EVIDENCE-BASED CARE AND THE CURRICULUM

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Abstract

An evidence-based approach has been a significant driver in reforming healthcare over the past two decades. This change has extended across a broad range of health professions, including oral healthcare. A key element in achieving an evidence-based approach to oral healthcare is educating our practitioners, both current and future. This involves providing opportunities integrated within simulated and actual clinical settings for practitioners to learn and apply the principles and processes of evidence-based oral healthcare (EBOHC). Therefore, the focus of this discussion will be on ways in which EBOHC and associated research activities can be implemented into curricula, with the aim of improving patient care. The paper will initially define the scope of EBOHC and research, what these involve, why they are important, and issues that we need to manage when implementing EBOHC. This will be followed by a discussion of factors that enable successful implementation of EBOHC and research into curricula. The paper concludes with suggestions on the future of EBOHC and research in curricula. Key recommendations related to curricula include: strengthening of the culture of a scientific approach to education and oral healthcare provision; complete integration of EBOHC into the curriculum at all levels; and faculty development to implement EBOHC based on their needs and evidence of effective approaches. Key recommendations to support implementation and maintenance of EBOHC include: recognition and funding for high quality
systematic reviews and development of associated methodologies relevant for global environments; building global capacity of EBOHC researchers; research into improving translation of effective interventions into education and healthcare practice, including patient reported outcomes, safety and harms, understanding and incorporation of patient values into evidence-based decision-making, economic evaluation research specific to oral healthcare, and effective methods for changing practitioner (faculty) behaviours; and extend access to synthesised research in ‘user friendly’ formats and languages tailored to meet users’ needs. Realising these recommendations may help to improve access to effective healthcare as a basic human right.

Introduction

Over the past two decades there has been a concerted push internationally to reform healthcare to improve patient care outcomes within the context of changing health systems (1). This is consistent with a major focus of the United Nations of achieving access to effective healthcare as a basic human right. One of the essential factors to achieve improved patient care is through changes in healthcare education (1). Therefore, key competences identified for all members of healthcare professions’ education that aim to improve patient care and health of communities, include embracing evidence-based healthcare as well as participation in research activities (1-4). Thus, the focus of this discussion will be on how evidence-based healthcare for patients and communities, specifically evidence-based oral healthcare (EBOHC) and research can be implemented into dental curricula, with the aim of improving patient care and health of communities. The paper will initially define the scope of EBOHC, research and curricula, what these involve, and why they are important. This is followed by discussion of the origin of evidence-based (EB) healthcare, the broad context in which EB healthcare is located and issues that need to be managed when implementing EBOHC. There is a discussion of factors that enable successful implementation of EBOHC and research as well as outcomes of curricula that have embraced these approaches. The paper will finish with suggestions on the future of EBOHC and research in curricula and makes recommendations.

What do we understand by evidence-based oral healthcare, research and curricula?

Evidence-based oral healthcare

For the purpose of this discussion, EBOHC is considered to require the integration of three domains when making clinical and community health decisions (Fig 1). Specifically, these domains include: patients’ biologies, preferences, values and expectations; the clinician’s expertise, including skills to perform patient care, and experience to recognise their individual patient and population needs; and the best available research evidence (5). In this paper evidence as a part of EBOHC is understood to be inclusive of the best research evidence appropriate to the healthcare question. If, however, evidence is not accessible or appropriate to the setting, then the best available knowledge is used. A key characteristic of EBOHC that distinguishes it from the use of research evidence in conventional healthcare settings is the acknowledgement of strengths and limitations of evidence - the acceptance of uncertainty, drawing on all available data where feasible and reducing bias in data synthesis (6). It also needs to be recognised that evidence is dynamic and needs to be contemporary to be useful. Thus, the overall aim of a practitioner
applying EBOHC is to make decisions in collaboration with the patient and/or the community to achieve the most favourable oral health outcomes ‘within the context of available resources’ (5, 7, 8 p4).

Fig 1. Evidence-based healthcare and the patient-clinician encounter (9).

For this discussion, it must be stressed that EBOHC is not considered to be the simple application of results of randomised clinical trials, systematic reviews or evidence-based clinical guidelines in isolation to the care of patients or communities: it is not ‘cookbook healthcare’ (6). Critical thinking and analysis of research are vitally important aspects of EBOHC, but they are not in themselves EBOHC. The synthesis of research evidence is not designed to dictate healthcare, but rather to facilitate the incorporation of ‘best available, current, valid and relevant evidence’ for the care of our individual patients and communities. For example, the best evidence may not address key clinical outcomes that are needed in decision making processes, such as patient views or the probability of achieving a benefit (or avoiding harm) each time a procedure is performed (6) or the costs or resources available for patient or population care (10). Therefore, EBOHC is a complex process, drawing on a range of evidence to inform healthcare including assessment of risks.

For the purpose of this paper, the process of EBOHC is summarised as follows:

- evaluate patient or community needs;
- identify an uncertainty or gap in understanding resulting in a need for clinical information followed by the development of a focussed, answerable question derived from defining the patient, the need for intervention, alternative interventions and possible outcomes;
- search for the best evidence;
- critically evaluate the collected evidence, appropriateness of the methodology used, applicability to the patient’s or community’s needs and degree of change;
- integrate the evaluated evidence with own experience and expertise, patient’s or community’s needs and available resources to inform decisions on the range of options for the patient or community to consider;
- evaluate EBOHC approach used and outcomes of decisions made (5-6, 8).
**Research**

The issue of promoting research in the curriculum was discussed at the previous DentEd Global congress (11). In the present paper, the scope of research within the curriculum will be restricted to the contexts of students using research (including systematic reviews) as part of an evidence-based approach to oral healthcare as well as participating in research that contributes to EBOHC. These latter activities might involve students participating in clinical research projects that utilise recognised study designs and methods (6) that can contribute best evidence for critical review by practitioners (and themselves). Other research activities could involve participation in the development of other EBOHC resources, including critically appraised topics (5) or systematic reviews (12) or translational research that is necessary to assist in a more rapid uptake of an evidence base through participation in practice-based research networks (13). It is noteworthy from the description of the EBOHC process (Section: Evidence-based healthcare), that there are strong parallels between the EBOHC process above and the scientific method.

**Curriculum**

Throughout this paper, reference to curricula refers to all levels of oral healthcare education, namely, undergraduate, postgraduate and continuing education for all members of the oral healthcare team. The term curriculum can have different meanings - product or process (14). For those with a product focus, the curriculum means a unit or programme outline that defines the content and directs students learning (14). For those with a process focus, the curriculum frames the learning environment, has a strong focus on processes of learning, and students and teachers collaborate, communicate and challenge each others’ understandings (14). These different meanings influence the educational approach developed for students: a shared language is therefore needed for effective curriculum development (14). For the purposes of this paper, a process-focus will be used as it is clear that the processes of EBOHC are important for implementation of EBOHC in practice.

