

## Assessment of Pathology Instruction in U.S. Dental Hygiene Educational Programs

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### Introduction

Medically compromised patients are individuals disabled from systemic diseases or conditions arising from aging, obesity, new infections and use and abuse of drugs.<sup>1</sup> These pathologic conditions can be associated with oral health problems. The needs of these individuals for oral health care are not being met due to their limited access to oral health care professionals. The Surgeon General's Report, National Oral Health Call to Action, reported the disparities in the nation's health delivery system, stating that it will take all health care professionals working together to promote oral health of our nation.<sup>2</sup> Dental hygienists are licensed preventive oral health professionals who have the potential to meet the needs of this medically compromised population. However, it is not known whether or not they are adequately prepared for this role.

According to the National Dental Hygiene Research Agenda, studies are needed to evaluate the extent to which current entry-level dental hygiene curricula prepare dental hygienists to meet the increasingly complex oral health care needs of the public.<sup>3,4</sup> Instruction in pathology content areas help prepare students for this role. It has been stated that the knowledge gained from pathology instruction enables students to understand and participate comprehensively in the delivery of health care.<sup>5</sup>

The Commission on Dental Accreditation (CODA) Standards for Dental Hygiene Education specifies that pathology clock hours (i.e., classroom time) be classified in terms of general pathology and oral

### Abstract

**Purpose:** To assess the instruction of pathology content in entry-level and advanced practitioner dental hygiene educational programs and the program directors' perceptions whether their graduates are adequately prepared to meet the increasingly complex medical and oral health needs of the public.

**Methods:** A 28-question survey of instructional content and perceptions was developed and distributed using Qualtrics® software to the 340 directors of entry-level and advanced practitioner dental hygiene programs in the US. Respondents rated their level of agreement to a series of statements regarding their perceptions of graduates' preparation to perform particular dental hygiene services associated with pathology. Descriptive statistics for all 28 categorical survey questions were calculated and presented as the frequency (percentage).

**Results:** Of the 340 directors surveyed, 130 (38%) responded. Most entry-level respondents (53%) agreed or strongly agreed (29%) that their graduates were adequately prepared to meet the complex medical and oral health needs of the public, while all respondents of advanced practitioner programs strongly agreed. More respondents strongly agreed to statements related to clinical instruction than to didactic courses. While 64% of respondents agreed that their graduates were prepared to practice unsupervised, if it were legally allowed, 21% were ambivalent. The extent of pathology instruction in entry-level programs varied, but most used traditional formats of instruction, educational resources and assessments of educational outcomes. Advanced practitioner programs emphasized histological and clinical examination of oral lesions and patient case studies.

**Conclusion:** Strengthening pathology instruction would ensure that future generations of dental hygienists would be adequately prepared to treat medically compromised patients.

**Keywords:** dental hygiene students, dental hygiene curriculum, dental hygiene programs, oral pathology, oral cancer, medically compromised patients

This study supports the NDHRA priority area, **Professional Education and Development:** Evaluate the extent to which current dental hygiene curricula prepare dental hygienists to meet the increasingly complex oral health needs of the public.

pathology.<sup>6</sup> By definition, general pathology content area focuses on "the nature of diseases, its causes, its processes, and its effects, together with associated alterations of structure and function,"

while content in oral pathology is devoted to “the etiology, pathogenesis, identification, and management of diseases, which affect the oral and maxillofacial regions.”<sup>5</sup> Systemic pathology, the branch of pathology that is concerned with the “etiologies, pathogenesis, and the host response specific to a particular organ system,”<sup>7</sup> is not specifically listed as a content area in the CODA documents and is often covered in general pathology courses. Clinical courses reinforce these concepts and apply them to clinical situations.

Assessment of general and oral pathology instruction in the entry-level dental hygiene programs has not been reported in terms of instructional content. It is not known whether the instruction in systemic and oral diseases and their treatment has evolved to the extent that students are prepared to treat the medically compromised population. It is known that one study of dental hygienists’ knowledge, opinions and practices, related to oral and pharyngeal cancer risk assessment, demonstrated that 74% of those surveyed believed that they were adequately trained to provide oral cancer examinations, yet only 16% correctly identified 11 out of the 14 risk factors for oral cancer.<sup>8</sup> That study indicated that current instruction in oral pathology may not be adequately preparing the dental hygienist to conduct oral cancer risk assessments.

