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Electronic Health Records in Dental Education: A Scoping Review and Quantitative Analysis of Publications

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Abstract

The use of Electronic Health Records (EHRs) by dentists is already a reality in several countries, including Brazil, both in private practices and in higher education institutions, also providing data for oral health surveillance and epidemiology. The purpose of this scoping review was to search the literature for publications on the importance, applicability, efficacy and ease of the use of electronic medical records in dental education. Following the terms of the PRISMA-ScR, this review sought publications on the use of EHRs in dentistry schools. The databases used in the search were Pubmed, BVS, Web of Science, Scopus and ProQuest, without language limitations and publication period, using the terms 'Dental School', 'Dental Education' and 'Electronic Health Records'. Initially, the search resulted in 548 articles. After reading the abstract, full text and removing duplicates, 63 were included. Then, it was divided in three groups according to main thematic: EHRs implementation (n = 25); Data obtained from Dental Schools EHRs used for publications (n = 26); EHRs system efficacy and challenges (n = 12). The use of electronic medical records in the teaching of dentistry collaborates positively with the development of students during graduation. We believe that this alternative of searching and collecting information will be increasingly used in epidemiological studies, due to its practicality and objectivity.

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Keywords

Electronic Health Record; Dental Education; Dental School

Introduction

Information and communication technologies are used to improve health services and it is defined as electronic Health (eHealth) [1]. Rapid advances in those technologies and applications increase new opportunities into existing health care services [2]. The initial reason for this necessity was to upgrade administrative functions of healthcare organizations due to its sizeable amount of data through health records generated [3]. Potential applications of this type of technology are health promotion and community mobilization actions; health education campaigns; epidemiological surveillance and monitoring; development of decision-making support systems [1].

In the past, these data were in the form of paper records and through enhanced informatics, they have developed into digitally stored records - Electronic Health Record (EHR) with evidence of a better filling of information than paper based systems [4,5]. There are no agreed data quality assessment framework to undertake data quality assessment in electronic health records; however, a consensus around data accuracy, completeness, consistency, credibility and timeliness has been agreed as key [6,7]. The use of EHRs has also a minor potential of cross infection when compared to paper records, principally in pandemic times [8].

In medicine, researchers have undertaken retrospective studies using the ever-growing repositories of observational data stored in Electronic Medical Records (EMR) [3]. Dentists have a long history of using computers for clinical tasks and new tools have been contributing to the analysis of the determinants of dental caries and in the decision making and its operational characteristics [9,10]. In oral research, there is the Consortium of Oral Health Research and Informatics (COHRI), a standardized data capture forms to form the “BigMouth” multi-institutional dental data repository of dental school, where real time electronic patient management systems, high volume, variety and high velocity data are routinely being generated [8,11].

Dental researchers have the potential to explore data to undertake more predictive studies to identify diagnostic patient groups, ideal care pathways and risk factors for poor outcomes [3]. Mining of these data for research has the potential, to improve dental health surveillance and epidemiology, which now is reliant on expensive surveys [12]. The aim of this integrative review to research in literature publications about importance, applicability, efficacy and ease of use of EHRs in dental education. The main idea of authors was to search what have been

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published until nowadays about this theme and through this, promote the support to institutions decisions about EHR implementation in dental schools in northeast Brazil.

Material and Methods

A scoping review of EHRs utilization in/for dental education was conducted in terms of the Preferred Reporting Items for Systematic Reviews and Meta Analyses Extension for Scoping Review (PRISMA-ScR) guidelines [13-19]. The main question intended to be answered was what is already published about the use of EHR in dental education. The databases used in the search were Pubmed, BVS, Web of Science, Scopus and ProQuest, without language limitations and publication period, using the terms 'Dental School', 'Dental Education' and 'Electronic Health Records' (Fig. 1).

Data Sources and Search Strategy

The literature search was conducted in March 2022 using terms according to review thematic in PubMed, BVS, Web of Science, Scopus and ProQuest (Grey literature). Fig. 2 shows the search strategy used and number of items found in each database, initially. No period of publication was limited in the search process and articles selection.

