

Original article

Evidence-based decision making and asthma in the internet age: the tools of the trade

At the dawn of the Information Age, the practice of evidence-based decision making (EBDM) is still hindered by many important barriers related to the decision makers, to the evidence *per se* or to the health system. Some of these barriers, particularly those related to the distillation, dissemination and packaging of research evidence, could be overcome by recent and ongoing developments in portable/wearable computers, internet appliances, multimedia and wireless broadband internet traffic. This article describes specific EBDM-related tools, with emphasis on internet-enabled “how to” books; and tools to improve the quality of reporting research, to formulate questions; to search for evidence; to access journals, systematic reviews and guidelines; to interact with organizations promoting EBDM; and to tailor evidence to individual cases. However, thinking that all barriers to the practice of EBDM could be solved by fancy information technology is naïve. Barriers related to the generation, interpretation, integration and use of the evidence demand more complex and perhaps unfeasible solutions, as overcoming them will require substantial changes in the structure of the health system, in the politics of science and in the way in which humans think and behave.

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We all want to make decisions that are based on the best available knowledge. However, keeping up with existing and new knowledge is not an easy task. Each year, the body of literature on asthma expands by thousands of new articles published in hundreds of journals and books and, increasingly, on the internet. Because of the speed with which the literature is growing and the limited availability of resources, most clinicians, researchers and patients may never benefit from the information that could best guide their decisions.

The need to handle information in efficient and responsible ways is what motivates the supporters of evidence-based decision making (EBDM), a process that involves the explicit, conscientious and judicious consideration of the current best available evidence from research to guide health-care decisions (1). There are other related terms, most of which are used interchangeably. The first term used, *evidence-based medicine*, referred primarily to physicians and medicine (2). Other terms include *evidence-based health care*, which refers to the process in relation to the health care system at large (3); *evidence-based practice*, used by the US Agency for Healthcare Research and Quality (known formerly as the Agency for Health Care Policy and Research) to designate a series of centres in North America, that are producing evidence reports and technology assessments to support guideline development by other groups (4). More specific terms are emerging rapidly. These include

evidence-based management (5); *evidence-based nursing* (6); *evidence-based mental health* (7); and so on. Not surprisingly, *evidence-based child health care* has been already introduced into the health lexicon (8).

Regardless of the term or focus, the process of EBDM includes the following steps (the description has been modified from another source (9)):

- formulation of answerable questions;
- systematic efforts to locate research evidence that could be used to answer the question(s);
- evaluation of the validity, relevance and applicability of the research evidence identified;
- integration of the evidence, if applicable, with other types of information, the values and preferences of the people involved in the decision, and the circumstances in which the decision is being made; and
- evaluation of the outcomes of the decision and of the decision makers' own performance.

Potential benefits of EBDM in asthma

EBDM could enhance the appropriateness of asthma-related decisions and lead to better patient outcomes, by encouraging the use of interventions of established efficacy and indicating those with dubious effects or clear harm. It could also provide clinicians, patients, policy makers, educators, researchers, funders and other

members of the public with a common platform on which they could interact. In addition, it could improve the efficiency with which health-related resources are allocated, as resources spent on interventions shown to be ineffective are shifted to more effective ones. Some claim that the most important benefit associated with EBDM is its ability to help decision makers identify knowledge gaps, leading to research with maximum validity, precision and relevance to fill these gaps (10). For instance, a systematic review showed recently that most questions around the risk of fetal malformations associated with asthma therapies remain unanswered (11).

Potential dangers of EBDM in asthma

The main dangers associated with the practice of EBDM are related to the manipulation and subversion of the process that generates the evidence or to misuse of existing evidence after it becomes available. Although a detailed description of different sources and types of manipulation and misuse of evidence is beyond the scope of this article, the following is a brief summary of some key issues.

Manipulation during the generation of evidence

Most research tools are very vulnerable to manipulation. The design, execution and reporting of research can be easily “engineered” by the people involved in the research process, to obtain results that meet their needs, expectations or prior beliefs.

The risk of manipulation is likely to increase in direct proportion to the presence and prominence of the following factors:

- a series of interventions that belong to the same group, but that have wide variations in price;
- potentially huge financial gains or losses for industry, depending on the effectiveness and safety of the interventions;
- ambitious researchers with unfulfilled dreams of fame and wealth;
- patients desperate for a cure; and
- a government or health-care provider organization desperate to cut costs.