Entry-level programs may benefit from studying the curricula of advanced practitioner dental hygiene programs: the California Registered Dental Hygienist in Alternative Practice (RDHAP) program<sup>9,10</sup> and the Minnesota Advanced Dental Therapist (MSADT) program.<sup>11,12</sup> Both types of advanced practitioner programs require completion of an entry-level dental hygiene program and a baccalaureate degree or its equivalence for admittance. These programs emphasize educating dental hygienists to effectively and safely provide care to populations disenfranchised by the current system of dental care delivery, while practicing unsupervised.<sup>9,11-14</sup> These underserved populations are likely to have complex health histories and suffer chronic medical and dental conditions; therefore, extensive preparation in pathology to recognize risk factors for systemic diseases and oral manifestations of systemic disease is required.

The purpose of this study was to assess the instruction of pathology content in entry-level and advanced practitioner dental hygiene educational programs and the perceptions of program directors whether their graduates are adequately prepared to meet the increasingly complex medical and oral health needs of the public.

## Methods and Materials

This cross-sectional study was approved by the University of California, San Francisco (UCSF) Institutional Review Board. All directors of the U.S. dental hygiene programs were selected (337 CODA-approved entry-level programs in the U.S., the Metropolitan State University MSADT Program and 2 California RDHAP Programs). Program directors were selected because the authors expected that they would have a comprehensive understanding of both the didactic and clinical aspects of the curriculum. The program directors’ email addresses were obtained from the American Dental Hygienists’ Association (ADHA) or the program’s website.

The survey questionnaire consisted of 28 closed-ended questions in the following domains: curriculum including clock and credit hours, educational format, educational resources, and assessments of educational outcomes, and instructor qualifications (12 multiple-choice questions); perceptions of general and oral pathology instruction preparing students for particular dental hygiene services (11 Likert-like statements); and demographic information about the program (5 multiple-choice questions).

The questionnaire items were pre-tested by 3 experienced dental hygiene educators: 1 who was teaching in a community college program and 2 who were teaching or had taught in a university dental school/baccalaureate program and a community college/associate degree program. They answered each survey item and provided feedback on the clarity of the questions and the amount of time spent to complete the questionnaire. Revisions based upon the educators’ input were incorporated into the final survey questionnaire.

The study was implemented using the UCSF online survey software program, Qualtrics®. A cover letter was sent to the dental hygiene program directors’ email addresses, stating the purpose of the study. The “UCSF Consent to be in Research” form was also sent for the participants to keep for their records. Informed consent was implied with the completed return of the survey. Identification numbers were used to ensure subject confidentiality, while permitting follow-up of non-respondents. Two follow-up letters were sent via Qualtrics® to participants who did not respond to the first request.

Respondents refer to program directors or representatives who completed the survey. Respondents rated their level of agreement to a series of statements regarding their perceptions of whether

current instruction in general and/or oral pathology has adequately prepared their students for particular dental hygiene services. Descriptive statistics for all 28 categorical survey questions were calculated, using SAS version 9.3 (SAS Institute, Cary, NC) and are presented as the frequency (percentage).

## Results

Of the 340 survey questionnaires sent to dental hygiene program directors, 130 (38%) were completed. All 3 directors of the advanced practitioner programs (2 RDHAP and 1 MSADT) responded.

### Demographic Characteristics of Institutions

The institutional settings of the respondents in the entry-level dental hygiene programs represented 4 different types of institutions known to sponsor dental hygiene programs, with the most common type (57%) being in a public or community college (Table I). Most (76%) of the institutions awarded an associate degree (Table II).

### Curriculum of Entry-level Dental Hygiene Programs

General and oral pathology content is presented in entry-level programs in either 1 course, including both general and oral pathology, or in 2 separate courses. Most of the entry-level programs (83%) combine the content into one 3-credit hour course. In the majority of programs (75%) in which there are 2 separate courses, general pathology was allotted 1 to 2 credit hours, and oral pathology allotted 2 credit hours. While the majority of entry-level programs (68%) dedicated 15 to 29 hours to general pathology, the dedicated clock hours for oral pathology had a broader distribution, with the highest percentage (40%) of programs in the 30 to 44 clock hour range (Table III).

