TEETHING PAINS: EXAMINING THE INTEGRATION OF ELECTRONIC RECORDS IN DENTISTRY AND MEDICINE

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Abstract

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The modern American healthcare system features a long-standing divide between medical and dental care. This divide is the product of long historical trends, but it has resulted in less optimal care for patients. Recent research shows that integrating care can improve patient outcomes and decrease the cost of care for patients with chronic disease. This integration can be mediated by integrated electronic health records. Interviews with practicing dental professionals at an Austin community clinic with an integrated patient record show high satisfaction among users and increased efficiency of care. In particular, the study showed that integrated records helped the oral healthcare providers fill gaps in their patient's medical histories. This study opens the door for considering the integration of dental and medical health records in institutions like community clinics, perhaps through incentives from the government.

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Introduction

Healthcare is a byzantine institution, rife with practices that often confuse patients, clinicians, and even the policymakers who implement the rules that underlie it. However, one of the most baffling aspects of modern healthcare is the complete sequestration of the medical and dental fields. There is evidence to suggest that such a division impedes healthcare professionals from delivering optimal healthcare to patients (Powell and Din 1). In particular, research throughout the past few decades has underlined the relationship between oral and systemic health (Geist and Powell 77, Foreman et al. 203). These findings have reiterated what intuition already suggests: the mouth is part of the body, so changes in whole body health can produce observable changes in oral wellbeing. This means that dental professionals must be aware of their patients' diseases, as these can impact future oral health. It also suggests that dentists can play a role in screening for diseases that typically fall under the purview of medicine.

One approach to promote cooperation between these two professions is to facilitate communication between the two groups through a connected electronic health record (EHR) system. However, while cross-compatibility between the professions is an oft-used buzzword among those who develop EHR systems, most dental and medical systems do not cross-talk in any manner (Powell and Din 2). As the importance of oral health to whole-body wellbeing becomes increasingly touted, the benefits of creating such EHR systems which can communicate with both dental and medical systems seem clearer.

However, there are still key questions that need to be addressed concerning how these technologies—specifically EHR systems—are being learned and used by practicing professionals. As healthcare becomes increasingly intertwined with this clinical-assistance technology, it becomes ever more important to interrogate how emerging and existing

technologies affect clinical practice. In particular, it is worth examining how these EHRs, now a seemingly ubiquitous feature of modern American healthcare, shape the experiences of both patients and clinicians. In the realm of medical care, this topic has been examined intensively (Evans 48). However, less attention has been paid to examining how EHR are implemented in dental care. The information on an integrated medical and dental record is even sparser. This is problematic because the patterns of EHR development observed in medicine cannot necessarily be extrapolated to dentistry.

Due to historical differences in the development of the two professions, adoption of burgeoning technology has followed different timelines in both. Such divergences have been codified and perpetuated by the healthcare system in modern times. While understanding the historical development of EHR systems is integral to the creation of a comparative picture of EHR systems in dentistry and medicine, such differences are best contextualized through interviews with practicing dental professionals. Such interviews illuminate how dental professionals learn about emergent technology in dentistry and how their interactions with such technologies shape their practice of dentistry. In this pursuit, this thesis outlines the results of a series of interviews assessing the attitudes of practicing dental professionals at a community clinic in North Austin, describing their experiences with both dental electronic health record systems in general as well as their attitudes on their integrated system.

These interviews revealed that an integrated record system was of great use to dental professionals, greatly augmenting their ability to keep track of patient medical and prescription history in particular. The accounts further suggest that an integrated EHR system can enhance the efficiency and accuracy of care, reducing the likelihood of costly medical errors that result in medical costs and patient harm. The findings, when combined with the results of other studies in

this field, suggest that cooperation between these two presently sequestered branches of health care could prove a valuable component in managing the care of patients with chronic disease. Due to the substantial link between oral and systemic health, integration of care may be able to play a role in reducing the substantial burden these diseases place on the healthcare system. Thus, this thesis will argue that the integration of dental and medical health records should be promoted especially in community health clinics through incentives from the federal government in order to improve patient outcomes and the ease of patient care.

I. The American Divide between Oral and Systemic Health

Historic Origins of the Professional Divide

One of the long-standing features of the modern healthcare landscape is the divide between dentistry and medicine. This division is seldom interrogated in depth because of how enmeshed it is: the two institutions stand apart from each other at almost every level (Powell et al. *xiv*). They each have their own schools, governing bodies, legislative mandates, and professional boards. Furthermore, on the patient's side, dental and medical care are often covered by separate insurance plans if the individual has coverage at all. An alien observer might be struck by the seemingly arbitrary demarcation between the oral cavity and the remainder of the body when it comes to the provision of health, but such a division traces its roots back several centuries. It is worth examining this historical context in order to understand why precisely the modern systems of medicine and dentistry stand so far apart from each other.

Evidence from historical texts seems to support the idea that the partition of care between these two realms is a relatively recent phenomenon. Historically, many of the individuals who were fascinated with oral health pursued this passion alongside with an interest in systemic health at large. For example, a 2600 BC tomb inscription praised the scribe Hesy-Ra as "the

greatest of those who deal with teeth, and of physicians" (ADA). This is one of the earliest records of a practitioner of dental health, and even so, the individual was still marked as a physician rather than as a distinct profession. The later writings of Hippocrates and Aristotle, famous for their medical theory, included dissertations on dental structure and disease alongside their findings on the systemic health of the rest of the body. Centuries later, Ambroise Pare, the father of surgery, published information about treating oral maladies in addition to the description of other diseases in his 1575 treatise, *Complete Works* (ADA). These early physicians considered the mouth as one of many parts of the body, not a domain unto itself. As a result, they studied its vagaries and afflictions alongside the rest of human anatomy and physiology. In a sense, these early practitioners of dentistry treated dentistry as a specialty of medicine rather than a domain unto itself. This reflects the fact that overall, medicine was far less specialized than it is today (Reiser 85).

Nevertheless, the early dental care they described was far removed from today's practice. Lacking the technology for detecting early cavities and the materials such as amalgam for repairing them, it was unusual for medical professionals to think about saving teeth until as late as the 18th century (ADA). Rather, the typical response to tooth pain was a simple extraction that could be performed even by a local barber. Indeed, in 1210, a Guild of Barbers was founded which included barber-surgeons who could perform bleeding and extractions alongside their more mundane services of shaving. These laypeople predominated over medically trained professionals in the dental field. Recognizing the need for some regulation, two hundred years after the founding of the Guild of Barbers, the French court issued royal proclamations to limit these barbers' scope of practice to dental extractions and bleeding. This act was one of the earliest in Western medicine established with the specific aim of regulating dental care. Thus,

this move by the French court was an early salvo in the gradual delineation between those authorized to provide dental care and those authorized to practice medicine (ADA).

Another phenomenon that contributed to this growing gap between the two professions was most physicians' reluctance to practice dentistry. Dental procedures that were more complex than extractions were supposed to be reserved to medically-trained physicians rather than the aforementioned barbers, but very few of these doctors had an inclination to spend an extensive time probing the unique features of the mouth. Again, this was partially due to the dearth of developments in the field which made the task of saving teeth a difficult task without much reward.

Moreover, a burgeoning disdain for surgery prevented many physicians from becoming extensively involved with dental care. In the West, soon after medicine became a profession requiring a university education in the thirteenth century, many doctors came to view surgery as more akin to a manual trade or craft. Additionally, due to the still rudimentary understanding of physiology at the time and the fact anesthesia had not been discovered yet, surgery was considered little better than barbaric butchery. The doctors considered its practice to be better suited to healers and the battlefield and instead turned their attention to more theoretical matters of health (Reiser 3). Meanwhile, those who actually sought to become surgeons started to receive their training through apprenticeships rather than medical schools. This trend prevailed until the mid-nineteenth century when the two strains of medicine were re-integrated (10). Thus, for several centuries, very few medically-trained physicians were interested in dental care because they considered it to be beneath their station since it required extensive surgical practice and the trade-like usage of highly specialized tools.

However, there were a few notable exceptions to this rule who carried out crucial work in advancing the field of dentistry from simple extractions to the actual science of preserving teeth. For example, in 1723, Pierre Fauchard published *The Surgeon Dentist, A Treatise on Teeth,* which described many aspects of oral health and dental practice (ADA). This was an early example of a work dedicated exclusively to teeth. Fauchard was not the only one to be interested in the field. A small subset of physicians and surgeons with a keen passion in the treatment and restoration of teeth began specializing in dental care, pushing forward advances in restorative dentistry such as gold fillings and dentures. These developments further increased the body of knowledge specific to the craft of dentistry.

In the 19th century United States, those who were interested in dentistry on its own could not gain admission to medical schools. However, the restriction became increasingly irrelevant because, thanks to the pioneers in the dental field, dental practice had come to require a body of skills not taught in medical school (Khazan). Thus, as the practice of dentistry became more sophisticated, increased specialization established a differing standard of knowledge that further rend the two professions asunder. As one symptom of this split, in 1839, the world's first dental journal began circulation as a recognition that advances in dentistry deserved distinction from those in medicine at large. A year later, the first dental organization was founded, and the world's first dental school was opened in Baltimore. The school issued a novel degree, the Doctor of Dental Surgery (DDS) that stood distinct from the Medical Degree (MD) awarded by medical schools (ADA). These occurrences were an early concrete manifestation of a rift between the two professions, and from this point onward, medicine and dentistry only continued to diverge further.

Origins of the Patient Coverage Divide

While the origins of the professional division stemmed from different practice requirements, the rift in patient coverage was solidified by variations in how the government treated the two fields. For example, in 1841, Alabama became the first state to try and regulate dentistry by assigning a dentist to the state's medical boards. However, they did not take the pain to enforce this law, and as a result, very few dental professionals were ever involved with the board in practice (ADA). While this incident reflected an early apathy towards the provision of dental care, the most important example of legislation codifying the differential treatment occurred in the 1960s when Medicaid was conceived and passed through Congress. At the time, only 2.3% of Americans had dental insurance, so the writers of Medicaid did not make a strong effort to prioritize dental coverage in the already controversial bill. Thus, dental care did not eke its way into the new law (Khazan).