**Why is an evidence-based oral healthcare approach important?**

As noted in the introduction, implementation of EB healthcare has been identified as a key outcome of healthcare professions education with the aim of improving patient care outcomes (1). An EB approach refers both to health-oriented and disease-oriented matters and has an impact at several aspects in the healthcare system, therefore its importance will be discussed under the following headings: patients and communities, students and practitioners, scientific, societal and financial.

**Patients and Communities**

A core aim of EB healthcare is that patients and communities receive better care resulting in improved outcomes through the use of EB research and guidelines in practice, resulting in a stronger scientific basis for health-oriented decision-making. This in turn results in ‘consistency, efficiency, effectiveness, quality and safety in healthcare’ (summarised in 5, 15 p 19). While there is growing evidence of effective practitioner behaviour change that has positive impacts on patients in healthcare (16), the realisation of this aim is not as widespread as needed (17) and this limitation in improving patient care is evident in oral healthcare and oral healthcare education (18-22). For example, studies show that as a result of a variety of practitioner and/or patient-related factors, patients continue to receive variable
medical or dental interventions (18, 23, 24) that may be unnecessary or even harmful (25). For oral healthcare, management does not necessarily reflect current understanding of the disease processes or is not consistent with guidelines for current recommendations for prevention or treatment (19, 26, 27). Systematic analysis of how the use of evidence impacts on patient care outcomes in oral healthcare is limited. There is some evidence that changes in provision of oral healthcare do not necessarily parallel research evidence on appropriate patient management (27 ERUPT project, cited in 28). There is, therefore a need to address the application of available evidence in clinical and health-oriented decision-making in oral healthcare by practitioners and students.

The informed patient has a critical role to play in EB healthcare in terms of contributing to decision-making as part of the standard informed consent process in healthcare. EB healthcare aims to support patients to be better informed and understand interventions (health promotion, prevention, diagnosis, treatment) through accessing where possible, online literature and databases, resulting in the provision of ‘independent and validated advice’ (7 p1035). For example, improvements in preventive approaches have been reported with increased rates of screening and vaccination in association with patients reminding their practitioners (reviewed in 17). Evidence of better informed patients is, however, equivocal and does not consistently result in the use of available evidence to inform clinical decisions, often due to patient preferences (25, 29). This is particularly relevant if patients access the plethora of non-scientific ‘evidence’ available on the internet. These studies (25, 29) highlight the need for the education of students and practitioners to effectively use and communicate evidence for the care planned to their patients. This needs to be completed in conjunction with working with patients to understand and acknowledge their values, which can be facilitated by story-telling (7), to arrive at a joint decision based on evidence (30). It is acknowledged however, that in time-pressured clinical settings, developing an understanding of patient values and communicating complex options is time-consuming (31) and therefore, other team members may be utilised to address this critical aspect of EBOHC. Recommendations for patients that discuss risks and benefits and decision aids to support patients’ understanding of treatment options are being used effectively in medicine, in particular, for ‘preference-sensitive’ treatments (32 p716). These recommendations are likely to be valuable in oral healthcare (33), however, literature on the use of such recommendations in oral healthcare remains limited.

**Students and Practitioners**

Educating students (and graduates) in EB healthcare, using the steps outlined in Section: Evidence-based oral healthcare supports the development of several core competences necessary for contemporary practice, namely, skills critical for lifelong learning (34). These skills include: self-assessment skills to identify gaps in knowledge and strategies to address these gaps; information literacy and critical appraisal skills; and communication and clinical skills for working with patients and understanding their needs and values. By supporting the development of these skills, EB healthcare provides an approach to assist students (and graduates) to manage the overload of information in healthcare programmes (35). One of the key foci of educating students in EB healthcare is to enable them to be ‘users of research’ rather than specifically ‘producers’ of research (35). The development of lifelong learning skills are considered critical to ensure patient safety through the student (and graduate) keeping up to date with developments in causes, diagnosis, prevention and management of oral health problems (36, 37). The EB healthcare process also provides students and practitioners with supported opportunities to learn to deal with
the uncertainty of clinical decision-making, where ‘frequently no “correct” decision exists’ (8 p2). Use of outcomes from research can assist with aspects of these uncertain decisions as part of the EBOHC process (8).

Scientific

With the continual publication of health-related research, EB healthcare can help practitioners manage overload of information. EB healthcare has lead to the development of collaborations for systematic reviews that facilitate students’ and practitioners’ use of evidence to inform decision-making for healthcare procedures and related outcomes. Professional groups have also been involved in the development of clinical practice guidelines to assist in decision-making processes in support of effective care (15). Another important scientific outcome of an EB healthcare approach has been the identification of areas where future research to support EB healthcare is needed (24, 30, 38, 39).

Other developments include:

- a range of tools and methods to assist in the synthesis of research findings, and critical appraisal of research (e.g. meta-analysis) and hierarchies to assist in the identification of best evidence (40, 41);
- checklists for completion and reporting of randomised controlled trials (CONSORT statement) (42), systematic reviews (QUORUM statement) (43, 44, 45) including guidelines for systematic reviews in education (46) and reporting for primary empirical research in education (47);
- checklists for critiquing diagnostic studies (48),
- statistical methods to manage bias in selection, performance, measurement and publication (6);
- development of criteria for grading the quality of evidence for and evaluation of clinical guidelines (49, 50); and
- development of approaches for transforming data into clinically useful information (6).

Particular to EBOHC, there are also resources and databases available, many online. Examples include the Cochrane Oral Health Group, Centre for Evidence-Based Dentistry, Pan-American Centres for Evidence-Based Dentistry ‘Evidentista’, the International Centre for Evidence-Based Oral Health, and Oral Health Specialist Library as well as journals specific to EBOHC (refer end of paper for details). These resources provide students and practitioners with a synthesis of the best evidence available in the form of systematic reviews or results of trials that they can integrate with the other key elements of EBOHC. Reviewing these resources also supports the practitioner’s continuing professional development. It is noted however, that the current limited availability of evidence-based resources in languages other than English excludes students, educators and practitioners in many parts of the world.

Considering the involvement of students in using, and contributing to research as part of EBOHC within the curriculum, the aim of this participation would be to further support their learning how to practice EBOHC on graduation and if possible, improve the return of graduates to schools as academic staff (12, 51). It is also anticipated that use of and involvement in research can help broaden the scope of understanding of research from the students’ view (52). This has been reported to be limited in different contexts and disciplines (53). Broadening students’ understanding of research should assist students to be part of, and contribute to the development of the scholarly, scientific discipline of oral healthcare (11, 12) through
the transfer of research into practice both during their studies and after graduation. Outcomes from research programs that have involved students in research projects have also had positive impacts on research output of staff (12, 54). These outcomes of student research programmes can therefore, be of value to our schools in the current context of assessing the quality and impact of research output that exists in many countries.

