CareQuest Institute for Oral Health®

RESEARCH REPORT

Oral-Systemic Interactions and Medical-Dental Integration

A Life Course Approach

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Introduction

Sonia is visiting her obstetrician-gynecologist (OB-GYN) for a routine visit during her second trimester of pregnancy. After giving Sonia a clean bill of health, her OB-GYN tells Sonia about an opportunity to visit with a dental hygienist who works in the office as part of the health care team.

Sonia agrees, and her doctor escorts her to an adjoining examination room, where she introduces Sonia to the office's dental hygienist, Margot. Margot greets Sonia, asks about her oral health, and conducts a brief oral health screening. She tells Sonia she sees initial signs of periodontal disease and recommends that Sonia see a periodontist for an evaluation and possible treatment. Margot also provides Sonia with oral health instructions and recommendations before Sonia leaves the office. After Sonia leaves, Margot enters her findings and recommendations into an electronic health record (EHR) that includes both Sonia's medical and dental records. The OB-GYN's office is able to bill the dental hygiene visit under Sonia's dental insurance. Through the EHR, Margot is able to send an electronic referral directly to the periodontist, so the dental office can contact Sonia directly. The periodontist's office receives an alert about the referral through its EHR system and contacts, and they contact Sonia and schedule an appointment two weeks later.

Shortly after giving birth to Parker, Sonia takes Parker to a well-child visit at the pediatrician's office. There, they are introduced to a nurse practitioner, Christopher, who is knowledgeable about recommended infant oral health care, preventing baby-bottle tooth decay, and the importance of having a dental visit by the age of one. Throughout all of Parker's pediatrician visits, Christopher gives Sonia helpful advice on how to care for Parker's oral health and does a warm handoff to a pediatric dentist ahead of Parker's first birthday. Through the interoperable EHRs between the pediatrician's and pediatric dentist's offices, the pediatric dentist is able to view Christopher's notes about all of Parker's pediatrician visits and is able to provide continuity of care for the family.

When Parker is six years old, he is diagnosed with Type 1 diabetes. Aware of the link between diabetes and periodontal disease, Parker's pediatrician once again includes Christopher in one of Parker's medical visits to do an oral health screening.

Christopher sees early signs of gingival inflammation in Parker's mouth and provides Sonia with guidance on how to floss his teeth regularly. He also puts in a referral through the interoperable EHR for Parker to be seen at his pediatric dentist's office for more frequent periodontal monitoring. Christopher can bill for this oral health screening and consultation through Sonia's dental insurance.

At the age of 25, Parker has been smoking cigarettes for about four years, a habit he picked up in college. During his annual physical, his primary care provider (PCP) talks with Parker about his tobacco use and reasons he may want to quit. His PCP does a brief intraoral examination and sees an area on the inside of Parker's cheek that she thinks looks suspicious. Using the interoperable EHR, she sends a referral to Parker's dentist for him to be seen later that week. At this dental visit, Parker's dentist does a biopsy of the lesion and sends it for analysis by an oral pathologist. Fortunately, the lesion is determined to be benign, and this result is shared via EHR with Parker's dentist and PCP. Parker receives a recommendation from his PCP for a tobacco cessation program, which he successfully completes. His dentist continues to monitor him for signs of oral cancer and communicates the results back to his PCP.

Now 72 years old, Parker is seeing an orthopedic surgeon about persistent pain in his hip. His surgeon recommends a hip replacement surgery, followed by a few days in the hospital. The orthopedic surgeon is well aware of the importance of good oral health in preventing hospital-acquired pneumonia and refers Parker to his dentist via the interoperable EHR for a pre-operative evaluation and prophylaxis as needed. As Parker visits his oral health team regularly, the hygienist recommends a routine cleaning; she and Parker's dentist agree that no additional periodontal treatment is needed. This recommendation is communicated back to the orthopedic surgeon, who moves ahead with scheduling the surgery. The procedure is successful, and Parker is discharged from the hospital with a new hip and a clean bill of health.

This vignette provides an example of a life course approach — involving the prenatal, early childhood, and adult portions of the life span — that focuses on the oral-systemic interactions (OSI) on which a medical-dental integration (MDI) model is built. In this idealized situation, Sonia's and Parker's medical providers were aware of the links between oral health and overall health, constructed their practices with these links in mind, and incorporated all the required technical and insurance infrastructure to provide integrated care.