Study Selection Criteria and Process

Studies regarding dental education in combination with EHRs utilization (such as description, evaluation, efficacy and data assurance) were included. Studies were excluded if they were not about dental education or not performed in dental schools and not related to this review theme. Letter to editor, guest editorial or reviews were also excluded.

Two reviewers (PDR and LWMR) independently screened titles and abstracts of studies retrieved by the initial search for preliminary inclusion (Fig. 3). Disagreements were resolved through discussion. Full-text articles for all candidate studies were then reviewed for final inclusion. If there was any unclear information on a study, the study authors were contacted for clarification.

Data Extraction, Charting and Synthesis

This review approach was selected due to it may provide a coherent framework and permits the synthesis of studies that explore a wide range of research questions with various research designs. The selected articles highly presented heterogeneity, so the authors reorganized then

in three groups to better understanding and categorization of those, according to main thematic: EHRs implementation (n = 25); publications with data obtained from Dental Schools EHRs by dental area of expertise (n = 26); EHRs system efficacy and challenges (n = 12).

Results

Fig. 3 summarizes the results by a flowchart of studies selection. Initially, 548 articles were retrieved. After title and abstract reading selection, 125 were evaluated based in full-text reading. After removing duplicate and applying exclusion criteria, 63 articles were selected for the final review. The selected publications range of a period from 2007 to 2022 (Fig. 4). In the first cited group EHRs implementation (n=25), the articles main thematic are listed in Fig. 5 and shows the reasons why dental schools should develop and implement EHRs [3,14-37]. Considering publications with data obtained from Dental Schools EHRs, many articles (n=26) were published based on data obtained from EHRs already implemented in dental schools all over the world and in all fields of dentistry (Fig. 6) [38-63]. The area of expertise in dentistry that most published were perio/implantology and Bucomaxillofacial (BMF) surgery was the one with less publications. Finally, EHR system efficacy and challenges in dental education (n=12) were reported in Table 1 according to positive and negative insights from the manuscripts [64-75]. Publications reported EHR analysis to evaluate system efficacy and data utilization for dental research, regarding the information with high accuracy and completeness. Improvement of Student's Critical Thinking (SCRT) was also investigated and use of EHRs in dental schools impacts positively SCRT [70].

	Terms searched
Keywords	"Dental Schools" OR "Dental School" OR "School, Dental"
	"Dental Education" OR "Graduate Dental Education" OR "Dental Education, Graduate"
	"Electronic Health Records" OR "Electronic Medical Records" OR "Electronic Medical Record" OR "Medical Record, Electronic" OR "Medical Records, Electronic" OR "Electronic Health Record" OR "Health Record, Electronic" OR "Health Records, Electronic" OR "Medical Records, Computerized" OR "Medical Record, Computerized" OR "Computerized Medical Record" OR "Computerized Medical Records"

Figure 1: Keyword used in the scoping review.

