about the distribution of diseases in populations in public health programs dates back to this era. At the same time, technical advancement in medical practice led to a reduction of its social impact. The fragmentation of medical care caused specialization, an emphasis on complementary

procedures, higher costs, and the capitalization of health care. The “identity crisis” in medicine, related to the dual mission of curing and preventing diseases, was one of the obstacles to its social impact, particularly in times of severe social and economic crises such as the Great Depression between the World Wars. Gutierrez and Oberdiek (2001, p.20) see this issue as follows: “The environment, the source of all causes of disease, momentarily ceases to be natural in order to become social. The causes of diseases should be sought in human living and working conditions.”

As a possible response to this conceptual impasse a movement to instill the social dimension into pedagogical strategies and curriculum reform emerged, most notably in the United States, and came to be called preventive medicine (Arouca, 2003). During this phase, in the 1940s and 1950s, numerous departments of preventive medicine were established around the world. White (1991, p.134) shows that in the United States, public health, epidemiology, community medicine, and management sciences were closely associated within these departments, but epidemiology gradually imposed itself into medical education programs and preventive medicine as one of the most dynamic segments in social/medical research. According to White (1991), greater understanding and acceptance of epidemiology and epidemiological thinking would be “promising keys” for dialog between medicine and public health, and consequently for moving closer to social issues. In one of the several examples of this process White provides, the University of Vermont converted its Department of Preventive Medicine into the Department of Epidemiology and Community Medicine in 1962.

In 1965, Austin Bradford Hill published an article containing what would be known as the “Hill criteria,” which postulated that causal association (measured by the relative risk between an exposure and a condition of sickness or health) is more likely if more criteria are met and the association stronger. Following clinical logic, Hill suggested that epidemiological findings should be consistent with the outcomes of other biological studies and clinical trials, providing “biological plausibility;” in other words, a plausible explanation would be consistent with the current level of knowledge on the pathological process, including such notions as temporality, biological gradient, and experimental evidence.

In *Clinical Judgment*, Alvan Feinstein (1967) stated that clinical reasoning would be enriched by understanding and evaluating the outcomes of different treatments, thus suggesting that clinicians needed to work with new research models. Years later, David Eddy (1982, 1988) described errors of clinical reasoning and how evidence had been or should have been utilized in the practice of medicine. Along these lines, at different points in the American and British research network, a movement back toward valuing concepts and methodological reinforcement of clinical practice emerged, based on the application of principles, strategies, and techniques from epidemiological research (Susser, 1999).

Various approaches founded on critiques of the preventative movements, community medicine, and clinical epidemiology were proposed to understand the health/disease process within the context of multiple constraints and determinants. The 1960s and 1970s were particularly rich in analyses criticizing the natural history of disease model (White, Williams, Greenberg, 1961, p.201-202) and proposing a broader approach that considered the relationships between health and social issues, since individuals socially produce their

lives within a historical time and the intensities and manifestations of different diseases depend on the characteristics of a given territory, whether these are social, cultural, economic, geographical, or even political.

In this sense, the model of the social determination of health/disease was an exemplary contribution. This model, which is referenced in Marxist/structuralist historical and sociological theories, linked the different dimensions of living conditions involved in the processes or relations of production. Still, during these decades excessive attention was paid to “determinants” that favored structures and neglected actors and subjectivities. Even the pursuit of “determinants”, in the final analysis (note the use of “final”), which so perturbed Marxist theoreticians and scholars, was to some extent misunderstood by health scholars, since such an extensive variety of aspects was considered (historical, economic, social, cultural, biological, environmental, psychological) in order to configure a certain health reality.

The pursuit of an explanatory framework capable of overcoming the linear, biologicist cause/effect concept foretold the role of social structure as a modeler of the processes of producing health or disease. From an analytical point of view, the notion of “causality” was replaced by the notion of “determination,” on the basis of which the hierarchy of conditions linked to social structure was considered. This model of social health production involved a thorough review of the object, the subject, and the means of organizing practices, not only in order to halt the progress of disease, but to overcome the linear and biologicist concept (Teixeira, 2002).

On another plane of medical knowledge, where innovative paths were also sought, the causation binary and system began to be reinterpreted as causation and ecology. Although it would permit notions and concepts from the field to interpenetrate, systematic observation of the role of the actor (doctor or patient) had not yet been considered. From this perspective, cultural factors, social practices, and the constitution of space were capable of eclipsing the understanding of “modes of living and lifestyles” derived from personal choices.