**Societal**

As EB healthcare aims to provide better care with resultant improved patient health outcomes, at the level of society this includes securing the best possible healthcare for groups of patients or populations and in doing so utilising current resources optimally. It is also expected that EB healthcare policy aims to develop decisions for healthcare provision, for example, screening for conditions, in groups of patients or populations (55), based on research, in contrast to input from interested groups (15). As for EB healthcare for individual patients, these decisions are based on healthcare needs for these populations, the available best evidence and the values of these populations (55). Part of the approach at the level of populations involves the social accountability of oral health practitioners and educational institutions, where they work with key players within organisations and society to target priorities, make evidence available and use this evidence to work with these groups in order to address their health issues (15), the environment and their quality of life. In turn, these approaches have implications for the funding available for different healthcare programmes.

**Financial**

Improving ‘value for money’ has dominated health policy debates over the past few decades. A key aim of EB healthcare has been to improve efficacy, which in turn should lead to increased efficiencies (15). These efficiencies should occur through funds being directed away from ineffective clinical practices or practices shown to have no effect, to support practices that have been scientifically shown to be effective (15). As noted in Section: Societal EB healthcare, in particular, in the form of decisions made for groups of patients or populations, e.g. screening decisions for age groups, has a financial impact ‘through maximizing the value from available resources’ (55 p988). But as costs of healthcare continue to rise, approaches are required to spend the limited funds, based on evidence of their effectiveness. For example, there is evidence that the implementation of evidence based-practices can lead to cost savings - one preventive approach for caries (application of fluoride varnish) was effective in reducing costs of care (56). Some critics, however, consider an EB approach to healthcare is a ‘form of rationing’ of resources (55 p988), notwithstanding the possibility that best evidence may indicate the adopting of a more expensive form of treatment than currently practised.

Other financial implications of EB healthcare include the focus of third parties (insurers, managed care organisations and employers) on the use of clinical practice guidelines as a means of reducing costs of healthcare (57). Cost reductions might be achieved through changing clinicians’ behaviours and/or limiting treatments, and therefore, diminish clinicians’ autonomy (15). In medical and oral healthcare, however, the widespread use of available guidelines can be limited (25, 26, 27) and so the impact of financial incentives/costs linked to guidelines is unclear. The influence of this approach by third parties to managing the costs of oral healthcare may differ as the funding and organisational structures differ to that of medical care in
Chapter 1.3                            Global Congress on Dental Education September 2007

many countries (13, 58). It is clear, however, that there is a need to address the economics of oral health and EBOHC in terms of costs-benefits (24, 59) and/or the operator for delivery of oral healthcare needs to be analysed (56) and debated. Another area that needs to be investigated includes the impact of financial incentives on the implementation of evidence in clinical decision-making in oral healthcare (ERUPT, 2006, cited in 28). The health economics of oral healthcare should also be included in the curriculum, as part of the analysis of evidence to inform clinical decision-making.

What is the origin of EB healthcare?

Following on the discussion of what EBOHC is and its value, it is useful to consider the evolution of EB healthcare. The modern origin of EB healthcare arose from developments in clinical research since the 1960s resulting in the need to apply this growing research evidence to inform and influence practice in areas of diagnosis, treatment and prognosis (60). The critical evaluation and use of research evidence in healthcare practice was a major driver for the shift to EB healthcare (8). This paradigm shift was initially elaborated by an international group of physicians from Canada, US, and France, many from McMaster University (60). A major focus of the Evidence-Based Medicine Working Group (60) was on the education of physicians to practice evidence-based medicine, including developing the necessary skills of identifying areas of uncertainty, often where there is a range of opinions or options in patient care, defining an answerable question related to a patient’s problem, efficiently accessing, critiquing and interpreting the evidence from the literature and then using this information, in conjunction with their patient’s needs and values, to inform the care provided. One of the key assumptions or planned outcomes of EB healthcare was that of improved patient healthcare and outcomes (60). As noted above (Section: Patients and Communities), improvements in patient outcomes from healthcare are needed.

Since the early 1990s EB healthcare has extended to other professions (8), including oral healthcare. The Cochrane Oral Health Group, established in 1996 arose to assist clinicians in managing the uncertainties of oral healthcare procedures and outcomes (Shaw, 2006, cited in 28). The International Association of Dental Research, Evidence-Based Dentistry Network was established in 2003 to promote and facilitate EBOHC research across the field (refer end of paper for details). As noted previously (Section: Scientific), several developments to support implementation of EB healthcare have followed.

What is the broader context of EB healthcare?

Healthcare Context

As a core aim of EB healthcare is to improve patients’ health outcomes, it is clear that in the broader healthcare context, EB healthcare is one of several approaches that contributes to the quality movement for improving healthcare (61). EB healthcare also interacts with risk-assessment principles, particularly in situations where limited evidence is available, requiring practitioners and patients to make judgements about risks and benefits of prevention, diagnostic tests and/or interventions which may not be fully defined. As a result, practitioners and students need to develop risk-assessment skills and be able to communicate these effectively to their patients to enable informed involvement of patients with clinical decision-making as part of the informed consent process.
**Economics Context**

EB healthcare also exists within the healthcare context of rising costs and issues of variations in care (15, 23) and so intersects with the economics of healthcare. The increasing costs of healthcare have certainly underpinned the interest in EB healthcare from healthcare policy makers. As noted (Section: Financial), ‘value for money’ is a major focus for healthcare policy debates that occur at different levels in healthcare – review of these should be included in curricula to develop students’ understanding of the costs of oral healthcare to individuals and society. A related area of economics that informs EB healthcare is health technology assessment (HTA). HTA is becoming an important activity throughout the world, in particular in some European countries including Denmark, Finland, Norway, the Netherlands, Spain, Sweden and the United Kingdom. HTA is important for informing practitioners and patients (and healthcare policy makers and other third parties) which treatments are more effective than current approaches or doing nothing (62). While studies with a health economic approach are rare within our field, analysis of available studies indicated it was more cost-effective to diagnose and treat risk groups than the average of an age cohort, the choice of diagnostic method affected the treatment costs per tooth saved, and time costs for patients’ attending dental appointments accounted for approximately 25% of all treatment costs (63). While the funding for oral healthcare in many countries differs to that for medicine (58), it is expected that HTA related to health promotion, prevention, diagnosis, and treatment of oral disease will have an increasing impact on oral healthcare decisions.

**Legal Context**

There is also interest in how EB clinical care guidelines might be used in the legal context (64). It is clear that guidelines provide ‘justified, advocated medical standards’ for care, and not legal or definitive standards of care: they provide a point of reference against which healthcare can be judged (64 p1027). It is clear that ‘slavish compliance with evidence-based guidance’ that does not take account of the patients’ needs and values, may not be defensible (64 p1024). A key issue in terms of guidelines being applied as the standards of care is the quality, currency and authority of the guidelines developed: the importance of criteria to evaluate guidelines is clear (48, 64).