Electronic Database	Search strategy used	Items found
Pubmed	("Dental Education" [MeSH Terms] OR "Dental Education" [All Fields] OR Dental School [MeSH Terms] OR Dental School [All Fields]) AND ("Electronic Health Records" [MeSH Terms] OR "Electronic Health Records" [All Fields])	206
BVS	(tw:("Dental Schools" OR "Dental School" OR "School, Dental" OR "Dental Education" OR "Graduate Dental Education" OR "Dental Education, Graduate") AND (tw:("Electronic Health Records" OR "Electronic Medical Records" OR "Electronic Medical Record" OR "Medical Record, Electronic" OR "Medical Records, Electronic" OR "Electronic Health Record" OR "Health Record, Electronic" OR "Health Records, Electronic" OR "Medical Records, Computerized" OR "Medical Record, Computerized" OR "Computerized Medical Record" OR "Computerized Medical Records"))	114
Web of Science	TS=(Dental Schools OR Dental School OR School, Dental) OR TS=(Dental Education OR Graduate Dental Education OR Dental Education, Graduate) AND TS=(Electronic Health Records OR Electronic Medical Records OR Electronic Medical Record OR Medical Record, Electronic OR Medical Records, Electronic OR Electronic Health Record OR Health Record, Electronic OR Health Records, Electronic OR Medical Records, Computerized OR Medical Record, Computerized OR Computerized Medical Record OR Computerized Medical Records)	112
Scopus	TITLE-ABS-KEY (Dental Schools OR Dental School OR School, Dental) OR TITLE-ABS-KEY (Dental Education OR Graduate Dental Education OR Dental Education, Graduate) AND TITLE-ABS-KEY (Electronic Health Records OR Electronic Medical Records OR Electronic Medical Record OR Medical Record, Electronic OR Medical Records, Electronic OR Electronic Health Record OR Health Record, Electronic OR Health Records, Electronic OR Medical Records, Computerized OR Medical Record, Computerized OR Computerized Medical Record OR Computerized Medical Records)	9
Grey Literature		
ProQuest	noft(Dental Schools OR Dental School OR School, Dental OR Dental Education OR Graduate Dental Education OR Dental Education, Graduate) AND noft(Electronic Health Records OR Electronic Medical Records OR Electronic Medical Record OR Medical Record, Electronic OR Medical Records, Electronic OR Electronic Health Record OR Health Record, Electronic OR Health Records, Electronic OR Medical Records, Computerized OR Medical Record, Computerized OR Computerized Medical Record OR Computerized Medical Records)	107

Figure 2: Search strategy used in each database and number of items found.

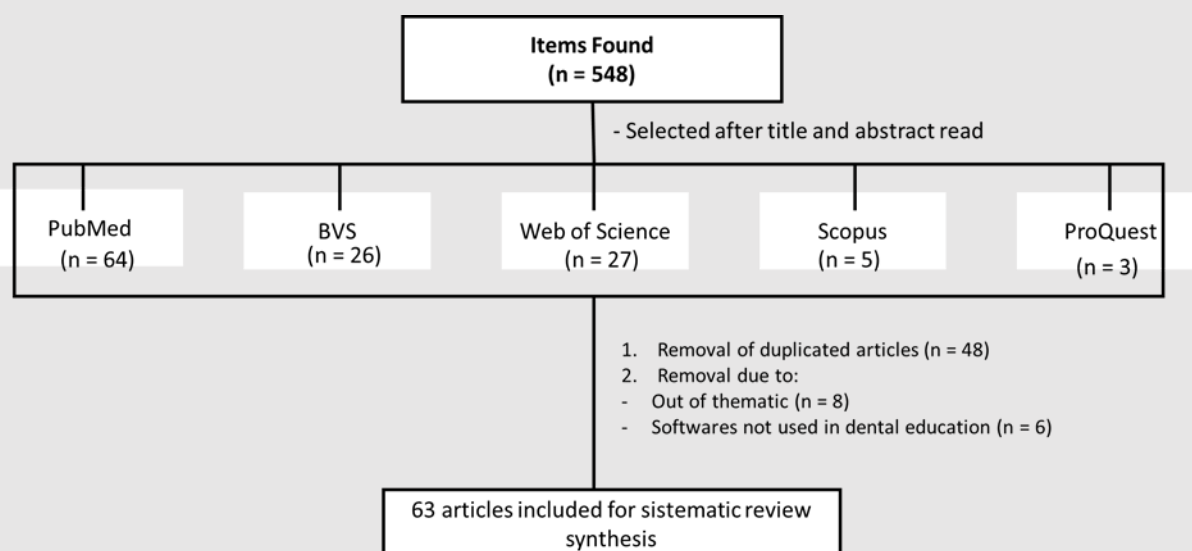


Figure 3: Flowchart of manuscripts search and selection.