Today, though Medicare and Medicaid have expanded greatly in their scope of coverage, they still do not cover comprehensive dental care in the majority of states (Khazan). In fact, most states do not cover dental services beyond cleanings, X-rays, extractions, and fillings. As a result, less than 5% of annual Medicaid budgets are put toward dental care despite the fact that dental procedures are quite costly. Additionally, these already feeble services are often the first to be culled by legislatures when their state budgets are strained, leaving needful patients in a serious lurch. As Khazan notes, during the Great Recession, California chose to cut down on dental benefits for the enrollees in government health care programs (though these benefits were eventually restored).

The legacy of this legislative separation has lingered for decades even as the healthcare landscape has changed around it. Even in 2014, when the Affordable Care Act was passed

outlining a suite of essential benefits, adult dental care was neglected. This list was supposed to provide a group of benefits deemed mandatory for all insurance plans, and it included such provisions as mental health services, preventative and wellness services, laboratory screenings, and maternity care. These benefits were all considered essential to assuring good health, yet adult dental care did not fall under this umbrella. Instead, under current ACA mandates, insurers are only required to offer plans for children under nineteen, and even so, these plans are not mandatory for purchase. Since many of these children's dental plans are stand-alone plans, they do not qualify for federal subsidies. Many parents whose families are in the coverage gap (they do not qualify for CHIP but cannot afford stand-alone coverage) have opted not to pay the additional fees for these plans (Saint Lotus). As a result, in addition to federal dental standards leaving adults in a lurch, they provide only a patchy level of coverage for children.

The results of such poor coverage are striking. 26.5% of American adults have untreated cavities and 42% have gingivitis. More gallingly still, 35% have periodontitis, a serious inflammation of the gums which, unchecked, can contribute to a variety of other illnesses. As noted by Foreman et al., "if these levels of untreated disease were applied to most systemic diseases, there would be public outcry" (170). As anyone with serious dental pain can attest, oral maladies can have a serious impact on quality of life and self-esteem, but as it stands, oral health demands diminished attention from the federal government. This state of affairs persists despite the substantial toll dental maladies exact on the pockets and the overall quality of life of those without adequate access to dental care. Thus, long historical trends have created a modern legal situation that separates both the practice of dentistry as well as the provision of dental benefits to patients from that of medicine.

The Effect of Dental Divide on the Diffusion of Innovations

This divide can mean that government incentives to adopt new technologies in dentistry are stymied by systemic differences in the two fields. A simple postulate holds that the government has the greatest stake in ensuring the quality and the accountability of the institutions it invests the most money into. Specifically, since the federal government spends considerable money on healthcare, it also has opted to invest substantial amounts of money in improving patient medical records nationwide. This decision was justified on the basis that electronic records can decrease costly medical errors and increase the efficiency of clinical practice (Kalenderian, Walji and Ramoni 401). As an example of this investment, in 2009, the Health Information Technology for Economic and Clinical Health (HITECH) Act was passed as part of the larger American Recovery and Reinvestment Act (ARRA). In the wake of the economic recession, ARRA sought to stimulate economic growth by investing federal funds in areas that were poised for growth and meaningful to improving the lives of Americans. Electronic health records were selected as one such industry with significant potential. Thus, the $27 billion HITECH Act was designed to encourage the adoption of electronic health records (EHR) while simultaneously improving HIPAA compliance with regards to EHR systems. M.H. Torres-Urquidy et al. gave its benefits as following:

> "Impetus from federal and state governments towards digitization of patient health records is aimed at avoiding errors in medical judgments from healthcare providers, reducing cost of healthcare delivery and improving overall care for the patient" (66).

With these lofty goals, the act provided monetary incentives to spur healthcare professionals to adopt electronic health records. The primary criterion used to receive such incentives was reaching a minimum threshold of Medicaid patients (Kalenderian et al. 401).

While dentists were included as possible beneficiaries of this largesse, far fewer dentists accept Medicaid patients than doctors or hospitals because most dentists own their own practices and set their own fee schedules. Additionally, there are fewer dental patients using Medicaid in general due to the aforementioned state of American federal dental benefits. Consequently, most dentists do not meet the HITECH's established Medicaid threshold to qualify for the monetary incentives given by the HITECH Act. Moreover, the Health Information Technology Regional Extension Centers (HITREC) that were established to help clinics implement EHR systems as part of the HITECH Act have not been of much help to dentists. Indeed, as Kalendrian et al. notes, "the primary focus of the centers is to physician practices" (402). Thus, the benefits of this legislation have not trickled significantly into dental care.

This act serves as an example of how federal incentives for adopting EHR in dentistry and other such areas of health care innovation are not as robust as in medicine due to institutional differences between dentistry and medicine. As a result, the government has been less effective at utilizing monetary incentives to motivate the largely private, insular field of dentistry into adopting its preferred reforms and innovations. This could be rectified if state or federal governments devoted more resources into funding and regulating dental care. Indeed, some have claimed that one way for the United States to establish a patient-centric model of healthcare is to "reduce the isolation of dentistry in the area of health policy and funding" (Powell and Din 9). However, as long as dentistry stands isolated from medicine, this is unlikely to happen. There are some dental care providers though that the government could potentially take a greater role in

influencing. These providers include dental schools and community clinics, both of which have many underserved patients. These two institutions may thus represent valuable avenues for the government to regulate and introduce dental EHR standards.

II. Integrated Medical and Dental Records

Advantages of Integrated Medical and Dental Care

The differentiation in how medical and dental benefits are parceled to patients leaves patients underinsured and reduces the ability of the government to regulate dentistry. However, the actual separation in the practice of the two disciplines is widely accepted. Modern medical professionals cannot replace modern dental professionals and vice versa. For example, dental education teaches a high degree of eye-hand coordination and precision through long hours of painstaking simulation. Such a rigorous training is not incorporated into the already packed undergraduate medical education. Moreover, the depth and degree to which dental students study oral anatomy is not required for success in the medical field.

Accordingly, it does not make sense to define dentistry as a specialty of medicine as some reformers suggested early in the 20th century (W.H.H. 845). A substantial body of specialized knowledge is required by the two professions today, so integrating their training would only increase the already lengthy educations of dentists and doctors. For the lone clinical specialty that bridges medicine and dentistry, oral surgery, an additional four years of medical education is instead used to supplement dental education. However, though the professions should not be integrated, patient care should. This can be accomplished by facilitating greater cooperation between the professions.

In particular, research through the past few decades has underlined the relationship between oral and systemic health (Table 1). These findings have reiterated what intuition already suggests: the mouth is part of the body, so changes in whole body health can produce observable changes in oral wellbeing. For example, diabetes mellitus produces a suite of symptoms that manifest in the mouth including redness, bleeding, halitosis, separation of teeth, and gingival

recession (Powell and Din 4). This means that dental professionals must be aware of their patients' diseases, as these can impact future oral health.

Table 1: Examples of Systemic Illnesses and their Connection to Oral Health

Systemic Illness or Disorder	Connection to Dental Health
Headaches	Can be caused by issues such as misaligned dentures, bruxism, or temporomandibular join disorders (Foreman et al. 211)
Earaches	Issues like dental caries may present as an earache due to shared nerve supply (212)
Bulimia	Bulimia, along with other illnesses that result in repeated vomiting, erode the enamel on the teeth, resulting in dental caries (Powell and Din 14)
Diabetes, Cardiovascular Disease, Kidney Disease	Increased complications connected to periodontal disease, the chronic inflammation of the gums (11)
Low Birth Weight	Periodontal disease has been connected to low birth weight deliveries (12)
Oral Cancer	Dental providers are uniquely situated to screen for mouth, neck, and other head cancers (13)

An example of an oral disease with particularly potent effects on systemic health is periodontitis. Periodontitis is the chronic inflammation of the gums. Unlike the milder disease of gingivitis which is reversible through improved dental hygiene, periodontitis can result in the destruction of tissue and the breakdown of the alveolar bones that surround the root of the tooth. This breakdown can eventually result in the drifting of teeth and tooth loss if the disease is left unchecked. Periodontitis is mostly irreversible so the best approach to its prevention is regular dental visits. Following its onset, it can also be managed by regular dental visits to stave off further deterioration of the oral tissue. Surprisingly, given its serious impacts, periodontitis

disease is very common: 40 to 60% of adults have moderate periodontitis and up to 15% may have periodontitis serious enough to endanger tooth retention (Preshaw et al. 22).

Troublingly, periodontitis also has a pernicious connection to chronic diseases like diabetes mellitus and heart disease in addition to its profound effects on the integrity of the teeth. For example, a study of diabetic children showed that this population had a much greater incidence of periodontitis when compared to a control group (Preshaw et al. 23). For this reason, it is important the physicians refer patients for dental services when they are diagnosed with diabetes and that they follow-up to ensure that the patients are receiving dental care. It is also important that dental care providers pay attention to symptoms that might suggest diabetes and counsel their patients appropriately. It is estimated that the rate of undiagnosed diabetes mellitus/pre-diabetes is between 27 and 53% so screening activities are valuable in all healthcare contexts (Greenberg et al., "American Dental" 62). In fact, Preshaw et al. suggests that dental care providers may be uniquely positioned to play this role "by virtue of the fact that many people visit their dentist regularly" (28).

In addition, the relationship between these two diseases may work in reverse as well- on top of diabetes contributing to periodontitis, periodontitis may actually contribute to the complications associated with diabetes. Studies show that periodontitis is associated with poor glycemic control which can reduce the effectiveness of diabetes treatment. Additionally, periodontitis predicted the development of nephropathy (i.e. kidney damage) among diabetic patients in the Gila River Indian community in a dose-dependent relationship (24). Scientists have postulated the association between periodontitis and the worsening of diabetes-related complications is likely owed to the chronic inflammation that characterizes periodontitis.

Chronic inflammation may "enhance the diabetic state" and diabetes may in turn worsen inflammation in a vicious cycle (26).

Luckily, this feedback loop can be interrupted by effective periodontal treatment. Meta-analysis of multiple studies have shown that periodontal interventions can result in reduced levels of hemoglobin A_{1C} (HbA_{1c}), a form of hemoglobin that accumulates in the blood of patients who have diabetes (27). Normal levels for HbA_{1C} are between 4 and 5.6%, but in diabetic patients, the levels are 6.4% or higher (Sherwani et al. 101). It has been found that conventional periodontal treatment can reduce HbA_{1C} levels by .4% which is a good improvement, especially when combined with other therapies (Preshaw et al. 27). For this reason, Preshaw et al. argue that there is "a cogent argument for involving the dental team in the management of diabetes" (28).

