

**Oral Health in America 2021: Making a Case for Curricular Change**

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ABSTRACT

Objectives: The NIH *Oral Health in America: Advances and Challenges* report<sup>1,2</sup> is the most recent evidence based review of the status of oral health in North America since *Oral Health in America: A Report of the Surgeon General*, which was published in 2000.<sup>3</sup> This article aims to synthesize and discuss information from the report pertinent to improving dental education to positively impact oral health. Calls to action and suggestions for implementation are presented.

Methods/Results: The authors reviewed each section from the report and identified key messages relevant to dental education. These were then combined into a framework based on the NIH report's three main "call to action" items.<sup>1,2</sup> A matrix for calls to action and implementation recommendations

was developed using the findings from the 2021 NIH report and a previous 2018 report on *Advancing Dental Education in the 21st Century*.<sup>4</sup>

Conclusion: The information discussed in the report related to dental education has the potential to improve oral health, and educators, schools, professional organizations, state, and federal agencies are called to develop and/or implement action plans focused on curriculum, competencies, workshops, guidelines, and policies based on the summary framework presented in this paper.

## INTRODUCTION

*Oral Health in America: Advances and Challenges*<sup>1</sup> and the Executive Summary<sup>2</sup> were published on December 21, 2021. This work is the first comprehensive scientific report on the status of oral health in the U.S. since *Oral Health in America: A Report of the Surgeon General*<sup>3</sup> and emphasizes evidence-based progress over the intervening 20 years. The report generated key summary messages and three calls to action (Figure 1).

This article provides a summary and discussion of key information with strong implications for dental education from this important and timely report. It uses the report's three main calls to action as a framework for important changes that should be considered for future dental educators (Figure 2). Within each section of the NIH *Oral Health in America* report, we describe how these calls to action may affect and/or pertain to dental education.

## METHODOLOGY

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The authors (all of whom participated in writing and editing various sections of the report) reviewed the six sections from the NIH *Oral Health in America Report* with a charge to look at challenges and opportunities pertinent to dental education. Each section presented data on various aspects of the oral health status of the population. The authors then reviewed these data in terms of the implications on the future of dental education.

As the authors identified educational issues, similarities began to unfold. In many cases, the educational issues were similar even though the populations were different; e.g. children, working adults, older adults, populations with special needs. Educational issues were categorized into the topics outlined in Figure 2.

The report's three calls to action served as the starting point for identifying dental education needs or changes. Some overlap of dental education implications occurs under each call to action, to indicate nuances affecting more than one area of education.

Finally, similarities were found between the implications for dental education in the NIH report, and a previously large education project in 2018 led by Drs. Formicola and Bailit titled *Advancing Dental Education in the 21st Century*.<sup>4</sup> A matrix (Table 1) was developed to summarize action items both from this 2021 report and the 2018 *Advancing Dental Education in the 21st Century* report, with recommended implementation suggestions related to these action items.<sup>4</sup>

## RESULTS

***Oral Health in America Report: CALL TO ACTION ONE. To significantly improve the nation's oral health, policy changes are needed to reduce or eliminate social, economic, and other systemic inequities that affect oral health behaviors and access to care.***

Each section noted that specific population groups—children, adolescents, working adults, and older adults—included subgroups with medically complex conditions that can impact their oral health and the care needed, which in turn can affect access to care. These complex conditions require an understanding of basic and clinical sciences by dental care providers in order to safely and effectively plan and provide needed clinical treatment, as well as to collaborate with other health professionals involved in the care of these patients.

In addition, for individuals of all ages and health conditions, the effect that social determinants of health have on oral health disparities and inequities and access to care cannot be overemphasized. Oral health disparities can be biological (differences between men and women) or socio-economic (lower SES and higher SES) or combinations of both. Disparities usually have a mathematical distinction, while socio-economic distinctions usually refer to inequities.

To this end, the following dental education needs were identified in the report:

1. Considerations for training in integrated basic and clinical sciences include:

- The rapid pace of innovation requires translation of basic research to clinical care. The basic science dental curriculum needs to stay up to date, with flexibility to incorporate new clinically-relevant research that demonstrates linkages between oral infections,

inflammation and systemic diseases. Students must understand the relationships between cellular level changes and clinical signs and symptoms, as well as have opportunities to translate this information into clinical patient care.