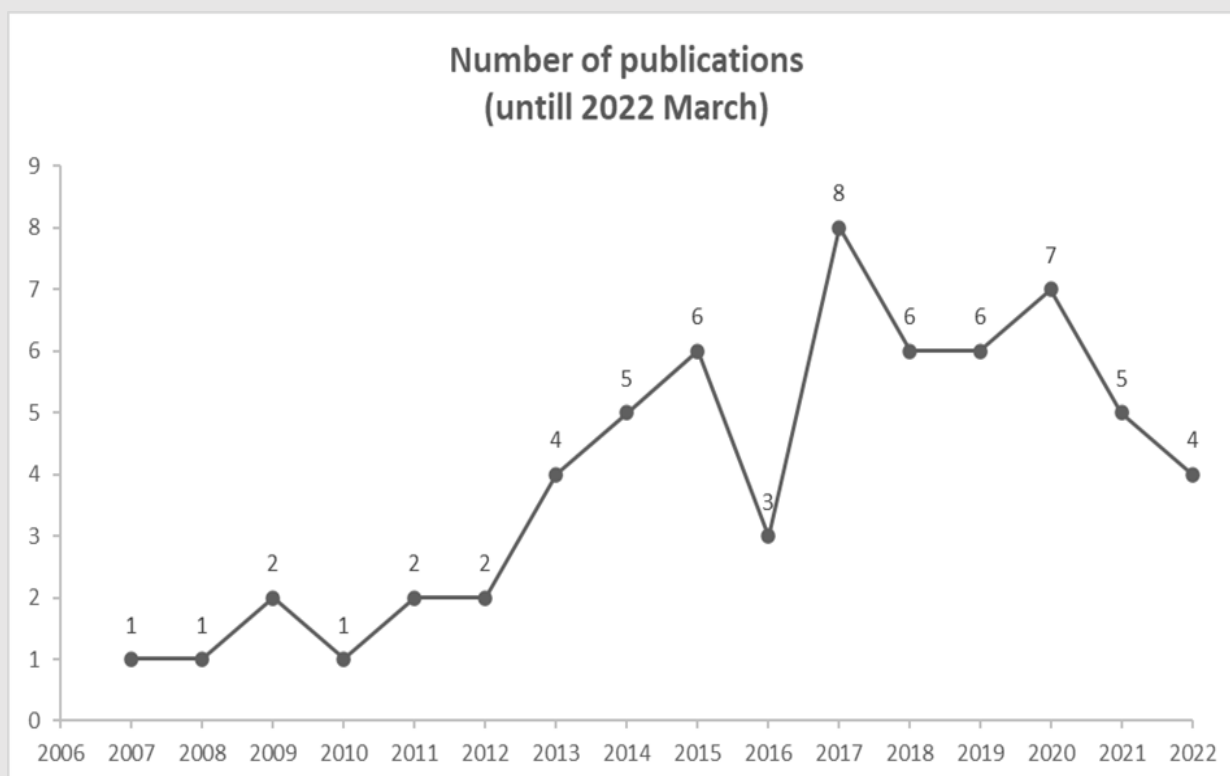


Figure 4: Number of publications with data obtained from EHRs per year.