These are only a few examples of studies in a large body of evidence that cites diabetes as a risk factor for periodontitis. This research is well established, leading some people to even refer to the disease as the "sixth complication of diabetes" (23). Unfortunately, the impact of diabetes on oral health and the therapeutic benefit of dental treatment for these patients are often ignored. For example, the Mayo Clinic's overview of diabetes on its website lists at the time of writing includes eight different complications that can result from diabetes and nine risk factors that can cause it. However, the site fails to mention periodontitis in either category, only mentioning gum infections as a symptom of diabetes. This is an example of how there appears to be less understanding of the ways in which dental professionals can work in synchrony with physicians in managing the myriad comorbidities associated with diabetes.

Finally, in addition to dentists playing a role in the management of systemic health issues like diabetes, physicians can also screen for dental maladies especially among patients who do

not regularly take advantage of dental services. For example, dental caries, more commonly

referred to as tooth decay, are the most common infectious disease found in young children. It is

estimated that children miss a cumulative 52 million hours of school due to tooth problems. At

particular risk are disadvantaged children, almost 40% of whom have tooth decay by the time

they start kindergarten (Powell and Din 6).

Pediatricians can reduce the incidence of this prevalent disease through early

intervention. For one, they can provide referrals to dentists for high-risk patients. They can also

play a role in dental education by teaching new parents how to care for their children's teeth.

This is a valuable avenue for encouraging pediatric dentist visits since children are far more

likely to visit the pediatrician than the dentist. Some people have even suggested that pediatric

checkups should incorporate the application of fluoride varnishes. However, current studies

show that 35% pediatric medical residents in a 2009 study reported that they had spent no time

learning about oral health requirements despite the prevalence of oral maladies among children,

indicating there is work to be done in this area (Foreman et al. 200).

Financial Advantages of Integrated Care

As promising as these results are, implementing integrated care requires an upfront

financial investment that may prove prohibitive. Fortunately, the improved outcomes that result

from integrated care have the additional, persuasive benefit of contributing to substantial savings

in healthcare spending. Healthcare spending constitutes one of the greatest sources of

expenditure in the U.S., ordering on the magnitude of trillions of dollars, so any potential source

of savings should be studied and applied (Foreman et al. 182). One area that represents a

significant chunk of American healthcare spending is the management of chronic health

conditions ranging from diabetes to heart disease. In fact, 76% of Medicare spending is on patients with five or more chronic diseases according to a 2006 study (183). The management of chronic diseases, especially those that occur in synchrony with other ailments, are complicated and costly because they require healthcare professionals to coordinate their care. Often, many medical specialists will be involved in tandem with managing the various comorbidities of a disease. However, the involvement of dental professionals is an undervalued component that could further improve the management of these chronic diseases.

Recognizing this potential, a 2009 pilot study was conducted on 21,000 Blue Cross Blue Shield Michigan members who were diagnosed with diabetes and heart disease among other chronic illnesses. These individuals were given access to regular periodontal care and dental coverage. After one year, the cost for the overall treatment of all the patients' illnesses was calculated. It was discovered that the total treatment cost for patients with diabetes decreased by 10% on average when they accessed regular dental services. This represented savings of $146 per month for diabetics receiving periodontal and dental preventative services (Foreman et al. 186). Compounded over many patients, this could represent an avenue for reducing the substantial burden of chronic disease on healthcare expenses.

Other private insurers have taken note of the incredible possibility for savings this strategy offers. Aetna, one of the nation's largest insurance providers, conducted a study similar to the Blue Cross Blue Shield study in 2008 on the records of 116,306 patients exhibiting at least one of diabetes mellitus, coronary artery disease, or cerebrovascular disease. Among these patients, the patients receiving periodontal care ultimately had lower measured risk during health screenings at the end of the trial period as assessed by a Episode Risk Group risk score. Aetna responded by beginning a Dental/Medical Integration (DMI) plan aimed at enhancing their

customers' dental benefits. This program was specifically targeted at patients who were deemed at risk including those patients with certain systemic diseases and patients who were pregnant. As a result of this DMI plan, "63% of at-risk members who had not been to the dentist in the previous 12 months sought dental care" (187). This impressive result shows how a synergy between medical and dental care, as facilitated by insurer incentives, can result in not just better patient outcomes but in significant savings to our heavily burdened healthcare spending.

The Promise of Integrated Patient Records

One way to accomplish this goal of integrated care is to enhance the communication of patient risk factors between dentists and physicians. This can occur in the context of integrated medical and dental practices, but these types of practices are uncommon. They are most frequently observed in hospitals and community clinics. Another approach to promote cooperation between the two professions is through the patients which is the most common approach today. Typically, the patients mediate information exchange from one party to another by filling out health history forms. Unfortunately, patient memory can be fallible. A 2016 study looked at the dental and medical records of cardiac patients at an armed forces clinic in Taif, Saudi Arabia where the medical histories in the dental records were self-reported by the patients. A retroactive examination showed that 75% of these histories in the dental records were incomplete or in disagreement with the corresponding patient's medical records (Hibshi et al. 568). Patients often failed to disclose all their medications properly or they neglected to mention events like past strokes (570). Similar results were reported in studies conducted by the Department of Defense on the medical records of their active duty personnel at the Walter Reed Medical Center. The records in this case had an 86% discrepancy rate (Powell and Din 16).

These two studies show that patients self-reporting their medical history on intake forms is not necessarily the best solution to the information gap.

This is problematic because knowledge of current medications and past illnesses can affect treatments plans, meaning that omissions or misremembered information can prove difficult for practitioners and patients alike in matters of healthcare. In a 1998 study of 178 patients' medical and dental records, at least three of the medical records were missing information categorized life threatening or important. The dental records were even more lacking with nearly 18 of the dental files missing some such crucial information (Powell and Din 16). As with the previous studies, these records were populated based on the patient's self-reported history. Thus, Powell and Din propose that a more suitable solution for relaying information from dental to medical professionals and back is would be through electronic health care records that can crosstalk (16).

An example of how a successful system-wide integration of care (in this case, between different medical branches) can reduce medical errors is the American Veterans Administration (VA). For the many veterans who make use of its services, the VA acts as a "one-stop shop" where all their members' health needs can be addressed. The VA has thus implemented a health-information-technology system that folds together all of a patient's records. This system has been shown to reduce medical errors, which created a net savings of $3 billion over 10 years. 86% of these savings were attributed to the reduction of costly medical errors and duplicate testing (Foreman et al.188). This VA case study serves as an example of how a common EHR system can function effectively in a government-run program, and it provides a template that the private healthcare industry might examine to see if it can increase efficiency. Thus, given the success

that integrating medical records produced, the findings of this study can no doubt be extended to the integration of medical and dental records.

Having a common digitized record between dentistry and medicine can also facilitate research. A case-control study performed at the College of Dental Medicine at Columbia was performed on patients with periodontitis (i.e. gum disease). This statistical analysis was facilitated by an integrated electronic health record maintained by the institution. The linkage between the records allowed the researchers to draw connections between oral and systemic health, leading the them to find several statistically significant associations between periodontitis and chronic diseases such as diabetes mellitus, hypertension, and conditions related to pregnancy (Boland et al. 474). In general, dental epidemiology could benefit greatly from pervasive adoption and usage of electronic health records because it increases the ease of using big data techniques that are becoming increasingly valuable in the fields of epidemiology and clinical research.

A final useful application of EHR systems is that EHR systems can prompt dentists to intervene in matters pertaining to systemic health. For example, in a trial, electronic dental records (EDR) were fitted with scripts and cues embedded into the system to remind the dental staff to initiate talks with patients about quitting smoking (Rindal et al. 1). As a result of these cues, the dental hygienists were more likely to initiate speaking about cessation strategies with their patients, leading to greater rates of referral to telephone counseling (1). Though this pilot study showed that dental professionals can play a strong role in intervening in smoking cessation, they often do not do so: for example, a 2003 study found that only 19% of surveyed dentists in the UK were inquiring about their patients' smoking habits as a matter of practice (Powell and Din 14). Thus, the cues in the EDR are an example of how patient record systems

can be a tool in the arsenal for encouraging dental interventions in behaviors that affect whole body health. In the opposite direction, a similar mechanism could be used to remind pediatricians to discuss oral health with their patients' parents. This is merely one potential idea of how increased cooperation between dentistry and medicine, as abetted by an EHR system, could prove fruitful in improving patient health and outcomes.

Important Features in an Integrated Electronic Health Record System

Though the benefits of an integrated system seem clear, it is important to narrow down the features of the patient record that are most beneficial to dentists and physicians before rushing headlong into implementation. Some features of patient records are useful to both professions, but others may prove extraneous. It is important to consider which features should be shared when designing such a record.

As a general idea, records have been a longstanding feature of clinical practice. Early practitioners often kept records through narratives written by the doctor summarizing the patient's condition. These narrative accounts were eventually supplanted by more standardized records featuring charts and numbers. Today, many practitioners rely on pre-made charts that are identical between patients except for the details. Reiser cites this trajectory as evidence of medicine's transformation from an imperfect art to a more rigorous science (77). The records are especially valuable in the modern healthcare system because patient records enable better record keeping, benefitting patients who often find themselves bouncing between specialists in a fractured medical field. Thus, the modern electronic system is merely an expansion of the long evolution of the patient record.

At the same time though, electronic health record systems present their own unique challenges to the user that might make their usage more fraught with issues. Reiser cites "capital costs, and allied concerns about investment return, capability to serve practice needs, and vulnerability to obsolescence" as all being barriers to the adoption EHR systems (97). Another concern is the time and difficulty required to learn and use a new EHR system. A system that slows or obstructs the practice of patient care with meaningless, trivial details is one that impedes practice rather than enhancing it. Such a system is unlikely to be adopted by any clinician unless they are forced into doing so by institutional pressure (such as in hospital or in corporate practice settings). Because dentistry often is practiced in a private setting, such institutional pressure is not present in dentistry. Instead, most dentists select an EDR solution based almost primarily on their preferences. Thus, such systems must be designed carefully by companies without extraneous features.

