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INTEGRATING EVIDENCE-BASED DENTISTRY CONCEPTS THROUGHOUT PRE-DOCTORAL DENTAL CURRICULUM

by

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ADAM LOWENSTEIN

ABSTRACT

Evidence-based dentistry (EBD), an evolving educational tool that started its rise in the late 1990's and early 2000's, is being used more every year in dentistry. EBD combines the most current scientific and clinical evidence with the dentists' expertise and the patients' needs and preferences to formulate the best option to treat the patient. Since patients are taking more time to research their oral health issues before seeing their dentists, the dentists and the dental team must be prepared for all types of questions. Having the tools necessary to understand the latest and most significant research allows dental professionals to consistently educate themselves. However, there is no independent committee that handles the current issues facing dentistry.

Using the topic of asymptomatic removal of third molars as a framework for EBD education, it can be used to help improve how schools educate their students. It is important that both the dental community and the public understand the scientific literature behind the removal of third molars because the existing practice of removing third molars without adverse symptoms is not statistically supported. Unfortunately, there is not enough evidence in favor of either side of the situation. Major databases, like PubMed, contain very little research on the asymptomatic removal of third molars, and those studies were not done recently.

For EBD to be successful in dentistry, it must function in the clinical environment, but initial training in the concepts of EBD must start during pre-doctoral education. The dental practitioner still must rely on his or her own experience, but the patient must also trust his or her dentist. EBD is based on trust because it is based on the trust you have demonstrated through your skills and your usage of all available resources. If the dentist can compile pertinent scientific data and information to share with the patient and make the best decision together, then the use of EBD will be beneficial to the field of dentistry.

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LIST OF ABBREVIATIONS

ADA .... American Dental Association

BU .... Boston University

BU GSDM ....Boston University Henry M. Goldman School of Dental Medicine

CRP .... Critical Review Panel

EBD...Evidence-Based Dentistry

MeSH .... Medical Subject Headings

SBUSDM .... Stony Brook University School of Dental Medicine

TUBCD ....Texas A&M University Baylor College of Dentistry

TUMHKSD......................... Temple University Maurice H. Kornberg School of Dentistry

TUSDM.. Tufts University School of Dental Medicine

UICD..University of Iowa College of Dentistry

UNECDM ....University of New England College of Dental Medicine

UPENNSDM.................................University of Pennsylvania School of Dental Medicine

UPSDM..University of Pittsburgh School of Dental Medicine

USCSD... University of Southern California School of Dentistry

UTSD ....University of Texas School of Dentistry at Houston

INTRODUCTION

Evidence-Based Dentistry

Evidence-based dentistry (EBD) combines the most current scientific and clinical evidence with the dentists' expertise and the patients' needs and preferences to formulate the best option to treat the patient (Alpaslan, 2012). According to the American Dental Association (ADA), EBD is the following:

> [A]n approach to oral healthcare that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating to the patient's oral and medical condition and history, with the dentist's clinical expertise and the patient's treatment needs and preferences. ("ADA, About EBD," 2014)

EBD is vital for the treatment of patients in that it allows dentists to personalize their dental care to best suit the patient. EBD is an important part of the dentistry of today and tomorrow, and has already allowed the profession to make great strides because there was and continues to be a need for scientific research to support dental processes and procedures ("ADA, About EBD," 2014). Before the establishment of a global system of interconnected computer networks, patients visited the dentist without knowing many specifics about their oral health. They would usually have acquired knowledge through conversations with friends, family members, and members of the dental team. Consequently, patients would not ask many questions of their dental provider. However, with patients being more educated today than ever before, it is of the utmost importance for dentists and the dental team to be prepared for all types of questions. Therefore, it is paramount for the entire dental team to continue their dental education after graduation. Having the tools necessary to understand the latest and most significant research allows dental professionals to consistently educate themselves and as a result, provide the best care to patients.

In order to understand how to these tools, dentists need to know how to ask an evidence-based question. This type of question is a not simple phrase; as described in Figure 1, it includes four specific components: the patient, intervention, comparison, and outcome (Georgia State University, 2015). When making a focused clinical question, we make the comparison between the control, or normal, group and the intervention (Boston University Alumni Medical Library, 2015). Another important part of the question is the outcome because we must measure some sort of result to allow for the most efficient research (Boston University Alumni Medical Library, 2015).

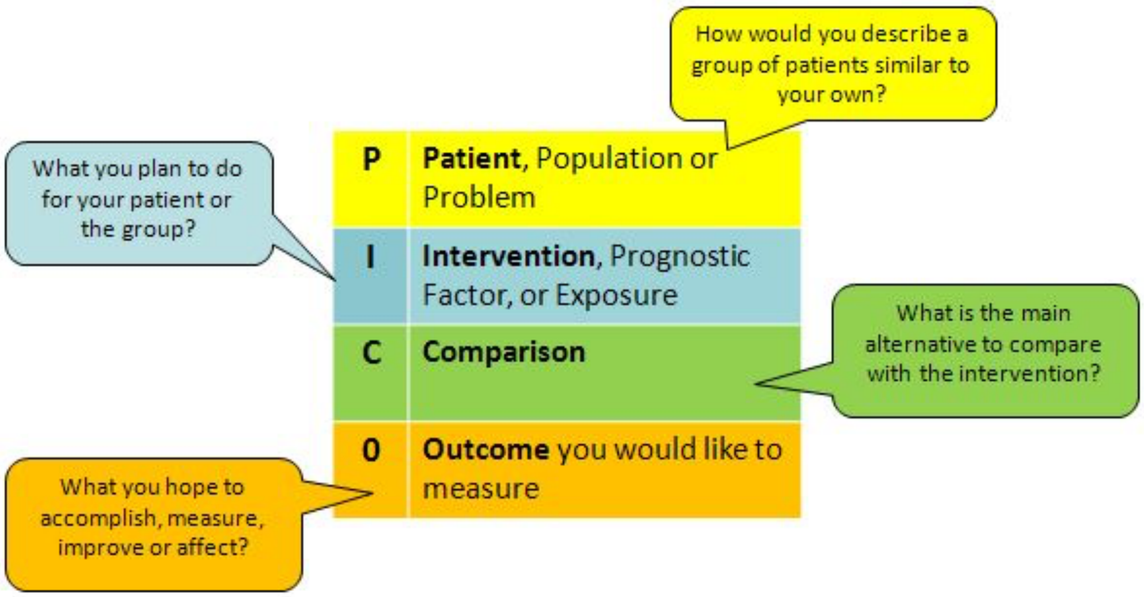

Figure 1. PICO Question. There are four components to constructing an evidence-based question: (1) the patient, population, or problem; (2) the intervention, prognostic factor, or exposure; (3) the comparison; and (4) the outcome measured. (Figure taken from Georgia State University, 2015).

After crafting a well-thought out question, dentists need to know what levels of evidence are most rigorous. Systematic reviews comprise the strongest evidence due to the compilation of other study designs in focusing on answering a specific question (Alpaslan, 2012). The most significant of the systematic reviews are ones that include only randomized controlled trials, which present the strongest form of unfiltered evidence. In order of strongest to weakest forms of unfiltered evidence, the other types of study designs are randomized control trials (RCT), cohort studies, case control studies, case reports, ideas, editorials and expert opinions, as shown in Figure 2 (Alpaslan, 2012). The importance of these levels of evidence is to give the dentist the opportunity to efficiently understand what type of studies have been completed and more importantly, what the validity of these studies are, thereby allowing better decision making when examining research.

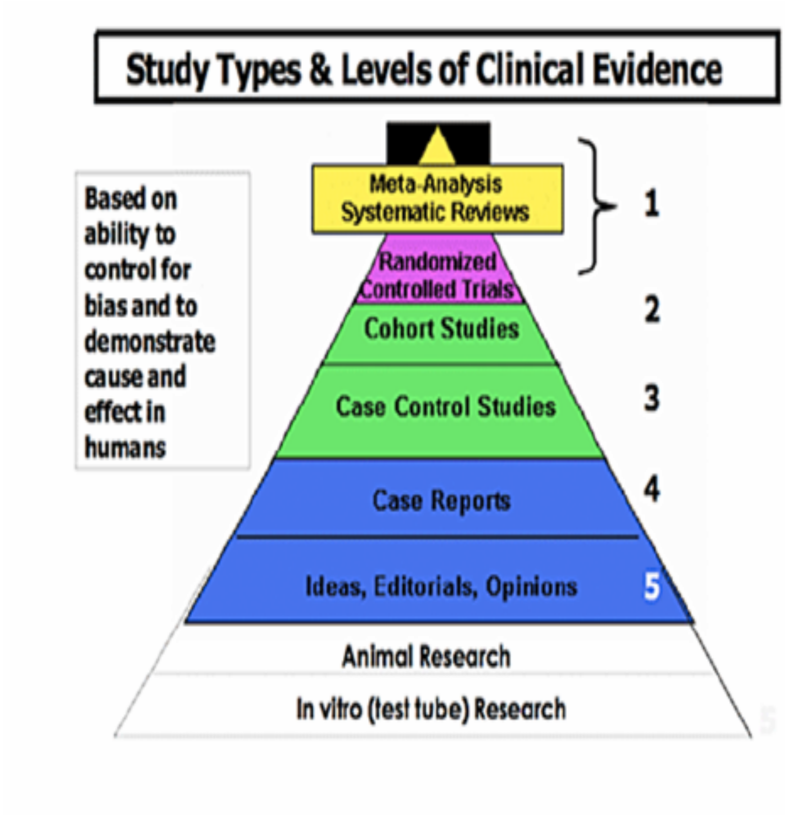

Figure 2. Study Types & Levels of Clinical Evidence. This pyramid shows the levels of evidence in terms of strongest to weakest study design. The strongest form of evidence is systematic reviews, which is followed by randomized controlled trials, cohort studies, case control studies, case reports, ideas, editorials, expert opinions, animal research and in vitro research. (Figure taken from Alpaslan, 2012 as modified by SUNY Downstate Medical Center, Medical Research Library at Brooklyn).