Oral health is a core component of overall health; a healthy mouth and a healthy body are bidirectionally related. An umbrella review shows that, as of 2022, researchers had published 293 systematic reviews with meta-analyses on the links between oral diseases and noncommunicable diseases (e.g., diabetes, cardiovascular disease, depression).[1] Oral diseases and systemic diseases are connected in a way that is consistent with a life course approach, with risk factors and health outcomes changing throughout the life span. Evaluating OSI through this lens allows us to better understand potential links between risk exposure and subsequent disease development as, in part, a function of an individual's age. As we look across the life span, we discover how physical, emotional, environmental, and social aspects of life relate to OSI.

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As our understanding of OSI increases, the importance of integrating medicine and dentistry for care across the life span becomes increasingly clear. MDI is an essential component of achieving overall health that is inclusive of oral health. MDI models are complex to design, are implemented with varying degrees of success, and yield benefits such as improved interprofessional communications and better health care outcomes.

This report discusses the need to understand a life course approach regarding both OSI and MDI. It provides a comprehensive overview of the bidirectional nature of oral and systemic diseases across different life phases and how health care delivery in an integrated form can improve access to care and health outcomes. Finally, it discusses the gaps, challenges, and barriers to creating integrated models, and provides recommendations to improve the future of MDI.

Connections Between Oral Health and Systemic Conditions Throughout the Life Span

Pregnancy and Periodontal Concerns

Periodontal disease, or infection and inflammation of the gingival tissue and bone around the teeth,[2] has been linked to adverse pregnancy and birth outcomes including preeclampsia (pregnancy-related hypertension),[3] preterm birth,[4] and low birth weight.[5] Pregnant individuals are also at an increased risk of periodontal infection, as pregnancy-related hormones may interact with other factors (such as elevated plaque levels) to worsen gingival inflammation.[6] Furthermore, pregnant individuals may not receive routine dental care during the prenatal period due to their own concerns about the safety of dental treatment during pregnancy[7] or the concerns of oral health providers.[8] It is safe to receive dental care during all stages of pregnancy,[9] and evidence suggests that receiving periodontal treatment may lead to improved birth outcomes, although this evidence is mixed.[10] A meta-analysis of 20 randomized controlled trials found that receiving periodontal treatment during pregnancy was associated with a reduced risk of preterm birth and perinatal mortality as well as increased birth weight.[11] In recognition of the importance of receiving routine dental care during pregnancy, prenatal and postpartum dental benefits have been extended to Medicaid participants across all 50 states and the District of Columbia as of October 1, 2022.[12]

Health Impacts of Early Childhood Caries

Despite the common misperception that "baby teeth" are not important because "they're going to fall out anyway,"[13] it is critical for children to have good oral health from their earliest days in order to avoid short- and long-term consequences of dental disease. Children are able to receive cariogenic bacteria directly from their mothers through vertical transmission of mutans streptococci early in life, possibly even before their first tooth erupts.[14] Children with such bacteria tend to have more dental caries than children with without these bacteria.[15] Early childhood caries (ECC) is the most common chronic

disease that occurs in childhood,[16] and is linked to numerous adverse health and quality of life outcomes. Severe ECC is linked to poor nutrition, weight loss, and iron-deficiency anemia, as children with severe dental decay are unable to eat nutritious foods due to chronic dental pain and dysfunction.[17, 18] ECC can negatively affect children's behavior, performance in school, and overall development.[16] The treatment for ECC itself can have a negative impact as well. Every year in the United States (US), approximately 100,000–250,000 children undergo dental treatment under sedation.[19] While generally safe when conducted under the direction of trained specialists, all sedation involves some level of risk of adverse events, including vomiting, respiratory depression, and aspiration.[20] The American Association of Pediatric Dentistry recommends that children see a dentist by their first birthday or within six months of the eruption of their first tooth in order to establish a dental home and prevent the development or progression of ECC.[21]

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Unique Oral Health Issues Facing Adolescents