A question emerged from the search for a new scientific reference on health: How are physicians affected by the overall reorientation in science and by evidence that cannot be explained by a traditional scientific model based on disease and cure? “Evidently, the patient is not a “silent” biological organism, nor disease a deviation from the norm of biological parameters alone” (Pauli, White, 1998, p.7). There was, consequently, a need to focus and reinterpret the relations between science, health, and illness; in other words, the role of scientific knowledge accumulated over centuries in the enrichment or impoverishment of medical practices.

With Rene Dubos and Ivan Illich, the figure of the patient began to gain ground within the medical field (White, 1991, p.76). Studies correlated social aspects with those related to health and illness, and in doing so placed the patient at the center of discussions on diagnosis and treatment. Life history was emphasized, along with clinical findings in making decisions about the best actions to take. Since the doctor/patient relationship is not linear or static but rather circular and dynamic, the creation of ties between them was seen to be necessary; this interaction would not “only” express a humanist attitude, but also be a scientifically-based act or effort.

During the final decades of the twentieth century, concepts such as causation and bio-semiotics gained prominence and indicated a new direction for medical practice, contributing to the establishment of a “new paradigm for the twenty-first century” (Pauli, White, McWhinney, 2000, p.166). Another concept that became known was White, Williams and Greenberg’s ecology of medical care (1961), which placed patients at different levels of medical care and was the origin of the concept of primary care. According to the ecology of medical care concept, patients control the process of decision making during the therapeutic process, deciding whether or not to utilize medical treatments. The ecology of medical care was mainly focused on the needs of the community; the more open character of this concept was notable in terms of “social determinants,” including subjectivities and choices as essential elements in the health/disease process.

According to White, Williams, and Greenberg (1961), it is important to relate the health conditions of population (defined on the basis of epidemiological criteria) with the decisions and models of medical care. Within the context of medical care, these authors state, the patient should be seen as a “primary unit” of observation which is more relevant than the disease. “The natural history of the patient’s medical care may be a more appropriate concern than the natural history of his disease” (p.188). Broadly speaking, research should not focus on prevalences and linear causal mechanisms, but rather the various factors that “inhibit or facilitate access and provision of the best health care to individuals and communities” (p.201-202).

According to Hannes Pauli and Kerr White (1998, p.12), new directions will inevitably have repercussions throughout all of medicine and health care, but these authors posit some conditions to stimulate the doctor/patient relationship, discussed in forums and articles. One crucial condition lies in the transfer of space by “curricular decision-makers” and “the highly specialized academic elite” (p.12) to groups of generalist practitioners and representatives from other health professions, working toward a vision of the world that is in tune with the social reality and with the patient.

As in other periods of historic transition that can be difficult to understand and navigate, for quite some time old conceptualizations were seen to be replaced by others: the doctrines of witnessing, belief and healing, and the paradigm of basic sciences, then the paradigm of EBP. This is a good time to mention the ideas of a pioneer in the sociology of medicine, the Colombia University professor Bernhard J. Stern, who collected the types of resistance to adopting techniques and knowledge within the field of medicine itself in his text on innovations in this area (Stern, 1941). During this long period, the new was seen to overlap the old, despite isolated resistance to complete replacement of the old paradigm by new ideas and practices. This can be seen in recent decades, *mutatis mutandis*, in the notions of care and primary care in various countries: strong resistance is seen to develop against changing the medical curriculum, against more humanist and resolutorial training, and against more consistent models of evaluation and certification. This contains a great challenge faced by the thought and actions of two icons of the revolution in clinical knowledge and health care practices in the late twentieth century: Cochrane and Sackett.

Archie Cochrane: social clinical practices guided by evidence

The epidemiologist Archibald Leman Cochrane (1909-1988), who symbolized this new paradigm, was born in Kirkland, Scotland on January 12, 1909. He received his degree in medicine from University College Hospital at the University of London in 1938. That same year he served as a physician in the International Brigades during the Spanish Civil War. In 1941, having become a captain in the Royal Army Medical Corps, Cochrane was taken prisoner in Crete, and worked as a medical officer in Salonika, Greece (Archive Cochrane Community, 2017). This recollection in his autobiography demonstrates how important he considered life experience to be in his work:

Another event at Elsterhorst [Germany] had a marked effect on me. The Germans dumped a young Soviet prisoner in my ward late one night. The ward was full, so I put him in my room as he was moribund and screaming and I did not want to wake the ward. I examined him. He had obvious gross bilateral cavitation and a severe pleural rub. I thought the latter was the cause of the pain and the screaming. I had no morphia, just aspirin, which had no effect. I felt desperate. I knew very little Russian then and there was no one in the ward who did. I finally instinctively sat down on the bed and took him in my arms, and the screaming stopped almost at once. He died peacefully in my arms a few hours later. It was not the pleurisy that caused the screaming but loneliness. It was a wonderful education about the care of the dying. I was ashamed of my misdiagnosis and kept the story secret (Cochrane, Blythe, 1989, p.82).

In 1948, Cochrane joined the Medical Research Council's Pneumoconiosis Unit at what is now the Cardiff University School of Medicine. There he began a series of pioneering studies on the use of randomized clinical trials (Archive Cochrane Community, 2017), which notably included a trial administered by the Medical Research Council (MRC) called the "Tuberculosis Unit" that same year. At the beginning of the twentieth century, tuberculosis was one of the United Kingdom's greatest health problems. In 1901, the Royal Commission Appointed to Inquire into the Relations of Human and Animal Tuberculosis was created, and in 1919 became the MRC, an independent council. The team chosen by the MRC for the 1948 trial included Marc Daniels, who for the previous four years had coordinated research on tuberculosis, Philip D'Arcy Hart, who was responsible for the first controlled clinical trial under the tutelage of the MRC, and Austin Bradford Hill, who established various principles for scientifically acceptable clinical trials (Hill, 1937). Another member, John Crofton, was invited to the MRC as a part-time researcher (Dalyell, 2009).

The MRC trial evaluated the therapeutic action of streptomycin in patients with pulmonary tuberculosis in order to bolster its legitimacy. A variety of information was gathered during this trial. First, streptomycin was found to not be suitable for treating tuberculosis; bacterial resistance to this drug was also seen to develop at an impressive speed, and significant and persistent side effects were observed. However, perhaps the best outcome was the fact that this trial created an atmosphere of immense respect for the research model adopted, and served as a starting point for various other similar projects. It was an important study in many aspects, because it allowed Bradford Hill to introduce randomized clinical trial (RCT) techniques into the "medical world," bringing the experimental approach closer to medical research. The importance of this measure is

not exaggerated. “It opened up a new world of evaluation and control which will ... be the key to a rational health service” (Cochrane, 1972, p.11).

As a researcher, from his earliest training Cochrane developed a skeptical attitude towards theories that were not experimentally validated, and defended the RCT model as clinical evidence. He sharply criticized the infrequent utilization of this method in clinical practice and the lack of “reconfirmations” of the results obtained. One reason for his strong commitment and adherence to the MRC’s research centered around the fact that to a certain extent, it would help overcome the prejudices of British science: “...for reasons that are still somewhat obscure, British science divided itself into pure and applied” (Cochrane, 1972, p.9), but for him, a clear line dividing these two attitudes toward science was unacceptable.

In 1988, at the end of an effervescent decade with regard to EBM and growing respect for RCTs as a research model, Archie Cochrane died. A year before his death, he referred to a systematic review of RCTs during pregnancy and childbirth as “a real milestone in the history of randomized trials and evaluation of care,” and suggested that other specialties should follow the methods used (Cochrane, 1989, p.24). This encouragement and endorsement of his points of view led to the opening of the first Cochrane Center (Oxford) in 1992. A year later, the New York Academy of Sciences held an event in his memory entitled “Doing More Good than Harm.” This was the foundation for the development of the Cochrane Collaboration, which was founded in Oxford in October of the same year by 77 researchers from nine countries (Bucci, Colamesta, La Torre, 2014).

Archie Cochrane favored the organization of a national health system providing public and effective treatment; in his opinion, all effective treatment had to be free. He defended scientific research as fundamental for the construction of clinical knowledge and for the efficacy and effectiveness of therapeutic procedures, which should be based on observational research strategies through controlled clinical studies. His work was recognized and honored with the creation of research centers focusing on EBM (the Cochrane Centers) and the Cochrane Collaboration, which even today maintains a worldwide network for sharing clinical practices based on evidence.

Sackett and problem-based learning

David Lawrence Sackett, an American-Canadian physician (1934-2015), is recognized as a central figure in modern clinical epidemiology and an inspiration for the EBM movement.