Class sessions in the entry-level programs consisted of lectures (100% of respondents), and most programs (80%) included class discussions of case studies. Many other types of educational formats were utilized: student presentations (47%), small group discussions (36%), video and DVD media (29%), and clinical demonstrations (21%). The educational resources used in the educational process for pathology content relied mostly on textbooks, especially those written for dental hygiene students (Table IV). Many programs supplemented instruction with clinical images of lesions, patient case studies and histological/microscopic images of lesions. In most programs, educational outcomes were assessed by written exams (78%) and

Table I: Distribution of Institutional Settings of the Entry-Level Dental Hygiene Programs

Institutional Setting	Number of Respondents (Percent) n=126
Vocational or technical	20 (16%)
Public or community college	72 (57%)
University, not associated with a dental school	20 (16%)
University, associated with a dental school	14 (11%)

Table II: Distribution of Types of Degrees/Certificates Granted By Institutions Sponsoring the Entry-Level Programs

Type of Degrees	Number of Respondents (Percent) n=123
Associate Degree	96 (76%)
Bachelor's Degree	22 (17%)
Certificate in Dental Hygiene	5 (4%)

written exams including identification of pathological images (78%), and evaluation of case studies (58%).

A dental hygienist with training in pathology was the most frequent qualification (27%) of the educator who provided the majority of the pathology instruction in the entry-level programs. Other frequently cited providers included dental hygienists (20%), general dentists (19%) and dentists with training in pathology (20%). The most prevalent setting for instruction in conducting oral cancer risk assessments in the entry-level programs was the clinical courses (83%). Preparation for oral cancer risk assessment was also included in the oral pathology course, according to a high percentage (72%) of respondents.

### Perceptions of Entry-level Dental Hygiene Program Directors

Respondents rated their level of agreement to a series of statements regarding their perceptions of whether current instruction in general and/or oral pathology adequately prepared their students for particular dental hygiene services (Table V). The statements related to students' preparation from instruction in general pathology (i.e. recognizing risk factors for systemic diseases and oral manifestations of systemic diseases) elicited agree as

the most frequent response, while most respondents selected strongly agree to the statement of students' being adequately prepared to identify risk factors for oral cancer. The majority of respondents selected comparable percentages of agree and strongly agree to statements

probing risk factors when conducting health history, counseling patients on reducing exposure to oral cancer risk factors and identifying oral lesions. Strongly agree was the overwhelming choice for 2 questions related to clinical instruction (i.e., performing a comprehensive intraoral and extraoral examination, including the palpation of lymph nodes, and feeling comfortable with performing the exam). The greatest percentage of ambivalent responses (21%, neither agree nor disagree) was related to the statement whether graduates were prepared to practice unsupervised, if it were legally allowed. Throughout the survey there was a small percentage of respondents (5%) who selected strongly disagree to each statement.

The most critical statement assessed in this study was whether graduates are adequately prepared to meet the complex medical and oral health needs of the public. Twenty-nine percent of the respondents strongly agreed and 53% agreed, for a total of 82%. The corollary statement of respondents' feeling confident about the students' preparation elicited responses of agreed (27%) and strongly agreed (58%) for a total of 85%.

### Advanced Practitioner Programs in Dental Hygiene

All 3 advanced practitioner programs offer general and oral pathology content in their curriculum. The 2 RDHAP programs use an online format, supplemented by limited classroom instruction and weekend seminars,<sup>9,10</sup> whereas the MSADT program is a full-time graduate program that utilizes classroom-based, web-enhanced, and clinical learning environments.<sup>11</sup> While the programs differ in format, all used the same educational resources: audio-visual materials, histological images of lesions, clinical images of lesions and patient case studies. Accordingly, identification of pathological images and evaluation of case studies were used to assess educational outcomes. One program also used the Objective Structured Clinical Examination (OSCE), which uses a variety of written and com-

Table III: Distribution of Didactic Clock Hours (i.e. Classroom Time) In the Entry-Level Programs of the Respondents of General Pathology and Oral Pathology Content Area (n=125)

	Didactic Clock Hours (h) n (Percent)				
	15 to 29 h	30 to 44 h	45 to 59 h	60 to 74 h	>75 h
General Pathology n=125	85 (68%)	20 (16%)	15 (12%)	4 (3%)	1 (1%)
Oral Pathology n=125	45 (36%)	50 (40%)	25 (20%)	3 (2%)	2 (2%)