Before looking into the research, knowing the details of what determines each study type is a must for dentists to be able to understand the findings. In order to determine which study design we are researching, we first ask if the exposures are assigned, as depicted in Figure 3 (Alpaslan, 2012). If the answer is yes, then it is an experimental study (Alpaslan, 2012). For experimental studies, if the exposures are randomly assigned, then the study is a randomized controlled trial. In a randomized controlled trial, the investigator randomly assigns subjects to either the control group or the experimental group. The control group receives the placebo or standard intervention while the experimental group receives the intervention being tested. If the exposures are not randomly assigned, it is a non-randomized controlled trial. The only aspect of a non-randomized controlled trial that differs from a randomized controlled trial is that the non-randomized one does not use a random process for assigning the subjects into the control group and the experimental group (Alpaslan, 2012).

However, if the exposures are not assigned, then it is an observational study (Alpaslan, 2012). If there is not a comparison group for the observational study, then it is a descriptive study. If there is a comparison group, then it is an analytical study. If the exposure and the outcome are determined at the same time, it is a cross-sectional study. This type of study measures an outcome of a population at one point in time or for a certain period of time. If the investigator knows the exposure at the beginning of the study, then it is a cohort study. A cohort study is a prospective study, in which the investigator follows up with the subjects to see if the outcome occurs. If the investigator knows the outcome before the exposure, it is a case-control study (Alpaslan, 2012).

Ideas, editorials, and expert opinions are near the bottom of the pyramid in Figure 2 because they are all not tested by studies.

Meta-analyses and systematic reviews are at the top of the pyramid because they are selected compilations of studies. While systematic reviews are collections of studies, meta-analyses are collections of the data from studies (Georgia State University, 2015). The meta-analysis is a way of statistically bringing together information (Georgia State University, 2015). With randomized controlled trials being the strongest form of unfiltered evidence, they are the best studies to be used in meta-analyses and systematic reviews.

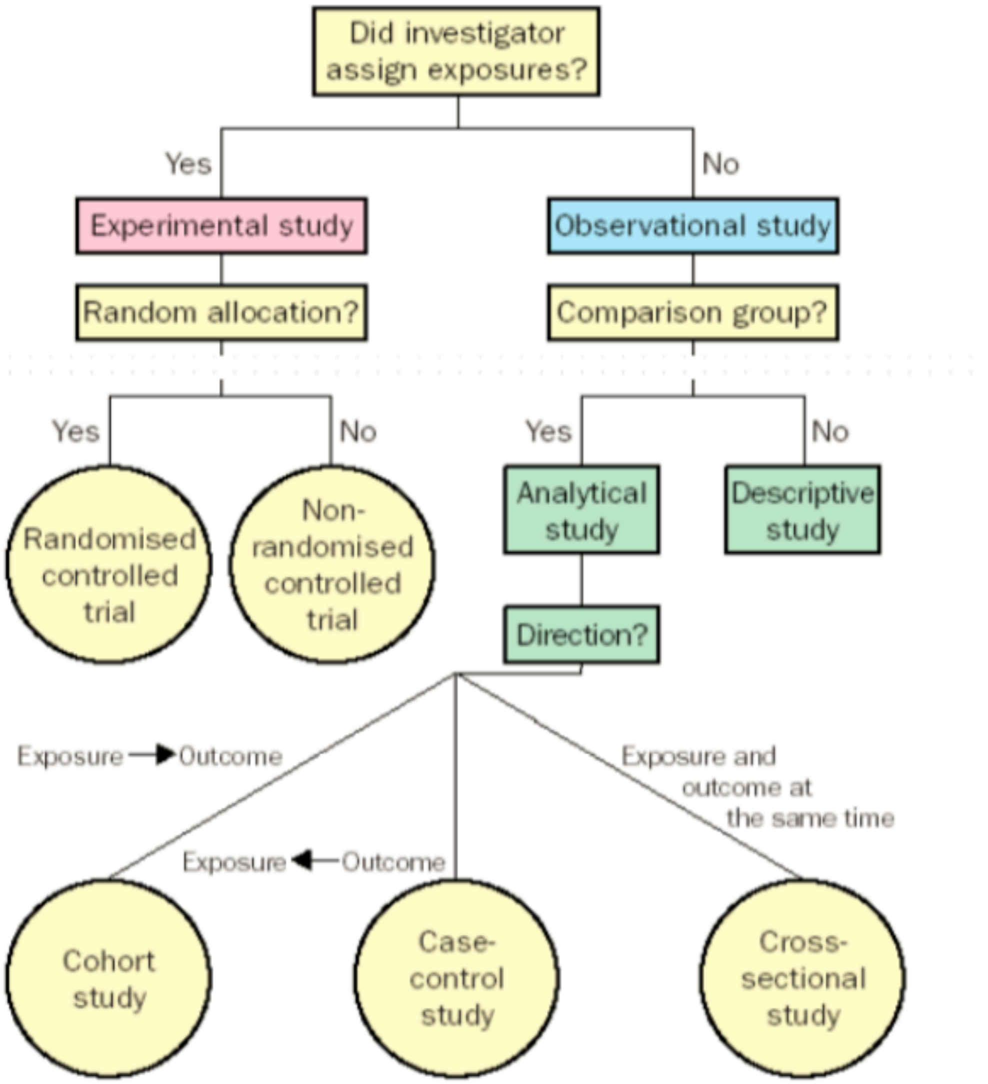

Figure 3. Study Design Flow Chart. In order to determine which study design we are researching, we first ask if the exposures are assigned. If the answer is yes, then it is an experimental study. For experimental studies, if the exposures are randomly assigned, then the study is a randomized controlled trial. If the exposures are not randomly assigned, it is a non-randomized controlled trial. If the exposures are not assigned, then it is an observational study. If there is not a comparison group for the observational study, then it is a descriptive study. If there is a comparison group, then it is an analytical study. If the exposure and the outcome are determined at the same time, it is a cross-sectional study. If the investigator knows the exposure at the beginning of the study, then it is a cohort study. If not, it is a case-control study. (Figure taken from Grimes & Schulz, 2002).

Communicating with Patients Regarding Best Practices

Not only do dentists need to be able to understand the most recent research, but they also need to be able to communicate it to a wide variety of patients. Communication is such an important part of using EBD in practice because the dentist must be able to share details to patients who have not had a formal dental education. An explanation that allows the patient to process all the intricacies of the dental procedure and to understand why he or she needs the procedure allows the patient to gain the trust of his or her dental professional. When patients do not understand the meaning of their symptoms, they are not in ownership of their own health issues; education helps to solve that problem and empower the patient. In addition to understanding the course of the procedures, the patient needs to know how to act in the future. The dentist needs to take the time to assess the patient's dental health requirements while the patient must share pertinent oral and systemic health routines and issues. Together, these conversations allow the dentist to better respond with an effective plan of treatment. The best method is for the dentist to ask open-ended questions in which the patient can speak freely, so that there is no leading the patient to answers (Bickley, 2009). Low-pressure conversations between the dentist and patient allow for a strong connection between both parties based on mutual respect.

For these reasons, EBD is a very important part of the dental school and continuing education curriculums. Dentists need to rely on unbiased evidence to make proper decisions based on objectivity and transparency when treating patients (Alpaslan, 2012). Effective communication of updated research to patients allows for a better overall experience for all parties involved in dentistry.

Since EBD brings together scientific and clinical evidence, the dentists' expertise, and the patients' needs, it should allow dentistry to consistently reach new heights. EBD has the ability to make a tremendous impact, provided dentists are trained how to use it most successfully.

EBD began to appear in the biomedical literature in the 1990's, but it did not become widespread until the early 2000's (Ismail & Bader, 2004). In 2001, the ADA officially recognized EBD with the organization's *Policy on EBD* (Maggio & Jeffery, 2008). Patients are increasingly taking the time to research their medical and oral health problems before seeing a health professional because they have an unlimited amount of seemingly-factual information available on the Internet. However, there is no independent committee which reviews all that is available online, thus dentists are challenged to better communicate current dental issues with patients.

The American Dental Association Critical Review Panel

The experts on EBD appear to be the members who comprise the ADA Critical Review Panel (CRP), which includes 17 members, including two Boston University (BU) Henry Goldman School of Dental Medicine (BU GSDM) professors - Paul Farsai, DMD, and Woosung Sohn, DDS - with extensive EBD experience as clinicians and consultants ("ADA, About EBD," 2014). The panel is charged with updating the information on the ADA's Center for EBD ("ADA, About EBD," 2014). The ADA CRP is the closest source to an official group that is making decisions regarding EBD.

Dr. Partha Mukherji, a fellow with the Academy of General Dentistry and an expert in the field, has spoken at the EBD Champions Conferences about championing EBD (Mukherji, 2013). He emphasized the importance of being respectful while having a professional discussion (Mukherji, 2013). Those who support EBD and utilize it clinically and elsewhere are allowing for professional discussion. The accumulation of data and the analysis of it has been a vital part of the growth of the profession. Unfortunately, problems arise when there is a lack of studies and a lack of motivation to publish new studies that can help areas of concern, such as the asymptomatic removal of third molars. Dr. Mukherji also detailed the eventual problem that EBD can lead to regarding dental insurance: he spoke of the "slippery slope" that could occur because insurance companies have the power to limit healthcare based on EBD (Mukherji, 2013). They could have a large impact on healthcare by making an evidence-based list of dental procedures that are allowed and not allowed (Mukherji, 2013). Dr. Mukherji suggested that EBD champions need to disseminate, implement, and spearhead; they need to ask more questions, read more literature, and investigate their ideas with studies (Mukherji, 2013). If they do so, then problems like the asymptomatic removal of third molars will not arise in the future.