The treatment of asthma provides ideal conditions for manipulation of research. Although manipulation can be detected easily in many cases, it can be impossible to detect, particularly when it is the result of small, very creative and subtle efforts at different points during the research process.

Misuse and abuse of EBDM after the evidence is generated

EBDM can be abused by almost any decision maker at any step of the decision making process. One frequent form of misuse takes place when a person decides to pay

attention only to research evidence that supports his or her prior beliefs or expectations, overriding all contradicting evidence or other sources of information. For instance, sensation-seeking journalists can portray a weak piece of evidence as a “breakthrough” to make a good case for a headline. One form of abuse particularly feared by clinicians relates to the interpretation of lack of evidence of effectiveness as evidence of lack of effectiveness. In these cases, payers may decide to fund only those treatments supported by strong evidence in order to save money or increase profits. The practice of EBDM can also become cult-like. Some decision makers may be willing to adhere to research evidence blindly, applying it in circumstances where it may not be appropriate while ignoring its limitations, the role of other types of information and the values and preferences of other decision makers (10).

These dangers may explain, at least in part, the resistance experienced by some decision makers in relation to the practice of EBDM.

Barriers to the practice of EBDM

Although EBDM has been generally assumed to be a “good thing”, its putative benefits have never been tested empirically. In addition, despite worldwide efforts to promote and implement it, EBDM has had a remarkably small impact on “real-world” decisions.

The relatively small impact of EBDM could be attributed to the existence of a series of barriers that hinder its implementation. These barriers could be associated with the decision makers, the evidence *per se*, and the health-care system. In theory, the introduction of effective and efficient strategies to minimize or eliminate these barriers would result in the rapid adoption and application of the principles of EBDM.

The following is a brief discussion of some of the most prominent barriers that hinder the practice of EBDM in asthma. They have been adapted from another source (10).

Barriers related to the decision makers

Despite the impressive efforts of the past 20 years to improve the use of evidence in decisions, there are still many barriers shared by all decision makers. Some are more prominent among health-care providers, while others are more important among those who lack clinical training, such as consumers, journalists, lawyers and planners. Although they are likely to affect all groups of decision makers, the barriers presented below do not affect all decision makers in the same way or order.

Some of the most important barriers to the practice of EBDM from a decision makers’ perspective include:

- *Lack of awareness*: some decision makers may not know about EBDM, and if they do, they may have a poor

understanding of it and therefore not realize its full benefits. Lack of awareness is likely to affect more those decision makers that do not have formal training in health and health-care issues.

- *Lack of time*: this is an important barrier that affects mainly the health-care providers. Most clinicians, for instance, are facing increasing workloads and are seeing how the amount of time available to study and to keep up to date is shrinking rather than expanding. This is compounded by the lack of reward systems that foster the practice of EBDM. With the advent and rapid growth of the internet, many patients are now having more time to explore the available research evidence than the clinicians involved in their care. Although rigorously generated data are not yet available, it appears that clinicians are often finding themselves upstaged by patients who bring along internet downloads with research evidence related to their medical conditions and treatments (12).

- *Lack of motivation*: some decision makers, even if aware of and with time to engage in EBDM, may not feel motivated to practise it. This could be explained, among other reasons, by their lack of trust in research and the whole EBDM approach, or by their perceived lack of skills to practise EBDM efficiently.

- *Inadequate skills and resources to access the evidence*: most decision makers, including prominent clinicians, have never had the opportunity to participate in courses and practical sessions on how to search the biomedical literature. Even if they did have such opportunity, most decision makers are unlikely to have access to programmes designed to maintain these skills and keep up with the developments in bibliographic databases. In other cases, particularly in developing countries, decision makers may have the skills but no access to sources of research evidence, namely computers, bibliographic databases or even journals.

- *Limited critical appraisal skills*: few decision makers have received formal courses on how to judge the validity and relevance of research evidence. Even if they had, the effects of such courses are still unclear (13).

- *Limited knowledge about how to integrate research evidence with other types of information*: research evidence is just one of many different types of information that decision makers can use to support and guide their decisions. Most people are likely to be influenced, to various degrees, by clinical, political, financial or anecdotal information. The interaction between different types of information in health-care decision making is perhaps as complex and poorly understood as the interaction between information, values, preferences and circumstances.

- *Limited knowledge about how to integrate research evidence with the values, preferences and circumstances of the decision makers*: planners, politicians, administrators, physicians, nurses, patients and the public base health-care decisions on external circumstances (such

as setting, financial and other resources available, marketing efforts by industry and the political climate) and internal circumstance (individual priorities, values, potential personal gains and losses and feelings about what is or is not important). Little is known, however, about the complex interaction among these factors. In particular, we have a poor understanding of how different types of information modulate each other, and how they are filtered by the values and preferences of the decision makers, and the circumstances under which decisions are made.