In 1967, he founded the first department of clinical epidemiology in Canada, at McMaster University, starting work in what at that time was the new area of research methodology, publishing articles in partnership with former students and colleagues such as Sharon Straus, Muir Gray, Brian Haynes, William Rosenberg, and Scott Richardson. In 1986, Sackett was appointed physician-in-chief at Chedoke-McMaster Hospital in Hamilton, Ontario, Canada. At McMaster, Sackett’s work on EBM took shape and flourished, particularly because of its influence on medical education reform and the development of problem-based learning. After starting as a study group at McMaster University in the 1980s, with a series of articles published in the *Canadian Medical Association Journal* (CMAJ) written by Sackett, Brian

Haynes, Peter Tugwell, and Victor Neufeld, the EBM movement really took shape in the early 1990s (Drummond, Silva, 1998; Lopes, 2000).

In 1990, Sackett was appointed head of the Division of General Internal Medicine at Oxford University in England, and four years later he was invited by Muir Gray of the UK National Health Service to start the first Centre for Evidence-Based Medicine in Britain. In 1999, he returned to Canada and created the Trout Research & Education Centre, where he researched randomized clinical trials and wrote significant texts on EBM and PBL. Retired, recognized, and celebrated for his contributions, he died in 2015.

David Sackett became known worldwide for his textbooks *Clinical Epidemiology: A Basic Science for Clinical Medicine* and *Evidence-Based Medicine: How to Practice and Teach EBM*. When the first edition of *Evidence-Based Medicine* was published in 2000, Sackett also wrote, with Sharon Straus, *Mentorship in Academic Medicine*, a guide from his point of view as an educator about the relationship that develops between young doctors and department heads as mentors. David Sackett and Sharon Straus also wrote an article entitled “Finding and applying evidence during clinical rounds: the ‘evidence cart,’” after determining that evidence could be used in making clinical decisions that could affect diagnoses and/or treatment.

Sackett made important contributions to the health sciences and the teaching and practice of medicine in order to improve the scientific quality of medical information and health care offered to patients through the training and education of researchers and clinicians. His studies included clinical findings that were significant for human health, as well as the first proof of the benefits of aspirin therapy for stroke patients (Castiel, Póvoa, 2001). As the formulator of a systematic clinical strategy, Sackett put the patient at the center of discussions about diagnosis and treatment, emphasizing the importance of life history and clinical findings in making decisions on the best actions to take. In this sense, the most relevant clinical studies focus on patients and emphasize diagnostic testing and the efficacy and safety of therapeutic and preventive procedures.

On evidence-based medicine

Although the term “evidence-based” medicine was introduced during the last decades of the twentieth century, the principles of this notion were not entirely new. The first discussions started in the seventeenth and eighteenth centuries with the work of the Bernoulli family, and more practical formulation solidified during the nineteenth century in France, more precisely in 1830 with Pierre Charles Alexandre Louis’s theory of *medicine d’observation*. He believed that physicians should make clinical decisions based on measurable experimental results (Román, 2012).

The expression “evidence-based” applies to the use of research in an attempt to broaden medical expertise and reduce uncertainty in the clinical process (diagnosis/treatment/prognosis) by continuously consulting the data produced (and validated) by clinical epidemiology research (Sackett et al., 1996). This new paradigm for care and training assesses the scientific quality of data in the areas of health, and represents the integration of clinical experience, the patient’s values, and the evidence available for the decision-making process related to caring for patients’ health (Jenicek, 1997).

The EBM movement has been the subject of intense scholarly debate on new strategies and methods for education and training, and has been recognized as a “new paradigm for care and education” that permits amplification of debate and reflection on the current teaching and practice of medicine (Drummond, Silva, 1998). Studies have called attention to the importance of training doctors with a critical spirit who can maintain the process of continuous training and education, reinforcing the notion that evidence-based medicine is crucial for better investigation of individual and social problems. Its statements and objectives are clear: in a nutshell, EBM is meant to improve care through access to facts that may be seen as approximating what in fact are “truths,” and attempts to identify the relevant problems of the patient and promote social applicability of conclusions (Bligh, 1995; Castiel, 1999; Castiel, Póvoa, 2001; Masic, Miokovic, Muhamedagic, 2008).