The Asymptomatic Removal of Third Molars

Several reasons exist resulting in EBD not being utilized as effectively, and these issues can be highlighted in a current dental problem that has largely been ignored: the asymptomatic removal of third molars. It is important that both the dental community and the public understand the scientific evidence behind the removal of third molars because the existing practice of removing third molars without adverse symptoms is not statistically supported (Rabin, 2011). Unfortunately, there is not enough evidence in favor of either removal or watchful waiting treatment plan. Major databases, like PubMed, contain very little research on the asymptomatic removal of third molars, and those studies were not performed recently.

In order to understand the age for removal of third molars, one must know the specific teeth and their status in the dental arch. The third molars are usually the most distal teeth positioned in the dental arch. Most often, an adult dentition includes 32 teeth with a third molar positioned in each quadrant, as pictured in Figure 4 (Phulari, 2014). Third molars can become impacted, which means that they have not erupted into the dental arch, as shown in Figures 5 and 6; they are often removed when this occurs (Kasat, Karjodkar, & Laddha, 2012). Although these teeth are officially known as third molars, they are often referred to as wisdom teeth (ADA "Tooth Eruption," 2006). Third molars were referred to as "teeth of wisdom" beginning in the seventeenth century and are simply known as "wisdom teeth" today (Bishop, 2013). The third molars, which usually erupt from ages 17 to 21, are typically the final teeth to appear in the mouth (ADA "Tooth Eruption," 2006).

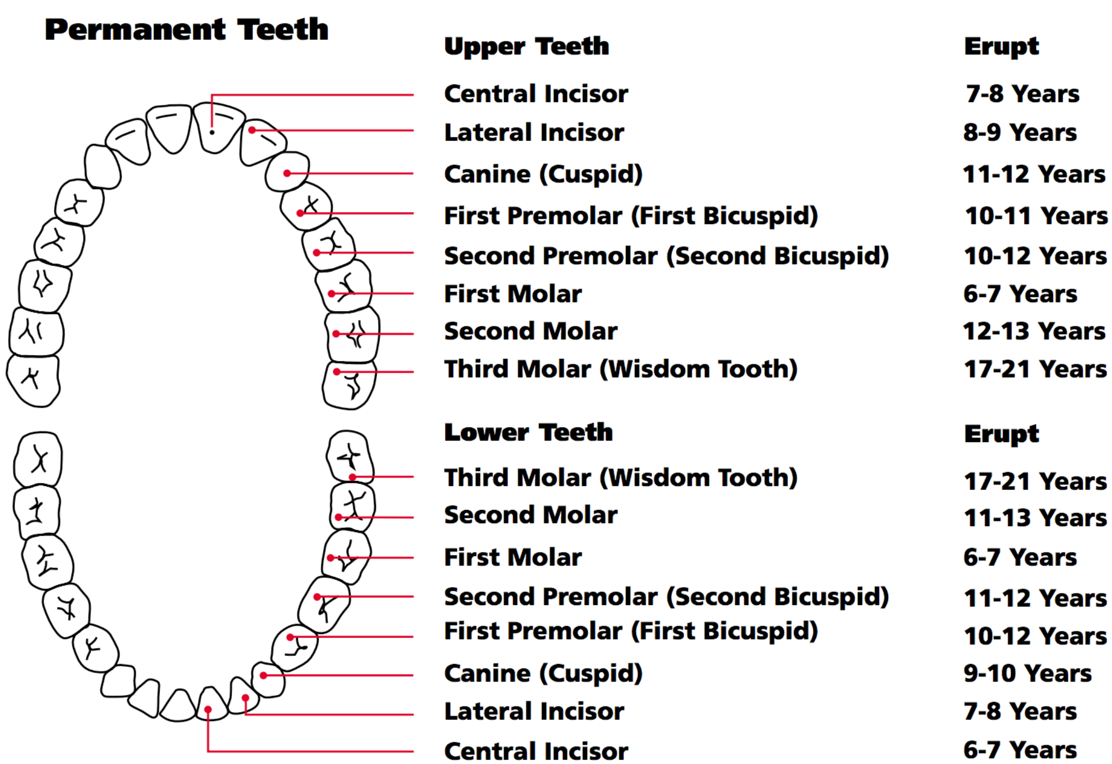

Figure 4. Permanent Teeth Eruption Chart. This chart shows which teeth erupt at what approximate years of age; the third molars most often erupt last. (Figure taken from ADA "Tooth Eruption," 2006).

Figure 5. Three Impacted Third Molars in a Panoramic Radiograph. This radiograph shows each of the four outermost teeth, the third molars, along with the rest of the adult's 28 teeth. The only third molar that is not impacted is the left mandibular (lower) third molar. (Figure taken from Yadav, Tyagi, Puri, Kumar, & Kumar, 2013).

Figure 6. Two Impacted Third Molars in a Panoramic Radiograph. This radiograph shows the two impacted third molars in the mandible. The left maxillary (upper) third molar needs to be removed because there is no second molar next to it, and the right maxillary third molar is in the maxillary sinus, which necessitates removal. (Figure taken from Kasat, Karjodkar, & Laddha, 2012).

Dental arches vary among individuals and a number of these are anatomically not able to accommodate third molars; other patients have third molars that grow ectopically into position, which necessitate the removal of those teeth. However, there appears to be minimal research supporting the traditional treatment approach that the majority of people should have their third molars removed even if they are not experiencing any adverse symptoms.

For example, there is no evidence supporting the correlation between third molar eruption and anterior crowding of mandibular and maxillary teeth. In 2007, there was a survey performed by Lindauer et al. that surveyed 393 United States orthodontists and 458 Unites States oral and maxillofacial surgeons if they thought there was an association. Lindauer et al. found that there continues to be a strong disagreement among orthodontists and a strong disagreement among oral and maxillofacial surgeons (Lindauer et al., 2007). Then, in 2009, Tufekci et al. found a different result. Their survey revealed that most Unites States and Swedish orthodontists agree that the eruption of mandibular third molars does not cause crowding (Tufekci et al., 2009). In 2014, Gavazzi et al. had 193 Italian members of the Society of Orthodontics and the Society of Oral Surgery complete a six-question online questionnaire concerning the role of third molars in causing mandibular incisor crowding. The Gavazzi et al. survey also disagreed with the results from the Lindauer et al. survey. The majority of the Italian orthodontists and oral surgeons in the Gavazzi et al. survey agree with each other, stating that the preventative extraction is unnecessary when third molars erupt (Gavazzi et al., 2014). In 1992, Thomas Southard was not able to confirm that third molar removal was associated with reducing or preventing late mandibular anterior incisor crowding (Southard, 1992). Then, Harradine et al. (1998) published a similar conclusion for their randomized controlled trial six years later. However, there has not been a more recent randomized controlled trial found on the major databases that can be compared to ones done by Southard and Harradine et al. The 17 years without an updated randomized controlled on the subject of third molar eruption leading to crowding shows that there is a lack of research on this topic of asymptomatic removal of third molars. In addition, since there are several surveys asking orthodontists and oral surgeons their opinions on the subject, there is still uncertainty due to lack of formalized controlled trials. Therefore, more studies on the association between third molar eruption and crowding should be performed.

If EBD was being applied at its highest potential, asymptomatic removal of third molars, which is not a new problem, would not continue to be rampant. Dr. Louis K. Rafetto, a Wilmington, Delaware oral surgeon who was the chairperson of the American Association of Oral and Maxillofacial Surgeons' task force on third molars, found that approximately 75 to 80 percent of people are not able to maintain their wisdom teeth (Rabin, 2011). There was also a Cochrane study in which the authors found that third molar removal could be reduced by 60 percent if they were removed only when patients were in pain or developed a condition related to third molars (Mettes, Ghaeminia, Nienhuijs, Perry, van der Sanden, & Plasschaert, 2012).

Not only has there been research not supporting the asymptomatic removal of third molars, but there is also a major group of countries that has stopped the benefits to pay for it. The United Kingdom, which has a publicly funded health care service, decided in 1998 to no longer pay for the asymptomatic removal of third molars, as documented by Britain's National Health Service, which found a lack of published reports that supported the need (Rabin, 2011).

Jay Friedman, a retired general dentist in California, published an *American Public Health Association* study that described the statistics associated with the asymptomatic removal of third molars (Friedman, 2007). He found that oral surgeons remove ten million third molars from five million people in the United States each year (Friedman, 2007). According to his study, almost 70 percent of the third molars removed are unnecessary (Friedman, 2007). The $3 billion-per-year operation also costs patients at least 11 million patient days in which they are not able to function at their highest potential. These people have lost many days to pain, swelling, bruising, and malaise (Friedman, 2007). Additionally, approximately 11,000 people have suffered from permanent numbness of the lip, tongue, and cheek due to nerve injury following the removal of their third molars (Friedman, 2007). The prevalence of postoperative problems is an oral health issue that needs to be resolved, especially since the prophylactic removal of third molars is not substantiated by scientific evidence (Costa, Pazzini, Pantuzo, Jorge, & Marques, 2013).