- *Poor understanding of the interaction between EBDM and other “ways of knowing”*: it could also be argued that the lack of impact of EBDM is best explained by the extent to which nonevidential factors influence decisions. These factors, which the traditional approach to EBDM does not address satisfactorily, include other very powerful “ways of knowing” that are essential to the decision making process, such as personal experience, rules of thumb and what is commonly labelled as “instincts” or “intuition”.

- *Poor understanding of the interaction among different decision makers*: the lack of understanding of the interaction among the different factors that influence decisions *within individual decision makers* makes it even more difficult to understand the interactions *among different decision makers* participating in the same decision.

Barriers related to the evidence

Even if decision makers have optimal skills to practise EBDM, they would face many barriers emanating from the current status of research evidence. Some of the most prominent evidence-related barriers include:

- *Abundance*: the amount of research evidence that is being produced in the world makes it impossible for any decision maker to keep up to date or even more importantly, to find valid and clinically relevant material in the overwhelming body of literature. In April 2000, a search of the Cochrane Controlled Trials Register, the largest collection of clinical trials in the world (see below), found that “asthma” was mentioned in more than 6000 citations or almost 2.5% of the total number of clinical trials identified to date. Clinical trials, of course, are just one of many research approaches that could be used to study asthma-related issues.

- *Poor internal validity (great risk for bias)*: as mentioned above, human beings are prone to bias. Empirical research, for instance, has shown consistently that most clinical trials exaggerate the benefits of treatments studied (14). Several factors contribute to this exaggeration of benefits. Many studies are designed, conducted and reported by researchers whose careers are closely linked to the interventions they evaluate. Most patients want interventions to be effective.

Funding is often provided by organizations that thrive on breakthroughs and positive results. The latter is particularly true for studies funded by pharmaceutical companies (15), which represent a substantial proportion of the total volume of research evidence available.

- *Limited relevance*: many research efforts fail to meet the needs of clinicians, policy makers and patients because they are designed to meet the needs of academics, funding organizations and regulatory agencies. Few studies include measurements of quality of life, patient preferences or the resource implications of interventions, and few last long enough to produce clinically meaningful answers. Most studies do not express their results in ways that clinicians, patients and policy makers can apply easily to their decisions, and are inadequate to help clinicians and patients select treatments among many options that have never been compared directly. We cannot afford to perpetuate this situation.

- *Limited precision*: most studies are too small to provide precise answers, particularly around adverse effects.

Barriers related to the health-care system

The barriers imposed by the health care system are very strong and without exception present all over the world. One of the most important barriers is the lack of financial incentives for clinicians, planners and policy makers to participate in EBDM. In the case of clinicians, for instance, performance tends to be judged by the number of patients they see and the resources they generate, rather than on their efforts to make decisions based on the best available evidence. Another important barrier is the lack of tools that could help decision makers to access and use the best available evidence to guide their decisions, at the right time, in the right place, in the right format and at the right speed. Most clinical settings, for instance, were designed and built before the era of the World Wide Web. Many settings, on the other hand, have to cope with rapidly increasing workloads that make it even more difficult to introduce information technology that could support EBDM.

Overcoming the barriers: the tools of the trade

As highlighted above, the fate of EBDM will depend, to a great extent, on the availability of effective and efficient strategies to minimize or eliminate the existing barriers faced by decision makers in the real world. Until recently, there were few solutions in sight.

Since the last decade of the 20th century, developments in information technology are allowing the creation of tools with unprecedented power that could foster the practice of EBDM. Some of these tools have been designed to help decision makers formulate answerable questions; find research evidence which

may answer them; appraise such evidence; consider its validity, relevance and applicability; and use and share the best available knowledge at the point of decision making (1).

The remainder of this article will provide a description of some of the most prominent tools for the practice of EBDM, with a focus on child health and the management of asthma in children. Emphasis has been placed on resources that are available on the internet, mainly free of charge.

How-to books

There are over 100 textbooks whose main purpose is to provide basic concepts and tools to support people interested in the practice of EBDM. For the purposes of this article, two books have been selected; one because it covers a wide spectrum of basic issues of EBDM and the other because it is available, free of charge, on the internet. A more extensive list can be found at the BMJ bookstore, one of the most comprehensive online resources to identify books on the basic principles of EBDM (16).