**Scholarly Context**

Finally, due to the scientific contribution of EB healthcare, it is clearly situated within the context of scholarly activities that are of particular relevance to our universities. Around the time EB healthcare was first being referred to in the literature (1992), Ernest Boyer published his book on scholarship, broadening the scope of how scholarship needs to be conceived in universities (65). While EB healthcare makes use of the scholarship of discovery (research), it is the application of this research in the healthcare setting, namely the scholarship of application, and how the outcomes of this scholarship can inform discovery, that is the basis of EB healthcare (66). As for all forms of scholarship, a critical element of the scholarship of application is the communication of the findings of scholarly application – this communication is important for the individual researchers, the institution and society in relation to improved healthcare (66). In terms of teaching and the use of an evidence-based approach, this falls under the scholarship of teaching, provided the approach is made
Evidence-Based Approach to Learning and Teaching

In discussing EBOHC and curricula that support the development and practice of EBOHC, it is logical to apply the concept of using an evidence base for educational practice - to evaluate our students needs, define questions, access and critically review best evidence for educational approaches relevant to our educational contexts, and then to use this to inform our practice and evaluate our efforts (68). Currently, there is not a widespread culture of teachers using research to inform their teaching decisions (69, 70) – dental education is no exception (71). Similar to health care, education is pressured by governments and policy makers to ‘do more and more things, to higher and higher standards’, with limited or fewer resources while being accountable (69 p108). As a result, educational approaches do change, often without a sound theoretical and research-based rationale that is founded on critically evaluated evidence that has been organised according to evidence hierarchies (68, 69). Therefore, just as evidence is needed to inform decision making in healthcare settings, application by teachers of educational approaches with sound foundations is essential, particularly given that the quality of care our oral health graduates provide is likely to be related to their education (Chen, 2002, cited in 72). It is noted however, that this relationship between education of health practitioners and positive patient or community health outcomes is indirect (68) and it is difficult to test this relationship (72).

Just as there are critics of EB healthcare, there are critics of an EB approach to learning and teaching, commonly referred to as EB education (EBE). The key issues with EBE relate to a focus only on the practical role of research such that questions that are valued only relate to the effectiveness of educational interventions (70). As a result, this interpretation ignores the varied values of what is wanted educationally and by whom, as well as potentially restricting practitioners’ scope for making judgments that take account of their specific contexts, for example, problems associated with national literacy strategies (70). Just as EBOHC is not ‘cookbook healthcare’ similarly, it is critical that EBE is not interpreted too narrowly with a focus only on ‘what works’, when in fact research of practice only provides knowledge of ‘what worked’ (70 p17). As for EB healthcare, it is the outcomes of these studies that must then be used to inform but not direct our practice (70). Research in education also has a complementary role to these practical outcomes as it helps develop our understanding of our contexts through different interpretations (deVries GH, 1990, cited in 70). It has also been argued that the ‘gold standard’ from healthcare - the randomised controlled trial has limited relevance to educational contexts given the numerous variables that cannot be controlled for, nor explained in educational contexts (73). Just as in healthcare, to prevent a narrow interpretation and application of EBE resulting in restriction of our views and approaches, there is a need to ensure individuals recognise and take account of the factors that impact on the process and outcomes of interventions, including the social, political, moral and cultural aspects of practice, as well as continue to engage in democratic debate of educational practice and policy (70).

Are there limitations in EBOHC?

A range of limitations of EB healthcare (5, 74 p838), which also apply to EBOHC have been identified. These include:
shortage of coherent, consistent scientific evidence;
• difficulties in applying any evidence to the care of individual patients;
• barriers to the practice of high-quality medicine;
• the need to develop new skills in identifying answerable questions, searching for and critical appraisal of the evidence;
• limited time to master and apply these new skills;
• limited evidence of positive patient outcomes following EB interventions; and
• limited access to resources to provide timely access to evidence in clinical settings.

These ‘limitations’ do not relate to the approach but rather the implementation of an EB approach to healthcare. To implement EB healthcare (see next Section), support for practitioners, educators and students is needed to develop skills within integrated settings, and to evaluate available evidence, including information provided to assist in the application of this evidence to individual patients (74). This latter step is critical to provide much needed evidence that EBOHC achieves better outcomes than current alternatives. For example in medicine, there is growing evidence of positive outcomes after interventions at different levels of healthcare delivery that have been shown to work (16, summarised in 25, 56, 75, 76).

While it is clear that the evidence base in oral healthcare is not as developed as in medicine, the limitation of evidence raises other key concepts that students and practitioners need to manage. Specifically, a lack of evidence is not evidence of no effect, and students and practitioners also need to learn to manage uncertainty (6). Drawing on the process of EBOHC (refer Section: Evidence-based oral healthcare), the focus is on best available evidence. A systematic review using a meta-analysis can contribute to estimates of ‘uncertainty and precision of the effect’ while clear delineation of limitations of clinical studies can be useful in identifying the degree of uncertainty as well as potential areas for future research (6 p16). As part of managing uncertainty there is a need to support students to understand and work with the concepts of efficacy and effectiveness and together with EB oral healthcare and risk assessment, these may assist in informing clinical decisions. Otherwise if the definition of appropriate evidence is too narrow, there is a risk of allowing uncertainty to cause paralysis in healthcare or unreasonably abandon EBOHC principles rather than use them to acknowledge and manage uncertainty constructively (5).

Considering the issues raised above, an expectation to locate and critically appraise evidence for ‘all knowledge gaps’ (8 p3, italics in original) is not realistic nor achievable. However, access to rapid critical appraisal, with development of ‘pre-searched, pre-appraised resources’, as may be found in specific journals on EBOHC, provides critical assistance for practicing EBOHC (8 p3; see end of paper for a range of resources). Focusing on questions of the most pertinent needs for patients can also assist in the issue of time limitations (74).

Other criticisms of EB healthcare are really ‘misperceptions’ and arise from ignoring key aspects of the steps in EB processes (74 p839). EB healthcare does not ignore or devalue clinical experience or patient or community values, but rather requires integration of evidence with clinical experience and expertise, and patient’s or community’s values to arrive at informed decisions (31, 74). Another issue that impacts on the practice of EB healthcare is that ‘good science’ can be overridden by political, economic and/or socio-cultural factors (77 p992) that can vary depending on the population involved (reviewed in 25). For example, practitioners may be uncertain
about the value and/or science underpinning recommendations or have difficulty in motivating patients to change their lifestyle (25). There is also the issue of the application of guidelines developed for one population being applied to another population which may have different disease prevalence (78). Both of these issues can be addressed through the development of effective critical appraisal skills and by the use of criteria to evaluate clinical guideline development (48), with subsequent redevelopment of appropriate guidelines for the local context (see Section: EB oral healthcare in emerging economies).

As noted previously, socio-cultural factors that influence the application of evidence in decision-making include patients’ demands for care and their beliefs and perceptions of what is appropriate care. Requests for inappropriate tests/treatments can lead to poor adherence to clinical guidelines (25). The influence of patients’ on their care has been demonstrated in oral healthcare, where treatment philosophies and care provided have resulted in patients’ preferences overriding evidence (29). Therefore, we need to support students and practitioners to develop competence in communication skills related to managing conflict as well as educating patients on the management of their problem (25). This aspect of patient care may be further assisted with the development of decision aids which have been reported to be effective in supporting patients in making informed decisions (32).

What is needed for successful implementation of EBOHC in the curriculum?

How can this be facilitated?