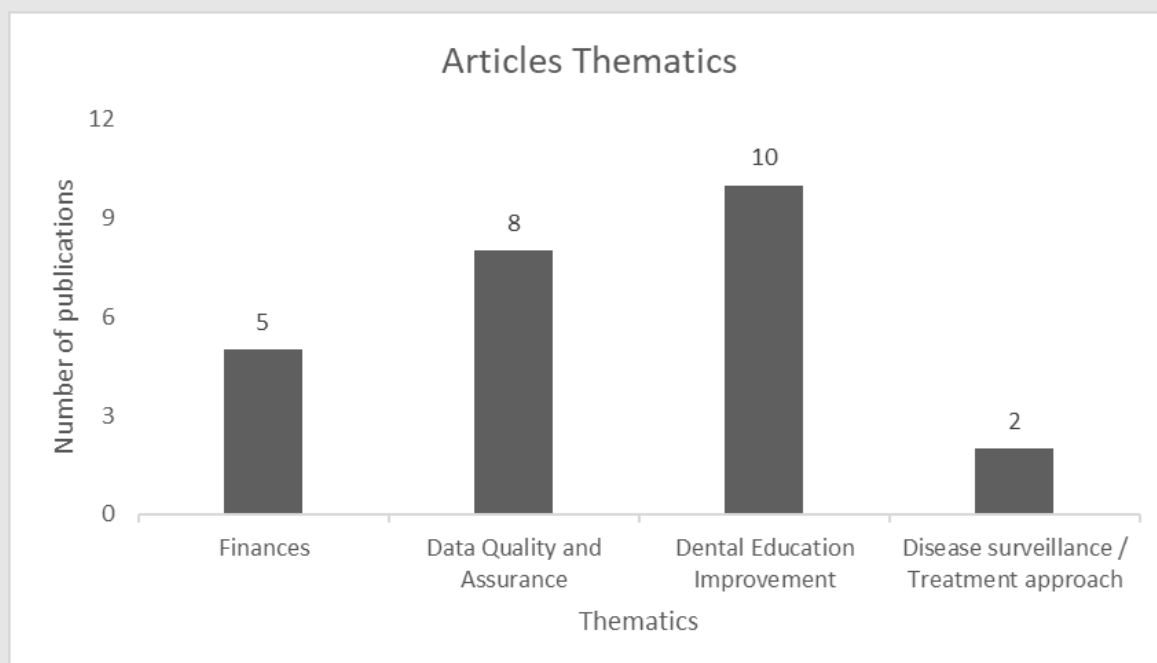


Figure 5: Main thematic supporting EHRs implementation in dental schools.

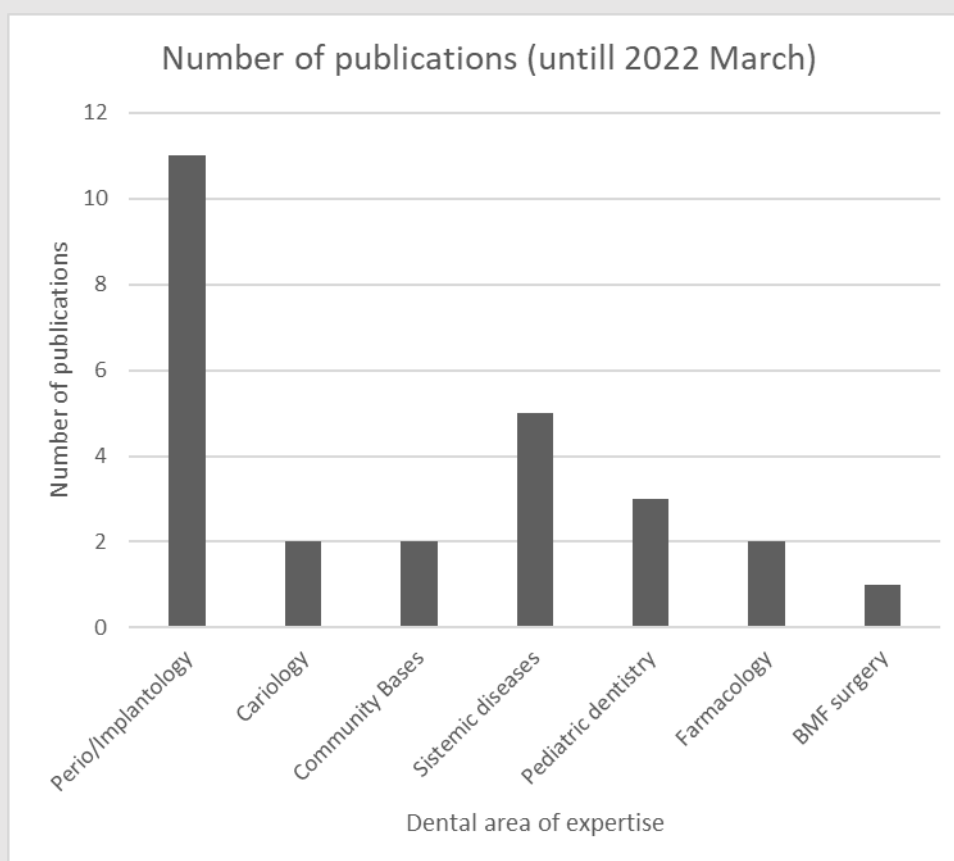


Figure 6: Publications with data obtained from EHRs by dental area of expertise.