In order for an integrated EHR system to meet the standards of being appealing (and more crucially, useful) to a practitioner, there are several primary design criteria that should be considered. A key factor to consider is the end user and his or her needs. The system should anticipate these needs and adjust the content to meet them accordingly. This design tenet has substantial implications on the implementation of an integrated EHR. For example, it is not relevant for a doctor to see gum pocket depth information collected by the dentist, and it is not necessary for a dentist to see the patient's eye exam results. This type of superfluous information would only hamper the individual's work flow by introducing a "cognitive burden" on the user to parse out extraneous details (Torres-Urquidy et al. 108). Given the tight schedules and the intellectual labor that many clinicians already perform, this extra headache could lead to a clinician deciding not to bother with the system at all.

For this reason, a truly shared system would be troublesome for its users. Instead, many practicing physicians and dentists support systems that can cross-talk and share only the most vital data. Says Wells Shoemaker:

> "I also think that integrated records will be very cumbersome, given the fact that the language used by the separate disciplines is so different, and the kind of detail required to support good decisions and good work is so different… To me, a more sensible solution would be to have a condensed "nugget" of information that could cross populate" (Foreman et al. 205).

This nugget would ideally contain only the most pertinent information to the clinician's practice. The contents of such a nugget could be transferred between systems with patient approval. Accomplishing this goal would necessitate some degree of cross-compatibility between multiple systems so that they can parse the nugget. As such, it would require cooperation between the manufacturers of EHRs in establishing interoperability standards. Nonetheless, it could greatly optimize the workflow of those working in patient care.

Following in this vein, the system must be easy to learn and use. Writing notes in the system should not take longer than writing notes by hand. The consequences of a poorly designed user interface (UI) include "user dissatisfaction, workflow inefficiency, and data inaccuracies" (Torres-Urquidy et al. 108). The system should be indexable and searchable. New users should be able to master the system without extensive training. There should be some degree of flexibility and customization so that the clinicians can enter data in a manner that suits their workflow without compromising the completeness of the record overall (Barrett and Stephens 167). Overall, usability is one of the paramount considerations in optimizing EHR design.

Another feature with significant promise in EHR is electronic Clinical Decision Support (CDS) systems. CDS systems use patient data entered in the patient record to produce "warnings, alerts, and other automatic analysis" (Torres-Urquidy et al. 111). For example, such a system might warn if a prescribed drug is contraindicated with another prescription the patient is currently taking. While some people fear that these types of clinical decision making tools could erode the critical thinking skills of clinicians, they nevertheless have the potential to be useful aids for ensuring that patient safety comes above all (Reiser 99).

Historically though, CDS systems have been less robust in dental record systems than in medical record systems. One reason for this is that the high costs of developing such systems means that the primary development of CDS systems occurred in large medical networks (Torres-Urquidy et al. 111). Meanwhile, dentists, who usually work small practices, cannot support the cost of this health IT. Thus, though there are some dental CDS systems, the push for more sophisticated CDS programs is not as strong as in medicine.

There are reasons for this beyond cost though. Importantly, diagnoses tend to be simpler in dentistry than in medicine, reducing the need for such a sophisticated support tool. In medicine, physicians often encounter illnesses and disorders that manifest as a complex set of interlocking symptoms. The physician must track and measure these carefully to hone accurate diagnoses, making CDS quiet useful. Meanwhile, though complex dental pathologies do exist, the majority of a general dentist's work is predicated around a few standard diagnoses such as dental caries and gingivitis. They rely primarily on X-Rays and their own sensory observations, so a CDS would not be very useful. A final reason CDS systems are less popular in dentistry is that dentistry is treatment focused: dentists are paid only for treatments rendered so the focus is on treatment planning over diagnosis (113). Given this lack of justification for a CDS system in

dentistry, an integrated EHR that balances the needs of both professionals would need to have very different modes for both groups.

Some research has been done to determine how this balancing can occur. A 2017 study surveyed medical professionals to determine what information they would like to see in such an integrated EHR system. Through focus groups, the researchers were able to identify a host of areas where the medical professionals were interested in having more information about oral health. The category they were most interested in was features for augmenting communication (Acharya et al. 335). The professionals cited medical situations such as headaches caused by temporomandibular joint disorder, sleep apnea, and cardiovascular disease as being cases where having access to dental records would be useful. They were also interested in tracking what medications the patients had been prescribed by their dentists: some were worried that their patients may be engaged in drug seeking behavior (335). Another area of interest was dental alerts—they wanted to know if the dentists had recorded any allergies or adverse reactions that might be relevant to their own practice (333). On the subject of system design, the medical professionals indicated that they would prefer an integrated EHR system that would display dental information in a manner similar to their existing EHR system (332). Overall, the participants were concerned with holistic health and trying to identify how dental treatments could affect their own medical treatments.

Patient-Held Records as an Alternative to Integrated EHRs

An alternative to cross-talking, integrated EHR systems would be patient-held records (PHR). These are records that are given to the patient to hold and transmit according to their preferences. This type of system would have the advantage of allowing patients to have greater

control over their own health information and how its transmitted. In addition, because the patient holds the record, in theory, they could easily pass the information to providers if they moved or were referred to a specialist. There has been support for this idea. 87% of the dentists surveyed in a 1996 study indicated that they believed an integrated medical-dental PHR would be of use. The physicians in this study also echoed this belief, albeit at a lower rate than the dentists: 68% of them responded that they believed this technology would be useful (Jones et al. 369).

As part of this study, patients at two Glasgow practices were given a two-page integrated medical-dental PHR printed on paper. Their attitudes towards the PHR were measured before and after the intervention. The patients seemed to like the way in which the PHRs allowed them to view their own metrics. 84% of them responded they would liked being able to see their own records (371). Nearly 41% of them discussed their records with their family members after bringing them home.

However, the utility of a PHR depends on the patient actually sharing their record with their *clinicians*. Some patients were unwilling to share all their information with all their healthcare providers. For example, while 85% of the patients thought their dentist should know some information about their other healthcare treatments, only 46% of the patients thought it was necessary for the dentist to know their full medical history (369). Less than 60% of patients were comfortable sharing psychiatric diagnoses or social problems (369).

Another factor that affects the usefulness of PHR is the patient actually remembering to bring their record to their appointments. While patients generally expressed positive sentiments towards the PHR, in practice, few of the patients regularly remembered to take the records to their healthcare provider. Only 16% of the patients took the records to their general physician

and only about 9% took the records to their dentist (370). Thus, while the patients seemed to like the PHRs, the fact they were not regularly taking them to their healthcare providers limited the utility to their dentists and doctors.

This issue could partially be explained by the physical format of the PHR, since paper copies are easy to misplace or forget. At the time this study was conducted in 1996 though, this was the easiest possible solution. Since then, attempts have been made to digitize patient held records. For example, in 2008, Google announced the creation of an online service where patients could store their health data and records (Reiser 100). However, as Reiser notes, there are significant privacy issues associated with allowing corporations to hold medical information. Health information has the immense potential to be monetized due to its commercial value. For example, it can be used by companies "to increase profits, promote expensive drugs, and cherry-pick patients who are cheaper to insure and market directly to consumers" (101). Private corporations do not appear to be bound by the 2003 Health Insurance Portability and Accountability Act (HIPAA) in the same way that covered health care entities (e.g. health plans, health care providers, and health care clearinghouses) are. Companies that hold patient records are instead treated as "business associates" and their only requirement is that they form contracts with the aforementioned covered entities to regulate how they use data. It is unclear how these contracts would work when they are drawn directly with consumers ("Office for Civil Rights").

In addition to these privacy concerns (and perhaps because of them), patients have not widely embrace electronic PHR systems. Google Health was retired in 2011 with the company mentioning the product "didn't catch on the way we would have hoped" (Brown). While some other electronic PHR solutions still exist, they also have not spread as widely as early advocates would have hoped. Thus, even electronic PHR systems that are easier to access than paper copies

still have low utilization rates, meaning they may not be the solution to integrating healthcare records between professionals. Thus, the traditional electronic health records used in practice today are a better solution to integrating care than the patient held record.

Challenges to Implementing an Integrated EHR Model

Though physicians, dentists, researchers, and even insurers all support the integration of the health record in theory, in practice, there are many challenges that make adopting integrated EHR systems difficult. One such issue is the gulf in the language and jargon used by the differing professions. Even between specialties and regions, there can be discrepancies in how certain disorders are coded and described, meaning that one clinician's records may be gibberish to another. The result is a Tower of Babel situation that compounds communication crises rather than ameliorating them.

One fundamental challenge is that there are many different software solutions for electronic health records, each with their own features and methods of data storage. Each practice or hospital might use a different EHR system entirely, making it difficult for these systems to communicate. Instead, they are like closed-networks: while the clinicians within the networks can communicate, those outside the network cannot use the information. Enabling systems to seamlessly communicate is an important step towards allowing different practitioners to share information with each other. The federal government has issued standards for interoperability, but without widespread adoption of these standards by the individual software companies, EHR systems become silent silos that cannot communicate.

One way medicine addresses this issue is through the usage of universal standardized codes called ICD codes and SNOMED-CT codes wherein each disorder is assigned a specific

shorthand moniker. These codes make it easy to enter data and bill patients. They also make it simpler to understand what other professionals have entered into the EHR system. Additionally, these codes "are essential in sharing clinical trials data between sites, and also with regulatory agencies" (Walji 239). In other words, they facilitate research between different cohorts and funding bodies. The codes may require some upfront training to use, but EHR systems can make their utilization easier by prompting users with the correct codes during record input or by automatically assigning the codes to the information that is input.

However, dentistry has lagged behind in the adoption of a set of standardized codes like those found in medicine. The aforementioned ICD codes, more suited for billing purposes than diagnoses, typically do not describe dental maladies in fine enough detail to be of particular use (Reed et al. 687, Walji 242). Meanwhile, the ADA and some dental schools have attempted to teach their students the usage of a system called SNODENT, which would be integrated into SNOMED, but the adoption of these codes has not been as robust as hoped (Reed et al. 687). The lack of adoption hampers the realization of the many benefits of implementing these diagnostic codes. For example, using standardized codes could benefit dental epidemiologists by making it easier to study widespread trends in oral health without having to go through and painstakingly standardize data. They would also facilitate crosstalk between medical and dental EHR. However, any attempt to achieve this goal necessitates a harmonized set of diagnostic codes that are used universally in dentistry and their widespread adoption, and this has not yet come to pass.