- The pandemic has reminded us of the importance of microbiology in 21st century dentistry. The impact of the oral microbiome locally and systemically, and best evidence about how to manage microbiome changes that lead to disease, needs to be continuously incorporated into basic sciences and clinical curricula.
- Better attention and focus to understand and recognize disparities in health among many groups, including women's health. For example, basic science curricula should address the biological basis for gender differences associated with oral health, such as the effect of female hormones on oral tissues, so students are better prepared to understand and address these differences.
- Medicine is constantly adding new pharmacotherapeutics to its care arsenal. Pharmacology courses need to remain current, as medications for chronic diseases change regularly, along with their impact on oral health and systemic health.
- The opioid epidemic remains a concern to all health professionals. Students should understand the implications of the use and abuse of opioids, methamphetamines and other addictive substances, and should know how to use best evidence-based approaches to manage acute and chronic pain, decreasing chances of dangerous addictions.
- Oral and pharyngeal cancer (OPC) continues to take a devastating toll on adults and older adults.<sup>5</sup> With five-year mortality showing little decline, dental students must understand the importance of a thorough oral cancer exam on each adult, and must be competent in doing this in clinical care.
- Evidence-based effective preventive interventions for oral cancer need to be promoted. The curriculum must incorporate up to date research on HPV-related cancers and its implication on diagnosis of OPC. Information on HPV vaccination for children and how to support it in clinical care must be incorporated into the curriculum.

- Medical advances have led to improved survivability of persons with disabilities and medical conditions. Diagnosis, treatment and follow-up for special needs and medically complex patients must be taught, assessed and revised with changing science, and opportunities must be provided in the curriculum to provide care to these population groups.

## 2. Considerations for training in population/social/policy sciences

Social sciences and population health sciences need to be introduced and/or strengthened in dental curricula. Social determinants of health (SDoHs) have a significant effect on oral diseases at all ages and will have implications for clinical education in the areas of risk assessment, preventive services, treatment planning, clinical treatment and its outcomes. The dental school curriculum must keep pace with research into SDoHs and train students on how to translate this information to assist patients in improving their oral health.

Community experiences immerse students in a broader and more life-like environment, exposing them to SDoHs which are critical drivers of the biology of dental disease, often making health outcomes less attainable. Health literacy also plays a critical role in patients' understanding of the nature of their disease and addressing it can help improve health decision-making. The solution may be a curricular approach that addresses patients first from their community and social structure, followed by the body and, finally, the oral cavity.

The following dental education needs were identified:

- Interprofessional management of conditions, both medical and dental, is important for the future of healthcare. Dental education should consider collaborations and research with other disciplines to better understand and address the implications of SDOHs on communities and individuals.
- Improved training in health policy and advocacy will be required to help graduates effect oral health policy changes. Skill development is needed to enable future students to interact more effectively with health policy-makers as advocates for increased access to care, preventive strategies, and improvements in SDOHs.
- The changes needed in education will require an expansion of the faculty and a differently trained faculty workforce. Current dental school faculty may not possess the skills needed to teach and implement the needed changes. Dental education may need to train and/or attract individuals with more varied professional backgrounds.
- Case management will need to be included in the skill set of dental professionals. Treatment planning courses should include consideration of how upstream determinants shape patient health-related attitudes and behaviors and how these can be effectively addressed in clinical settings.
- Dental education will need more emphasis in evidenced-based health promotion and health literacy training in the curriculum. The curriculum should enable students to help educate patients to understand the nature of their oral diseases and make more informed decisions about prevention and treatment services.

### 3. Considerations for clinical education

Throughout the life cycle, individuals age and manage various chronic diseases. As a result, dental students and their faculty must be comfortable taking a thorough health and medication history and be competent in both chronic disease management and referral. With caries and periodontal disease still very prevalent in certain populations of children, adults, and older adults, dental education must



continue to build robust training in risk assessment and preventive dental therapies into the curriculum to prevent and/or slow these preventable oral diseases.

The following dental education needs were identified:

- The complexity of dental care will only increase as the population ages rapidly.
- Dental students must be competent in taking a medical and medication history for medically complex and special needs patients and modifying the treatment accordingly, ideally using integrated electronic health records.
- The COVID-19 pandemic showed us that acute and chronic disease states are long-term care concerns. Children, adolescents, adults and older adults managing multiple chronic diseases will benefit from risk assessment protocols and preventive services to decrease the damaging effects of chronic diseases and/or medications on the patient's oral health.
- Incorporating high quality evidence-based clinical practice guidelines in the treatment planning process reduces random variation in treatment planning and helps to ensure that patients receive the best care possible. Students must be trained to use best evidence-based strategies during clinical care. Implementation into the curriculum will require faculty standardization and calibration.
- Dentistry lags behind medicine in digital characterization, management and tracking of disease. Diagnostic codes must be incorporated into the clinical and didactic curriculum to enable faculty and students to evaluate results of treatment procedures and communicate with non-dental colleagues.
- There needs to be rapid integration of innovation with traditional clinical techniques, particularly clinical practice guidelines as they become available. Students must be competent in the prevention of oral diseases and be able to provide combined medical and surgical management of oral diseases that meets the individual needs of each patient in a person-centered care model.