Specific Aims or Objectives

EBD training is in its onset, and its early phase is still in its infancy at many learning institutions that teach dentistry. Dental schools want their students to be as informed as possible, and the same goes for dental organizations. Knowledge is power, and it is very important in a world full of readily accessible information online. Most agree that evidence-based learning is vital to the advancement of all means of education, and the dental community is no exception (Davies, 1999). Therefore, the main objective of the following study is to propose how EBD coursework and how curriculum teaching these skills can be improved in the future. Specifically, this paper will:

- Complete a thorough review of published literature addressing EBD with a focus on the asymptomatic removal of third molars
- Propose recommendations on how to improve EBD education with the asymptomatic removal of third molars as a model

This study should provide insights into what is currently taught and how to better teach EBD effectively to different groups, including both students and practicing dentists. This study will show the most efficient ways to incorporate EBD training into the dental curriculum.

PUBLISHED STUDIES

Evidence-Based Dentistry

Dentists, as with all health professions, need to continue to be life-long learners and students of their profession in order to remain knowledgeable of the advancements and best practices in their chosen field (ADEA Statement on Professionalism in Dental Education," 2015). Additionally, because they are encountering patients who are coming into the office with more questions than they had before, they must have strong interpersonal and communication skills. Dentists can learn about EBD by attending upcoming conferences, such as ADA's two-day EBD Champions Conference, the ADA Center for EBD educational courses, and the EBD Custom Workshops ("ADA Center for Evidence-Based Dentistry Education Courses," 2014). Colgate Oral Health Network also provides online continuing education courses, some of which relate to EBD ("Colgate Oral Health Network Dental CE Courses," 2014). All of these courses provide dentists the opportunity to learn about the most recent studies that pertain to their profession and more importantly, how to access the information themselves. However, all of these courses are associated with the ADA Continuing Education Recognition Program, and therefore, the majority of official EBD courses for current American dentists are within one entity: they are ADA-sponsored, CE-credit courses.

Clinicians interested in EBD can find a large number of resources on the ADA's Center for EBD website as well ("ADA Center for Evidence-Based Dentistry Resources," 2014). The ADA Center for EBD allows public access to several organizations, journals, databases, tools to find evidence, critical analysis, systematic reviews, summaries of systematic reviews, clinical recommendations and guidelines, tutorials, and glossaries of terms ("ADA Center for Evidence-Based Dentistry Resources," 2014). Those experienced with EBD can use this information to further understand the newest findings in dentistry and, in particular, specialties.

Even more important, resources on the ADA Center for EBD website are the "Critical Summary Authors" that provide summaries of very large reviews, allowing clinicians to find updated information more rapidly ("ADA Center for Evidence-Based Dentistry Featured Authors Archive," 2014).

With EBD being introduced as a new field in academia, almost all the information on the practice of EBD is found online. In 2008, Julie Frantsve-Hawley compiled dozens of important EBD sources (Frantsve-Hawley, 2008). The best websites to find systematic reviews and clinical recommendations and guidelines are found in Tables 1 and 2, respectively.

Table 1: **EBD Resources for Summary of Systematic Reviews.** Listed are 10 links where dentists and those interested in EBD can find summaries of systematic reviews. (Table taken from Frantsve-Hawley, 2008.)

Summaries of Systematic Reviews

Resource	Link	Information Available
EBD at ADA.org	www.ada.org/goto/ebd	Summaries of dental systematic reviews published elsewhere (new ADA-sponsored critical summaries are under development); additional Web resources
Journal of Evidence-Based Dental Practice	http://journals.elsevierhealth.com/periodicals/ymed	Summaries of dental systematic reviews, plus commentary and analysis; critical evaluations of published articles on various topics
Database of Abstracts of Reviews of Effectiveness (DARE)	http://www.crd.york.ac.uk/CRDWeb/	Structured abstracts of systematic reviews; includes commentary on overall review quality
National Library for Health—Oral Health Specialist Library	http://www.library.nhs.uk/oralhealth/	Structured abstracts of systematic reviews
Evidence-Based Dentistry journal (UK)	http://www.nature.com/ebd/archive/index.html	Systematic review summaries/analyses.
Evidentista (Pan American Centers for Evidence-Based Dentistry)	http://us.evidentista.org/?o=1026	Clinical questions and answers grouped by topic area
Agency for Healthcare Research and Quality (AHRQ)	http://www.ahrq.gov/clinic/epcquick.htm	Summaries of AHRQ evidence reports on dental caries, dental patients who are HIV positive, scaling and root planning therapy, and others
Bandolier: Dental and Oral Health	http://www.jr2.ox.ac.uk/bandolier/booth/booths/dental.html	Critical appraisals of systematic reviews and supporting studies on dental topics
Cochrane Oral Health Group	http://www.ohg.cochrane.org/reviews.html	Abstracts and plain-language summaries of dental systematic reviews
Centre for Evidence-Based Dentistry	http://www.cebd.org/?o=1069	Evidence summaries from the Oral Health Specialist library grouped by topic and/or specialty area

Table 2: **EBD Resources for Clinical Recommendations/Guidelines.** Listed are 10 links where dentists and those interested in EBD can find clinical recommendations and guidelines. (Table taken from Frantsve-Hawley, 2008.)

Clinical Recommendations/Guidelines

Resource	Link	Information Available
National Guideline Clearinghouse	www.guidelines.gov	Clinical practice guidelines
ADA Evidence-Based Clinical Recommendations	http://www.ada.org/prof/resources/ebd/clinical.asp	Evidence-based clinical recommendations on oral health topics, including topical fluoride and sealants
PubMed Clinical Queries (National Library of Medicine)	http://www.ncbi.nlm.nih.gov/entrez/query/static/clinical.shtml#reviews	Clinical practice guidelines grouped by category
National Institute for Health and Clinical Excellence (NICE)	http://www.nice.org.uk/guidance/index.jsp?action=byTopic&o=7298&set=true	Clinical guidelines from UK on dental recall
Centers for Disease Control and Prevention (CDC) Division of Oral Health	http://www.cdc.gov/oralhealth/guidelines.htm	Guidelines developed by CDC and the Task Force on Community Preventive Services
Scottish Intercollegiate Guidelines Network	http://www.sign.ac.uk/guidelines/published/index.html#Dentistry	Clinical guidelines on dental topics available as full guidelines and in quick reference guide format
Royal College of Surgeons (RCS) of England	http://www.rcseng.ac.uk/fds/clinical_guidelines	Clinical guidelines on common clinical situations
Agency for Healthcare Research and Quality (AHRQ)	http://www.ahrq.gov/clinic/cpgsix.htm	Clinical practice guidelines from the National Guideline Clearinghouse, Department of Health and Human Services, and AHRQ
SUMSearch	http://sumsearch.uthscsa.edu/	Searches free online resources—PubMed (Medline), Database of Abstracts of Reviews of Effectiveness (DARE), National Institutes of Health (NIH) Guidelines Clearinghouse—to retrieve systematic reviews and/or clinical guidelines.
Centre for Evidence-Based Dentistry	http://www.cebd.org/?o=1069	Guidelines and consensus statements

On PubMed, EBD can be found as a part of two Medical Subject Headings (MeSH) categories. In the "Health Occupations" section within the "Disciplines and Occupations Category," both the "Dentistry" and "Evidence-Based Practice" major topics include EBD ("Evidence-Based Dentistry," 2015). The "Evidence-Based Practice" major topic, which also includes Evidence-Based Medicine, was only introduced in 2009 ("Evidence-Based Practice," 2015). The addition of EBD to the PubMed MeSH terms shows that the discipline is on the rise in peer-reviewed journals. It also allows allow people to quickly and efficiently search for EBD information on PubMed.

The EBD research process is very important to the future of dental education because more evidence allows for a better understanding of the manner in which EBD should be implemented into certain classes. On March 4, 2015, the annual Bates-Andrews Research Day was held at the Tufts University School of Dental Medicine (TUSDM), where dental students shared their research with the community ("Bates Day Award Winners," 2015). The co-winners of the Omicron Kappa Upsilon Hilde Tillman Award found that recent graduates from dental school need to spend more time learning EBD earlier during their four years because those students said they learned about EBD too late into their schooling (Velayo et al., 2015). If many of the semester-long and yearlong courses in dental school can present EBD in an academic setting, then it will provide an important base for them to learn about clinical EBD.

The Dental Competencies and EBD Courses

On April 2, 2008, the ADEA House of Delegates approved the "Competencies for the New General Dentist," which includes three references to EBD. Although some dental schools do not have EBD courses, the ADEA highlights EBD in the preamble. The competencies state that a general dentist should be a primary oral health care provider that can work both independently and with others to practice EBD to assist in improving the health of society. The entry-level competencies also include EBD. They state that beginning general dentists should practice EBD to find the best research to aid their expertise while keeping the patients' needs in mind. In the appendix, there is also a glossary of terms entry for EBD, which defines the term the same way the ADA Center for EBD does. With the ADEA House of Delegates having approved this evidence-based approach to dentistry seven years ago, EBD should be on the rise in dental schools (ADEA, "Competencies for the New General Dentist," 2015).

At the BU Henry M. Goldman School of Dental Medicine (GSDM), dental students receive a syllabus at the beginning of each course, and it allows the students to know what different types of main topics will be covered. There are 18 topics included in the BU GSDM dental competency curriculum (Table 3):

Table 3. BU GSDM Dental Competencies. There are no dental competencies that directly relate to EBD. The bolded competencies are for first-year courses biochemistry, physiology, and microbiology. (Table taken from Lehman, 2014.)

Number	Competency
1	Diagnosis
2	**Treatment Planning**
3	Preventive Dentistry
4	Pain Control
5	Medical Emergencies
6	Periodontology
7	Restoration of Teeth
8	Replacement of Missing Teeth
9	Occlusion
10	Endodontics
11	Oral Surgery
12	Orthodontics
13	Regulations
14	**Infection Control**
15	Patient Management
16	Practice Management
17	**New Procedures**
18	**Outcomes Assessment**

For example, the 'diagnosis' competency applies to the biochemistry, physiology, and microbiology courses (Lehman, 2014). Biochemistry also includes 'treatment planning,' 'new procedures,' and 'outcomes assessment' (Schreiber, 2014). Microbiology also has a minor link to the 'infection control' competency (Oberhaus, 2015). However, although EBD is taught as a full-year course for first-year students at the Henry M. Goldman School of Dental Medicine, there is not an 'EBD' competency (Boston University, "DMD 1," 2015).