Another pressing concern is that the two professions have different objectives for their systems, meaning their patient records often do not meet each other's standards. Take the case of medicine where some of these desired objectives are in fact specified by the federal government as "meaningful use" guidelines that must be present in a certified EHR system. The Centers for

Medicare and Medicaid Services (CMS) have identified these objectives as core features that they expect medical and dental facilities to have in their EHR systems in order to qualify for CMS reimbursement. Many of these features entail incorporating data into a structured format. Others include features like patient reminders and the ability to submit data to public health agencies (Powell et al. 152).

Many electronic medical records (EMR) are designed to implement these objectives. On the other hand, though dental EHR systems contain some of these meaningful use features, they are not likely to meet all such requirements because many are not relevant to dentistry. For example, as discussed previously, dental EHR systems are unlikely to embrace CMS requirements for clinical diagnoses systems because they are not useful in dentistry. It is also unlikely that dental EHR systems will implement the clinical quality measures required by CMS because these measures are medical specific (153).

There is potential for the CMS eventually to develop meaningful use standards that are more appropriate to dentistry. One such metric could be the number of high-risk patients, such as smokers, who are screened for oral and pharyngeal cancer. Another measure worth considering would be the percentage of pediatric patients receiving caries-prevention such as fluoride varnish (156). However, there is little evidence that CMS will mandate such requirements any time soon, so dental records have few constraints from the government on how they are designed. Thus, there are few incentives to design an electronic dental record system that would simultaneously accommodate CMS meaningful use standards for medicine. This is a barrier to integrating records since physicians need systems meeting those standards.

Attitudes of Practitioners and Patients towards Integrated Care

In addition to these substantial technical challenges associated with integrating the disparate content of EHR systems, the greater difficulty is changing the attitudes of clinicians in a way that promotes an exchange of ideas. Dentistry often proves attractive to aspiring individuals because the field allows for a high degree of autonomy. Dentists most often work in their own private practices as opposed to hospitals or large clinic settings. They exert greater control over their practice and how their offices run. They also seek professional membership in powerful lobbying bodies that ensure this autonomy is protected from overregulation. However, this comes at the expense of dental professionals often being cloistered away from other healthcare workers. Moreover, they are less subject to institutional pressures, whether governmental or administrational, that might otherwise prod them into adopting new standards.

An additional challenge posed by the attitudes of practitioners in integrating care is that dental staff may feel uncomfortable with being thrust into the role of screening for medical maladies (and vice versa), thus rendering the benefits of an integrated record system moot. For example, dental staff at Marshfield Dental Clinic were gathered in a focus group to offer their perspectives on various proposed meaningful use standards for dental electronic health record systems. The staff seemed comfortable with suggested changes to recording medication requirements as they aligned with the staff's current practices. However, when it came to items like providing weight counseling, they expressed significant reluctance. Some viewed this as taking away time from what they perceived as their primary function: educating patients on oral health topics (Powell et al. 157).

Dentists also felt reluctant stepping into roles they felt were out of their purview. For example, the majority of dentists felt they would not be comfortable offering weight counseling

information without evidence establishing a stronger link between obesity and oral health (Greenberg et al., "Addressing Obesity" 75). At present, a few studies have linked obesity to periodontitis, but these studies are limited and do not establish a dose-response relationship, meaning the connection cannot be called anything more substantial than correlation (Preshaw et al. 2). Due to this lack of evidence, the dentists were not interested in advising their patients on their weight. They did not want to appear judgmental for fear of causing offense to their patient (Greenberg et al., "Addressing Obesity" 75). This example shows that there are limits to the degree to which dentists feel willing to step into medical areas. Integrating care may be helpful only for the chronic diseases where there is a clearly established reason for dental professionals to intervene (e.g. diabetes), even though there have been some calls for dentists to take heavier roles in all matters of public health.

Luckily, for the diseases that are actually relevant to dentistry, other studies have reported that dental hygienists feel open to taking a greater role in screening for systemic disease. Screening has the aim of "[identifying] patients at increased disease risk at a point when early intervention can impact disease progression or delay disease onset" (Greenberg et al., "American dental" 64). As is, dental hygienists play a significant role in educating their patients on oral health services, so it is possible that their role could be extended. Greenberg, Kanto, and Bednarsh suggest a model in which the dental hygienist administers tests for diseases like diabetes and the dentist discusses the results (62). They tried to measure dental hygienists' attitudes towards this model through a survey which was mailed nationwide to hygienists.

The respondents expressed high support for oral healthcare providers screening for diseases like hypertension (93.5% approval) and diabetes mellitus (88.8% approval). They also showed a high willingness to work with physicians with 93.9% of the hygienists being willing to

refer patients to physicians should the screening results demonstrate need. A lower proportion

were willing to discuss the results of the screening with the patients (73.3%), suggesting many

hygienists feel this may be out of their area of expertise. They were also less willing to take on

tasks significantly out of their current scope of practice such as taking blood samples (57.1%)

and sending the samples to laboratories for analysis (57.7%) (63, 64). Improving their comfort

with these activities would likely require additional training such as through continuing

education.

Indeed, training was identified as one of the factors that the hygienists in this study felt

was most crucial for implementing medical screening into their activities. Support from the

dentist, patient willingness, and availability of time were also rated as being highly important.

Dentists also cited similar factors as affecting their willingness to engage in these activities. Like

the hygienists, the majority of dentists felt it was important to screen for diseases like HIV,

diabetes, and hypertension. They also showed willingness to write referrals to physicians

(Greenberg et al., "Adressing Obesity" 69).

On the medical end, a related study showed that physicians are in fact willing to receive

these referrals from dental professionals. A survey administered to primary care physicians

(PCPs) nationwide showed that the majority would receive dental referrals (89%) and discuss

patient progress with dentists when necessary (76%). They also responded positively when

surveyed about the role they thought oral healthcare providers could play in medical screenings:

71% felt that dentists could play a role in screening for diabetes, and 77% of the physicians felt

that they could screen for hypertension (Greenberg et al., "Physicians' attitudes" 225). The study

indicated that the majority of PCPs did not find it important if the referrals came from a dental

professional instead of a medical professional. Instead, the most important considerations in

accepting dental referrals were patient willingness and the dentists' level of training (228). Interestingly, less experienced practitioners were more willing to accept referrals from dental providers than their peers who had been practicing longer. Greenberg, Thomas, Glick, and Kantor offer the following explanation for this trend:

> "These results suggest that there may be a trend toward greater acceptance of integration and an interdisciplinary approach to health care delivery, and [this] may be a result of increasing emphasis on interprofessional education" (230).

Recent trends in medical education have emphasized cooperation between healthcare professionals as a means of creating a patient-centric health system that improves health outcomes. One of the primary objectives of interprofessional learning is to reduce prejudices that exist between professionals. A second key aim is to educate students on the roles and capacities of other professionals, thereby helping them understand how those other groups can augment patient care (Parsell and Bligh 96). Thus, an emphasis on these skills in undergraduate medical and dental education may improve the willingness of dental and medical professionals to cooperate, centering the patient's health at the heart of the healthcare model.

A final important perspective to consider is patient attitudes towards the integrated record. As discussed previously, patients are comfortable with sharing some medical information with dentists but not others (Jones et al. 371). A panel of healthcare providers, interviewed at Marshfield clinic in Wisconsin on the subject on integrated records, cited this patient privacy concern as a major barrier. They noted that patients' concerns may be linked to the "perception of dentistry as a business rather than a healthcare establishment" (Acharya et al., "An Integrated" 349). The panelists suggested this attitude could be ameliorated through outreach aimed at educating the patients on the benefits of allowing for their records to be shared between the two

groups. This could take the form on an informed consent form that the patients would ideally be briefed on upon patient intake.

Nonetheless, there does appear to be widespread support among dentists and hygienists in engaging with physicians to pursue integrated care. There also appears to be support, though more modest, among patients and physicians to participate in this healthcare model. The support among practitioners can be improved through interprofessional education and training, and patient support may be secured through outreach efforts. The cooperation of all these groups is needed in order to make integrated care and integrated EHR a reality.

Dental Schools as an Opportunity to Introduce Future Dental School Professionals to Integrated EHRs

Because education plays such a vital role in shaping how a individual will eventually practice medicine or dentistry, schooling is a good place to introduce dental students to EHR systems and best practices regarding their usage. As previously discussed, dental practitioners tend to exert significant control over their practices. They are typically the owner or partner in their practice (though corporate models are starting to proliferate), so they have the ability to choose the type of system they prefer. It makes sense that dental professionals, given this choice, would default to the methodology they feel most comfortable with. Thus, training is the best time to introduce prospective dental professionals to EHR usage alongside guidance on how the technology can enhance their ability to record data and make diagnoses. This training can make them more comfortable with the technology and more likely to use it in the future.

The EHR can also augment the curriculum and better the learning of the students. One way to achieve this is by bolstering students' critical thinking. A study was conducted focusing

on students at three different dental schools that were all using axiUm, an electronic health record system that includes interactive teaching modules (Reed et al. 2015). The researchers administered a Health Sciences Reasoning Test (HSRT) to two cohorts of students, those who had been exposed to the dental diagnostic terms used in the EHR and those who had not. The test was designed to assess their critical thinking skills in the context of healthcare specifically. In the case of clinical practice, such critical thinking involves the process of synthesizing patient data, determining a diagnosis, and selecting a suitable treatment plan to ameliorate the issue.

The researchers in this study hypothesized that "the EHR would support critical thinking skills by presenting or providing the framework and sequence of steps that can involve critical thinking" (Reed et al. 689). They predicated this hypothesis on the belief that providing a standardized workflow for decision making could increase the efficiency and accuracy of the treatment process. After testing the two cohorts, they found that students who had experience using the terminology found in the axiUm EHR had significantly higher HSRT scores than those who had not been previously exposed (694). Given that critical thinking skills have become a topic of increased interest to dental accreditation boards, these results suggest that the integration of EHR early in clinic can improve dental students' skills.