#### 4. Considerations for IPE/IPP

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Integration of dental and medical services is an important strategy to increase access to care for underserved patients, improve patient care delivery and outcomes, and reduce costs. Through partnering with other groups, dental schools can provide care through an interprofessional care (IPC) model in their communities, and educate students in a more complex practice model that can also help strengthen, develop and test innovative strategies for integration of oral, medical, and behavioral health.

Intra- and interprofessional education (IPE), has become a priority in dental curriculum reform in the last decade, and should continue to expand in the future. While dental education already has competencies for dental education associated with IPE, explicit outcomes (e.g., skill sets, oral health outcomes, communication, collaboration, etc.) and assessment strategies to meet the goals of the 2021 NIH report will need to be better articulated. A major obstacle will be identifying faculty with the necessary background in health system science.

High-risk behaviors clearly affect oral conditions in adolescents, adults, and older adults. It is critically important for dental students to be able to learn how to best assess these high-risk behaviors, and how manage their impact on oral health and the relationship with general health.

The following dental education needs were identified:

- The dental school faculty of the future will look different than today. Programs for faculty training and calibration in IPE will be needed and/or expanded, with some faculty needing to function across disciplines.

- IPE models abound in communities. Dental schools need to continue to support training in IPE and expand opportunities for participation in IPC, particularly in dental shortage areas, to enhance training and outcomes of oral healthcare to underserved populations.
- Working and older adults with multiple chronic diseases benefit from dental care provided in inter-professional settings. To the extent that dental students can participate in extramural rotations that enable inter-professional practice with physicians, pharmacists, and/or psychologists, dental students will enhance their clinical skills in caring for patients with multiple chronic illnesses.
- Strategic planning within dental health professional education should include moving in the direction of establishing extramural rotations that include inter-professional practice as a critical component of dental education when possible.
- The report hopes to establish a broader concept of oral healthcare. The dental curriculum should consider expanding its inter-professional education curriculum to address the unique health needs of both the chronic pain (TMD) patient and the patient who experiences significant dental fear. For example, psychology doctoral students could work with dental students and patients in addressing coping strategies for pain and dental fear.
- SDoHs can impact well being and mental health, and mental health can impact oral health. Dental students should learn to screen for mental health issues, and understand the impact of mental health on oral and general health, including the consequences of commonly used medications and substances on oral health.
- Other disciplines hold keys to better oral healthcare. Interprofessional education with psychology doctoral students and/or nursing students could help enhance the dental students' education in treating the high-risk patient with substance abuse or addiction disorders.

##### 5. Considerations for treatment of diverse populations

Changing population demographics present unique challenges to improving access to care and communicating with dental patients.

Several sections of the report challenge dental education to improve teaching dental students to provide dental care for patients with disabilities throughout the lifespan (e.g. children, adolescents, adults and older adults).

Adolescence becomes pivotal in the transition to adult care, and greater recognition of emotional, social, and developmental transitions from childhood that affect health, healthcare-seeking behavior, and disease predilection should be infused during dental education. The adolescent challenge may be among dental education's most significant, with greater emphasis needed on these patients rather than sorting them into either pediatric or adult care pathways.

Women's health programs have potential to improve oral health prior to pregnancy in women and lower risk of a premature or low birth weight infant, as well as help mothers identify oral health issues that may occur in their children.

Chronic diseases often appear during adulthood, and transition to older adulthood can result in disabilities from these various chronic diseases over time. For example, a patient may be diagnosed with rheumatoid arthritis in middle age, but not manifest disability in extremities until older adulthood. Additionally, older adults have factors that may make obtaining dental care more difficult for them, including their living status and loss of employment based dental insurance. Research shows

that access to dental care is more difficult for older adults who are homebound or living in long term care facilities.

The physically disabled, cognitively impaired, veterans, homeless, and incarcerated populations—all special needs populations—have great difficulty obtaining needed preventive and treatment services.

The Commission on Dental Accreditation (CODA) Predoctoral Standards for Dental Education require that dental schools provide treatment for special needs populations. To the extent that dental schools establish special needs facilities or partner with special needs organizations, they will comply with CODA standards but, more importantly, dental students will benefit from the clinical experience of providing dental care to patients with special needs.

Integration of special needs patients into the daily clinical education and operation of a dental school is the desired goal. This enables students to understand that patients with special needs present within a “range of normalcy”, and many can receive dental care in a dental school (or future private practice) environment.