Reference	Number of Patients	Objective	Positive Insights (+)	Negative Insights (-)
Claman, et al., 2021 ⁷¹	Patients = 291	Evaluate the extent of concordance and significance of inaccuracies between a parent reported medical history in a nonintegrated Electronic Dental Record (EDR) and an integrated Electronic Health Record (EHR)	EHRs allow clinicians access to a greater depth of health history information in real time compared to nonintegrated health records	Medical history-taking skills should remain at the forefront of dental education and dental practice
Walji, et al., 2020 ⁷²	Electronic Health Records = 1,885	Determine how well the triggers performed in finding AEs and what characteristics dental AEs had in terms of types and severity	Triggers development to identify and measure harms after dental procedures may	Not reported

			improve safety and quality of care delivered	
Adibi, et al., 2019 ⁷³	Electronic Health Records = 54,086	Determine misreporting of two important health conditions at the time of dental assessment and examination	The degree of misreporting of those conditions (diabetes and hypertension) was low and the improvement of policies that support the integration of medical and dental records may improve dental quality of care	There was a relationship between increase of age and hypertension misreporting and illustrates an urgent need for policy innovation within a currently fragmented health care delivery system
Burcham, et al., 2019 ⁷⁵	Students = 210 Electronic Health Records = 519	Assess student perceptions, self-reported behaviors and charting practices regarding medication documentation	Students' perception of the importance of patient documentation may be perceived	Complete medical history and medication documentation was not importantly appreciated by the students
Maserat, Davoodi, Mohammadzadeh, 2019 ⁷⁴	Students = 15	Analyze strengths, weaknesses, opportunities and threats of electronic dental and oral record implementation in clinics of School of Dentistry, Tehran University of Medical Sciences	Use of electronic dental and oral records can help to improve quality of information and ultimately leads to improvement in quality of care.	Absence of mandatory rules and standard business processes, expert and motivated specialists and finally lack of cultural infrastructure.

Kalenderian, et al., 2018 ⁷⁶	Electronic Health Records =100 (pilot study)	Develop EHR-based targeted dental triggers to allow for the identification of Adverse Events from electronic dental records.	Adverse events in dental patients may be detected by EHR-based triggers	Not reported
Reed, et al., 2015 ⁷⁷	Students = 386	To investigate whether use of the diagnostic system and terminology terms positively impacted predoctoral dental students' critical thinking skills and refine protocols	Utilization of EHRs with dental DDS in dental schools may impact positively student's critical thinking	Not reported
Walji, et al., 2014 ⁷⁸	EHRs users = 103	Methods for EHR evaluation	Recommendation of using three different methods (user testing, semi-structured interviews and surveys) to provide a comprehensive approach to identifying EHRs usability challenges and specific problems	EHRs evaluation is not a simple and comprehensive method and a multi-method approach is recommended
Tokede, et al., 2013 ⁷⁹	Diagnostic terms = 29,965 Procedure codes = 249,411	Report of the utilization and valid entrance of the standardized dental diagnostic terminology - Ezcodes.	The correct use of a standardized dental diagnostic terminology possibilities a creation of a reliable platform for undertaking clinical, outcomes and quality improvement-related research.	There was a need for specific training of dental providers about the dental diagnosis importance and how to use terms in EHRs

Walji, et al., 2013 ⁸⁰	EHRs users = 92	Evaluation of a widely used EHR interface that allow the entrance of diagnostic terms, using multi-faceted methods to identify problems and work with the provider to correct them using an interactive design method.	An independent usability evaluation coupled with a close collaboration with the EHR provider offers an opportunity to better understand, prioritize and provide a timeframe to address usability issues	Main issues were related to terminologies and missing functions and concepts
White, et al., 2011 ⁸¹	Dental procedures = 115,004	Report the results of the use of a diagnostic coding system in a large dental school's predoctoral clinical practice	Dental diagnostic terminology can be incorporated within an electronic health record and utilized in an academic clinical environment.	The principal challenges in the development of EHRs are terms choice and ease of use.
Shelley, Johnson, BeGole, 2007 ⁸²	Patients = 281	Evaluate the use of an EHR system for assessment of quality of care in an academic dental institution.	EHR system has great potential for ongoing dental treatment quality assessment and improvement and also for improve patient treatment outcomes	Not reported

Table 1: Insights from articles that measured EHR system efficacy and challenges (n = 12).