Table IV: Educational Resources Used In the Educational Process by the Entry-Level Programs

Educational Resource	Number of Respondents (Percent) n=126
Audio-visual materials	71 (56%)
Textbook	120 (95%)
Websites	43 (34%)
Evidence-based research articles	68 (54%)
Histological images of lesions	79 (63%)
Clinical images of lesions	111 (88%)
Patient case studies	100 (79%)

puter based techniques.<sup>15</sup> The pathology instructors in advanced practitioner programs had all been educated at the doctorate level: a general dentist, a dentist with training in pathology and a scientist with background in pathology. Students received instruction in conducting oral cancer risk assessments in clinical and oral pathology courses. One program included oral cancer risk assessments in a course, titled "Health Assessment and Oral Diagnosis Reasoning." All advanced practitioner respondents selected strongly agree to whether their graduates are adequately prepared to meet the increasingly complex medical and oral health needs of the public. Of the rest of the statements regarding perceptions that current instruction prepares graduates for particular dental hygiene services, all but one of the respondents selected strongly agree. The exception was that one respondent simply agreed to the statement regarding the students' preparation to practice unsupervised.

### Discussion

This study assessed pathology instruction in dental hygiene programs from 2 different perspectives: examining the instruction of pathology con-

Table V: Perceptions of the Respondents From Entry-Level Dental Hygiene Programs

Statement (n=number of respondents)	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
The current instruction in general pathology adequately prepares our graduates to recognize risk factors for systemic diseases (n=126)	32%	48%	12%	3%	5%
The current instruction in general and oral pathology adequately prepares our graduates to recognize oral manifestations of systemic disease (n=125)	39%	52%	3%	1%	5%
The current instruction in oral pathology adequately prepares our graduates to identify risk factors for oral cancer (n=126)	60%	33%	2%	0%	5%
The current instruction in oral pathology adequately prepares our graduates to probe these risk factors when conducting a health history (n=125)	42%	46%	8%	0%	4%
The current instruction in oral pathology adequately prepares our graduates to counsel patients on reducing exposure to oral cancer risk factors (n=124)	45%	41%	8%	2%	4%
The current clinical instruction adequately prepares our graduates to perform a comprehensive intraoral and extraoral examination, including the palpation of lymph nodes (n=124)	65%	27%	3%	0%	5%
The current clinical experiences adequately prepare our graduates to feel comfortable performing a comprehensive intraoral and extraoral examination (n=125)	70%	24%	2%	0%	5%
The current didactic and clinical instruction in oral pathology adequately prepares our graduates to identify oral lesions (n=126)	44%	48%	3%	2%	4%
The current instruction in general and oral pathology adequately prepares our graduates to meet the complex medical and oral need of the public (n=126)	29%	53%	10%	5%	4%
The current instruction in general and oral pathology adequately prepares our graduates to practice independently, if legally allowed (n=126)	22%	42%	21%	10%	5%

tent and surveying directors of both entry-level and advanced practitioner programs as to their perceptions of their graduates' preparation to perform particular dental hygiene services. Results indicated that 29% of respondents from entry-level programs strongly agreed and 53% agreed that their graduates were adequately prepared to meet the complex medical and oral health needs of the public. All respondents of advanced practitioner programs strongly agreed that their graduates were adequately prepared for that role.

The curricula of entry-level programs varied as to the extent of general and oral pathology instruction. This is not surprising as CODA does not dictate specific credit hours, clock hours or format of instruction to meet accreditation standards. Their

requirements are general and currently allow considerable flexibility and latitude in structuring and implementing educational curricula and assessing outcomes of the educational process. While this philosophy has stimulated curricular innovation, with excellent academic results, some programs may have benefitted from more stringent requirements from CODA.