A second study conducted in Europe in 2012 echoed these findings. This study focused more specifically on the treatment planning skills of students using EHR (in this study, the students used axiUm as well). The treatment planning aspect is one of the most important components to dental practice. To carry out this process successfully, "the clinician discriminates between pertinent and non-pertinent information to arrive at diagnoses" (Tokede et al. 34). In the study, students working in clinic were given a series of scenarios and then instructed to chart their treatment plans in the EHR according to the workflow diagrammed in Figure 1. Their

created plans were then evaluated and assigned points on accuracy and completeness. It was

found that overall, the students earned only 41.9% of the possible points on average.
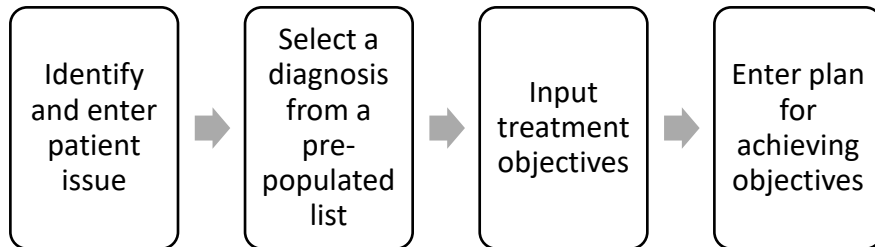
Identify and enter patient issue → Select a diagnosis from a pre-populated list → Input treatment objectives → Enter plan for achieving objectives

Fig 1. Treatment planning steps when using axiUm EHR systems (Tokede 36)

The authors of this study posited that the students' difficulty stemmed primarily from

their unfamiliarity with the EHR systems. They noted that the students' instruction had

heretofore involved the usage of paper records which allowed the students to chart their data and

treatment plans in free text. However, EHRs "are most powerful in the context of structured

data… there is a greater emphasis on the entry of coded values for diagnoses and procedures"

(Tokede et al. 38). This represents a completely novel workflow which resulted in the students

having difficulty with selecting appropriate treatment plants. Given that EHRs are becoming ever

more common and the advantages of EHRs to reducing medical errors, it is important that these

systems be introduced early in education because this will shape how the dentists works

throughout their careers.

An additional reason dental schools ought to introduce EHR is that, unlike the private

practices where many dentists will end up, dental schools are uniquely poised to reap the benefits

of the HITECH act. In order to provide ample patients for their students, dental schools operate

low-cost clinics where patients can have many of their fees waived. Thus, dental schools are able to meet the minimum threshold of patients covered by Medicaid, making them eligible to receive funding for establishing an EHR system (Kalenderian et al. 401). This provides an excellent opportunity for dental schools to establish EHR systems that are certified, meaning they meet CMS meaningful use guidelines. As mentioned previously, the guidelines are more focused on the provision of medical care and may not yet be fully suitable for dentistry. Nevertheless, there are certain exceptions to these standards that dentists can take advantages of: for example, eligible providers do not need to meet the objective of submitting electronic immunization data if they do not administer vaccines. In this way, dental schools are situated to make use of government incentives to offset the IT costs associated with using and operating certified EHR systems.

For these reasons, dental education is the optimum setting in which to introduce EHR systems to students. This means it is also an excellent opportunity to introduce students to possibilities of integrated electronic health records. Students should be exposed to the idea of integrated records and how they can be used in the treatment planning process. They also ought to be familiarized to a greater degree with the ways in which dentists can screen for systemic diseases and play a role in their management.

Dental schools may be an especially valuable setting for this education since dental schools are often situated as part of larger healthcare institutions. For example, the Columbia University College of Dental Medicine announced in February of 2018 multiple initiatives aimed at integrating medical and dental care. Officials cited their aim as being able to "bring oral health care into the age of precision medicine" and "improve dentistry's standing for the transition to value-based care" (Miliard). They plan to integrate their medical and dental records in the EHR

system Epic so that they can be shared among the physicians and dentists at Columbia, New York Presbyterian, and Weill Cornell Medicine. Columbia also mentioned ambitious plans that involve taking the multiple sources of data from both medical and dental records and using them for epidemiological studies.

However, while the benefits of integrated records in professional dental education are manifold, one downside to this aim is that dental education must prepare students for different practice settings. The reality is that many of these settings lack integrated records, so it may not be a good idea to teach students to rely on information they may not have during their actual educational experiences. Additionally, the school itself may not have integrated records. Though many dental schools and medical schools operate near each other, this is not always the case, and sometimes, even if there is a medical branch in the same healthcare system, a patient at the dental clinic may not also have a record at the medical clinic. These issues could be addressed by having the students do rounds in satellite clinics that have the integrated records and rounds in clinics that do not, thus exposing them to all kinds of records.

III. A Case Study of a Community Health Center

As discussed previously, there are significant benefits to the integration of medical and dental care including decreasing the cost of care for patients with chronic disease and improving their quality of care. However, this integration is hindered by significant barriers such as the lack of interoperability for health record software. Market demand to drive solutions to these issues may not be robust in the private sector due to long-standing institutional divides between medicine and dentistry. However, there are some institutions such as dental schools that are situated to implement such systems. Acharya et al. ("An Integrated") suggest another such institution, stating "large and growing federally supported primary care programs may represent the best opportunity for demand for software developers to move forward with integrated products" (336). Community health centers (CHC) are thus an ideal setting for deploying and evaluating the advantages of an integrated system.

Community health centers serve patients who belong to typically underserved populations, and they receive significant government funding. CHC have existed in some form since 1965 to provide care for at-risk populations. Beginning in 1976, with Section 330 of the Public Health Service Act, CHC began providing preventative dental services (e.g. cleanings) as a mandatory offering. This was an early recognition that oral health is a valuable component in the suite of primary care preventative services. However, while some clinics also offered more advanced dental services voluntarily, these were not required. It was decades later, during the Bush administration, that grants were used to expand the CHC program in scope to include more comprehensive oral health services (337). The Healthy People 2020 initiative, which aims to establish dental components in 83% of CHC by 2020, is an example of how the federal government has made CHCs a central part of their mission to expand dental coverage (338).

Because CHCs offer both medical and dental services under one provider, they are an especially valuable setting for investigating efforts aimed at integrating care. This also aligns with their emphasis on "community control, equitable access to comprehensive primary care services, and an interest in improving the health of communities" (336). Their patients often belong to underserved populations, such as minorities or low-income households, that are especially susceptible to chronic diseases like diabetes or heart disease (337). This makes CHC a good setting for examining how these vulnerable populations can benefit from integrated care. A final exciting trend that makes CHCs a valuable environment for studying integrated care is the fact that almost all federally-funded CHCs are already using EHR in some capacity. A 2014 survey showed that 96% of the 1152 CHCs in the U.S. have EHRs in some form (Government Health IT Staff). This is an impressive improvement from 2009 when only 49% of surveyed CHCs were using EHR systems (Acharya et al., "An Integrated" 338).

The following study seeks to document the experiences of dentists working in a CHC that has successfully implemented an integrated record system. This research expands on scholarly work that has been conducted in this field including studies such as the Marshfield Focus Group study that interviewed an interdisciplinary panel on key issues related to integrating medical and dental care in the context of their CHC (Acharya et al., "An Integrated" 338). The present study takes this research further by focusing on a CHC in Austin, TX where this integrated care model has been used for nearly eight years with the assistance of an integrated EHR system. I have no conflicts of interest to report in performing this study.

Method

For this study, qualitative methods were used. These methods are suitable for studies focused on phenomenology, an approach focused on describing a phenomenon by investigating it from the perspective of those who are familiar with it (Teherani et al. 670). In this study, I investigated how dental professionals practicing at an Austin, TX CHC (heretofore referred to pseudonymously as Neighborhood Care) felt about the integrated EHR system that was established in their clinic in 2010. Data was collected through a series of semi-structured oral interviews conducted on premises in April 2018. Ten oral health care providers (OHCP) were interviewed including two hygienists and eight dentists, one of whom was the practice manager. The median age of the OHCPs was 37 years (Fig. 2).
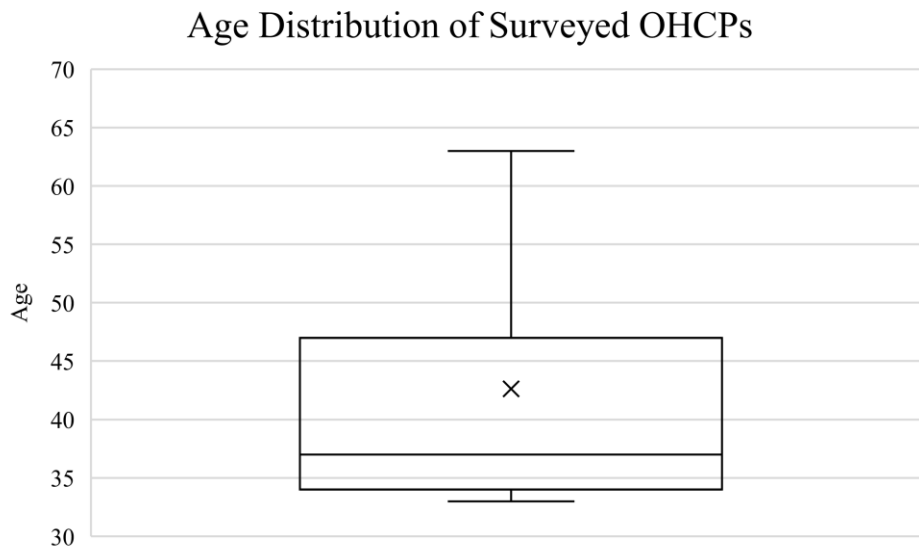
Fig. 2. Age Distribution of Surveyed OHCPs

The interviews consisted of a set of eleven questions and additional probes designed to further understand their perspectives. The questions were designed to determine the OHCP's positive and negative opinions towards the EHR systems. Several of the questions were also aimed at determining how the OHCPs learned about the EHRs and new technology in general.

The oral interview was accompanied by a paper survey that collected demographic data including the interviewee's age, dates of dental related-education, position, settings he or she had worked in, and settings she or he had used EHRs in (Table 2). The respondents were assigned to pseudonyms to protect confidentiality.

Table 2: A Summary of the Settings in Which the Participants have Practiced

Prior Employment Settings	Number of OHCPs who Practiced in this Setting	Number of OHCPs who Used an EHR in this Setting
Corporate	6	3
Community Clinic	10	10
Dental School Clinic	2	2
Private Practice	8	5
Integrated Medical/Dental Clinic	2	1
Mobile Clinic	4	2
Hospital-Based	1	1

Subsequently, I listened to the recordings and took detailed notes for each interview. The responses were then coded. Examples of the coding used included positive responses, negative responses, and neutral responses. Certain emergent codes such as "need for efficiency" were also used to code the data as common responses began to emerge from the interview. Finally, themes were determined from the data when they met Owen's (1984) criteria for determining interpretive themes in relational communication: (1) *recurrence*, in which a shared idea or meaning materializes and is salient among participants; (2) *repetition*, in which key words,

phrases, or sentences surface multiple times across participants; and (3) *forcefulness*, in which words or phrases are stressed vocally by participants. These themes were evaluated for each question. Through this process, I uncovered largely positive sentiments towards the EHR systems tempered by small frustrations with certain technical shortcomings of the software. The OHCPs were particularly impressed by the EHR's efficiency and its ability to fill in blanks in the patient's medical history. They were frustrated by lack of customization and system failures. Overall, the interviews support the idea that integrated records can be a valuable tool in improving patient care in CHCs.