Research into the dissemination and implementation of EB healthcare into curricula has mainly focused on medical education, with very few studies specific to oral healthcare (79, 80). There has, however, also been significant research that has identified factors that are needed to enable dissemination and implementation of EB healthcare and related research into medical practice, with resultant changes in practitioner behaviour (17). The evidence from these studies suggests that strategies addressing all the different levels in clinical practice, namely, patients, practitioners, healthcare team members, and the organisation, are needed for achieving lasting change (17). A range of methods are also required to achieve change in practice behaviour. For example, the availability of clinical guidelines alone is not sufficient to achieve change in practice (25). The outcomes from these studies (reviewed in 17, 25) are of relevance to oral healthcare education as many practitioners also teach students (81) and identified facilitators for change in dental practice (82) are consistent with these studies. Other studies in oral healthcare provide support for the need for multilevel interventions to achieve application of research evidence by practitioners (27. ERUPT project, cited in 28). For example, the ERUPT project (cited in 28) investigated the effect of fees and/or education on the use of research evidence from the Cochrane review of fissure sealants. It was reported that use of a fee significantly increased application of fissure sealants but did not have an impact on the appropriate use of fissure sealants, while education had no impact on either placement or appropriate use of a fissure sealant. In relation to supporting current knowledge and use of an evidence-based clinical guideline for management of asymptomatic impacted third molars, knowledge and decision-making for simulated cases significantly improved for practitioners who received guidelines, reminders, etc by comparison with the practitioners from the control group (27). However, there was no difference in the referral rates between the groups of practitioners. It is of note that undergraduate dental students were able to use recommendations from clinical guidelines for asymptomatic impacted third molar management, resulting in a decrease in decisions to recommend removal of third molars by comparison with students who did not have access to these guidelines (83). As noted by these
authors, how access to these guidelines during their programme influences students’ practice on graduation needs investigation. Access to clinical guidelines alone has been shown to have limited effects (17).

Many of the factors identified in the medical studies are common across the professions although variations in the organisation of delivery and funding of oral healthcare may contribute to some differences in the success of implementation (58). It is clear that further strategies in oral healthcare need to be investigated. These need to be selected based on the evidence of their effectiveness, together with targeting the different levels within oral healthcare as factors that impede change in practice can arise at each of these different levels (17, 25). It is beyond the scope of this paper to discuss in detail the different approaches used to achieve change in practitioners’ behaviours: however, application of similar approaches in dental school contexts may be effective in achieving the necessary change in the learning opportunities, in particular, as a significant number of teaching staff are practitioners (81). The following table summarises various factors and suggested methods that can be implemented to achieve successful dissemination and implementation of EBOHC in practice and oral healthcare education contexts, based on experiences in other healthcare professions.
Table 1: Factors and proposed methods for successful dissemination and implementation of research evidence in oral healthcare for practitioners and students.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Methods</th>
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| Access to and translation of sources of evidence that are easy to use and understand (28, 31) | • Provision of consistent written communication of synthesised findings of evidence-based reviews and guidelines that demonstrate their relevance, and are supported by educational packages and other support materials, in a range of accessible formats (e.g. computer software to support identification and monitoring of patients) with follow-up personal discussions/visits, and concomitant financial reimbursement for use (17, 25)  
• Involvement of practitioners/academic affiliates in the development of synthesised clinical guidelines (25) |
| Strengthening of a science and research culture in dental practice and education (28) | • Implement EBOHC across the curriculum using interactive clinically integrated learning activities (37, 84, 85)  
• Involve students during their programmes and practitioners in research activities, particularly related to EBOHC, using strategies that have been shown to enable full participation throughout a project (54, 86, 87) |
| Change management for practitioners (this is also applicable to practitioners as educators) (17, 28) | • Analysis of needs of practitioners and target setting, including identification of particular problems with changing procedures (25)  
• Collaborative development of clinical guidelines that follow internationally agreed criteria for optimum guidelines (48) and where possible, are based on evidence as it has been shown that evidence-based guidelines are better implemented than others not based on scientific results (88)  
• Pilot testing of implementation programme for use of reviews/guidelines (25)  
• Series of interactive clinically integrated continuing education activities linked to practitioners' patient needs (37, 84, 85)  
• Use of behavioural change strategies, e.g. electronic reminders in practice management systems and audit, however, evidence is mixed and depends on the focus of practice change (17, 25, 89)  
• Develop patients’ knowledge and decision aids which have been reported to be effective for prevention (17, 32) |
| Patient education and demands                                 | • Improve communication skills for practitioners to manage conflict with patients' requests and evidence, and educate patients about their conditions (17, 32)                                                                                                       |
| Reorient health services                                       | • Implement evidence of health promotion, prevention and intervention effectiveness in the organisation of healthcare services taking into account the needs of the community                                                                               |
As noted, factors involved and methods for successful change in curricula necessary to integrate EBOHC into students’ clinical practice are similar to those summarised in Table 1. It is anticipated therefore, that to achieve curriculum change, there is a need to identify strategies that work at the different levels in dental school contexts, namely, students, academics, practitioner-educators, oral healthcare-team members and the organisational/educational context in which the learning occurs. Examples of methods that might be implemented to support change in dental school contexts include ready access for both staff and students to synthesised research findings, participation by staff in workshops and related activities about how to practise EBOHC (12) as well as how to integrate EBOHC into the curriculum at different levels and preferably integrated within actual clinical contexts, in contrast to stand alone EBOHC courses (79, 80, 85). A multilevel approach is necessary as there is evidence of a poor uptake and, in turn, application of an evidence-base in different environments including dental schools. Examples include caries risk assessment and preventive interventions (19); the use of fissure sealants (ERUPT, cited in 28); management of impacted third molars (27); and teaching of posterior composites (21, 22, 90). These latter studies demonstrate that it is not only practitioners who are slow to change their practice, in this case teaching, even when new graduates will lack competences important for contemporary clinical practice. Therefore, we need to develop a receptive learning community of educators (91) using models as discussed for practitioners to implement EBOHC in clinical instruction.

An example of a staff development programme to achieve curriculum change in EB healthcare for dental hygiene, and occupational and physical therapy, has been tested with positive results (Forrest and Miller, 2001, cited in 80). Similar to designing effective approaches for implementing EB guidelines in practice (25), this programme began with an investigation of staff needs related to EB healthcare knowledge, skills and approaches to teaching, followed by a four day interactive programme on EB healthcare knowledge and skill development. Participants at the workshop also developed an educational plan to implement EB healthcare into their programmes. Evaluations of outcomes of the four-day workshop and implementation of their educational plans demonstrated improved EB knowledge and skills, implementation of various aspects of EB healthcare processes using active learning strategies, as well as supporting colleagues to implement EB healthcare into their teaching (Forrest and Miller, 2001, cited in 80).

From this study (80), following a needs analysis for participating staff, the key elements of successful staff development programmes for EB healthcare were identified as:

- Programme development by a multidisciplinary team involving health professionals, health-focused librarians, education, research and computer experts;
- use of active learning strategies;
- access to relevant databases;
- allocation of significant time -2- 4 days of workshops;
- development of plans and provision of time to implement changes;
- provision of follow-up support; and
- evaluation of outcomes.