As adolescents become more independent from their parents, they may face unique challenges to their oral health. E-cigarettes are the most common form of nicotine used by adolescents, with more than 14% of high school students and 3% of middle school students reporting that they used e-cigarettes within the past 30 days in 2022.[22] "Vaping" (the use of e-cigarettes) is linked to increased risk of periodontal disease as well as oral lesions.[23–25] Additionally, there are concerns about the potential long-term neurologic effects of high levels of nicotine on the developing brain during adolescence.[26] Adolescents are also more likely to experience injuries to their mouths through school athletics, such as cuts to the lips and broken teeth.[27, 28] Approximately 5% of adolescents have some kind of oral piercing,[29] and piercings in the tongue and lip are linked to gingival recession and tooth chipping or cracking.[28, 30] As adolescents gain more autonomy over their diets, they may be more likely to choose more carbohydrates and sugary beverages, which are linked to increased caries.[31] Oral health providers are valuable resources to advise adolescents and their parents/caregivers on immunizations, including for the human papillomavirus (HPV), that are recommended to start in early adolescence.[32] More than half of adolescents aged 13 and above meet with their health care provider without their parents present,[33] indicating the importance of integrating medical and oral care so that primary care providers can continue to monitor the oral health of their adolescent patients and encourage regular dental care.

Increased Independence Affects Oral Health in Young Adulthood

As individuals move out of adolescence and enter young adulthood, some oral health risks remain while new issues can emerge. Although some young people begin using tobacco and alcohol earlier, the age at which individuals in the US can legally purchase both is 21.[34, 35] Chronic use of alcohol, tobacco, or both together significantly increases the risk of developing oral cancer[36] as well as pulmonary disease, cardiovascular disease, and depression.[37, 38] Additionally, the mean age of onset for eating disorders is 18 for bulimia nervosa and anorexia nervosa, and 21 for binge eating disorder.[39] Eating disorders are linked to oral health impacts such as tooth erosion, gingival recession, and enlarged parotid glands,[40] as well as systemic effects such as anemia, muscle wasting, hypotension, cardiac damage, and infertility.[41] As oral health professionals may be the first health care providers to observe oral signs of tobacco use as well as eating disorders (e.g., tooth staining and erosion),[42, 43] it is critically important for oral health providers, physicians, and behavioral health specialists to be part of an interdisciplinary team to treat individuals with substance use or eating disorders.

Middle Age and Its Oral Health Implications

According to results from the National Health and Nutrition Examination Survey (NHANES; 2009–2014), more than a third of US adults over the age of 30 have mild to moderate periodontitis, and 7.8% have severe periodontitis.[44] In addition to the health effects linked with periodontal disease mentioned above (i.e., adverse birth outcomes, impacts from vaping), other systemic health conditions appear to have a bidirectional relationship with periodontal disease, particularly as adults age. Much of the scientific literature in the area of OSI addresses the relationship between periodontal disease and diabetes mellitus.[45] There is considerable evidence that "diabetes increase[s] the risk for periodontitis, and periodontal inflammation negatively affect[s] glycemic control."[46] Substantiating the relationship between the two conditions, clinical studies have shown that treatment for periodontal disease results in a reduction of hemoglobin A1C (HbA1C, or blood glucose) levels.[47, 48] Additionally, large-scale analyses of medical and dental claims data find an association between periodontal treatment and subsequent decreases in overall diabetes-related health care costs.[49, 50]

In addition to its relationship with diabetes, periodontal disease has also been linked to cardiovascular disease (CVD). A large-scale prospective cohort study found a significantly increased risk for stroke and ischemic heart disease in adults with periodontitis.[51] A similar prospective study found that, when controlling for diabetes and smoking history, adults with a periodontal disease diagnosis, prior periodontal treatment, or self-reported tooth loss due to periodontal disease were at significantly greater risk of developing peripheral artery disease.[52] Individuals with periodontitis have been found to have higher levels of low-density lipoproteins and triglycerides than those without periodontitis.[53] Finally, nonsurgical periodontal treatment is linked with significantly reduced systemic levels of inflammatory biomarkers associated with coronary heart disease.[54, 55] Thus, as individuals age and become more likely to develop systemic conditions such as diabetes and CVD, it becomes all the more important to ensure that adults receive appropriate oral health care, particularly related to treatment of periodontal disease.