There are well-defined competencies at the TUSDM as well. As a part of the TUSDM 2020 Oral Health Curriculum, the school revised its competencies to the following (Table 4):

Table 4. TUSDM Dental Competencies. In total, there are 16 competencies, including the nine treatment subcategories. The bolded competencies are for the ones involving EBD. (Table taken from Tufts University School of Dental Medicine "D.M.D. Curriculum," 2014.)

Number	Competency
1	Diagnosis
2	**Treatment Planning**
3	Treatment
A	Emergency Management
B	Oral Health Promotion
C	Prevention of Pain and Anxiety
D	Malocclusion and Space Management
E	Oral and Maxillofacial Surgical Therapy
F	Oral and Maxillofacial Pathology and Radiology
G	Endodontic Therapy
H	Operative and Prosthetic Therapy
I	Periodontal Therapy
4	Community Involvement
5	Practice Management
6	Ethics and Professionalism
7	**Information Management and Critical Thinking**

While there may not be a reference to EBD on the surface, the 'treatment planning' competency is very much related to EBD (Tufts University School of Dental Medicine "School Competencies," 2015). In addition, with the 'information management and critical thinking' including EBD, the TUSDM is on its way to having the newest and best research incorporated into its treatment of patients. The 'information management and critical thinking' competency requires graduates to employ EBD patient care (Tufts University School of Dental Medicine "School Competencies," 2015). With the TUSDM having recently implementing its 2020 Oral Health Curriculum, the school is ready to move into its next phase of dentistry, which very much includes EBD.

Similar to TUSDM, some American dental schools do not have courses dedicated to EBD. The University of Texas School of Dentistry at Houston (UTSD) does not have a course ("DDS Course List," 2015). The UTSD was established in 1905, but still does not have any EBD component in its curriculum ("About the School," 2015). A new dental school, the University of New England College of Dental Medicine (UNECDM), does not have an EBD course either ("Dental Medicine Curriculum," 2015). The UNECDM received its initial accreditation in 2012, and it has not incorporated EBD into its curriculum yet ("Accreditation," 2015).

The University of Pennsylvania School of Dental Medicine (UPENNSDM) and the Temple University Maurice H. Kornberg School of Dentistry (TUMHKSD) also do not have EBD courses in their respective well-established programs. The UPENNSDM has an extended assortment of elective pre-doctoral courses in addition to its core curriculum ("Academic Programs & Admissions," 2015). However, none of the courses that the UPENNSDM offers are EBD ones ("Academic Programs & Admissions," 2015). For the TUMHKSD, there are no EBD courses either, but the school does offer teaching of EBD in relation to pediatric dentistry ("Course Series Descriptions," 2013).

Although there are some schools that do not have EBD-dedicated courses, the Stony Brook University School of Dental Medicine (SBUSDM) and the University of

Pittsburgh School of Dental Medicine (UPSDM) do each have an EBD course. In the SBUSDM's extensive second-year curriculum, the school offers an "EBD & Critical Thinking" course (UPSDM "D.D.S. Curriculum," 2014). However, the UPSDM desires that its students learn EBD as early as possible; the school's EBD course is taught in the fall of the first year ("First-Year Curriculum," 2015). Both the SBUSDM and the UPSDM incorporate EBD early, and it allows their students to apply research through most of their time in dental school as well as after they graduate. Each of these schools is moving in the right direction with the early exposure of EBD to students, but there are some dental schools that are implementing a broader application of EBD in order to better prepare their students.

While the University of Iowa College of Dentistry (UICD) does not have a specific EBD course listed on its website, it is incorporating EBD into its curriculum more than the aforementioned schools ("The D.D.S. Program," 2015). The ninth of its 13 competencies requires that its students know how to provide evidence-based care by finding, analyzing, applying, and communicating information (UICD "Collegiate Competencies for the New Dentist at the College of Dentistry and Dental Clinics," 2015). Not only does the dental school have a competency dedicated to EBD, but it also has been integrating EBD into its new curriculum since the early 2010's. By teaching first-year dental students how to think critically and showing second-year, third-year, and fourth-year students how to apply EBD, the UICD is preparing its students the proper technique to analytically approach dentistry in the clinic and outside of dental school (Marshall et al., 2014).

There has been success with a similar curriculum change that occurred with the Texas A&M University Baylor College of Dentistry (TUBCD) in 2008. Hinton et al. measured EBD aptitude in the following four categories for two EBD-trained classes and one untrained class: practices, experience, attitudes, and knowledge. In general, they found that the students and faculty members trained in EBD scored stronger compared to their untrained counterparts in the knowledge and attitude categories, meaning they had acquired more knowledge and had more positive attitudes towards EBD after being trained in EBD (Hinton, McCann, Schneiderman, & Dechow, 2015). With the UICD and TUBCD having implemented EBD-based curriculums, they have shown that a broader application of EBD is important in making students better lifelong learners.

The Asymptomatic Removal of Third Molars

We chose to use asymptomatic third molar removal as an example to demonstrate the advantages and shortcomings of EBD. The asymptomatic removal of third molars, an issue that has a variety of studies associated with it, has not been impacted directly by newly published research, which suggests that the prophylactic removal may not be warranted as it continues to be one of the most common surgical procedures performed by dentists today (Andersson, Kahnberg, & Pogrel 2010).

In 2014, Sigron et al. indicated that alveolar osteitis is the most commonly found complication after wisdom-tooth removal. This report, evaluated 1,199 cases in the mandible, retrospectively. Of the third molars removed, 101 (8.4%) complications occurred, and the authors' findings were similar to those in comparable studies (Table 5).

Almost half (50 cases- 4.2%) of the complications were alveolar osteitis, which is the inflammation of the alveolar bone, usually leading to a dry socket. Sigron also found that females were of higher risk for alveolar osteitis than men and that the risk for developing the problem was 6% for patients who suffered from a previous pericoronal infection. It is clear that third molar removal is necessary at that site of infection. Other commonly occurring complications were the following: 12 (1%) temporary and six (0.5%) persistent sensation disorders and 15 (1.25%) abscesses. There were also seven (0.6%) dehiscences, in which the patient lost alveolar bone on the facial aspect of the tooth. In addition, five (0.4%) cases of post-operative bleeding were found in addition to four (0.32%) sequestra, one (0.08%) fistula, and one (0.08%) hematoma (Table 5) (Sigron, Pourmand, Mache, Stadlinger, & Locher, 2014).

Table 5. Summary of Complications found in Mandible after Third Molar Removal. (Table amended from Sigron et al., 2014.)

Complication	Number	%
Alveolar osteitis	50	4.2
Abscesses	15	1.3
Temporary sensation disorders	12	1
Dehiscence	7	0.6
Permanent sensation disorders	6	0.5
Post-operative bleeding	5	0.4
Formation of a sequestrum	4	0.32
Fistula	1	0.08
Hematoma	1	0.08
Total	101	8.4

The authors found a significant correlation ($p<0.0001$) between the radiological projection of the mandibular third molars and post-operative sensation disorders, supporting the use of caution when removing third molars from the mandible (Sigron et al., 2014).

Also in 2014, Pourmand et al. published a retrospective study of 1,562 cases in the maxilla. In the study, 543 molars were surgically removed while 1,019 were non-surgically removed. In the 1,212 patients for this study, there were 106 (6.8%) complications in 92 patients of the 1,562 operations. Of the 1,212 patients, 7.6% had at least one complication with the removal of a third molar. The complications were 5.1%

intra-operative and 0.8% postoperative in this retrospective study (Figure 7). Alveolar osteitis was less common in the maxillary arch when compared to the mandibular arch retrospective study, as it occurred post-operatively in just six (0.4%) maxillary cases (Pourmand, Sigron, Mache, Stadlinger, & Locher, 2014). An oroantral fistula (OAF), a hole between the oral cavity and the sinuses, was the most common maxillary complication: it was found in 38 (2.4%) cases (Borgonovo, Berardinelli, Favale, & Maiorana, 2012). The authors found that the risk of OAF correlated with increasing patient age ($p = 0.0368$). In addition, the risk of OAF increased with root fractures. When analyzing pre-operative panoramic radiographs, they found that observing the projection of the root tips to the sinus floor is significant evidence when assessing the risk of OAF. Therefore, as the mandible study by Sigron et al. (2014) explained, caution should be taken when making the decision to remove third molar; there should also be caution taken for removal in the maxilla (Pourmand et al., 2014).