<center>*Findings*</center>

Research Question 1: How do you keep patient records here?

This question was a simple diagnostic question, asked in order to give an idea of how the OHCPs used the EHR system. This question elicited more descriptive answers, so some of the features described will be listed below. The consequences of these features for the care of the patient will be elaborated on in greater detail in subsequent questions.

Data Entry into the EHR System

This clinic utilized Nextgen EHR which connected the medical records to the dental records. D.D., a dentist, described the workflow of using the software as such: "treatment plan for the initial exam, write down all the planned treatment, complete the treatment when they come back." Based on the interviews, the EHR system appears to have functionality that allows the user to create patient charts, treatment plan, access X-ray radiographs, and consolidate scanned in forms. One additional feature that was mentioned was the ability to create pop-up fields for free-text entry.

Connection to EMR

The EDR and electronic medical record (EMR) systems at Neighborhood Care are integrated, allowing the OHCPs to view information about the patients such as their history of doctor appointments, prescription information, and their health history. However, this function can only be used if the patient also sees both the medical and dental staff at the clinic. This is not true for all patients.

A series of follow-up probes with the practice manager revealed that the selection of Nextgen as the EDR solution was almost entirely driven by the medical staff of Neighborhood Care. Said A.C., "medical had Nextgen and they had spent millions of dollars on Nextgen [which] did have a dental record," leading to the dental side also adopting Nextgen as their electronic record solution in 2010. When asked if dental had any input in this decision, A.C. responded, "Did we have any input? Absolutely not."

However, A.C. noted that medical was dissatisfied with the software and was considering a switch, noting that the "EDR is a whole lot easier to use than EMR." Another interviewee echoed this assessment, saying, "in medical, there are a lot of prompts that stop you and you can't proceed without filling them," suggesting the EMR is more rigid than the EDR. Nevertheless, A.C indicated that any future software solution would need to keep the integrated functionality, saying,

> "[There's] talk of changing to a different EMR, but it has to be able to integrate with our dental record or they're going to have to purchase dental software and do data transfer and all the nightmare that goes with that."

This indicates that the integrated record has become a feature that may make it difficult for CHCs to be flexible in switching EHR software solutions.

Research Question 2: What are some positive aspects of the EHR system that enhance your ability to provide care?

Efficiency and Ease of Use

Efficiency and ease of use were mentioned by half of the OHCPs as being features of the EHR that greatly enhanced their ability to provide care. As a hygienist summarized, the system is "fast, easy to access, and very user friendly." Two OHCPs mentioned templates as being a feature that saved time.

The EHR was compared favorably against paper records by multiple OHCPs. They noted that paper records required them to sift through more information which could prove frustrating. M.M., a hygienist, was emphatic in expressing her preference for electronic records, stating:

> "I am very happy that we have electronic health records. I worked at a private practice where they were still using paper records, and I did not like it at all. It was so slow and so time consuming to find charts and find what was done. I wouldn't be a dental hygienist without [electronic] dental health records."

Easy to Learn

Five of the OHCPs praised the current system as being easy to learn. The system was said to have a "low learning curve" that didn't require more than a few days to become comfortable.

Coordination of Care

Multiple dentists were impressed by how the EHR system allowed them to coordinate care easily. Neighborhood Care is a multi-dentist clinic which means the dentists sometimes share patients. As one dentist noted, while the clinic endeavors to maintain continuity of care by

keeping a patient with the dentist who originally planned treatment, this is not always possible. For these cases, having the EHR system is very helpful because it allows the clinician to track the patient's "progression."

> "Even if the patient doesn't see the same provider, we can still provide continuous care through that because we can read back through the notes." -O.P.

The practice manager also praised the EHR for eliminating issues with legibility, an important concern when multiple providers are sharing the same notes. This improved legibility decreases the likelihood of medical errors due to information being misread or ignored.

Hub for Documents

A final function appreciated by the dentists was the EHR's ability to consolidate paperwork and documents. Five of the OHCPs mentioned this trait as being helpful. Neighborhood Care, though mostly electronic, still uses paper for certain functions. C.L. gave a few examples of these uses which include consent forms, insurance cards, and medical histories. These papers are scanned into the record by the administrative staff when necessary. Having the documents located in this hub decreased the time spent juggling papers and reduced the likelihood of important documents being lost. Furthermore, the OHCPs liked having the patient X-Rays in one location so they could flip through them and track their patients' progression.

G.H., a hygienist, mentioned another advantage to having the documents scanned into the record: "[EHR] are good for patient privacy because you don't have paper laying around." Reducing the number of eyes on the records is certainly an advantage of having the documents centralized in the EHR repository.

Research Question 3: What are some drawbacks to EHR systems that you find impede your ability to provide patient care?

System Failure

System failure was the most commonly cited issue with the EHR system, mentioned by seven of the OHCPs. The system would occasionally stop working, freeze, or run slowly. The OHCPs blamed "networking interruptions" and "system malfunctions." The interviews revealed that when the EHR shuts down, the dental clinic comes to a stop because there is no "system [they] can fall back on." It was noted that during shutdowns, "medical goes to paper but since X-rays are electronic, when NextGen goes down, it makes providing dental care problematic."

Thus, because their charting functions and X-Rays are on the EHR, they cannot work until the EHR is brought back online. This was cited as a major concern because shutdowns could last up to thirty minutes, severely pushing back their schedule. However, Neighborhood Care has a dedicated IT staff that they call for technical issues because they are a large clinic. This raises the issue of how smaller, private clinics would need to adjust to system shutdowns.

Not Completely Paperless

Neighborhood Care is not yet completely paperless. As mentioned, consent forms for procedures like extractions and health histories are still filled by hand. One OHCP mentioned that this means documents can still be lost or scanned in incorrectly. One dentist even mentioned that she noticed radiographs not being correctly entered sometimes, leaving her unable to work.

C.L., a dentist, mentioned she had heard some clinics were trying to go fully paperless by using tablets equipped with styluses for patients to sign. However, C.L. did not think that solution would be a good fit for Neighborhood Care, noting that their patients were underserved.

She felt that many of the patients were not comfortable with technology and that noted that some were illiterate. However, she did suggest that patients may be able to use such technology if assisted by staff, and she stated that she believed "everything should be electronic as much as possible."

Lack of Customization

One major concern, mentioned by four of the dentists, was being unable to customize the template given. The practice manager noted this was a point of contention: some of the practitioners preferred entering their notes in free text form according to the method they were used to rather than filling out the specific template in the EHR. Indeed, this sentiment was echoed by several dentists though they seemed to recognize the need for standardization:

"If I want to write a certain thing and I want it to be on a template [I'm used to], it's harder because there's already a template. [I know] another doctor probably wouldn't want to use my template." -J.J.

"I have my own set of notes that I like so I was just deleting everything and pasting my own notes in there. [However] we were told before you have to follow that template." -I.M.

"Sometimes with certain codings, because we are such a big organization, you cannot go in and change something individually whereas out in private practice, you can tailor it to your particular needs. Here, it has to be generalized for everyone to use. If you want something done, everyone has to agree on it." -O.P.

As noted by I.M., there are workarounds to make the system easier to use. Stephens and Barrett describe these types of workarounds, found in electronic healthcare records, as being examples of change appropriation, "modifications to a technology's built-in features that help people accomplish their work" (167). However, the practice manager expressed disapproval for these workarounds. She noted they led to redundant information being entered and they made audits difficult. Nevertheless, she conceded that "in a big group practice, as standard as you can keep it is the way to go, but that frustrates some people."

Lack of Sophistication

In some measures, the dental EHR is not yet sophisticated enough to meet the demands of the OHCPs. For example, the pre-populated lists of diagnoses do not have enough granular detail sometimes to accurately characterize a treatment. One dentist noted some difficulty fitting their actual treatment to the ones listed in the program. Another dentist described a workaround to this issue that entailed using the EHR's built-in pop-up function. This allows the user to enter a free-text pop-up message that can amend what has been entered in the template, enabling the user to correctly clarify the treatment. However, she raised the concern that "you can do a pop-up, but if someone else is seeing that patient, they might not see that." The dental EHR presently still requires more detailed treatment options.

Another issue was that the program was not streamlined. Dentist D.D. complained about having to click multiple times through different "Are you sure?" messages to accomplish a goal. Another dentist complained that it was frustrating having to log-in and out during the transfer of care from the hygienist to the dentist. Information entered accidentally while the hygienist was

logged in had to be deleted and re-entered. She stated she would like to see a function that made switching users more efficient.

Research Question 4: What features do you believe are most important in a patient record?

User Friendliness

Three OHCPs mentioned this as being an important feature, with one dentist noting user friendliness enabled them to "spend more time with your patients and less time entering data."

Health History

This was the feature most commonly cited as being important. The OHCPs found it valuable to be able to see the patients' medical history, allergies, and medications without needing to sift through papers or rely on the patient's account. Said one hygienist:

"If I were to go through paper charts, it would probably take me forever versus the electronic health record where I can click the tooth number and get all the history forever. I know what's the history, what has been planned."

Research Question 5: In what setting were you first exposed to dental EHR systems?

Settings

Three of the OHCPs mentioned dental school or hygienist school. This low number is likely due to the older median age of the interviewees which was 37. EDRs were just in the process of being widely implemented when they were in school. In fact, two dentists mentioned they used paper records primarily but their schools had been in the process of switching while

they were enrolled. Two OHCPs mentioned Neighborhood Care as being their first exposure to EHR. Two mentioned private offices. See Table 1 for a full list of addressing this question.

Research Question 6: How do you generally learn about new technologies in dentistry?

Continuing Education

Half the respondents indicated continuing education was a setting in which they learned new technology.

On-the-Job Training

Three respondents said they learned new technologies at work "if they decide to take on a new system." One dentist remarked that learning on the job at Neighborhood Care differed from private practice because "there is a lot more tailored information you can get in private practice."