We should also note that the proponents of EBM, namely Archie Cochrane, David Sackett, Sharon Straus, Muir Gray, Brian Haynes, William Rosenberg, and Scott Richardson, had close contact with epidemiology in their duties as clinicians and were struck by epidemiological and statistical data that helped them to better understand their patients' diseases and make therapeutic decisions (Román, 2012).

How did David Sackett and his colleagues define EBM? What are the main concepts that characterize it, and the skills needed by those who practice it? David Sackett is credited with the classic definition of EBM: “conscientious, explicit, and judicious” use of the best available evidence in decision making on patient care, alongside physician experience and patient preferences (Sackett et al., 1996; Sackett, 1996). This definition puts research evidence in its rightful place in overall patient care. Some postulates were summarized by a close associate, Milos Jenicek (1997, p.188):

formulation of a clear question arising from a patient's problem which has to be answered; searching the literature for relevant articles and exploring other sources of information; critical appraisal of the evidence (information provided by original research or by research synthesis, i.e. systematic reviews and meta-analysis); selection of the best evidence ... for clinical decision; linking evidence with clinical experience, knowledge, and practice and with the patient's values and preferences; implementation of useful findings in clinical practice; evaluation of the implementation and overall performance of the EBM practitioner, and teaching others how to practice EBM.

Considered a central theme in clinical practice, formulating health policies, and training and educating health care professionals, EBM perfected the use of reasoning beyond the clinical sample and integrated experience with clinical evidence in systematic research, i.e. the “rational” application of scientific information and a more effective and safe diagnosis for treatment.

In other words, from early on its proponents defended clinical practice based on decisions resulting from the judicious use of evidence, individual experience integrated with clinical evidence from systematic research. In this sense, the claim was that doctors (and today, all health care professionals) needed to know about and read scientifically rigorous publications (with well-designed and well-conducted studies) and make them accessible to students and other members of the professional team.

In the absence of individual clinical experience, what procedures should be adopted, by a resident physician, for example? In a text directed toward professionals still lacking experience, Guyatt et al. (1993) traced a path to follow. First, assume clinically uncertain situations conducive to a search for evidence-based therapeutic procedures; these situations involve questions and challenges related to making a therapeutic decision. The text then presents the steps required to overcome this uncertain scenario: the doctor should seek out and review the relevant literature (using software and subject headings or descriptors) about the patient's condition or disease, and when articles that discuss issues related to diagnosis and treatment are found, limit the results to "randomized controlled trials." Then, confirm those articles that directly report overcoming uncertainty and recommend the most appropriate therapeutic conduct. One premise of the text by Guyatt et al. is that disease is diagnosed via available laboratory or imaging exams, reducing the degree of uncertainty in the therapeutic process.

Five steps are presented as good clinical practice: (a) formulating the clinical question – establish the scientific issue of interest based on the literature and convert the information (on prevention, diagnosis, prognosis, therapy, causation) into a question; (b) accessing information – identify the relevant information to answer the scientific questions of interest; (c) critical analysis of the information – critically evaluate the applicability of evidence in clinical practice; (d) application in the clinical context – determine the best course of action, considering the problems of the patient and/or a population; (e) evaluation – assess the effectiveness of implementing the first steps, and seek ways to improve them (Drummond, Silva, 1998).

Thus defined, these steps form the link between good scientific research and clinical practice, since they allow patients' clinical status to be identified via clinical investigations and permit more secure diagnostics in making care decisions while potentially reducing uncertainty in the clinical process of diagnosis/treatment/prognosis (Sackett et al., 1996). Efficiency addresses less expensive and more accessible treatment for patients' benefit, while security indicates that an intervention is reliable enough to make any undesirable effects on the patient less likely (El Dib, 2007). Hence the importance of the research process and the use of its results to improve care provided to individuals and to the community.

Sackett and his collaborators said that EBM was not impossible or difficult to practice, but could not be understood as "cookbook medicine" or a magic formula (Sackett et al., 1996). Clinical evidence should inform but "never" replace the doctor's experience or expertise, since this experience determines whether the evidence applies to the clinical status of the patient. If so, it is the physician who also decides whether the evidence will be integrated into the clinical process (diagnosis/treatment/prognosis) (Davidoff et al., 1995). Sackett et al. (1996) maintained that physicians must base their decisions and actions on the best possible evidence and remain continuously up to date about clinically important information, summarizing evidence systematically, since during clinical examination various needs for information needs related to therapy can be identified. Sackett and his colleagues believed that doctors, even when dealing with basic medical topics, need to expand their readings as a scientific exercise in order to develop an adequate opinion on

assessment, diagnosis, and management of pathologic conditions, maintaining that “good doctors use both individual clinical expertise and the best available external evidence, and neither alone is enough. Without clinical expertise, practice risks becoming tyrannized by evidence, for even excellent external evidence may be inapplicable to or inappropriate for an individual patient” (Sackett et al., 1996, p.71).