Evidence-based medicine: how to practise and teach EBM. This pocket-sized book is the best-seller in this field. Now in its second edition, this book contains 260 pages and a free CD-ROM produced by five of the foremost proponents of EBDM in the world. A description of the contents of the book is available on the internet (17).

Written for the practitioner, this short and highly practical book makes a strong case about the feasibility of the practice of EBDM in busy clinical environments. The chapters cover the whole spectrum of clinical practice and also practical tips on how to formulate answerable questions and find the best evidence to answer them. The accompanying CD-ROM contains background papers from 14 other health disciplines, clinical examples and extended descriptions (including sample Web pages) of several key evidence sources, some of which are targeted specifically to child health or provide access to tool for handheld devices (18).

Randomized controlled trials: a user's guide. This book contains eight chapters with answers to the 100 most frequently asked questions about randomized controlled trials (RCTs) and EBDM. It is included in this article because it is now available on the internet, full text and free of charge (19).

Tools to improve the quality of reporting of research

Authors interested in reporting RCTs and systematic reviews can find checklists and flowcharts prepared by international collaborative efforts (20, 21). Similar efforts are under way to assist and improve the reporting of other types of research articles.

Tools to formulate answerable questions

The formulation of answerable questions is one of the most important, and yet overlooked and underestimated, aspects of EBDM. Under ideal circumstances, the practitioner of EBDM should be able to assemble questions that include information on the broad characteristics of the participants (i.e. children between 8 and 12 years of age), the condition (i.e. mild asthma), the setting (i.e. school), the interventions (i.e. inhaled steroids) and the outcomes (i.e. compliance) (22). Educational resources and tips on how to formulate questions can be found elsewhere (23).

Tools to search for research evidence

Tools to access MEDLINE on the Internet. MEDLINE became available on the Internet, free of charge, in 1997 (24). This service, also known as PubMed, includes refined search strategies for optimizing searches for clinically useful studies (25). An ambitious (and very controversial) project led by the US National Institutes of Health aims at extending access to the full text of articles published in peer-reviewed journals, free of charge, on the internet. If successful, this project (also known as PubMed Central), will provide links to PubMed abstracts of the references used in the articles, figures sized for on-screen viewing and support for supplementary information such as data tables, streaming video and high-resolution images (26).

Free access to journal contents

While PubMed Central evolves to include all journals in biomedical sciences, many individual journals are already making their contents available free of charge on the internet. There are several collections of asthma-related journals available online on the internet (27, 28).

A new breed of internet-based journals is emerging. These are journals that are produced and disseminated entirely through the internet. An example is BioMed-Central (29).

Appraisal tools

Validated tools to appraise evidence. There are several validated tools to assess the quality of RCTs, systematic reviews and clinical practice guidelines (30–32).

The CATMaker. This is an internet-based software tool that helps clinicians produce short summaries of articles on clinically relevant topics, known as “critically appraised topics” (CATs). These CATs can then be used and enhanced by the clinician who produced them or by colleagues who come across the same clinical issues and relevant publications elsewhere. The CATMaker is associated with a CATbank, a storage and retrieval

facility for a collection of CATs available on the internet (33).

The tool includes the following functions:

- prompts clinical questions, search strategy and key information about any relevant study found;
- online critical appraisal guides for assessing the validity and usefulness of the study;
- automatic calculation of clinically useful measures (and their 95% confidence intervals);
- assistance to formulate clinical “Bottom Lines” from the study once it is read;
- creation of one-page summaries (CATs) that are easy to store, print, retrieve and share (as both text and HTML files);
- reminders on when to update each CAT; and resources on how to teach others how to practice EBM.

Evidence-based publications

This is a group of secondary or “new breed” publications that perform the initial sorting of evidence using explicit methods to identify valid and clinically useful articles from a large number of journals, and then provide concise informative titles, abstracts and commentaries that help readers discern whether the information applies to their own decisions. Surprisingly, these publications are typically thin and relatively infrequent in publication (e.g. bimonthly or quarterly), reflecting the fact that a very small proportion of the literature is really worth reading. *ACP Journal Club (ACPJC)*, the first of these “evidence-based” publications, appeared in 1991. It was followed by *Evidence-Based Medicine (EBM)* in 1996 and *Evidence-Based Nursing* and *Evidence-Based Mental Health* in February of 1998. Similar journals are already emerging in many other areas in health care.