Combining general and oral pathology into 1 course, often also covering systemic pathology content, seems popular. The general pathology content includes basic pathologic processes, such as inflammation, infection and immunity, and the application of these processes to specific organ systems. These applications are often considered to be systemic pathology. A strong background in

general and systemic pathology is essential to be adequately prepared to recognize risk factors for systemic diseases and oral manifestations of systemic diseases. Multiple studies have shown the link between periodontitis and systemic diseases, such as diabetes and cardiovascular disease. However, this relationship between periodontal disease and systemic disease is complex and requires a fundamental knowledge of pathological mechanisms.<sup>16</sup>

The emphasis of programs on oral pathological conditions is evident in the number of clock hours of oral pathology content. Accordingly, more respondents agreed that their students were adequately prepared in the dental hygiene services, which are based on oral pathology content. This content may be more directly related to clinical dental hygiene, such as identifying oral lesions. Oral cancer, its common oral sites and risk factors, is a substantial part of oral pathology. These concepts are also taught in the initial dental hygiene clinical course, where students learn how to conduct comprehensive extraoral and intraoral examinations.

Instruction in conducting oral cancer risk assessments occurred in both the oral pathology course and in the lecture and clinical components of the clinical courses. Most respondents agreed that their students are adequately prepared to identify risk factors for oral cancer. Adequate preparation in this service may be overly optimistic, considering the results of one study of graduate dental hygienists, which demonstrated that only 16% correctly identified 11 out of 14 risk factors.<sup>8</sup> Generally, respondents agreed more positively about the preparation of their graduates in clinical experiences than in didactic material. Because in this study the majority of pathology instructors were dental hygienists with training in pathology, perhaps there is greater emphasis on clinical aspects of pathology instruction. Clinical procedures, such as intraoral and extraoral examination and medical history, are repeated with each clinic patient, so the high percentage of adequate preparation for these procedures is not surprising. On the other hand, only 74% of graduate dental hygienists in the previously mentioned study responded that they were adequately trained to provide oral cancer examinations.<sup>8</sup> That study differed from the current study, in that it surveyed dental hygienists as to their preparation, while the current study questioned program directors as to their perceptions of the preparation of their graduates.

Graduating dental students have been surveyed as to their perceptions of their oral cancer education. In one study the students perceived a lack of requisite knowledge and skills, which would be

necessary to incorporate oral cancer detection procedures into their oral health care delivery.<sup>17</sup> In a similar study dental students perceived that they were not adequately trained to perform biopsies or to interpret pathology reports, although they felt comfortable performing the oral cancer examination.<sup>18</sup> Dental students, as well as dentists, have been assessed as to their knowledge of common sites for oral cancer. As examples, only 55% of students at one dental school knew the most common sites for oral cancer,<sup>19</sup> and only approximately half the dentists in a nation-wide survey knew the 2 most common intraoral sites of cancer.<sup>20</sup> This leads one to speculate as to what factors are important in improving comprehension and retention of pathology instruction.

In the current study, the format of didactic instruction in the pathology courses included the traditional modes of lectures, but with a greater emphasis on new technology. Lecture was the most commonly utilized instructional format in the responding dental hygiene programs with a variety of other useful adjunct educational tools incorporated into the curriculum (e.g. YouTube, student-led discussions and online weekly activities.) Several research studies have probed the effectiveness of various educational models. Digital teaching elements were reported to enhance student learning using pen-technology, YouTube, and virtual conferencing in organic and biochemistry courses, as well as using virtual microscopy to study pathological images.<sup>21,22</sup> Medical students' retention rates of instructional material improved with the use of interactive software and multimedia tutorials, as compared to lecture format.<sup>23,24</sup> Multimedia instruction in health professions education is equal or more effective than traditional instruction for attainment of knowledge, skill and performance, as evidenced by a literature review.<sup>25</sup>

The curricula of all 3 advanced practitioner programs use audio-visual materials and histological and clinical images of lesions, emphasizing the importance of being able to recognize, as well as understand, the underlying mechanisms of pathological lesions. Patient case studies were another popular educational resource. Studying these case studies provides excellent opportunities for the students to apply their knowledge of general, systemic and oral pathology to hypothetical patients, as well as to practice making decisions as how best to treat their future patients, who may have complex medical and dental needs. Utilized more fully, these educational resources would strengthen the pathology instruction in the entry-level programs.

Students from some entry-level programs may

not be prepared, as evidenced by 5% of the respondents that strongly disagreed with each of the perception statements. One can only speculate as to the reasons creating these negative evaluations of the pathology instruction at the respondents' institutions. There could be budgetary problems or difficulty in recruiting a qualified, conscientious pathology instructor. Perhaps the students are entering the program without an adequate scientific background to be able to comprehend pathologic concepts. Programs in educational settings that limit their length are said to struggle to incorporate new content and technology into their overcrowded curriculum.<sup>26</sup> Examining the curricula of the advanced practitioner programs may provide examples to offer ideas for strengthening the pathology curriculum at these institutions.