The following dental education needs were identified:

- Personal dental care is the future. Cultural competence and cultural humility need to be emphasized as critical competencies to care for patients today and in the future, given the changing demographics of the U.S. population.
- Dental students will need to possess awareness and skills related to medical consultations for their patients with chronic illnesses and must become comfortable working with their physician, nurse practitioner and other health professional colleagues. Dental education should facilitate this model.

- Dental schools should consider developing oral health education, prevention and treatment programs for women of child-bearing ages to reduce adverse outcomes for the pregnant woman and her baby, and to improve oral health for her other children.
- Dental students need to have experience caring for the unique needs of special care and medically complex children and adults, particularly conducting a thorough social, medical, and medication history, developing a treatment plan, conducting risk assessment, providing clinical dental care, and evaluating the results of oral healthcare on the patient's health.

6. Considerations for access to care:

Access to care issues can be addressed in part, by policy changes, particularly those related to reimbursement for dental care. Research by the American Dental Association Health Policy Institute (ADA HPI) has shown that income and dental insurance are key drivers for use of dental services.

Data on use of dental services by the ADA HPI has demonstrated that, over the past 15 years, use of dental services has increased for children and older adults, but not adults.<sup>6</sup>

Children's use of dental services shows the lowest disparities between white and Black children, but disparities between white and Black seniors is the greatest. Low-income children have seen the greatest increase in use of dental services and almost match the use of dental services by middle-to-high income children<sup>7</sup> as a result of the Children's Health Insurance Program (CHIP), dental benefits for children in the Affordable Care Act, and Medicaid expansion.

Use of dental services by working adults has remained stable or decreased over the past 15 years. Older adults have seen increases in use of dental services, with higher income adults and older adults using dental services more frequently than low-income adults and older adults. The lack of a dental benefit in Medicare contributes to low utilization of dental services by older adults.

The following dental education needs were identified:

- To improve reimbursement for dental services, dental schools should partner with other organizations to educate policy makers on the importance of providing oral health to improve overall health; e.g., expansion of a state's dental Medicaid benefits for adult patients, inclusion of a dental benefit in Medicare for older adults.

***Oral Health in America Report: CALL TO ACTION TWO. To improve oral health for more people, dental and other healthcare professionals must work together to provide integrated oral, medical and behavioral healthcare in schools, community health centers, nursing homes, and medical care settings, as well as dental clinics***

1. Curriculum changes

Adoption of integrated electronic health records (EHRs), the use of more efficacious coding for diagnoses and treatment, especially diagnostic codes, and the implementation of new models for reimbursement are needed to increase the effectiveness of the oral health workforce, and integration of the oral health workforce with the healthcare system. These changes should be part of the training of the dental workforce in dental school settings.

A major change since the Surgeon General's Report in 2000 has been development of electronic dental records and the nascent integration of those electronic dental records into an integrated EHR.

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The development and use of safety and quality measures and dental diagnostic codes (in addition to procedure codes) can help monitor improved outcomes for oral healthcare. Although many academic institutions and some large group practices have already adopted standard diagnostic terminologies, the vast majority of dental practices do not use them, and neither the dental insurance industry nor government funders require diagnostic codes. Connecting a diagnosis to treatment can improve the measurability of care provided and, ultimately, the quality of oral healthcare.

The growing emphasis on quality metrics and value-based payments is further prompting more emphasis on evidence-based practices, health literacy, patient-centered care, and population health outcomes. All of these need to be part of the skills acquired, used and assessed during dental education. While CODA currently addresses some of these competencies in the Pre-doctoral Standards for Dental Education, these skills will continue to increase in relevancy for the future of clinical dental practice.

The following dental education needs were identified:

- Dental schools should consider adopting EHRs that integrate with health systems when they decide to upgrade or change their EHRs.
- Dental students should be taught to incorporate evidence-based practices and health literacy into their patient care experiences. (CODA currently has an evidence-based practice standard.)
- As graduates evaluate their practices using a population perspective of their patients, e.g., looking for trends in disease risk or outcomes, the EHR can assist them with these reviews. Quality metrics processes should be taught to dental students so they can



evaluate patient outcomes in their future dental practices. (CODA currently has a clinical quality improvement standard.)

2. Considerations for clinical settings to deal with inequities and access to care

Alternative dental care delivery sites have emerged as educational opportunities. When used well, they have broadened exposure of dental and dental hygiene students to diverse populations, to individuals with more complex dental and social needs, and to patients with limited access to care. Community-based education provides predoctoral and advanced education programs rich experiences that can compensate for limitations of crowded curricula, campus-limiting dental facilities, and/or faculty removed from communities that shape pediatric, special needs, or older adults' oral health.<sup>8</sup>

The complexity of future patient needs will require more collaborative and interprofessional education based in community settings. The dental "school" of the future may be organized around a constellation of healthcare services facilities, rather than a single oral health clinical facility. While inter-professional care may occur within a dental school, it may be best accomplished outside the dental school. Community-based experiential learning provides students insight into why disadvantaged communities exist, how living in such communities has an impact on health, and what strategies are effective in addressing these conditions.