According to Davidoff et al. (1995), difficulties maintaining clinical advances in the area of medicine are related to the time physicians need to dedicate themselves to reading on this topic. The surprising assumption is that a “good clinician” should read up to twenty articles per day, 365 days per year, on topics related to the specific problems of patients. The knowledge needed to analyze the results depends on the nature of the question. Along these lines, in analyzing studies on diagnostic testing it is essential for physicians to understand clinical and epidemiological terms such as sensitivity, specificity, relative risk, relative risk reduction, and absolute risk reduction in order to reach the correct conclusions about the prognosis and therapy.

EBM requires new clinical skills, including the ability to use knowledge and experience to effectively identify each patient’s state of health and diagnosis, the individual risks and benefits of proposed interventions, as well as the patient’s values and personal expectations. This is a continuous process of problem-based learning, particularly the need for clinically significant information on diagnosis, prognosis, therapy, and other issues related to clinical practice and public health. For both,

during the process of practicing EBM, which goes from identifying the problem to selecting the alternative to be adopted, it cannot be forgotten that each person who seeks medical care is unique, despite having similar characteristics to other patients. Evidence that comes from studies conducted with groups of patients helps make decisions more accurate, but cannot be detached from clinical experience (Lopes, 2000, p.287).

A final note about EBM, in its Canadian aspect inspired by Sackett, speaks to its nature related to social practice. In convergence with Cochrane’s position, Sackett was convinced of the value of his proposal of evidence-based clinical practice to strengthen the Canadian system of socialized medicine.

The health professional was not responsible for “curing,” but rather “caring” — the ultimate goal should not be the cure, but rather the “conditions of care” that allow a cure, care within which it can take place. A cure can happen during the process, even spontaneously. Improvement after a medication is administered does not prove that the drug is the cause. Witnessing does not prove efficacy; it may constitute a hypothesis, a source for research, but it must be verified. A disease can present natural periods of improvement, or spontaneous improvement, but even in chronic diseases in which spontaneous improvement is unlikely, periods of stability may be associated with non-specific psychological or symbolic processes that are characteristic of a placebo effect. Establishing the difference between these two events is decisive for health professionals. Scientific rationality must be present to avoid deviations resulting from witnessing a cure, and to consecrate validation of the outcome.

It is the awareness of this fact that Georges Canguilhem (1978) considers the watershed between scientific western medicine and other types of medicine, as well as between the

doctor and the healer. The latter claims the cure as proof and as legitimacy of his or her action, while doctors do not stop being who they are or cease practicing medicine even if this does not lead to a cure.

In search of the best clinical evidence for patient care

According to Sackett et al. (1996), the best evidence should be considered when randomized controlled studies (based on relevant and methodically adequate clinical trials) are performed to test the efficacy of a therapeutic approach in a given population of patients. Such studies should be conducted according to the norms and standards of ethics for research in the biomedical field. It is consequently important that they assess the effectiveness of pharmaceuticals and potential side effects compared with existing therapies. It is fundamental to minimize “intuition” and emphasize clinical experience, observation, reasoning, and access to evidence obtained by scientific research and by the transfer and dissemination of knowledge. There is, therefore, a daily need for valid assessments for diagnosis, prognosis, interventions, and prevention. A good doctor should be able to identify and compile the best studies, learn to critically assess the available literature, and make this evidence available.

In this sense, one of the greatest achievements of EBM promoted by the dissemination of Cochrane’s ideas, particularly through the network organized by his disciples, has been systematic reviews and/or meta-analyses, methods through which researchers identify various studies on a topic and critically analyze them in order to summarize the best available evidence. These summaries and analyses have the advantages of following rigorous scientific methods and replicability (Mulrow, Cook, Davidoff, 1997).