The advanced practitioner programs were developed to help serve the underserved population and improve access to care. Furthermore, Mertz and colleagues confirmed that RDHAP practices were successfully "improving access to care, particularly for minority, medically compromised and disabled populations."<sup>27</sup> Both types of advanced practitioner have been able to meet the needs of this population because they are legally able to practice unsupervised in residential care facilities, public health clinics and with homebound patients. In the current study, the statement whether graduates are prepared to practice unsupervised, if it were legally allowed, elicited many undecided responses. This may indicate that the directors of entry-level programs have not formulated their opinions on this controversial issue. Perhaps they are not aware of what unsupervised practice entails, so they could not evaluate the students' preparation for it. Unsupervised can have multiple meanings, often based upon the scope of practice of individual states. Direct access may be a better term, as defined in a recent document: dental hygienists being "allowed to initiate treatment, based on their assessment of a patient's needs without the specific authorization of dentists, to treat the patient without the presence of a dentist, and to maintain a provider-patient relationship."<sup>28</sup> In 2001, ADHA developed a policy which stated that "dental hygienists who are graduates of accredited dental hygiene programs are competent to provide services without supervision."<sup>29</sup> This situation would increase the opportunities to care for the underserved population.

The major limitations of this study involve the lack of definition or clarification of terms used in the questionnaire. In the questionnaire no definitions of pathology were provided, and all statements related to pathology instruction were written specific to either general pathology or oral

pathology, with no mention of systemic pathology. Directors who are familiar with the term, systemic pathology, may have been confused as to how to address the statements related to student preparation based on the students' instruction in general pathology, because students may have been prepared for the task, not based on general pathology content, but on systemic pathology content. Another undefined term was "adequate preparation." Respondents may have interpreted this expression with various meanings of student proficiency. The intent was the extent of preparation for students to be deemed competent, defined by CODA as "the level of knowledge, skills, and values to begin the practice of dental hygiene."<sup>6</sup> However, it is not clear whether respondents interpreted this in the same manner. "Training in pathology" was another ambiguous expression, not defined in the questionnaire. The authors intended that it would be interpreted as advanced education; even so, advanced education could have a broad range of educational possibilities, from completion of one continuing education course to being board certified in oral pathology. The authors neglected to formulate a question addressing these options, so the interpretation of the respondents is not known. Consequently, no data were collected to base a recommendation of the most appropriate qualification of an educator who would provide the majority of pathology instruction.

Clock hours may have been a weak choice to assess the amount of pathology instruction in the curriculum. Reporting clock hours may have required respondents to do the calculations, which could contribute to either an over or under estimate of classroom time. The authors assumed that program directors would have been familiar with reporting clock hours, as completion of the biannual survey of didactic clock hours requires listing of the clock hours, which provide instruction in the required content areas, such as general and oral pathology.<sup>30</sup> The wide variation in clock hours may have been due to the lack of clear pathology terms in the survey, causing the directors to interpret the questions differently.

Another limitation of this study is the low response rate (38%). Although the quick response time and ease of electronic surveys makes electronic surveys desirable to use, they tend to have lower response rates than mailed surveys.<sup>31,32</sup> Internet surveys also have a higher proportion of incomplete questionnaires.<sup>33</sup> While in the current study, 174 (52%) questionnaires were started, only 130 (38%) were completed. A few program directors requested to forward the research questionnaire to the pathology instructor, so these surveys may

have been started by the program director, but not finished by the pathology instructor. As the population of electronic mail user increases, electronic surveys may become more popular and the user more likely to respond.<sup>34</sup>

## Conclusion

The majority of program directors, who responded to this survey, agreed that their current entry-level curricula do prepare graduates to deliver effective dental hygiene care to the medically compromised population. However, some study respondents strongly disagreed. These programs may benefit from a standardized curriculum, as well as evaluating the pathology learning experiences of their students and addressing the weaknesses. Applying the pathology curriculum guidelines, employing educators with advanced education in pathology, and introducing more and diverse multimedia resources into the curriculum

may strengthen these programs. As the population ages and the numbers of medically compromised patients increase, entry-level curricula will need to evolve to serve this patient population. Strengthening and standardizing pathology instruction among programs will ensure that future generations of dental hygienists will be adequately prepared to meet the increasingly complex medical and oral health needs of the public.