It is clear the elements of effective staff development for EB healthcare mirror many aspects that are effective in supporting EB healthcare change in clinical practice (17). They are also consistent with a systematic review of evidence of effective staff development programmes based on experiential learning, receiving feedback, use of peers as role models and use of a range of instructional methods (92).
In terms of an EB healthcare curriculum, similar elements that are necessary for development of practitioners and staff are also needed for our curricula to support our students to practice EBOHC. It should be emphasized that we are not advocating simply adding a separate course to the curriculum, but rather infusing the principles and processes of EBOHC throughout all aspects of the curriculum. As outlined by Sackett et al. (5 p183), the following proposed approach for an EB curriculum draws on social constructivist, cognitive and behavioural theories of learning and is characterised as:

- patient-centred;
- learner-centred;
- active and interactive;
- modelled as essential to becoming an expert clinician;
- match, and take advantage of, the clinical setting and circumstances;
- well-prepared; and
- multi-staged.'

The elements of this approach are consistent with contemporary approaches to learning (93, 94) and healthcare education (95). The educational outcomes for EBOHC can be defined by the five core steps of the EB healthcare process (refer Section: Evidence-based oral healthcare) (8). These outcomes can be achieved through a range of active and facilitated, small group learner-centred activities with patients (simulated or real and where possible, from the students’ clinical experience) (8, 79). As part of this process, there are helpful oral healthcare resources available to support students’ (practitioners’) learning about critical appraisal of the literature (36). Students still need opportunities to identify uncertainties in their practice and integrate their analysis of evidence into their EBOHC (96). Other activities to support students practicing EBOHC include use of summarised treatment planning decisions in the form of educational prescriptions (5). At the commencement of clinical practice, students should continue to complete educational prescriptions, and related summaries of critically appraised topics could then be kept in the clinic for reference and updating by other students/staff (79, 97). To ensure the learning and assessment activities provide authentic experiences, the time-pressured context of clinical settings needs to be modelled where possible (8). Comparison of this approach with more conventional approaches to learning in clinical settings is summarised in Table 2.
Table 2: Comparison of learning in clinical settings for conventional and evidence-oriented approaches

<table>
<thead>
<tr>
<th>Conventional approach</th>
<th>Evidence-oriented approach</th>
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</thead>
<tbody>
<tr>
<td>Knowing what you are supposed to know</td>
<td>Knowing your knowledge gaps and how to manage them</td>
</tr>
<tr>
<td>Uncertainty discouraged and ignorance avoided</td>
<td>Uncertainty legitimized through learning by questioning</td>
</tr>
<tr>
<td>Focus on authority, apprenticeship, learning from accepted wisdom</td>
<td>Focus on clinical evidence, assessment, ability to challenge accepted wisdom</td>
</tr>
<tr>
<td>Learning by discreditation: name and blame those who do not know</td>
<td>Learning by converting problems into questions and solving them by finding, appraising, storing, and acting on experience and evidence.</td>
</tr>
<tr>
<td>Unsystematic observations, including case series, accepted as evidence of effectiveness</td>
<td>Systematic reviews of scientific studies accepted as evidence of effectiveness</td>
</tr>
</tbody>
</table>

As noted previously in terms of patient involvement in decision-making, integrating available evidence with patients' needs and values is an essential component of EBOHC. Therefore, we need to support students (and practitioners) to develop appropriate communication skills related to managing conflict as well as educating patients on the management of their problem (25). Students need opportunities to learn about and use decision aids to support patients in making informed decisions (32) as part of obtaining informed consent.

In turn, assessment of each outcome of EBOHC needs to developed to match the various learning activities and related planned outcomes (8, 93), and this should occur throughout the learning process to ensure assessment supports learning (98). A recent systematic review of instruments (99) that have been used to assess learning outcomes of EB healthcare education provides a valuable resource to support these developments. This paper outlines the range of outcomes that the various instruments assess, some assessing all EB healthcare steps, as well as suitable uses for these instruments, e.g. for formative or summative assessments. Of course, the instruments discussed need adaptation for EBOHC assessment purposes, with the development of relevant oral health situations. There are also a number of instruments that are critiqued in the paper that are of use to evaluate aspects of EBOHC curricula, focusing on the different levels for evaluation of educational interventions, some relating to EB healthcare behaviours in practice (100)(refer Section: Outcomes of EB healthcare educational interventions).

Strong parallels with the processes of EB healthcare are evident in a recently reported framework for research skill development (101), which could be adapted for dental programmes. The framework provides a guide to the different levels of research activity in which students can participate at different levels of their programmes (101), and provides an example of how this has been implemented in human biology courses. There are several other examples of approaches to systematically incorporate research into dental curricula at all levels of programmes at a number of dental schools in the United States (12, 54). A key aspect of these programmes is the integration of the research activities into the overall dental programme. Another common element of these programmes involved staff development to support these new initiatives and collaboration between staff and students. It is noteworthy that some of these programmes have been implemented in schools which were not located within research intensive institutions.
A further component to the integration of research into the curriculum could be through the establishment of practice-based research networks (PBRN) (54, 86). These networks have been shown to be effective in enabling ‘translation of evidence into practice’ (13, 86 p96). In turn, they provide staff development opportunities for clinical full-time and sessional practitioner/educators to participate in research (54). Students also can participate in research (54) as well as experience EBOHC in practice-based settings (86) and this involvement may prove valuable in encouraging their continual involvement in and use of research on graduation. As discussed by Niederman and Leitsch (13 p297), it is proposed that PBRN can become ‘engines of clinical knowledge creation’ by enabling the translational research that is necessary to assist in a more rapid uptake of an evidence base for oral healthcare decisions. This in turn is expected to improve healthcare quality (13). The development of a PBRN has also been shown to lead to changes in the curriculum to focus, e.g. on the medical approach to caries management, including risk assessment and participation of students and clinical staff in research (54).

**What are the outcomes of EB healthcare educational interventions?**

As for processes designed to change clinical practice, there is a need to evaluate the effectiveness of all aspects of EB healthcare that students learn (8, 102). These evaluations should use appropriate quantitative and qualitative methods and preferably valid measures of important outcomes that may include, but are not restricted, to self-rated outcomes (102). Examples of outcomes include knowledge, critical appraisal skills, attitudes, behaviours or performance related to the practice of EBOHC and patient health outcomes (8, 99, 102). This latter outcome has been seldom evaluated (99, 100, 102). A recent systematic review (99) identified only two papers that used quality audits to evaluate patient outcomes following EB healthcare educational interventions (75, 76). A reason for limited analysis at this level is partly due to the indirect relationship between these factors (68, 85, 102). It is clearly, however, a key outcome of EB healthcare education and, as such, there is a need to evaluate approaches that address patient and population health outcomes as well as the other ‘lower level’ outcomes of our evaluation hierarchy (72, 100).