Traditional medical care providers are taking a greater interest in oral health and contributing in important ways. As we see new providers entering the arena, we are also seeing oral healthcare move out of the dentist's office, and into more frequently visited locations, such as schools and medical clinics. Such activities need to be supported through policy interventions that address cost and licensure concerns.

With awareness of complex patient needs that require team-based approaches to treatment, along with the desire to train students to work within group-setting environments, there is an increased need for training in clinical leadership and practice management. Team function, communication, practice settings, payment models, scope of practice, IT/digital, etc. are all part of effective practice management. Assessment of these outcomes should be based on demonstration of knowledge on objective tests, and participation in care delivery in diverse settings.

The following dental education needs were identified:

- Dental schools should incorporate community rotations into the curriculum to provide students with an understanding of the challenges faced by many low income or rural individuals in accessing dental care.
- Community-based experiential learning, when done well, exposes students to the effect social determinants of health have on health and oral health.
- Clinical rotations that provide students with experience treating marginalized populations such as: institutionalized elderly, the homeless, prisoners, refugees, and isolated rural populations, expand the dental students' depth and breadth of clinical experiences; these rotations will make them more likely to provide treatment to these populations upon graduation.
- Dental schools should consider partnering with various community organizations to develop care delivery sites in alternative settings to reach marginalized populations.
- Dental schools should consider developing clinical leadership training that includes both conceptual understanding and skill development in relations to team building, facilitation, negotiation, communication, and development of emotional intelligence.

### 3. Technology considerations

Technology will drive a number of changes in the future for dental education. Advances in diagnostics and imaging, digital technologies for patient care, electronic health records, telehealth patient visits, artificial intelligence, and virtual reality will all play a significant role in how dental students are educated in the future.

Advances and innovations in clinical dental education will require agility, flexibility and significant capital investment. The future for clinical education will require a broader therapeutic armamentarium, use of algorithmic care patterns, digital workflows and management of social determinants of health in cooperation with communities and professionals beyond the dental school.

The following dental education needs were identified:

- **Advances in Diagnostics:** Evidence-based dental education should address the challenges of TMD diagnosis and management, periodontal disease diagnosis, and new techniques for salivary diagnostics.
- **Digital Technologies:** Dental schools must incorporate new technologies into dental education for diagnostic procedures. Teledentistry, digital workflows for imaging, and CAD/CAM for restorative, prosthodontic and implant treatment will facilitate dental care for adults and older adults.

- Integrated EHRs should be promoted in dental schools: Electronic health records facilitate the integration of oral health and systemic health when caring for patients (working adults and/or older adults) with multiple chronic diseases.
- Teledentistry: Dental schools should introduce students to tele-dentistry to improve access to care for all populations, and especially to marginalized individuals.
- Incorporate new clinical technologies: Dental schools should incorporate new evidence-based technologies to preserve tooth structure and monitor the efficacy of these interventions over time, regenerative pulpal therapies for children, etc.
- Quality of care improvements: Quality of care will improve and be supported by improvements in information technology, including use of diagnostic codes, artificial intelligency, and interoperability of the electronic medical/dental record. Dental schools need to train students on how to incorporate quality improvement into their care management.
- Digital readiness and collaborative practice: Dental schools should ensure that students leave school competent in using technology, diagnostic coding, and are experienced in working with interprofessional teams.

4. State/national considerations:

Policies at the state and federal levels can serve as barriers to access needed dental care. For example, barriers to interprofessional practice integration, policies restricting scopes of practice, and barriers to education of diverse provider types in certain settings, will continue to require changes in state licensing laws. Changes must be made to the reimbursement system, whether Medicaid, Medicare or private insurance, to ensure that reimbursement for certain patients, certain procedures and/or in diverse settings allow patients to receive the oral healthcare they need. Provider education changes

through CODA revisions, and information sharing among educators will be required if schools provide educational opportunities for students in integrated healthcare settings.

The following dental education needs were identified:

- Dental education must help develop, advocate, and implement policies to remove barriers to oral healthcare for all patients.
- Dental education must continue to serve as a safety net for access to dental care for underserved populations and continue to address the need for knowledge on access and disparities.
- Dental education must model professional behaviors that recognize and educate students about oral health disparities and inequities and participate in safety net programs that care or provide reimbursement for marginalized populations.
- Dental schools must partner with integrated health systems to provide interprofessional clinical care experiences for dental students.