The Critical Importance of Good Oral Health for Older Adults

As adults age into their later years, establishing and maintaining good oral health become even more important. In a prospective study of more than 2,000 adults who did not have any cognitive impairment at baseline, individuals with oral frailty (e.g., missing teeth, difficulties in eating and swallowing) were significantly more likely to develop mild cognitive impairment during the study period compared to adults without oral frailty.[56] Periodontitis is linked to a significantly increased risk of dementia in adults over the age of 50.[57, 58] In a prospective study of adults aged 75–80 years, the adjusted risk of developing dementia was significantly lower in adults receiving periodontal treatment, and those with five or more periodontal treatments had a lower risk of overall dementia, Alzheimer's disease, and vascular dementia compared to adults without periodontal treatment.[59]

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Among older adults who are hospitalized, poor oral health is linked to a higher risk of developing pneumonia. Specifically, the risk of developing hospital-acquired pneumonia is higher in individuals with missing teeth and heavy dental plaque.[60] In a study of the effectiveness of an oral health protocol in an acute care setting, an increase in oral hygiene care (including patients receiving oral heath kits) was associated with an 85% reduction in cases of non-ventilator hospital-acquired pneumonia (NVHAP) compared to adults on acute care units on which nursing staff received only a "refresher training on the . . . usual oral care protocol" but no oral health products.[61] Large-scale medical and dental claims data show that, among adult Medicaid participants, receiving preventive dental care during the 12 months prior to hospitalization, or receiving periodontal treatment during the six months prior to hospitalization, is linked with a significantly reduced risk of developing NVHAP compared to those who did not receive dental care prior to hospitalization.[62]

Why Integrated Health Care Systems Should Understand Oral-Systemic Interactions Through a Life Course Approach

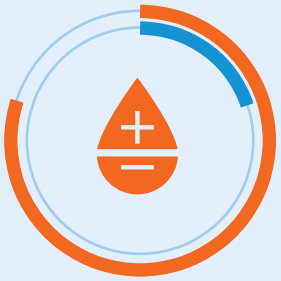
A life course approach considers factors that apply during development and aging, which might influence disease onset.[63, 64] This approach is related to the time between exposure to risk factors and disease development and progression at the individual and population levels.[65] The life course approach follows the framework of risk accumulation, critical and sensitive periods of exposure, and underlying socio-environmental determinants of health experienced at different life course stages.[66] According to the life course approach, providers should treat diseases at onset rather than waiting until the disease has progressed.[65, 66]

As previously described, OSIs start during the prenatal period and are part of a person's lifelong journey. As a result, both oral health providers and physicians must be knowledgeable about the links between oral and systemic health, and how poor health in one arena can influence the other. Providers from each sphere must also be willing and prepared to refer patients to one another as appropriate. In the prenatal period, OB-GYNs should be knowledgeable about the role of good oral health for both the pregnant person's overall health and the health of their child; oral health providers should be comfortable providing care to pregnant persons throughout pregnancy. Integrated care between the OB-GYN and oral health provider will help ensure the health of the pregnant person and their unborn child. After the child is born, a referral from the child's pediatrician to a pediatric dentist in time for the child's first birthday[21] should be as routine as the handoff from an OB-GYN to a pediatrician. As children develop into adolescents and become more independent from their parents, they may see both oral health providers and physicians as trusted adults with whom they can share concerns they do not want to discuss with their parents. Close communication between these providers may result in detecting concerning behavior in their mutual adolescent patients, such as use of tobacco, alcohol, or drugs, or the early development of an eating disorder.

Into adulthood, an MDI approach allows health care providers to screen, refer, and advise patients who may be unaware of their risk factors for many chronic diseases. For example, it is estimated that more than 20% of adults with diabetes mellitus and 80% of adults with pre-diabetes are unaware that they

have these conditions.[67–69] In their systematic review and meta-analysis of studies examining point-of-care diabetes testing of dental patients previously undiagnosed with diabetes, Chinnasamy and Moodie found that 11% of these patients were diagnosed with diabetes and 47% with pre-diabetes.[70] Dental visits can incorporate diabetes testing and other health screenings, such as blood pressure and HIV testing. Since nearly 10% of individuals who see a dentist in a given year do not see a physician,[71] incorporating health screenings into the dental visit is all the more important to improve access to care, as is anticipatory guidance for preventive medical care such as childhood immunizations and the HPV vaccine, as well as adult immunizations such as those for yearly influenza, SARS-CoV-2 (COVID-19), respiratory syncytial virus (RSV), and varicella-zoster virus (shingles).