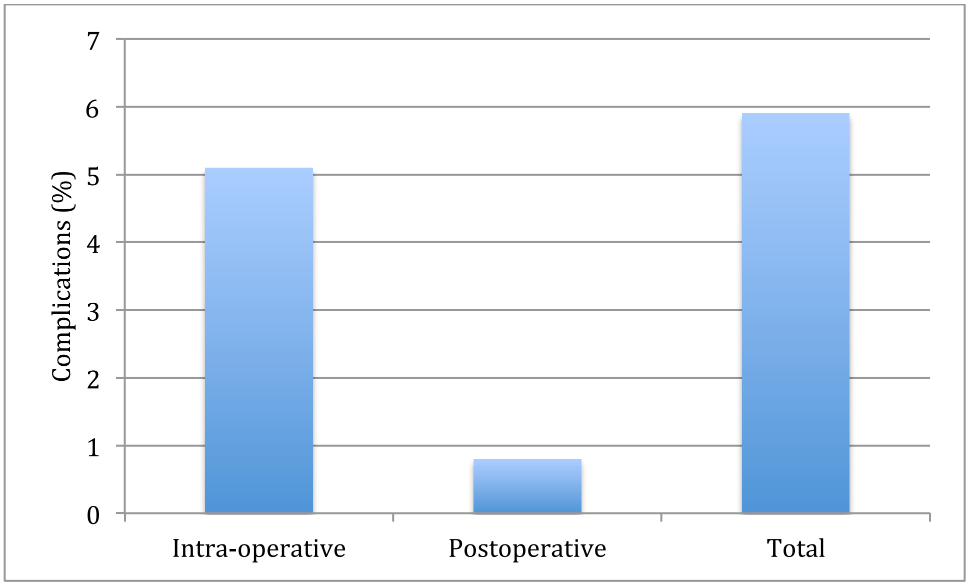

Figure 7. Frequency of Complication following Maxillary Third Molar Removal. As shown, intra-operative complications occurred much more often than postoperative complications. (Figure taken from Pourmand et al., 2014)

In a report by Costa et al. (2013), only four papers were included in a systematic review after analyzing 260 pertinent papers. These included studies by Southard (1992), Sigron et al., (2014), Pourmand et al., (2014) and Harradine et al. (1998). Costa et al. also searched for randomized clinical trials and systematic reviews in PubMed, *BBO*, *LILACS*, *Web of Science*, *EMBASE*, *BIREME*, and *Cochrane*. They did not restrict by year or language with their searches. After the search for papers was completed, two independent reviewers agreed on the four eligible papers: two were from the year 2005, one from 1998, and one from 1982. Even with the vigorous selection process, there were several flaws with the four papers, including inadequate sample sizes. The results of the systematic review were that there is little scientific evidence supporting the prophylactic extraction of third molars (Costa, Pazzini, Pantuzo, Jorge, & Marques, 2013).

A randomized controlled trial by Southard (1992) that was one of the four articles included in the *Brazilian Oral Health* systematic review had a sample size that was inadequate. The authors began with 164 patients, which entered the study in 1984. Unfortunately, only 77 (47%) patients returned to be monitored. Of the 77 patients, 44 were randomly chosen to have their third molars removed. The control group's mean was a 2.1-mm increase in lower labial segment irregularity. For those who had their third molars removed, the mean increase in irregularity fell by 1.1 mm. However, with $p = 0.15$, the difference was not statistically or clinically significant. Therefore, it cannot be concluded that third molar removal reduces or prevents late mandibular anterior incisor crowding (Southard, 1992).

As stated, alveolar osteitis is the most commonly found complication associated with third molar removal in the mandible (Sigron et al., 2014), whereas OAF occurs more often after third molar removal in the maxilla (Pourmand et al., 2014). The sample sizes of both of these *Swiss Dental Journal* studies were strong, as they each involved more than one thousand third molar removals. These studies were effective as retrospective studies due to the importance of collecting the information on third molar removal complications.

The *Brazilian Oral Research* systematic review by Costa et al. (2013) evaluated the effectiveness of 260 papers, but only found four related to the prophylactic removal of third molars. Costa et al. deducted that the prophylactic removal of third molars was not substantiated by the research. Additionally, the Harradine et al. (1998) randomized controlled trial on late mandibular incisor crowding was one of the four papers also found to have inadequate sample sizes. Each of the papers involved randomized controlled trials and only one had a low standard of quality judgment. The 1998 crowding trial, which found that there was no evidence supporting third molar removal to help avoid late mandibular incisor crowding, was the only one of the four to have a method error analysis performed.

More recently, across all health professions, an emphasis has been placed on prevention, but third molar removal, even though it has been a long-standing tradition of practicing prevention, may be too aggressive. The commonly reported reasons for third molar removal are not substantiated in the research.

DISCUSSION

Evidence-Based Dentistry

Although people have easy access to a large amount of information via the Internet, they may not be making the correct decisions regarding their oral health. In addition, most do not know how to find the most recent research and use it to their advantage; additionally much of the information online is not peer reviewed and as such may not be accurate. People are also acquiring knowledge through conversations with their friends and family members. Consequently, most patients enter the dental office with some information, but not necessarily the best information to help them make an informed decision. Therefore, dentists need to be ready to field a variety of questions concerning the information that patients read, hear, and see from diverse sources.

Education has changed substantially over the last few decades. Technology has affected the methods in which students of all ages and schools engage with educational material. Students have transitioned from originally having face-to-face lectures in classrooms to now watching video lectures on a seemingly-endless number of electronic devices. There are hybrid classes and flipped classes. However, according to Boston school psychologist Dr. Kate Roberts, the more people use their devices, the less they rely on person-to-person communication (Johnson, 2014). In doing so, this group of people may be missing key learning experiences. With numerous reliable sources of information online, such as the National Library of Medicine, Web MD, the Mayo Clinic, Up to Date, and the CDC, people may tend to neglect a key source: the human interaction. A conversation between people creates connections and leads to human growth that sometimes cannot be found online by just reading, listening, or watching. Those three actions are very important in learning, but the analysis of information and subsequent growth allows great strides to be undertaken when people congregate.

Instead of the typical dental school model with lectures and exams, the Center for Craniofacial Molecular Biology of the University of Southern California School of Dentistry (USCSD), now known as the Herman Ostrow School of Dentistry of USC, experimented with problem-based learning a couple decades ago. The completely problem-based program, which was proposed and implemented for 12 USCSD D.D.S. students in 1995, involved a faculty facilitator with six students per group. They learned clinical dental skills with the use of clinical charts, radiographs, and medical reports. The type of hands-on learning that the USCSD implemented in 1995 is still in use today (Fincham et al., 1997). In addition to the USCSD's admissions process including critical thinking, it offers mock problem-based learning because the school wants to prepare its students for an important part of its curriculum ("Admission Requirements," 2015). With the classroom environment continuing to be vital to USCSD, the school is incorporating into its curriculum a broader application of how dentists and their teams work together after dental school.

Dental schools are moving in a better direction today with EBD implementation, as many schools have acknowledged the importance of EBD, and some schools have made great strides to incorporate it into their respective curriculums. With the TUSDM studies supporting the early and frequent exposure to EBD, the dental schools need to follow suit. In addition to the BU GSDM, both of the other Massachusetts dental schools need to improve their respective EBD curriculums. The next step is EBD application: interdisciplinary study and clinical EBD. The BU GSDM, which has a yearlong EBD course for its first-year dental students, is one of four dental schools to have produced an online EBD tutorial for the ADA Center for EBD Resources website ("ADA Center for Evidence-Based Dentistry Resources," 2014). Unfortunately, the BU link to the tutorial on the ADA website is the only tutorial link that is not found on the server ("ADA Center for Evidence-Based Dentistry Resources," 2014). However, one can find the tutorial using any search engine, and it introduces EBD very well. With the BU GSDM having multiple experts on the ADA CRP as well as a course for its students, it is in the forefront of EBD education.

The other Boston dental schools have fallen behind the BU GSDM in their EBD education. As opposed to the BU GSDM, the TUSDM does not have a course solely dedicated to EBD ("D.M.D. Curriculum," 2015). Since school does have a specific competency relating to EBD, it has changed its curriculum standards to include EBD: the first of the five TUSDM "Competency Statements for the Contemporary Dental Graduate" includes the understanding of the relationship of evidence between oral health sciences and dental clinical care ("D.M.D. Curriculum," 2015). The TUSDM's mission, vision, and values also include a reference to EBD, but not as directly as in the competency statements: one of the values is a to advance dentistry with the congregation of education and research ("Mission, Vision & Values," 2015). As a part of the TUSDM's commitment to EBD, it has some EBD lectures incorporated into its

‘Introduction to Dental Practice’ course (“D.M.D. Curriculum,” 2015). Dr. David Leader, a TUSDM associate professor and featured ADA Center for EBD critical summary author, provides EBD guidance (“ADA Center for Evidence-Based Dentistry Featured Authors Archive,” 2014). With the TUSDM recently changing to its “2020 Oral Health Curriculum,” it should soon move to having a semester-long or yearlong EBD course soon to teach its future dentists how to research during and after dental school.

While TUSDM is incorporating EBD, the Harvard School of Dental Medicine does not even have a course relevant to EBD or a professor responsible for EBD (“Curriculum Overview and Organization,” 2015). The three dental schools in Massachusetts are a microcosm of EBD education in dental schools in the United States. They range from having a yearlong course to not having any formal education. Harvard prides itself on its world-renowned research (“Research,” 2015). Harvard has fallen behind in teaching and researching EBD. The only easily-accessible Harvard-associated EBD information is its CE course on evidence-based implant dentistry, which was offered in 2011 and 2012 at Mass General Hospital in Boston (“CE Course on Evidence-Based Implant Dentistry,” 2015). Harvard’s dedication to EBD would be better exemplified by an emphasis of it during dental school. However, if Harvard would prefer catering to graduated dentists, more classes on EBD would be a start to ingraining EBD into its educational fabric. A dentist that recently graduated would be more inclined to stay connected with his or her alma mater if the school offered CE-credit classes.

Implementation of EBD Outside of the Research Institution

Although there exists a 27-page operations manual that dictates how the ADA CRP operates, the panel is not transparent due to the fact that it is associated with the ADA and its affiliates ("ADA, About EBD," 2014). In addition, since there is a lack of transparency, financial support could also be a problem. For example, if the status quo of asymptomatic third molar removal is working for insurance companies and dental professionals with regard to finances and resistance to change, then there would be no impetus for a change of the situation to benefit the public. In order to allow for the best science to be practiced and for EBD to be employed in the best possible way, there must be a completely independent group that makes decisions solely based on the research.