Sales and Advertising

Two respondents stated that sales representatives and advertisements like fliers were key way in which they kept up with new technology. Said A.C., "There's an information void once you get out of dental school. You are dependent on a sales rep or journals or advertising."

Research Question 7: What role should dental schools play in introducing emerging dental technologies?

Positive Attitude towards Introducing Technology in Education

All OHCPs responded positively to introducing the basics of new technology in dental school. A.C. stated that dental school is "where most everyone learns about new technologies."

M.M., a hygienist, agreed with the utility of introducing technology during training. She noted that once you learned the basics of one EHR system, picking up new EHR systems was easier. G.H., also a hygienist, did not have EHRs in school despite receiving training as recently as 2016. He called this a disadvantage, stating that he had to learn to "work in a whole new way."

Research Question 8: How do you think an integrated system would be beneficial to your practice?

Patients as Imperfect "Historians"

When asked this question, seven out of ten of the OHCPs responded that the integrated EHR could fill gaps in the patient-provided health information by using medical records. Four of the dentists used some variation of the term "imperfect historian" to describe how patients often misremembered or neglected to mention their pertinent health information.

C.L. offered some theories as to why the patients might be poor historians: "It might be because they can't remember, don't think it's important, or [they're] embarrassed." Other dentists also responded that they felt patients would frequently forget information or fail to mention it because they did not think the dentists would require the information. However, the dentists stressed that they needed this information, with one stating that she liked the integrated record because, "I can see their medications because they can sometimes conflict with dental treatments."

C.L. offered an anecdote about a recent patient in which the patient's inability to recall their medications frustrated her. The patient had been prescribed an antibiotic by a doctor from a local hospital for an infection of the gums and then referred to the clinic for outpatient care. However, when asked, the patient could not recall the antibiotic's name. Because the hospital

does not share records with Neighborhood Care, she could not check the name of the antibiotic and evaluate its fitness for the patient's treatment.

Ability to View Health History

The dentists described widespread satisfaction with the ability to see the patients' medical records, with five specifically citing this feature. Two dentists noted that it allowed them to take a role in managing their patient's chronic conditions.

> "It's important to see chronic diseases, diabetes in particular. Dental conditions can be dependent on their diabetes and vice versa. We're trying to get more integrated with that and cardiac" -A.C. (Practice Manager)

> "We sometimes see the patients in between them going to their doctor's visits…and we monitor their blood pressure. We monitor if it's on a high range, and if they are under the care of a doctor, we're like hey, 'You need to go back. This isn't right.'" -C.L

C.L. also noted that being able to see certain lab results like HIV lab results was helpful. Handling patients with HIV requires medical clearance unless their HIV lab results show the disease is being managed. C.L. liked the ability to bypass having to get this clearance or have an "uncomfortable conversation" with the patient by looking at the lab results.

C.L. further reported frustration with a previous CHC where she worked at where the record was not integrated. She stated that the "doctors [at the other clinic] were like 'Why do you guys need access [to our records]? You're just dentists.'" Thus, she preferred Neighborhood

Care's system. Interestingly though, another dentist noted that though Neighborhood Care had integrated records, she did not think the medical branch was taking advantage of them. She stated "we see medical a lot but the medical doesn't see out charts a lot."

Research Question 8: What are some barriers in dentistry to implementing new technologies?

Cost

Cost was the most commonly cited barrier with four OHCPs mentioning it. Noted a hygienist, "The biggest problem is cost. If the employer doesn't want to implement or have people who can support it for problems, [adoption] will not happen." A.C. noted the costs of dental technology is prohibitively high and recalled a closet full of failed, pricy technology from her days of private practice.

Training

Nextgen was described as being easy to learn. However, one dentist felt the training had been rushed. The company had flown out two representatives to teach the dentists how to use the technology over two days. She felt there were many features they were underutilizing because the training had been quick.

Research Question 9: What do you think your patients' opinions are of the EHR system?

Apathy

Few of the dentists believed their patients noticed the EHR system in any way. One stated that they probably liked it because they were able to request copies of their information more

easily. However, others noted that their patients did not really seem to look much at the monitors which were located behind the chair, out of the patients' view.

Research Question 10: Is there anything we haven't discussed today that you would like to add?

Most OHCPs did not have additional commentary. One hygienist, M.M., used this question as a chance to reiterate her appreciation for the dental EHR system.

Discussion

Overall, the interviews revealed high satisfaction among the OHCPs at Neighborhood Care with the integrated records. They expressed positive sentiments about the software's ease of use, quick learning curve, and ability to enhance the efficiency and organization of their practice. This is consistent with some of the past findings conducted on physicians that showed physicians who adopted EHR had positive views compared to those who had not (Ajami and Bagheri-Tadi 129). In particular, the OHCPs appreciated the fact their EHR was integrated because it allowed them to fill in gaps in the patients' medical histories using records from the medical half of the CHC. They viewed this as enhancing their ability to provide care.

However, they did experience some frustrations with specific limitations of their software. One such grievance was with the lack of ability to customize their templates. As Stephens and Barrett observe, change appropriation can "[facilitate] feelings of efficacy" by giving the users a sense of ownership over the technology (183). In Neighborhood Care, the lack of customization appeared to interfere with the dentists' established methods of note-taking. Furthermore, users expressed frustration with technical difficulties, including system shutdowns.

Some clinicians were also frustrated that the system did not have thorough enough options to cover all treatments, leaving them to have to correct the record with free-text notes. However, all these limitations were software-specific. In regards to the integrated functionality of the record, no complaints were raised.

This study provides evidence that an integrated medical-dental record greatly enhances the practice of dentistry in an integrated CHC. These findings suggest that other CHCs might be able to use integrated records for their patients to pursue better oral health outcomes. Because a significant barrier to implementation is cost, this initiative might be incentivized by government grants, such as those that were offered as part of the HITECH act. A second barrier, lack of training, could be addressed through continuing education courses since many of the OHCPs indicated this was the primary way they learned new technology. Based on these interviews, benefits of pursuing this goal of integration include improving patient outcomes, increasing the efficiency of dental practice, decreasing the cost of chronic care, and reducing medical errors.

Limitations and Future Study

A major limitation of this study is that it only focused on the attitudes of dental professionals. Previous research has shown that physicians show less interest than dentists in the advantages of integrated care (Greenberg et al., "Physicians' attitudes" 225). This finding was echoed by the comments of some of the interviewed OHCPs who implied that medical was not utilizing the integrated record to the same degree they were. This is an important consideration since it appears Neighborhood Care's choice of EHR systems was dictated by the medical team without input from dental. Another limitation is that I only examined a single practice location, and while these dentists and hygienists were generally positive, it is difficult to know if that

sentiment is related to the inner workings of this dental practice or the specific EDR system being used. Future studies should explore the physicians' perspectives to determine if they make use of the integrated records and how they feel about the dentists' use of their records as well as expanding on perspectives of different types of EDR software systems and how teams use these systems in their actual practice.

IV. Conclusion

Prevailing trends in healthcare right now look to find policies that can provide value-based care and reduce the burdens of chronic disease as the costs of healthcare spiral ever higher. Dental cooperation is an overlooked piece of this puzzle. However, due to long-standing historical trends, the modern institutions of dentistry and medicine are divided in their education, regulatory bodies, legislative policies, insurance coverage, and provision of care. This is problematic because a large body of recent research has shown that integrating dental and medical care can improve patient outcomes and decrease costs, particularly among patients suffering from chronic illnesses. Surveys have shown that dental professionals, medical professionals, and patients all show openness to this model of care. Studies also indicate that knowledge and willingness to engage in integrated care can be improved by interprofessional education. However, bridging the professional divide requires the coordination of care. This aim is best facilitated by interprofessional training and by an integrated electronic patient record that would allow clinicians to share information like blood pressure, chronic disease status, and prescription history.

There are substantial barriers to this type of record though. Dental and medical professionals have different uses for their record systems so a one-size-fits-all approach will not necessarily work. Instead, the systems need to be designed to they can exchange "nuggets" of relevant data. Additionally, meaningful use standards for EHR systems are not as widely adopted in dentistry as they are in medicine because the standards are tailored to physicians. Thus, meaningful use standards, like interoperability, are in their infancy in dentistry. This issue is compounded by the fact that grants aimed at improving EHR compliance to federal CMS standards often exclude dental offices since most do not meet CMS Medicaid eligibility

standards. Instead, innovation in dental records is largely driven by the private market where there is less demand for interoperability.

For this reason, I argue that community health centers could be an ideal focus for policy when exploring how to implement integrated records. CHCs, which are eligible for government grants, are able to put these systems in place because many of them already offer both dental and medical care. Furthermore, their underserved populations are especially susceptible to chronic disease (Greene and Yedidia 807). Therefore, they would benefit greatly from integrated care because it has been shown to improve patient outcomes for chronic diseases like diabetes. These types of records would also have the potential to save CHCs money since it has been shown that patients with chronic diseases who receive dental services end up costing their insurers less money due to improved patient outcomes (Foreman et al. 186). Finally, integrated records reduce the chance of medical errors and improve the efficiency of practice (Foreman et al.188). The results of my interviews with the oral health care providers at this CHC provide some support for including CHCs in the implementation of integrated records because the staff dsiplayed such a high feeling of satisfaction with their system.

One way to pursue this benefits is for the federal government provide grants to CHCs to stoke the adoption of integrated systems. This will spur innovation in this area among the companies that manufacture such systems which could result in these systems being taken up more widely in the private sector. Second, my findings suggest that healthcare professionals should be familiarized with the benefits of integrated care through their professional education and through continuing education courses. This will enhance their openness to cross-professional collaboration and may also improve the adoption of integrated systems. Finally, we need additional research on how to implement meaningful use standards more suitable for dentistry.

At present, these standards are not widely applied to dentistry because many of the standards are not applicable. CMS could create standards for EDR that include EMR compatibility and incentivize their adoption. Private insurance companies might also be able to offer benefits to providers who adopt these systems since integrated care can result in savings to the insurance companies.

I believe the adoption of these policies might substantially improve the adoption of integrated records, which could be a key component in encouraging interprofessional cooperation of dentists and physicians in patient care. This will in turn decrease the cost of patient care and improve their health outcomes, making this approach a valuable avenue to explore in the modern healthcare landscape.

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