Bandolier, another important member of this group of tools, is produced monthly by the Oxford Anglia NHS Region in the United Kingdom (34). It contains very useful “bullet points (hence Bandolier) of evidence-based medicine”, which are available on the internet, free.

Specialized compendia of evidence for clinical practice

Three superb examples are the Cochrane Library, Best Evidence and Clinical Evidence.

The Cochrane Library. This is the main product of the Cochrane Collaboration, an international organization that aims to help people make informed decisions about health, by preparing, maintaining and ensuring the accessibility of rigorous, systematic and up-to-date reviews (and where possible, meta-analyses) of the benefits and risks of health-care interventions (35). The rapid growth and recognition of the Cochrane Collaboration has been due, to a great extent, to its extensive use of the Internet to provide interested individuals with access to

manuals, tools and training materials to facilitate the design and conduct of the reviews, easy access to the reviews, and continuous open peer-review (1).

The Cochrane Library is a regularly updated electronic library designed to give decision makers the evidence they need to make informed health-care decision making, with special emphasis on data from RCTs. Launched in April 1995 as the Cochrane Database of Systematic Reviews (CDSR), it was renamed to reflect the inclusion of additional important related databases, making it perhaps the most comprehensive source of evidence for all those interested in EBDM. The Cochrane Library is issued quarterly and contains general information on the Cochrane Collaboration, a handbook on how to conduct systematic reviews, and the following four databases:

- *The Cochrane Database of Systematic Reviews (CDSR)*: this is a rapidly growing collection of regularly updated systematic reviews of the effects of health care prepared by members of Collaborative Review Groups. It also includes protocols of reviews in progress. A search of the Cochrane Library in March of the year 2000 revealed 59 completed reviews and 58 protocols under development by members of the Cochrane Collaboration (35). In a recent review of systematic reviews and meta-analyses on the treatment of asthma, Cochrane reviews were shown to be more rigorous than those published in paper-based peer-reviewed journals (36).

- *The Database of Abstracts of Reviews of Effectiveness (DARE)*: this is a database of structured abstracts of thousands of systematic reviews from around the world, all of which have been completed outside of the Cochrane Collaboration. These reviews have been approved by reviewers at the National Health Service Centre for Reviews and Dissemination at the University of York, England. DARE also includes brief records of reviews that may be useful for background information, abstracts of reports of health technology agencies worldwide, and abstracts of reviews in the journals *ACP Journal Club* and *Evidence-based Medicine*. In March 2000, DARE included information from 35 reviews related to asthma.

- *The Cochrane Controlled Trials Register*: this is the most comprehensive collection of RCTs in the world, which results from worldwide ongoing searches of the biomedical literature, using manual and electronic means. As mentioned above, this database included over 6400 citations related to asthma in the first issue of the Cochrane Library of the year 2000.

- *The Cochrane Review Methodology Database (CRMD)*: this is a database that contains hundreds of citations of articles on the science of research synthesis and on practical aspects of preparing systematic reviews.

The Cochrane Library is available on CD-ROM for Windows and Macintosh and should be regarded as an

evolving product. More details on the Cochrane Library and on distributors can be found on the internet (35).

Best evidence. This is an easy-to-search database that includes the contents of all the issues of the journals *ACP Journal Club* and *Evidence-based Medicine* (37).

Clinical evidence. This is a new addition to this group (38). It is a 6-monthly updated compendium of evidence behind common clinical interventions and practices, produced jointly by the BMJ Publishing Group and the American College of Physicians – American Society of Internal Medicine. It provides “a concise account of the current state of knowledge, ignorance, and uncertainty about the prevention and treatment of a wide range of clinical conditions based on thorough searches of the literature”. The producers emphasize that *Clinical Evidence* is not a textbook of medicine nor a book of guidelines. It summarizes the best available evidence, and where there is no good evidence, it says so. The entire contents of *Clinical Evidence* will be available on the Internet shortly.

The National Guideline Clearinghouse. The National Guideline Clearinghouse™ is an internet-based public resource that enables access to evidence-based clinical practice guidelines and that allows comparisons of recommendations produced by different organizations in North America (39).

The National Guideline Clearinghouse™ (NGC) is a comprehensive database of evidence-based clinical practice guidelines and related documents produced by the Agency for Healthcare Research and Quality (AHRQ) (formerly the Agency for Health Care Policy and Research [AHCPR]), in partnership with the American Medical Association (AMA) and the American Association of Health Plans (AAHP).