***Oral Health in America* Report: CALL TO ACTION THREE. To strengthen the oral health workforce, dental education needs to diversify the composition of the nation's oral health professionals, address the costs of educating and training the next generation, and ensure a strong research enterprise dedicated to improving oral health**

1. Diversity considerations.

The diversity in health professional training must change to accommodate population characteristics and needs. While we have seen some increases in the diversity of those entering oral health professions, the social and demographic profile of the dental workforce still does not reflect the profile of the population.<sup>9</sup>

Racial and ethnic diversity within dental and allied dental professions is increasing modestly.

Nevertheless, underrepresentation continues to be a concern for some racial/ethnic groups within the oral health profession, and efforts to address and decrease these disparities within the faculty, staff, and student workforce are imperative.

The following dental education needs were identified:

- Dental schools must continue to recruit underrepresented minority (URM) students and faculty to reflect the US population and engage in pipeline activities to insure opportunities for all interested in a dental career.
- Dental schools must continue to seek financial support for scholarships to recruit rural and first-generation professional students to pursue a career in dentistry.
- Dental education should take the lead in research to better understand and address disparities in workforce composition and background.

## 2. Workforce: Training the next generation of providers

Dental schools should provide students with exposure to a variety of workforce models. Solo, private dental practices have decreased as a percentage of all dental practices, with a commensurate increase

in the number of group practices and corporate-owned practices during the past 20 years. These trends are expected to continue in the future.

Most oral healthcare occurs in private dental offices, yet people increasingly receive care where they live, work, and learn—including in educational settings, community health centers and clinics, Federally Qualified Health Centers (FQHCs), dental schools, long-term care facilities, and mobile practices. In addition to dentists in private practices who accept Medicaid and CHIP dental coverage, the dental safety net includes dental schools and education centers that train dentists, dental assistants, hygienists, and therapists. These academic institutions will continue to serve as dental care safety net sites for those with Medicaid, CHIP, or no insurance. From 2016 to 2017, about one in six visits to dental students were provided outside the dental schools and in community settings.

The structure of the workforce is changing. Providers of oral healthcare now include new professional groups, such as dental therapists and community dental health coordinators, who increasingly represent essential healthcare resources for underserved populations. Dental and health professional schools can play a role in educating these new professionals. These new professionals need to be embraced and included in ways that improve access to affordable care and care outcomes. Physicians and nurses are being educated to provide oral health screenings and preventive services.

Since 2000, professional education programs have expanded to include training for additional providers, such as dental therapists, advanced-standing dental hygienists, and CDHCs. Since 2000, a number of new dental schools have opened, increasing the number of dental students enrolled.

The following dental education needs were identified:

- Dental schools should serve as models for care delivery for patients having difficulty accessing dental care, and accept Medicaid, CHIP or other publicly funded reimbursements.
- Dental schools should develop roles for dental therapists and community oral health coordinators in improving oral health of patients in the dental school and the community.
- Dental schools and other educational settings must continue to support development and implementation of programs to recruit and educate a diverse workforce for all dental team members.
- Opportunities for dental students to interact with diverse dental team members should be part of dental education and training.
- Dental schools may consider partnering with schools and/or long term care (LTC) facilities to develop oral health and clinical preventive programs (e.g., fluoride varnish applications) for a non-dental healthcare workforce.
- Dental schools should become leaders in training the oral healthcare professional workforce to treat children, special need patients and older adults using a collaborative team (Dentists/RDHs/Dental Therapists/Community Oral Health Coordinator).

### 3. Cost of dental education

The high cost of dental education is one of several factors determining which students apply to dental school, where graduates choose to practice, and how they practice. Dental education loan repayment and scholarship programs are important tools for enhancing workforce diversity. A few federal and state programs are available to reduce the cost of dental education. However, awareness of these programs and their use among underrepresented minorities and lower-income individuals remains



limited. While federal loan repayment programs exist, they are often under-funded making it difficult for health professional graduates to benefit from them.

The high cost of dental education needn't be assumed as a necessary part of doing business. Dental education must help students identify financial aid programs and advocate for more support to assist students needing financial aid to pursue a dental education. Dental schools also need to develop pipeline programs to recruit under-represented minority students and support them throughout their dental education.