Finally, the connection between oral and mental health affects individuals at every life stage and is bidirectional in nature. Depressive symptoms, such as lack of motivation, feelings of worthlessness, and fatigue, may adversely affect adults' behaviors related to oral hygiene maintenance.[72–74] Greater risk for dental decay and tooth loss can lead to more frequent pain experiences, social isolation, low self-esteem, and reduced quality of life and, in turn, can be associated with worse mental health.[75, 76] Both physicians and dentists are able to screen patients for depression relatively easily with measures such as the Patient Health Questionnaire (PHQ-9),[77] and should be comfortable screening and referring patients to behavioral health providers when appropriate.



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With this foundational understanding of the OSI, it seems clear that oral and medical health should be integrated at all levels of primary care following a life course approach. Such integration will benefit patients across their life span.

Cost Savings Associated with Medical-Dental Integration

MDI not only improves oral and overall health across the life span but also reduces costs. As noted above, large-scale medical and dental claims data analyses show savings in diabetes-related health care costs following treatment for periodontal disease.[49, 50] Similarly, providing individuals who have diabetes and periodontitis with periodontal treatment was predicted to save each individual an average of $5,904 in health care costs, using a simulation study of NHANES data.[78]

In a study of nearly 600,000 patients undergoing heart valve surgical procedures, the average hospital charges and length of hospital stay were significantly higher for patients with gingivitis or periodontitis compared with other patients.[79] For individuals newly diagnosed with heart disease, providing periodontal treatment is linked with lower outpatient health care costs.[80]

To date, studies examining the effects of periodontal treatment on health care costs have relied on analyses of medical and dental claims data in order to have sufficiently large sample sizes to detect cost savings differences between groups. However, dental claims data often lack diagnostic codes, leaving researchers to infer periodontal disease severity through the number of treatments provided. Randomized controlled trials involve screening for health conditions as part of inclusion/exclusion criteria, yet are often too small in scale to determine health care cost savings on the same scale as claims analyses. Furthermore, randomizing patients with periodontal disease to either optimal care (i.e., scaling and root planing) or suboptimal care (i.e., routine prophylaxis or waitlist control) raises ethical concerns.

Consistent use of dental diagnostic codes and increased interoperability between electronic medical and dental records are two key strategies that could provide more robust data about the cost savings associated with medical-dental integration. Such data efforts will allow large-scale analysis of claims data to determine which interventions produce the most health care cost savings and most optimal patient health outcomes.

Successes and Challenges of Systems in OSI-MDI

There are several examples of health care systems that have thoughtfully implemented an MDI model, even while facing continued challenges in designing, implementing, and evaluating the success of these programs. The Medical Oral Expanded Care (MORE Care) initiative has been successful in increasing the average proportion of pediatric dental patients receiving fluoride varnish in primary care practices across four states.[81] Providing different forms of continuing medical education to PCPs on oral health screening, referrals, counseling, and fluoride varnish application resulted in nearly half of the PCPs providing 20 preventive dental visits activities (screening, fluoride varnish, etc.) or more to Medicaid-enrolled children in North Carolina.[82] One of the more successful examples of MDI model is the integration of dental health into well-child visits (WCVs). WCVs are a keystone of delivering preventive services in pediatrics in the US. WCVs monitor the growth, development, and behavioral health of a child. In recent years, WCVs have often included an oral health component, based on recommendations from the American Academy of Pediatrics and the American Academy of Pediatric Dentistry.[83–85]

Tiwari and colleagues examined the relationship between WCVs and preventive dental visits (PDVs) using a large, multistate Medicaid claims data set (1.3 million children).[86] There was an overall trend for children with at least one WCV to have more preventive dental visits compared with all children enrolled in Medicaid. This trend was seen at all ages, although the dental visits for children by age one were significantly fewer in both groups. As children approached the ages of three and four, the difference between the two groups (prior WCV versus no prior WCV) became wider: At age three, 50% of children with a prior WCV had attended a PDV, versus 37% of all Medicaid-enrolled children, and by age four, the corresponding figures were 59% versus 48%. Having a WCV had a greater influence on visiting the dentist for older age groups.