The NGC mission is to provide physicians, nurses and other health professionals, health-care providers, health plans, integrated delivery systems, purchasers and others an accessible mechanism for obtaining objective, detailed information on clinical practice guidelines and to further their dissemination, implementation and use. Key components of NGC include:

- structured abstracts (summaries) about the guidelines included and their development;
- a tool for comparing two or more guidelines side-by-side;
- syntheses of guidelines covering similar topics, highlighting areas of similarity and difference;
- links to full-text guidelines, where available, and/or ordering print copies;
- an electronic forum, NGC-L, for exchanging information on clinical practice guidelines, their development, implementation and use; and
- annotated bibliographies on guideline development methodology, implementation, and use.

Collections of websites of resources and organizations supporting EBDM

These are Internet-based “look up” services that provide access to evidence-based information and to sites that support EBDM. Examples include the Center for Evidence-based Child Health Web site; The Health Information Research Unit at McMaster University; The Center for Evidence-based Medicine, Mount Sinai Hospital and University Health Network, University of Toronto and Netting the Evidence (8, 40–42).

Tools to tailor evidence to individual patient characteristics

There is a proliferation of Internet “calculators” designed to match unique individual profiles with an underlying evidence-based knowledge repository and sources of potential feedback. Examples include tools for morbidity risk assessments, drug dosing and delivery of up-to-date evidence-based care recommendations, all tailored to a person’s unique values, preferences and circumstances (1). To increase compliance with the recommendations, the Internet can also be used to deliver reminder messages to providers and consumers.

Looking ahead: beyond text, desktop computers and providers

To date, most efforts to promote EBDM have been text-based and focused on the needs of health providers. Until now, text has been the most efficient way for humans to disseminate scientific information. With the rapid evolution of information technology we already have tremendous opportunities to exchange research evidence using formats that are more consistent with our human nature. If current trends in the development of multimedia and broadband communications continue, it will soon be possible to anyone to produce and receive knowledge involving visual, auditory, tactile and even olfactory stimuli. These new modalities of communication may provide the long awaited solutions to increase the level of functional health literacy among the public, which are alarmingly low even in developed countries (43).

Thanks to existing and ongoing developments in portable and wearable computers, internet appliances (e.g. fridges with internet access) and wireless networks, all groups of decision makers now have the opportunity to exchange knowledge to and from anywhere in the world. Clinical settings and homes are rapidly becoming knowledge management centres. This is creating unprecedented opportunities for new partnerships between health-care providers and the public (44, 45). However, the rapid proliferation of consumer-orientated communications technology is also creating important threats to the traditional role of the health-care system and its professionals, who will lose their “mind share” unless they take

effective measures to keep up with the changes in the world around them (46).

All these changes will have a profound effect on the management of diseases of childhood. With the rapid proliferation of access to the Internet at home and at schools, there will be an increasing number of opportunities to engage parents and children in the decision making process (47). One example of this is LinkMedica’s Knowledge Management Center, a joint effort by industry, patient groups and academics, to provide people affected by asthma with access to interactive glossaries and multi-level summaries of the best available evidence on the management of asthma (48). Another good example is that of interactive evidence-based stories designed to help children with asthma, their parents and teachers to learn about asthma and to access the best available knowledge through the internet. The story, entitled “Mr Knowsit learns about asthma” includes a cartoon character with insatiable curiosity, Mr Knowsit, who helps readers bring intuitive insight, their own values, the experience of others, research evidence and internet technology together, to contribute to their learning process (49). It is through initiatives such as these that children could become familiar with basic principles of health-related decision making and research evidence and obtain high levels of health literacy. If efforts such as this succeed, children will be in a better position to participate in health-care decisions that affect them directly. Interventions targeting children may also have long-lasting effects that could reduce the need for additional education and reinforcement once they become adults, leading to potentially stronger collaborative efforts with future generations of children and parents.

Closing remarks

At the dawn of the Information Age, the practice of EBDM is still hindered by many important barriers. Some of these barriers, particularly those related to the distillation, dissemination and packaging of research evidence, could be overcome by recent and ongoing developments in virtual reality, portable/wearable computers, internet appliances, multimedia and wireless broadband internet traffic. Thinking that all barriers to the practice of EBDM could be solved by fancy information technology is naive. Barriers related to the generation, interpretation, integration and use of the evidence demand more complex and perhaps unfeasible solutions, as overcoming them will require substantial changes in the structure of the health system, in the politics of science and in the way in which humans think and behave.

Note added in proof

For biographical details of the author, please visit http://www.uhnres.utoronto.ca/ehealth/html/who/eh_who_bio_jadad.shtml.

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