The following dental education needs were identified:

- Dental schools must seek and advocate for additional financial support for URM students to pursue a dental education.
- Federal loan repayment programs must budget an increased amount of loan repayment funds to ensure that dentistry does not become a profession accessible only to the middle and upper class.
- GME funding should be available to increase the number of advanced dental education programs in hospitals and FQHC settings.
- Dental faculty/leadership should identify improvements to make dental education more efficient and effective at all levels to sustain the oral healthcare system, help reduce the cost of dental education, and potentially help lower students' educational debt.

#### 4. Research considerations:

The future of the dental profession as a scientific health profession is only as strong as the research enterprise underlying it. Dental education must continue to embrace its research mission and support and advance dental science. Faculty must pursue research and serve as role models for recruiting the next generation of dental scientists. The future research needs will require individuals with expertise in artificial intelligence, social and population science, materials and device engineering, data analytics, etc. Training programs will be required to recruit these types of scientists into dentistry and dental education.

The following dental education needs were identified:

- NIDCR and other federal and scientific agencies (HRSA, NSF, Howard Hughes Institute, etc.) need to further support training programs for scientists in dental schools.
- Dental schools need to support and advance the generation of new knowledge by faculty and provide research experiences for dental students.
- The intersection of science and patient care must be nurtured by training students in contemporary, evidence-based care and assessment of health outcomes using quality assurance tools commonplace in other areas of healthcare.

## DISCUSSION

The future of dental education will require that educators, schools, professional organizations, state and federal agencies develop curriculum, establish competencies, conduct workshops, create guidelines and develop or change policies based on the educational needs previously listed. In fact, many of the education actions needed based on the NIH Report were similar to those identified by Formicola and Bailit in the 2018 report *Advancing Dental Education in the 21st Century*.<sup>4</sup>

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Calls to action from both the NIH Report and the *Advancing Dental Education in the 21st Century* report, as well as a list of potential implementers for these actions, are shown in Table 1. Dental schools, the American Dental Education Association, and CODA will bear the bulk of the work needed to effect change for the future of dental education. Strengthening the dental research enterprise in dental schools will require that schools and universities work collaboratively with the International Association for Dental Research, NIH, and other scientific agencies.

## CONCLUSION

This article provides insight into the dental education implications of the recently released NIH report: *Oral Health in America: Advances and Challenges*.<sup>1</sup> The scientific advances that are presently occurring, and will continue to occur, require today's faculty to continue to update, revise, and renew the dental curriculum to meet the needs of future dental clinicians and the patients they are privileged to treat.

Dental students of the future may use haptics and virtual reality in the simulation lab before they treat patients. Digital technology will dominate the clinical environment. Dental graduates of the future will be more likely to practice in a group setting—whether with a medical group, FQHC, or a dental support organization—using an integrated electronic health record, and providing many procedures using a digital workflow for diagnostic, imaging, preventive and/or treatment procedures. Future reimbursement methods may require diagnostic codes in addition to treatment codes, and patient outcomes will need to be monitored to evaluate the quality of care and health status.

Change is never easy and often more difficult in a dental school. As faculty educate students to be resilient, they themselves must remain resilient and flexible. In the words of Stephen Jay Gould “Obsolescence is a fate devoutly to be wished, lest science stagnate and die.”<sup>10</sup> While we never envision ourselves becoming obsolete or our dental school curriculum becoming obsolete, the scientific advances of today and tomorrow will require that we rethink what we are teaching our students, why we are teaching them, and how we are teaching them. The NIH *Oral Health in America: Advances and Challenges* helps us answer these questions.

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TABLE 1. Summary of calls to action from the NIH Oral Health in America (~) and Formicola and Bailit “Advancing Dental Education in the 21<sup>st</sup> Century” (\*) with suggested implementers (key below)

Calls to action identified from:

~ NIH Oral Health in America

\*Advancing Dental Education in the 21<sup>st</sup> Century

CALLS TO ACTION	Implementers
Move from a student-centered to a patient-centered model of care to transform the economics of clinical education*	2
Move to more community based required rotations with defined competencies~	2, 4
Increase federal and state subsidies for safety net care.*	8, 9
Strengthen and integrate teaching of the clinical, biomedical, population health, and	2, 3, 4, 5

behavioral sciences*	
Invest in recruiting a diverse faculty for full-time academic careers *	2
Invest in developing faculty for full-time academic careers and leadership*~	2, 4
Hire/appoint faculty with strengths in population health and behavioral sciences~	2, 3
Recruit a diverse student body*	1, 2
Change pre-admissions criteria to include more population health and behavioral sciences ~	1, 2
Increase diversity of thought in the accreditation process*	5
Downsize dental education.*	2
Create models to contain the cost of education~	2, 8, 9
Increase integration with medical and other health professions schools.*	2, 3
Move more clinical education to patient-centered delivery settings. (Eg community health centers)*~	2
Prepare students to manage the care of children *~	2, 4, 5
Prepare students to manage the care of older adults and treat patients with complex dental and healthcare needs.*~	2, 4, 5
Prepare students for advances in the microbiome, connections between oral-general health and pharmacology~	2, 4, 5
Prepare students to use technology (digital workflows and telehealth)~	2, 4, 5