The same group of researchers went a step further to evaluate the role of location of service of the WCV and its association with PDV attendance for children from birth to age 20 — again using a large multistate data set (3.7 million children).[87] The study revealed some noteworthy trends for Medicaid-enrolled children. First, the most often utilized locations for WCVs were the medical office and hospital, where about 90% of the

visits were completed. Both federally qualified health centers (FQHCs) and rural locations were utilized less often for WCVs. Again, WCVs had a stronger influence on the likelihood of visiting the dentist for older age groups than for younger children. Children ages 5–9 had the highest odds of attending a PDV after a WCV at all three locations, followed by children ages 10–14. Possible explanations for these findings include increased parental oral health awareness as their children grow older and increased dentist comfort in treating older children.[88]

However, in both of these studies, a dental assessment during the WCV — either an examination or a dental diagnosis — was not conducted for a high percentage of children. In the first study, only 2–3% of children received a dental exam during a WCV. In the second study, children received the highest percentage of dental assessments at office or hospital visits (3%); however, this is a very low percentage of all the children who received a WCV. Several reasons have been identified for this lack of implementation, including a lack of training and burnout at the clinical level, lack of prioritization of oral health in WCVs, and lack of will at the leadership level.[89]

Another example of MDI implementation can be found in recent efforts to integrate behavioral health into oral health. The Clackamas Health Center (CHC) in Oregon is implementing a pilot program to transition its dental clinics into trauma-informed clinics. By implementing a trauma-informed approach universally, CHC hopes to reduce the patient anxiety that is often associated with dental treatment, improve attendance rates in its dental clinics, and increase rates of completed treatment. The project is based on a life course approach, with providers acknowledging that early life experiences, including those related to dental anxiety, can affect health over a lifetime and across generations. Their Trauma Informed Care workgroup — which includes dental, medical, and behavioral practitioners — developed policies, protocols, and trainings for the entire staff. All patients over the age of 10 complete a dental anxiety scale at intake and at an annual exam. Based on the resulting score, the dental provider has several options to offer the patient to make the dental visit comfortable. If the score is 19–20 (considered high dental anxiety), a behavioral health provider is introduced to the patient for a brief consultation. At future dental visits, the behavioral health provider is present with the patient to provide support and coaching in coping skills. This is a pilot program funded by CareOregon Dental, which absorbs the cost of the behavioral health provider's participation. However, to sustain this behavioral and oral health integration, an increased billing to accommodate the behavioral health services would likely need to be covered by patients' insurance plans.

Such examples are an important reminder that systems can innovate to integrate medical, behavioral, and oral health. Although each clinic faces unique barriers and there is no single formula for the success of the MDI model, there are a few general rules for success and sustainability. Financial viability is critical to successful MDI. Most integrated models start small, or are phased in, and can grow into large, complex models once the success of the initial model is demonstrated. MDI implementation represents a cultural shift for the whole organization, from the front desk to the clinician. Thus, aligning expectations, obtaining leadership buy-in, building infrastructure (including interoperable EHRs), and closing referral loops are some of the initial steps in establishing integrated care models.[90]

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Gaps in the Understanding and Implementation of OSI and MDI

Currently, we see that MDI models are compartmentalized, as most provide care for only vulnerable populations by decreasing the number of facilities, appointments, and providers with whom a patient must interact. Most MDI models use small and phased integrations as initiating steps that can build a foundation for more extensive programs. The main barrier to a successful MDI model is the lack of an interoperable EHR, which is necessary to access medical records, make referrals, and collect data to ultimately measure success.[90]

MDI models are usually not built with financial viability in their structure, as most of the models start as funded projects. A few reports have recently argued that financial viability is one of the most important components of MDI's success and sustainability.[91] There are clinical models that show that when dental providers are embedded in medical offices, the dental providers can bill dental insurance. Medical providers can bill medical insurance for preventive services such as fluoride varnish and oral health counseling.[91] However, there is minimal evidence that dental providers can bill for preventive medical services such as blood pressure measurement.