For any dentist who is new to EBD, they should first understand how to approach EBD. Those who are interested in the profession's field of research would most likely have difficulty if they have not done some form of research previously. In addition, transitioning to online learning is something that established dentists will need to embrace. In order to do so, they should either try some of the tutorials produced by schools and organizations or consult with one of the EBD experts or authors. The tutorials can be helpful, but attending one of the conferences or making a phone call to an expert or author can be a more effective way to jumpstart a person new to EBD. Communication with an EBD expert allows for many more opportunities to learn the art of EBD. It can also allow for mentorship, which is an important part of growth and education. Although the face-to-face conversation is the best method, a person new to

EBD should prepare for a conversation by studying the tutorials along with what research they can comprehend.

Dr. Mukherji, an expert in the field, has his private dental practice experimenting with what could be the next frontier of EBD research. At M Dentistry in Fort Worth, Texas, Dr. Mukherji has trained his staff in EBD's processes, especially on how to utilize the ADA's EBD website effectively to find the best studies as well as how to communicate the information (Mukherji, 2013). In addition to speaking with patients about the new studies, the staff members learn how to use social media to further discuss and understand the important information. To enhance their ability to stay updated with fresh research, he and his staff members pose new and important topics to discuss and research on a monthly basis (Mukherji, 2013).

It is important to include everyone in the office because each person can bring a variety of opinions to the conversation. The diverse contributions make for a better overall experience in the office. With staff members finding the latest research on topics that interest them, they can contribute to dentistry in many new ways. Dentists who recently have graduated from dental school will find these types of offices more intriguing to join as an associate because they can be even more of an asset.

The Asymptomatic Removal of Third Molars

A large segment of the population does not know that they should always be in consultation with an oral surgeon before deciding if someone needs to have his or her third molars removed. Studies have been conducted on the asymptomatic removal of third molars, but they are not conclusive thus far. When this third molar material is presented in a classroom environment, professors should keep the following objectives in mind:

1. To explain why third molars may not need to be removed as often as they are.
2. To help understand when third molars should be removed.
3. To explain the complications associated with third molar removal.

At the beginning of the lecture about the asymptomatic removal of third molars, it is important to have as many of the students speak about their academic and personal experiences with third molar removal. The experiences can be personal as well as from secondhand information from their friends and family members. The discussion before the presentation of material allows the audience members to engage with the topic, so they can understand the misconceptions before they are presented. It is important to explain the research and demonstrate that there are very few recent studies on the topic. In addition, the students should know to consult with an oral surgeon if they think there is a problem with a patient's third molars. Many dental professionals have access to the most updated information regarding the subject, but the attending oral surgeon is the one who determines the best treatment plan for the patient. Since the asymptomatic removal of third molars is lacking in terms of research, future studies should be done on the procedure. In addition, they should be done on how dental insurance affects treatment decisions, how advertising affects treatment decisions, and if post-orthodontic relapse can occur after third molar removal.

There are often times when the crowding of teeth is mentioned as one of the reasons that third molars need to be removed. In addition, the fear of future oral health problems can influence the decision. However, parents should not be making the decision to remove third molars by themselves. With specialists in oral surgery readily available, the decision to remove third molars should be done in consultation with an experienced oral surgeon. There should be a mutual decision made when looking at the evidence. The three conclusions from the scientific literature can advise:

1. Caution should be taken when removing third molars from both the mandible and maxilla.

2. The results of Costa et al.'s 2013 systematic review demonstrate minimal scientific evidence supporting the prophylactic extraction of third molars.

3. One cannot conclude that third molar removal reduces or prevents late mandibular incisor crowding.

Conclusion

For situations like the asymptomatic removal of third molars, there may be an option for those looking for independent research: study groups. Many dental districts have their own study groups, and like Dr. Mukherji's "study group" within his office, they can find answers to new questions regarding dentistry. These groups can also happen within learning institutions, as more students are conducting research today than they have before. However, very few randomized controlled trials are associated with the importance of an EBD education relating to the use of EBD in clinical practice. With such vast library access in each of the dental schools, students can enter post-bachelor's credential-enhancing programs like the BU Master of Science in Oral Health Sciences program and conduct their own research that allows for growth for them, their faculty advisors, and the schools. Within the next few years, the next step would be to increase the number of randomized controlled trials

For EBD to be successful in dentistry, it must function in the clinical environment, but initial training in the concepts and advantages of EBD must start during their pre-doctoral education. The dental practitioner still must rely on his or her own expertise, but the patient must also trust his or her dentist. EBD is based on trust because it is based on the trust you have demonstrated through your skills and your usage of all available resources. If the dentist can compile pertinent scientific data and information to share with the patient and make the best decision together, then the use of EBD will be beneficial to the field of dentistry.

LIST OF JOURNAL ABBREVIATIONS

BBO	Brazilian Bibliography of Dentistry
BIREME	Operations of the Biblioteca Regional de Medicina
Cochrane	Cochrane Database of Systematic Reviews
EMBASE	Excerpta Medica Database
LILACS	Literature in Health Sciences published in Latin American and the Caribbean Sciences

REFERENCES

Alpaslan, G. (2012). What is Evidence Based Dentistry [PowerPoint slides]. Retrieved from http://www.tdb.org.tr/evident/documents/What_is_EBD.ppt

American Dental Association (2006). Tooth Eruption. *The Journal of the American Dental Association*, 137(1), 127 http://www.ada.org/~/media/ADA/Publications/Files/patient_58.ashx

American Dental Association. (2014). ADA, About EBD. Retrieved from http://ebd.ada.org/en/about/

American Dental Association. (2014). ADA Center for Evidence-Based Dentistry Education Courses. Retrieved from http://ebd.ada.org/en/education/

American Dental Association. (2014). ADA Center for Evidence-Based Dentistry Resources. Retrieved from http://ebd.ada.org/en/resources/

American Dental Education Association. (2015). ADEA Statement on Professionalism in Dental Education. Retrieved from http://www.adea.org/Pages/Professionalism.aspx

American Dental Education Association. (2015). Competencies for the New General Dentist. Retrieved from http://www.adea.org/about_adea/governance/Pages/Competencies-for-the-New-General-Dentist.aspx

American Student Dental Association. (2015). Licensure By State. Retrieved from http://www.asdanet.org/licensuremap.aspx

Andersson, L., Kahnberg, K., & Pogrel M. A. (2010). Oral and Maxillofacial Surgery. United Kingdom: Blackwell Publishing Ltd.

Bickley, L. S. (2009). Bates' Guide to Physical Examination & History Taking: Interviewing and the Health History [PDF]. Retrieved from http://culturalmeded.stanford.edu/pdf%20docs/Bates_Chapter_2.pdf

Bishop, M. (2013). Ars scientia mores: science comes to English dentistry in the seventeenth century. 2. Charles Allen's Treatise of 1685/6. *British Dental Journal*, 214(5), 239-242.

Borgonovo, A. E., Berardinelli, F. V., Favale, M., & Maiorana, C. (2012). Surgical Options In Oroantral Fistula Treatment. *The Open Dentistry Journal*, *6*, 94-98. http://doi.org/10.2174/1874210601206010094

Boston University Alumni Medical Library. (2015). Forming a Clinical Question. Retrieved from http://medlib.bu.edu/tutorials/ebm/pico/

Boston University. (2015). DMD 1. Retrieved from http://www.bu.edu/academics/sdm/courses/dmd-i/

Colgate-Palmolive Company. (2014). Colgate Oral Health Network Dental CE Courses. Retrieved from http://www.colgateoralhealthnetwork.com/dental-ce-courses/

Costa, M. G. Pazzini, C. A., Pantuzo, M. C., Jorge, M. L., & Marques, L. S. (2013). Is there justification for prophylactic extraction of third molars? A systematic review. *Brazilian Oral Research*, 27(2), 183-188.

Davies, P. (1999). What is Evidence-Based Education? *British Journal of Educational Studies*, 47(2), 108-121.

Fincham, A. G., Baehner, R., Chai, Y., Crowe, D. L., Fincham, C., Iskander, M., Landesman, H. M., Lee, M., Luo, W., Paine, M., Pereira, L., Moradian-Oldak, J., Rosenblum, A., Snead, M. L., Thompson, P., Wuenschell, C., Zeichner-David, M., & Shuler, C.F. (1997). Problem-based learning at the University of Southern California School of Dentistry. *Journal of Dental Education*, 61(5), 417-25.

Fox, C., Kay, E. J., Anderson, R. (2014). Evidence-based dentistry – overcoming the challenges for the UK's dental practitioners. *British Dental Journal*, 217(4), 191-194.

Frantsve-Hawley, J. (2008). Evidence Locator: Sources of Evidence-Based Dentistry Information. *The American Dental Association Center for Evidence-based Dentistry*, 8(3), 133-138.

Friedman, J. W. (2007). The Prophylactic Extraction of Third Molars: A Public Health Hazard. *American Journal of Public Health*, 97(9), 1554-1559. http://doi.org/10.2105/AJPH.2006.100271

Gavazzi, M., De Angelis, D., Blasi, S., Pesce, P., & Lanteri, V. (2014). Third molars and dental crowding: different opinions of orthodontists and oral surgeons among Italian practitioners. *Progress in Orthodontics*, 15(1), 60.

Georgia State University. (2015). Writing Systematic Reviews for the Health and Social Sciences: EBP. Retrieved from http://research.library.gsu.edu/c.php?g=115802&p=751597

Grimes, D. A. & Schulz, K. F. (2002). An overview of clinical research: the lay of the land. *Lancet*, 359(9300), 57-61.