Discussion

This review aimed to demonstrate the publications that included EHRs in dental education all over the years, resulting in a range in the period of 2007 to 2022, showing a highly increase of

publications in the last decade. From the best of our knowledge, this is the first review with the electronic health records utilized in dental schools' approach. Due to heterogeneity of publications, the reviewed articles were divided in three groups to better exploration and comprehension the different kind of data obtained.

The selected articles for each group were defined according to its aim or data utilized for its writing. Our strategy to summarize the data obtained from the searched databases were developed to a better understanding of what is published until now about EHRs implementation, what can be obtained from registered data and how it can support researchers in dental schools EHR implementation. Through this done, we may help other researchers interested in the field to understand what data can be obtained and how to publish it. Also, dental school administrators may have a better understanding of the importance and challenges of using electronic health records.

EHR implementation in dental schools and its design are important factors that must be planned previously any user's utilization. The knowledge of experts in this area should be used for design, implementation and use of electronic health records [22]. Functional requirements of electronic records in dental schools are different from those in medicine and nursing and should be developed according to the users' needs and organizational resources [76].

There are barriers that challenges EHR implementation, as the lack of comfort with technologies and the lack of prepared professionals to provide training and support to users; system configuration and maintenance; reporting writing and costs [28,37]. Some cost analysis studies can be found in literature, but only a few addresses the full spectrum of diverse implementation costs, efficiency and costs of health care [77]. Also, providing multiples opportunities for users to learn to use the system and to develop a communication plan may be a valuable tool for trying a better system utilization experience [30]. Moreover, shared experiences among institutions about EHR implementation may promote opportunities to reduce costs, time frame and failures [78].

The use of electronic health records may replace papers in dental schools but those institution must always provide patients an electronic copy of data recorded in EHRs, complying with the Privacy Rule by an e-mail or any other electronic way [17,25]. Other advantages of EHRs implementation are documentation quality and reduction of medical errors [77]. Also, the report of relevant clinical information increased 1.3-fold when compared with a paper format and fewer missing data were observed using EHR systems [79,80]. Reed, et al., reported an interesting comparison between students (n = 386) before and during the EHRs utilization, which it may impact positively student's critical thinking associated with diagnostic system terminology [70].

Quality of information and care may also be improved utilizing dental record system by planning actions in oral diseases prevention and health promotion and clinical decision support [17,67].

One of the most recurrent difficulty determinants in using EHRs systems are the terms of choice in dental diagnostic terminology [74,32,34]. Usability issues are also important factor in dental education utilizing dental records and it is recommended a close collaboration with the EHR provider to solve those issues [71,73]. The student's perception of the importance of patient documentation may be also observed [69]. Effort to eliminate these weaknesses turning them into strengths points may be a good strategy for encouraging investment in IT projects.

During EHRs system use, data entry process needs to be simplified to collect data periodically in a format that records episodes and enables data linkages allowing aggregation and secondary analyses for quality improvement of system and epidemiological assessments [3,24,71]. Another important point to be considered is the way of storing the data obtained. One way to a better experience is registering the information in a cloud based EHR, what offers significant cost savings and easy access, including storage data in a big repository that can be access from different institutions and share data for research [25].

Conclusion

The use of electronic health records in dental education collaborates positively with the development of students during graduation, even contributing to the improvement of critical thinking. It is also possible to audit and determine clinical decisions based on the interaction of teacher-student profiles, in addition it promotes greater ease in obtaining data previously entered the system and the possibility of linking retrospective information for research purposes. Much is being published based on the data obtained from the EHRs and we believe that this alternative of searching and collecting information will be increasingly used in epidemiological studies, due to its practicality and objectivity.

Conflict of Interest

The authors declare no conflict of interest.

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