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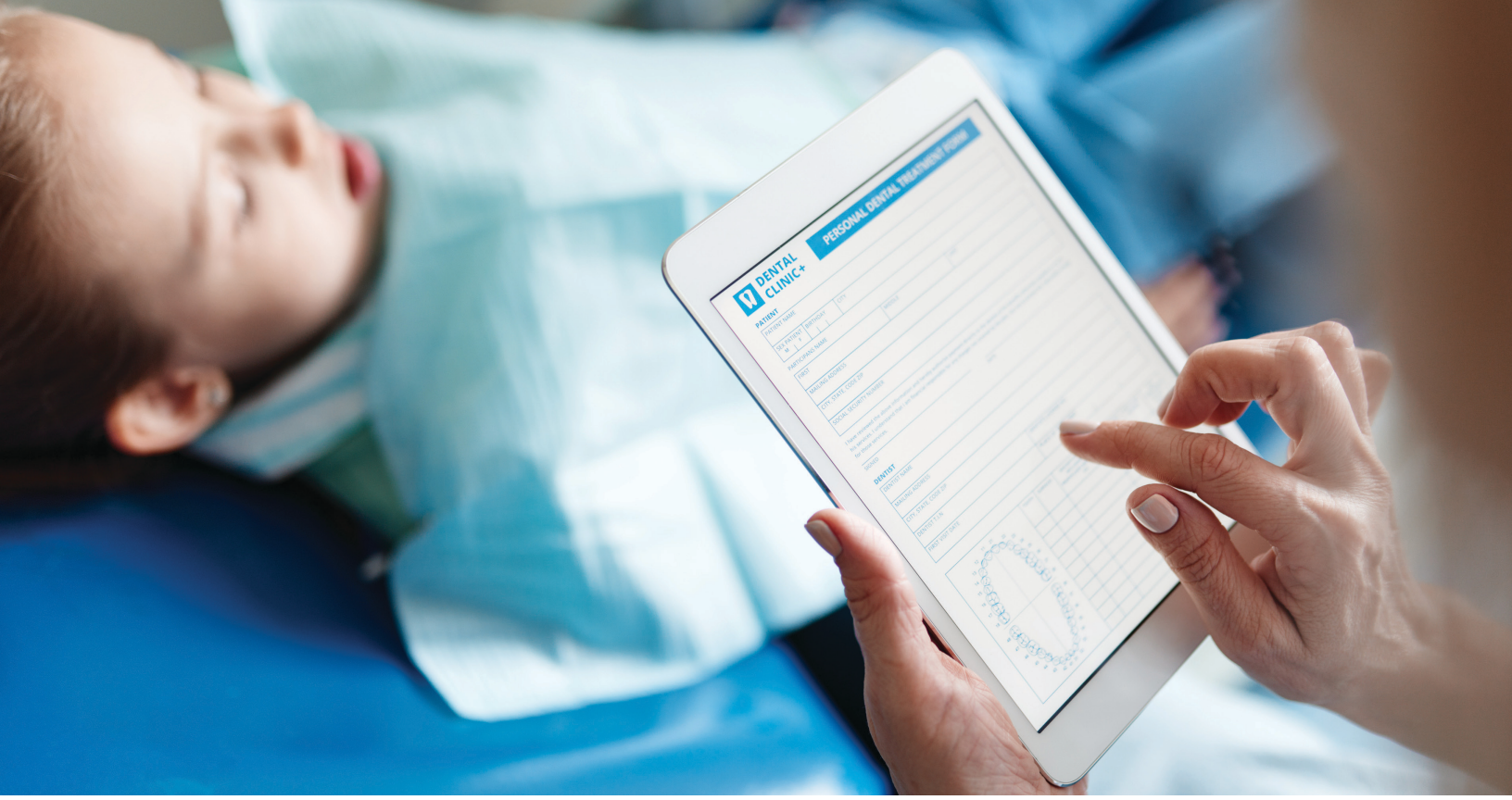
Developing an Integrated Information Exchange, Workflows, and Payment Structures