Physicians require systematic reviews to efficiently integrate existing information and provide data for rational decision making. Systematic reviews determine whether scientific findings are consistent and can be applied to the everyday lives of individuals and/or populations. Meta-analyses, in particular, help make estimates of treatment effects and exposure risk more precise, and better reflect reality (Mulrow, Cook, Davidoff, 1997). “Parameters, protocols, meta-analyses, and epidemiological data are extremely important in producing knowledge and, in turn, medical theory, but should not replace the art of caring, which requires empathy and intuitive abilities and in certain cases may abandon the incorporation of ‘evidence’” (Castiel, Póvoa, 2002, p.19).

According to Masic, Miokovic, and Muhamedagic (2008, p.219), the “EBM-oriented clinicians of tomorrow have three tasks: 1. To use evidence summaries in clinical practice. 2. To help develop and update selected systematic reviews or evidence-based guidelines in their area of expertise. 3. To enrol patients in studies of treatment, diagnosis and prognosis on which medical practice is based,” since EBM uses scientific evidence that exists and is available at the time to apply its outcomes in clinical practice.

The next step is knowing which study design best answers the clinical question. Systematic reviews, with or without meta-analyses, are considered level I evidence, followed by large clinical trials (mega-trials, with over 1,000 patients) or level II evidence. Clinical trials with fewer than 1,000 patients are level III, and cohort studies (without a

randomization process) are considered level IV evidence. Case-control studies are level V, case series VI, and case reports level VII (Cook et al., 1995).

EBM involves many challenges, and since its application relates clinical experience with scientific evidence to the needs presented by the patients, some questions arise, such as: How can physicians stay up to date and monitor the number of publications with new scientific information in the area of health? How to differentiate between strong and weak evidence? How to quantify uncertainties and probabilities? What are the best sources of information? How can doctors help develop and update systematic reviews in their area of expertise if they do not have time for reading on their patients' specific problems?

Unfortunately, as Sackett et al. (1996) noted, after their academic training many doctors decrease their reading load due to the accumulation of activities in professional practice, among other factors, which could generate a progressive decline in their clinical competence. This is a problem doctors have to face: data that were previously accepted and disseminated, but discarded after new scientific discoveries. EBM does not guarantee good research results, but may be helpful in reducing the chances of error and ineffective or iatrogenic practices.

On evidence-based practice and its contribution to all professions

The expression EBM has “evolved” to evidence-based practice (EBP) in order to broaden the use of epidemiology and careful evaluation in decision making (Broeiro, 2015). EBP means integrating clinical practice with the best available evidence from research, similar to Sackett's original definition of EBM. Like EBM, the process was also described in steps: “Translation of uncertainty to an answerable; systematic retrieval of the best evidence available; critical appraisal of evidence for validity, clinical relevance, and applicability; application of results in practice; evaluation of performance” (Dawes et al., 2005, p.5).

Evidence-based practice is recognized as a fundamental competence for health professionals in various careers and cultures. During the era of evidence-based medicine and exponential growth in knowledge, recent studies have discussed the importance of EBP and its contribution to changes in the care provided to patients and their families by health professionals. It is a reflective practice based on scientific knowledge and clinical skills that promote improvement in the quality of care and services provided to patients (Al-Baghli, 2013; Campbell et al., 2013; Broeiro, 2015; Albarqouni et al., 2018).

EBP has been integrated into the curricula of undergraduate and graduate programs in health around the world. “It has the potential to improve the quality of health care” (Albarqouni et al., 2018, p.1) as well as the results of treatment for patients. At the same time, according to Albarqouni et al. (2018), there are variations in the curricula and the content of EBP and little consensus about the most essential competencies and skills that professionals should acquire to attain its potential benefits.

How can EBP be expanded to ensure improvement in care provided to patients? According to Albarqouni et al. (2018), EBP should not be isolated in each discipline and/or restricted to each profession. Health professionals need to understand how other disciplines use EBP in clinical care. These authors highlight the importance of essential skills for the

clinical practice, which should be fundamentally interprofessional, with teamwork, mutual respect, and shared values. They state that shared decision making is an opportunity to improve the results of treatment.

Nandiwada and Kormos (2018) also state that interprofessional education can ensure a standardization of EBP among professionals from different areas, guaranteeing high-quality care based on evidence and also creating a “culture of conducting research.” In general, transferring research results to clinical practice promotes improvements in the quality of care by boosting the reliability of interventions, increasing outcomes for the patient and reducing costs. Interprofessional education, in turn, is an activity that involves professionals from various areas who learn together, interactively, to improve collaboration and the quality of health care. This interactivity promotes the development of skills needed for effective collaboration (Reeves, 2016).