Evaluation of EB healthcare curricula have demonstrated a range of outcomes associated with different approaches to EB healthcare education. Earlier reports of curricula interventions have been positive. These include significantly better questions and database searching in groups who participated in sessions aimed at developing these skills (5), and the development of lifelong learning skills and attitudes (34). More recent studies of the outcomes of EB healthcare education have demonstrated positive experiences for participants (medical students, residents and interns) following a month long programme integrated into usual inpatient clinical rounds (103). This pilot study also reported that participants considered that completion of the EB process for 12 searchable questions related to new patient admissions during the month had lead to changes in the management of 50% of patients, would change how they managed future patients with similar conditions for 75% of participants and for the majority of participants, the process had helped them learn about the disease process. In another study, significantly increased use of evidence in the therapies provided to hospital patients was found (97). Residents and physicians in this latter study participated in an educational intervention focused on developing skills in EB healthcare in conjunction with providing convenient access to evidence on the hospital ward. Significantly increased use of evidence in the therapies provided to hospital patients resulted from participation in the programme (97). Another recent study of a six-week elective unit clearly demonstrated the
integration of all steps of EB healthcare process within real settings which had an impact on patient care (104). The approach reported in this latter paper draws on many of the key elements identified as critical for learning EB healthcare (5, 8, 37) and provides an example of a thorough evaluation for interventions in curricula, addressing all evaluation levels (100).

However, just as there are barriers for practitioners to implement EB healthcare, it is clear there are barriers to the successful implementation and achievement of outcomes of EB healthcare curricula interventions. Many of these are not peculiar to EB healthcare curricula but if we are to move our curricula forward, staff need to be proactive and manage these to ensure successful outcomes. Examples of barriers that were identified from a range of evaluation methods in the context of EB healthcare curricula included (104, 105):

- unequal contributions to student teams/groups;
- limitations of evidence in terms of availability, ease of access and relevance to their clinical context;
- limitations in the learning environment related to limited staff acceptance or application of evidence; assessment focused on textbook knowledge; lack of requirement to use evidence from clinical teachers;
- lack of opportunity to apply EB healthcare skills due to clinical context, e.g. limited continuity of care and technologies available were not as current as those discussed in the literature; and
- time constraints in finding and critically appraising evidence in the context of their heavy course workload.

In summary, the key components of a model for implementing EB healthcare into the curriculum are (5, 8, 37, 79, 80, 103, 105):

- staff development programs about practicing and facilitating learning of EB healthcare, enabling them to act as role models;
- authentic (simulated and real) small group-based learning activities which may include problem-based learning and are focused on learning and applying the principles and processes of EBOHC in clinical settings over a sufficient time period to ensure students provide continuity of care and evaluate their practice, and their learning is assessed with appropriately matched tasks addressing all steps in the EBOHC process (refer Section: Evidence-based oral healthcare); beginning activities should focus on questions for which there is reasonable available evidence, before moving to areas of practice with limited evidence;
- adequate organisational support, including incorporation of EBOHC into strategic plans, and curricula outcomes and linked to clinic and assessment policies, resources for staff development and time to implement changes, as well as provision of adequate infrastructure in the form of computers, printers and real-time access to full text databases in appropriate languages in both simulated and actual clinical settings; and
- evaluation of outcomes at all levels (100), including patient health outcomes.

**What approaches facilitate evidence-based oral healthcare in emerging economies?**

Resources in emerging economies are limited, making it critical that healthcare is evidence-based to ensure very limited resources are not wasted (106). There is a
clear need for student, staff, and practitioner development in practicing and teaching EB healthcare and EBOHC (106, 107, 108), especially considering the distribution of global oral disease, particularly for disadvantaged groups (109). As noted previously (78), the use of evidence from outside the local context can be problematic, therefore, requiring analysis of the effectiveness and efficacy of methods within the local context (106). This requires collaboration between countries to broaden the applicability of evidence to local contexts as well as tools for students and staff involved in learning and teaching EBOHC. The Cochrane Collaboration, in conjunction with the WHO and other health and teaching focused networks, has been a major driver in supporting this collaboration in medicine (106, 110) as well as providing access to the Cochrane Library in emerging economies (110). The next step of course, requires policies and systems to support the dissemination and associated change that in turn often needs the support of key people (106). A framework for dissemination and implementation of EB healthcare has been used successfully over several projects in many countries (e.g. China, Thailand, Nigeria, South Africa, and Ghana) (106). Consistent with analysis of positive outcomes for changing practice (17), this framework addresses different levels in the healthcare system including community members, depending on the issue to be addressed and the systems in place, to bring about effective change and positive outcomes (106). It is expected that similar activities, building on existing global networks and targeting different levels of oral healthcare, are needed to effect change in oral healthcare and improved oral health outcomes in emerging economies. Research into what works best to effect change in different contexts is needed.

What is the future of evidence-base oral healthcare?

From the developments of the past two decades since EB healthcare became a focus in the literature and how it can be implemented in practice, the following developments in EBOHC are anticipated:

- Growth in collaboration between researchers and practitioners, notably in the form of developing clinical guidelines and/or establishment of PBRNs to assist in the translation of research into practice (13);
- Continued developments in synthesis of data for use by students and practitioners – to assist them in critiquing and applying the available evidence;
- Implementation of tested methods to support students and practitioners to practice EBOHC;
- Growth in regular quality assurance approaches, including clinical audit by practitioners, evaluating the outcomes of treatment provided (111) and as a result, collaborative care of patients, involving different members of oral healthcare team who have different scopes of clinical experience and expertise for providing care for patients;
- Development of a range of computer-based data collection tools to monitor effectiveness of approaches designed to support EBOHC;
- Growth in development of computer-based decision trees for complex decisions and that incorporate clinical guidelines (33), their use being supported by approaches proven to be effective in supporting EBOHC;
- Growth in the development and use of decision aids for patients; and
- Continued targeting of research to address gaps in our knowledge, including HTA.
Conclusions

Clearly, considerable change is needed to achieve the aim of implementing EBOHC and research into curricula. These changes involve dental practice, dental schools, patients, and the organisations that manage, fund, develop and implement policies that influence oral healthcare, research and education of practitioners. Proven processes of change management, drawing on the evidence of effective approaches used in EB healthcare will be needed to achieve sustainable changes across these various groups. This may need to be a gradual process over a generation - an evolution rather than a revolution.

Recommendations and areas of further investigation

The following recommendations, including areas for further investigation, have been organised into key areas that the group considered will need to be addressed to enable implementation of EBOHC and research into the curriculum. These recommendations apply to all levels of education (undergraduate, postgraduate and continuing education) for all members of the oral healthcare team. It is important to recognise that the evidence-base is continually developing and is dynamic. The scope of evidence to be considered as discussed in Section: Evidence-based oral healthcare is understood to include ‘best available, current, valid and relevant evidence (8 p4).