Update facilities to allow for technology use (integrated E.H.R, digital workflows and telehealth)~	2, 3
Use of Diagnostic Codes~	2
Improved safety and quality control~	2, 4, 5
Increase the integration of dental and medical education and practice (interprofessional education).*~	2, 4
In the longer term, integrate dental postdoctoral programs into the overall system of U.S. residency education.*	2, 9
Welcome and facilitate basic oral health education for other health professionals.*~	2, 3
Make research a core mission.*	2, 4, 5, 6, 9
Recruit research faculty members*	2, 6, 7
Increase support for early-stage researchers and students.*	2, 6, 7
Place increased emphasis on interdisciplinary and collaborative research.*	2, 6, 7
Address the structural barriers to developing strong research programs.*	2, 6, 7, 9
Strengthen CODA research standards for dental schools.*~	2, 5

Potential Implementers include:

1. Pre dental
2. Dental/Allied schools
3. University
4. ADEA
5. CODA
6. AADR/IADR
7. NIH
8. State level (eg Boards of registration)
9. Federal Level

FIGURE 1. Permission granted

**Box. Key summary messages for *Oral Health in America: Advances and Challenges***

- Good oral health is important for the overall health and well-being of individuals of all ages, their families, communities, and the nation.
- Through research and policy changes over the past 20 years, we have made substantial advances in the understanding and treatment of oral diseases and conditions, yet many people of all ages and demographic backgrounds still have chronic oral health problems and lack access to care.
- Healthy behaviors can improve and maintain individuals' oral health; these behaviors are shaped by social and economic conditions in which people are born, grow, work, and live.
- Oral and medical conditions often share common risk factors, and just as medical conditions and their treatments can influence oral health, so can oral conditions and their treatments affect other health issues.
- Substance misuse and mental health conditions negatively affect the oral health of many, and oral health providers are an integral part of the interprofessional team caring for these individuals. Professional schools have been challenged in preparing dental providers with the knowledge and skills needed for these new roles.
- Oral health services are evolving rapidly towards interprofessional models of delivery that integrate services across the health professions and expand access to care through new practice settings and new professional roles.
- The COVID-19 public health crisis has challenged the nation's health care system, including oral health care providers as never before, and with those challenges came new ways of ensuring safety during provision of dental care, of treating disease, and recognizing that oral health cannot be separated from overall health.

**Call to Action:**

- To significantly improve the nation's oral health, policy changes are needed to reduce or eliminate social, economic, and other systemic inequities that affect oral health behaviors and access to care.
- To improve oral health for more people, dental and other health care professionals must work together to provide integrated oral, medical, and behavioral health care in schools, community health centers, nursing homes, and medical care settings, as well as dental clinics.
- To strengthen the oral health workforce, we need to diversify the composition of the nation's oral health professionals, address the costs of educating and training the next generation, and ensure a strong research enterprise dedicated to improving oral health.



FIGURE 2. Outline of Major Areas as presented in the manuscript

<ul style="list-style-type: none"> <li>● Curriculum:             <ul style="list-style-type: none"> <li>○ Basic sciences</li> <li>○ Integration of basic and clinical sciences</li> <li>○ Clinical sciences</li> <li>○ Social and population health sciences</li> <li>○ Interprofessional education/interprofessional practice_(IPE/IPP)</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>● Integration of oral health and overall health             <ul style="list-style-type: none"> <li>○ Electronic Health Record (HER)</li> <li>○ Interprofessional training</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>● Access to dental care             <ul style="list-style-type: none"> <li>○ Community-based dental education</li> <li>○ Reimbursement methods for oral health care</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>● Workforce Development             <ul style="list-style-type: none"> <li>○ Diversity in oral health workforce</li> <li>○ Recruitment and pipeline programs</li> <li>○ Financial aid/load repayment programs</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>● Policy Development             <ul style="list-style-type: none"> <li>○ Reimbursement changes, e.g. expansion of dental benefits for adults in Medicaid, dental benefits in Medicare, private insurance changes</li> <li>○ Licensure changes</li> <li>○ Accreditation changes</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>● Research             <ul style="list-style-type: none"> <li>○ Increasing the number of dental scientists</li> <li>○ Expanding the number of training programs for scientists in dental schools</li> <li>○ Broadening the types of scientists conducting dental research</li> </ul> </li> </ul>