Better patient understanding of the clinical evidence or desired outcomes can boost their trust and adherence to clinical recommendations. Along these lines, developing collaborative skills and competencies for critical assessment of research during training will help health care professionals make decisions about what research evidence is suitable for application in the areas where they work. Well-defined skills and competencies are essential to make EBP feasible in health care environments.

The practice of EBP is usually triggered by encounters with patients that led to doubts about the effects of the therapy, the usefulness of diagnostic testing, the prognosis of the disease, and/or the etiology of disorders. It is a practice that demands new skills of health professionals, including efficient literature search and the application of formal rules of evidence in evaluating clinical literature (Dawes et al., 2005).

According to Facchini (2002), the qualification of health practice and appreciation of its more humanized nature requires a relationship between the health professional and patients and their families. Restructuring of this practice should reinforce the professional's perception of the limits of drug intervention and clinical procedures and the possibilities of expanding care, particularly with respect to the psychological and social dimensions of the human being. Transforming the practice requires attitudes, skills, and competencies directed at humanizing care and coordinated management of health activities.

The EBP movement associated with the health area has mainly been discussed in Canada, the United Kingdom, and the United States in recent decades. In Brazil, this movement is mainly developing in medicine, and discussions are still incipient in other areas of health care. As studies in the literature attest, there is a gap between the scientific knowledge produced by research and its use in professional practice. This scenario makes EBP more difficult, and health professionals need to overcome many barriers to use research in care environments (Kim et al., 2013; Al-Baghli, 2013; Campbell et al., 2013).

Broeiro (2015) reminds us that the “process of scientific knowledge/professional practice” must start in university training, by including subjects intended to help students understand the importance of research in producing scientific evidence; in other words, the importance of research and the use of its outcomes to improve the care provided to the patient.

EBP requires organizations to maintain a constant commitment to best practices and universal access to electronic EBM databases. Health professionals need to understand the

principles of EBP and develop a critical attitude, in terms of their own practice as well as in relation to evidence. According to Sackett (1996), in making any clinical decision the initial question should be: What is the best procedure, according to the values and clinical circumstances of the patient? Sackett and Cochrane would say that a good doctor must make a rational and judicious decision about the best evidence. Along these lines, more than knowing the standards, the health professional should be able to decide which standard is most relevant to each case. EBP includes the search for and critical appraisal of the evidence available, and implementation of conclusions into practice for better patient care.

Final considerations

Despite its far-reaching origins, EBM is a relatively young practice with impacts that are just beginning to be felt. Today, because of numerous innovations in the area of health care, professionals in this field need to make decisions based on scientific principles in order to select the most appropriate intervention for the specific care situation (Schmidt, Duncan, 2003). Clinical practice consists of making choices. What test is best suited for diagnosing a particular disease? Which treatment would be most effective for a certain patient? The answers to these questions depend on the doctor's knowledge, skill, and attitude, the resources available, and overcoming uncertainty.

EBM will reach maturity when the medical community as a whole realizes the importance of this new paradigm for care and training in dealing with patients, and incorporates the essential assumptions and attributes into clinical skills. These assumptions and attributes include a willingness to recognize and admit the possibility of uncertainties in order to convert them into clinical evidence. The concrete fact is that, even with the praise that Cochrane and Sackett and evidence-based clinical practice deserve, five decades after the phrase "evidence-based" was first used in a text it is only applied to a small percentage of the evidence that needs to be demonstrated. And perhaps even worse, various trials are the result of extra-scientific factors: personal decisions without scientific justifications, the pharmaceutical industry, lack of resources, technical difficulties, passivity, and disbelief. We are led to believe that the appearance of EBM, with the reaffirmation of RCT as a differentiated process of acquiring knowledge and legitimizing a certain form of conduct, was how medicine positioned itself against the fact that it was effectively not founded on clinical evidence.

Finally, the role of EBP (an expanded term used in the literature to include other health areas) that requires organizations committed to best practices and universal access such as EBM should also be emphasized. Health professionals need to understand the principles of EBP and develop a critical attitude about their own practice; they must strengthen their decision-making skills based on evidence and centered on the patient, in order to better respond to the needs of the population in primary care.

NOTE

¹ In this and other texts in Portuguese, a free translation has been provided.

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