General Recommendations:

- While there is limited evidence that EBOHC works, it appears to be a key opportunity to improve health and well-being of patients and communities by integrating evidence with the skills of caring. We therefore, recommend that EBOHC is at the core of learning, teaching and research for oral healthcare.
- EBOHC is a developing process: outcomes from EBOHC must be carefully evaluated and the results used to improve its application in teaching and research to improve oral health.
- The scientific culture in education and healthcare provision needs strengthening by embedding principles of research and EBOHC at all levels of education. This is needed to achieve the application of the scientific approach to the assessment, planning and delivery of effective prevention and care for every individual.
- Development of EBOHC competences and evaluation of outcomes is the responsibility of individuals, faculties and organisations according to their needs.

Evidence-based approach to learning and teaching

Dental educators need to use the best available evidence (refer Section: Evidence-based oral healthcare) from health and higher education research to inform our educational approaches to support EBOHC learning. There is a need to have a ‘double transformation’ (70 p2) in dental education, i.e. not only use by educators of evidence for practicing EBOHC and how it contributes to improvement in patient and community oral health outcomes, as is happening in medicine (72), but also relevant research into education that supports learning of EBOHC.
To support educators to achieve these two aspects of evidence-based oral healthcare education, there is a need to:

- provide access to available information of synthesised research (e.g. Cochrane Library; Evidence-Based Education UK [EBE Network]; Campbell Collaboration, which includes a Medical Education Research Group; Best Evidence Medical Education Collaboration; refer to end of paper for details);
- support staff development for educational research and related qualifications (71) and the analysis of best evidence, particularly for sessional practitioner-educators (68);
- establish and fund a collaborative network of dental educators to share educational materials (for staff development and student learning, including validated assessment tools) (5, 8, 30);
- fund collaborative research involving dental educators and other health educators, using appropriate methodologies to address our research questions and evaluate educational interventions (6, 69);
- investigate the impact of ‘teaching EBOHC on clinical outcomes, particularly those that matter to patients’ by establishing a network to evaluate EBOHC educational interventions (30 p987); and
- enhance recognition of the value and importance of educational research (68, 71).

Development of Research for use in EBOHC

As noted previously (Section: Research) explains that this paper is restricted to the contexts of students and practitioners participating in research that contributes to EBOHC. To achieve this, there is a need for:

- recognition of research synthesis and systematic reviews as research and development of associated methodologies for research synthesis and systematic reviews as research;
- systematic research synthesis involving international collaborations applicable in different global environments;
- capacity building of EBOHC researchers (e.g. the Aubrey Sheiham Public Health and Primary Care Scholarship; refer end of paper for details);
- research conducted in and relevant to the intended setting for delivery, including emerging economies, and practice–based research networks;
- research into outcomes relevant to patients and populations including patient reported outcomes, safety and harms;
- support for economic evaluation research in oral healthcare, initially involving collaboration with other disciplines while capacity in this area is further developed;
- research into improving translation of effective interventions into education and healthcare practice; and
- funding agencies to support the above activities.

Implementation of Evidence for use in EBOHC

As noted (Section: Research), this paper is restricted to contexts where students and practitioners use research as part of an evidence-based approach to oral healthcare. The aim is to ensure that those involved in oral healthcare can think objectively and
critically appraise all aspects of their practice, including scientific literature as relevant. Specifically, oral healthcare teams need to:

- understand the principles of research relevant to their practice;
- appraise critically the scientific and professional literature and their practice;
- plan and provide care for individuals and communities based on their values and the best possible evidence that includes an understanding of the limitations of the available evidence.

To achieve widespread implementation of an EBOHC approach, the following are needed:

- ‘data on changing behaviours (of practitioners) other than self-reports’ (30 p987) to inform the best approach to achieve change in behaviour to adopt an EBOHC approach by dental educators, practitioners and students (17);
- understanding and incorporation of patient values in evidence-based decision-making (7); and
- access to available information of synthesised research in languages and ‘user friendly formats tailored to meet needs to stakeholders’, (30 p 987) that includes dental educators, practitioners and students.

**Curriculum content and processes for learning and using EBOHC**

To integrate EBOHC into our curricula we need:

- staff development including fostering a culture of evidence-based approaches, development of authentic (simulated and real) small group-based learning activities, and matched assessment, adequate organisational support, evaluation of outcomes (see Section: Outcomes of EB healthcare educational interventions and recommendation above re a collaborative network) that enables the incorporation of the scientific process as an integral element of oral healthcare and education; and
- institutional and faculty level development of core competences and outcome measures of performance for EBOHC, e.g. ‘translation of uncertainty into an answerable question’, searching and retrieval of evidence, critical appraisal, including healthcare technology evaluation/assessment, application of reviewed evidence to patients, involving risk assessment and communicating with patient, and self-assessment/evaluation of performance (8 p5, 98).

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Resources

Courses
University of Oxford
http://cpd.conted.ox.ac.uk/healthsciences/courses/short_courses/EBD/

UCL Eastman Dental Institute, International Centre for Evidence-Based Oral Health: 4 day intensive systematic review training course www.eastman.ucl.ac.uk/iceboh

Introductory Textbooks


Online Resources
American Dental Association http://www.ada.org/prof/resources/positions/statements/evidencebased.asp

Best Evidence Medical Education Collaboration http://www.bemecollaboration.org/

Campbell Collaboration http://www.campbellcollaboration.org/

Cochrane Collaboration & Oral Health Group http://www.cochrane.org

Centre for Evidence-Based Dentistry, Oxford http://www.cebd.org

Evidence-Based Dentistry Network, International Association of Dental Research www.dentalresearch.org

International Centre for Evidence-Based Oral Health http://www.eastman.ucl.ac.uk/iceboh

Oral Health Specialist Library (part of NHS national Library for Health) http://www.library.nhs.uk/oralhealth/ (open access)
Pan American Centres for Evidence Based Dentistry ‘Evidentista’
http://www.evidentista.org

The Cochrane Library: The Cochrane Collaboration
http://www.thecochranelibrary.com

The Swedish Council on Technology Assessment in Health Care
http://www.sbu.se/www/index.asp

Guidelines and statements
Federation Dentaire International (FDI). National and international database of guidelines and statements www.fdiworlddental.org

National Guideline Clearinghouse www.guideline.gov

National Institute for Health and Clinical Excellence (NICE) http://www.nice.org.uk

Scottish Intercollegiate Guidelines Network (SIGN) http://www.sign.ac.uk

Speciality Journals
The Journal of Evidence-based Dental Practice
http://www2.us.elsevierhealth.com/scripts/om.dll/serve?

Evidence-based Dentistry http://www.nature.com/ebd/

List of relevant conferences
4th International Conference of Evidence-Based Health Care Teachers & Developers

2nd International Conference on Evidence-based Advanced Dentistry
16-19 November, 2007 Hong Kong Academy of Medicine and Prince Philip Dental Hospital, Hong Kong. http://dent25.hku.hk/congress/

3rd International Meeting Methodological Issues in Oral Health Research: Clinical Trials and Evidence Based Dentistry. 16-18th April, 2008 Università Degli Studi Di Milano, Instituto di Statistica E Biometria “Giulio A. Maccacaro” Milan, Italy.
http://www.orikata.it


Scholarships
The Aubrey Sheiham Public Health and Primary Care Scholarship
http://www.cochrane.org/docs/Fellowshipsandscholarships.htm
References