Harradine, N. W., Pearson, M. H., & Toth, B. (1998). The effect of extraction of third molars on late lower incisor crowding: a randomized controlled trial. *British Journal of Orthodontics*, 25(2), 117-122. http://dx.doi.org/10.1093/ortho/25.2.117

Harvard School of Dental Medicine. (2015). Curriculum Overview and Organization. Retrieved from http://hsdm.harvard.edu/academics/dmd/curriculum_overview_and_organization

Herman Ostrow School of Dentistry of USC. (2015). Admission Requirements. Retrieved from http://dentistry.usc.edu/programs/aspid/admission/

Hinton, R. J., McCann, A. L., Schneiderman, E. D., & Dechow, P. C. (2015). The winds of change revisited: progress towards building a culture of evidence-based dentistry. *Journal of Dental Education*, 79(5), 499-509.

Ismail, A. I. & Bader, J. D. (2004). Evidence-based dentistry in clinical practice. *The Journal of the American Dental Association*, 135(1), 78-83.

Johnson, Chandra. (2014). Face time vs. screen time: The technological impact on communication. Desert News National. Retrieved from http://national.deseretnews.com/article/2235/Face-time-vs-screen-time-The-technological-impact-on-communication.html

Kasat, Karjodkar, & Laddha. (2012). Dentigerous cyst associated with an ectopic third molar in the maxillary sinus: A case report and review of literature. *Contemporary Clinical Dentistry*, 3(3), 373-376.

Kishore, M., Panat, S. R., Aggarwal, A., Agarwal, N., Upadhyay, N., & Alok, A. (2014). Evidence Based Dental Care: Integrating Clinical Expertise with Systematic Research. *Journal of Clinical and Diagnostic Research*, 8(2), 259-262.

Lang, L. A., & Teich, S. T. (2014). A critical appraisal of evidence-based dentistry: The best available evidence. *The Journal of Prosthetic Dentistry*, 111(6), 485-492.

Lehman, W. (2014). Physiology course syllabus [Class handout]. Henry M. Goldman School of Dental Medicine, Boston University, Boston, MA.

Lindauer S. J., Laskin D. M., Tufekci E., Taylor R. S., Cushing B. J., & Best A. M. (2007). Orthodontists' and surgeons' opinions on the role of third molars as a cause of dental crowding. *American Journal of Orthodontics and Dentofacial Orthopedics*, 132(1), 43-8

Maggio, L. A., & Jeffery, K. M. (2008). Helping a dental school put the "e" in evidence-based dentistry. *Journal of Medical Library Association*, 96(2), 152-155.

Marshall, T.A., Straub-Morarend, C.L., Handoo, N., Solow, C. M., Cunningham-Ford,

M. A., & Finkelstein, M. W. (2014). Integrating critical thinking and evidence-based dentistry across a four-year dental curriculum: a model for independent learning. *Journal of Dental Education*, 78(3), 359-67.

Mettes, T. D., Ghaeminia, H., Nienhuijs, M. E., Perry, J., van der Sanden, W. J., & Plasschaert, A. (2012). Surgical removal versus retention for the management of asymptomatic impacted wisdom teeth. *The Cochrane Database of Systematic Reviews*, *6*, CD003879. http://doi.org/10.1002/14651858.CD003879.pub3

Mukherji, P. (2013). Evidence-Based Champions Conference 2013. How Can I be a Champion? [PowerPoint slides]. Retrieved from http://ebd.ada.org/~/media/EBD/Files/13_Partha.ashx

Mukherji, P. (2014). Evidence Based Champions Conference 2.0. Implementing EBD in Practice: strategies to incorporate principles of EBD to your practice [PowerPoint slides]. Retrieved from http://ebd.ada.org/~/media/EBD/Files/EBDChampions2/PARTHA.ashx

National Center for Biotechnology Information. (2015). Evidence-Based Dentistry. Retrieved from http://www-ncbi-nlm-nih-gov.ezproxy.bu.edu/mesh/68055094

National Center for Biotechnology Information. (2015). Evidence-Based Practice. Retrieved from http://www-ncbi-nlm-nih-gov.ezproxy.bu.edu/mesh/68055317

Oberhaus, S. (2015). Dental microbiology and immunology course syllabus [Class handout]. Henry M. Goldman School of Dental Medicine, Boston University, Boston, MA.

Phulari, R. (2014). Textbook of Dental Anatomy, Physiology and Occlusion. New Delhi, India: Jaypee Brothers Medical Publishers Ltd.

Pourmand, P. P., Sigron, G. R., Mache, B., Stadlinger, B., & Locher, M. C. (2014). The most common complications after wisdom-tooth removal: part 2: a retrospective study of 1,562 cases in the maxilla. *Swiss Dental Journal*, *124*(10), 1047-1051, 1057-1061.

Rabin, R. C. (2011, September 5). Wisdom of Having That Tooth Removed. *The New York Times*. Retrieved from http://www.nytimes.com/2011/09/06/health/06consumer.html

Research. (2015). Harvard School of Dental Medicine. Retrieved from http://hsdm.harvard.edu/research

Schreiber, B. (2014). Dental biochemistry course syllabus [Class handout]. Henry M. Goldman School of Dental Medicine, Boston University, Boston, MA.

Sigron, G. R., Pourmand, P. P., Mache, B., Stadlinger, B., & Locher, M. C. (2014). The most common complications after wisdom-tooth removal: part 1: a retrospective study of 1,199 cases in the mandible. *Swiss Dental Journal*, *124*(10), 1042-1046, 1052-1056.

Smaïl-Faugeron, V., Fron-Chabouis, H., & Courson, F. (2014). Methodological quality and implications for practice of systematic Cochrane reviews in pediatric oral health: a critical assessment. *BMC Oral Health*, 14-35.

Southard, T. E. (1992). Third molars and incisor crowding: when removal is unwarranted. *The Journal of the American Dental Association*, 123(8), 75-79. http://dx.doi.org/10.14219/jada.archive.1992.0224

Spielman, A. I., & Wolff, M. S. (2008). Overcoming Barriers to Implementing Evidence-Based Dentistry. *Journal of Dental Education*, 72(3), 263-264.

Stony Brook University School of Dental Medicine. (2014). D.D.S. Curriculum. Retrieved from http://dentistry.stonybrookmedicine.edu/dentalprograms/dds

Temple University Maurice H. Kornberg School of Dentistry. (2013). Course Series Descriptions. Retrieved from http://dentistry.temple.edu/admissions/curriculum/course-descriptions

Tufekci, E, Svenskb, D., Kallunkic, J., Huggared, J., Lindauere, S. J., & Laskin, D. M. (2009). Opinions of American and Swedish Orthodontists about the Role of Erupting Third Molars as a Cause of Dental Crowding. *The Angle Orthodontist*, 79(6): 1139-1142.

Tufts University School of Dental Medicine. (2015). Bates Day Award Winners. Retrieved from http://sites.tufts.edu/dentalcentral/2015/03/09/bates-day-award-winners/

Tufts University School of Dental Medicine. (2015). D.M.D. Curriculum. Retrieved from http://dental.tufts.edu/academics/curriculum/

Tufts University School of Dental Medicine. (2015). Mission, Vision & Values. Retrieved from http://dental.tufts.edu/about/mission-statement/

Tufts University School of Dental Medicine. (2015). School Competencies. Retrieved from http://tusk.tufts.edu/competency/competency/view/school/school/Dental

University of Iowa College of Dentistry. (2015). Collegiate Competencies for the New Dentist at the College of Dentistry and Dental Clinics. Retrieved from https://www.dentistry.uiowa.edu/education-competencies

University of Iowa College of Dentistry. (2015). The D.D.S. Program. Retrieved from https://www.dentistry.uiowa.edu/education-dds

University of New England College of Dental Medicine. (2015). Accreditation. Retrieved from http://www.une.edu/dentalmedicine/about/accreditation

University of New England College of Dental Medicine. (2015). Dental Medicine Curriculum. Retrieved from http://www.une.edu/dentalmedicine/program/curriculum

University of Pennsylvania School of Dental Medicine. (2015). Academic Programs & Admissions. Retrieved from http://www.dental.upenn.edu/academic_programs_admissions/dmd_program/dmd_curriculum/selective

University of Pittsburgh School of Dental Medicine. (2015). First-Year Curriculum. Retrieved from http://www.dental.pitt.edu/first-year-curriculum

University of Texas School of Dentistry at Houston. (2015). About the School. Retrieved from https://dentistry.uth.edu/about-school

University of Texas School of Dentistry at Houston. (2015). DDS Course List. Retrieved from https://dentistry.uth.edu/education/doctor-dental-surgery/curriculum/course-list

University of the Pacific, Arthur A. Dugoni School of Dentistry. (2015). The Dugoni Experience. Retrieved from http://www.dental.pacific.edu/The_Dugoni_Experience/Three-Year_DDS_Program.html

Velayo, B., Stark, P., Alghanem, T., Midle, J., Finkelman, M., & Wang, H. (2015). Evaluation of the Promotion of Critical Thinking and Integration of Evidence-Based Dentistry in the Pre-doctoral Clinical Courses (Unpublished doctoral dissertation). Tufts University, Boston, MA.

Wang, H., Velayo, B., Alghanem, T., & Stark, P. (2015). Validation of Evidence-based Dentistry and Critical Thinking Application Assessment Tool (Unpublished doctoral dissertation). Tufts University, Boston, MA.

Yadav, S., Tyagi, S., Puri, N., Kumar, P., & Kumar, P. (2013). Qualitative and quantitative assessment of relationship between mandibular third molar and angle fracture on North Indian population: A clinico-radiographic study. *European Journal of Dentistry*, 7(2), 212-217

CURRICULUM VITAE

[redacted]