One of the main concerns in building MDI models is that the infrastructure needed for sharing patient information — electronic medical and dental records — is seldom integrated or interoperable. Switching EHR programs requires extensive time and financial resources, making it a barrier to the implementation process. Some large hospital systems have shown how integrated EHRs can reduce gaps in care, improve access to care, and improve patient outcomes.[92] The question remains how a solo health care provider can make such a shift. Cloud-based online patient portals may be an answer that could reduce the need for software that harbors EHRs.[93]

Dental and medical insurance are siloed from one another, and dental benefits do not follow a life course approach. Steps need to be taken to improve and combine payment structures by, for example, enhancing public and private health care coverage for oral health care throughout the life span. An example of this would be to make sure that pregnant persons have insurance coverage for dental care. Another example is coverage for primary oral health care for all patients with diabetes. Furthermore, using value-based care models to move away from fee-for-service models and improving population health via preventive efforts can be done by bundling payments, using accountable care organizations, or incentivizing providers.



Building Evaluation and Cost Saving from the Start

The key to accurate evaluation of health outcomes and cost savings is to establish robust data collection infrastructure from the start of the integration of medical and dental systems. As noted above, interoperability between medical and dental EHR systems is critical to be able to track patient visits, prescriptions, referrals, health outcomes, and health care costs incurred on both the medical and dental side. Systems that speak to each other allow health care professionals to provide more comprehensive, whole-person care to their patients, and allow researchers to see the "whole picture" when analyzing health care utilization, health outcomes, and cost savings. Furthermore, when oral health care providers include diagnostic codes when submitting claims, they can better track their patients' health outcomes (e.g., reduced periodontal pockets, decreased caries risk) over time. Including diagnostic codes also produces more detailed data, through which researchers can determine which interventions produce the most health care cost savings and most optimal patient health outcomes. Patients, providers, and the health care system as a whole benefit from such an integrated, robust system.

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Framework Recommendations for Implementing MDI Across the Life Span

The success and sustainability of MDI models depend on following a life course approach. We offer a few recommendations that will act as a foundational framework for developing a life course–based MDI with sustainability as a primary pillar.

1. **Educating medical, dental, and allied health care workforce members in MDI.**

   As we move forward in the MDI process, we need to think of how to educate the next generation of health care providers while continuing to educate current practitioners in this area, building and renewing awareness, and developing tools that help them implement MDI in practice. In the 1990s, the Institute of Medicine pointed out that dental education was siloed and fragmented.[94] Since then, several reforms have been made — from vertical and horizontal integration of curricula to include diverse content across disciplines, to conceptualization of content and developing different models of learning.[95, 96] Also, interprofessional education-related competencies have been built, and other testing and evaluation modalities have been developed, that are used in dental education. However, more needs to be done to expand this interprofessional educational model.

2. **Implementing bidirectionality of integrated medical and dental teaching and practice.**

   We need to develop a system that mandates teaching about oral health in health care programs outside of dentistry, instilling core clinical competencies for primary care providers. An excellent example can be found in nursing programs that have moved beyond the traditional head, eyes, ears, nose, and throat (HEENT) examination by including an oral component (teeth, gums, mucosa, tongue, and palate) to create the HEENOT examination.[97–99]

3. **Changing state practice acts and scope of practice for dentists.**

   One example of this state-level change is the expansion of the scope of practice for dentists in Oregon to include providing vaccinations.[100] Oregon offers a model for increasing awareness of MDI for both providers and policymakers; these efforts are still being phased in as the beginning of a longer road toward broader integration.

4. **Increasing patient awareness to improve acceptability of MDI models.**

   Although there is an enormous amount of literature related to provider awareness of MDI, there is a paucity of data about the patient's side. The limited data have shown that patients are supportive of MDI.[101, 102] Much needs to be done to create awareness among patients about the benefits of MDI for them and their families — such as the benefits of receiving many of their health care services under one roof and improved quality and coordination of care. Including patient outcomes data — including both subjective satisfaction ratings and objective health outcome measures — will be key to evaluating the success of MDI models. Also, establishing patient navigation tools and patient support groups, so patients can gain a better understanding of the impact of MDI, are important first steps that can increase patient demand for MDI.

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