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## References

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1. Little JW, Falace DA, Miller CS, Rhodus NL. In: Dental management of the medically compromised patient. 7th ed. St. Louis: Mosby/Elsevier Publishing; 2008. p. 7.
2. U.S. Department of Health and Human Services. National call to action to promote oral health: a report of the Surgeon General. U.S. Department of Health and Human Services. 2000.
3. American Dental Hygienists' Association. National Dental Hygiene Research Agenda: revised March 2007. American Dental Hygienists' Association. [Internet]. 2007 [cited 2012 Sep 15]. Available from: [http://www.adha.org/resources-docs/7834\\_NDHRA\\_Statements.pdf](http://www.adha.org/resources-docs/7834_NDHRA_Statements.pdf)
4. Forrest JL, Spolarich AE. A Delphi study to update the American Dental Hygienists' Association National Dental Hygiene Research Agenda. *J Dent Hyg.* 2009;83(1):1-20.
5. ADEA compendium of curriculum guidelines (revised edition). Allied dental education programs: pathology for dental hygiene education. American Dental Education Association [Internet]. 2005 Feb [cited 2013 Nov 6]. Available from: <http://www.adea.org/sitecollectiondocuments/compendiumofcurriculumguidelinesforallieddentaleducationprograms.pdf>
6. American Dental Association Commission on Dental Accreditation. New and revised accreditation standards. [Internet]. 2011 [cited 2012 Sep 20]. Available from: [http://www.ada.org/~media/CODA/Files/2016\\_dh.ashx](http://www.ada.org/~media/CODA/Files/2016_dh.ashx)
7. Systemic Pathology Definition. [Internet]. 2014 [cited 2014 Jan 10]. Available from: [http://www.cram.com/search?query=systemic+pathology+lecture+1&image\\_filter=all&period=any&sm=1](http://www.cram.com/search?query=systemic+pathology+lecture+1&image_filter=all&period=any&sm=1)
8. Forrest J, Horowitz A, Shmuley Y. Dental hygienists' knowledge, opinions and practices related to oral and pharyngeal cancer risk assessment. *J Dent Hyg.* 2001;75(4):271-281
9. Community involvement: special care resources. University of the Pacific, Dugoni School of Dentistry [Internet]. 2012 [cited 2012 Sep 8]. Available from: [http://dental.pacific.edu/Community\\_Involvement/Pacific\\_Center\\_for\\_Special\\_Care\\_\(PCSC\)/Special\\_Care\\_Resources.html](http://dental.pacific.edu/Community_Involvement/Pacific_Center_for_Special_Care_(PCSC)/Special_Care_Resources.html)
10. RDHAP program spring 2014. West Los Angeles College [Internet]. 2012 [cited 2012 Sep 8]. Available from: <http://www.wlac.edu/allied-health/RDHAP%20Program%202014%20-%20Flyer.pdf>
11. Where life and learning meet. Metropolitan State University [Internet]. 2012 [cited 2012 Sep 20]. Available from: <http://www.metrostate.edu/msweb/explore/gradstudies/masters/msadt/>
12. Glasrud P, Emberston C, Day T, Diericks RW. Minnesota Dental Association: A history of Minnesota's dental therapist legislation: or ... what the heck happened up there? AAPD [Internet]. 2009 [cited 2012 Sep 20]. Available from: <http://www.aapd.org/assets/news/upload/2010/4131.pdf>
13. Position paper: access to care. American Dental Hygienists' Association. American Dental Hygienists' Association [Internet]. 2001 [cited 2013 Sep 20]. Available from: [http://www.adha.org/resources-docs/7112\\_Access\\_to\\_Care\\_Position\\_Paper.pdf](http://www.adha.org/resources-docs/7112_Access_to_Care_Position_Paper.pdf)
14. Stolberg RL, Brickle CM, Darby MM. Development and status of the advanced dental hygiene practitioner. *J Dent Hyg.* 2011;85(2):83-91.
15. Norcini JJ, Holmboe ES, Hawkins RE. Evaluation challenges in the era of outcomes-based education. In: Holmboe ES, Hawkins RE, ed. Mosby/Elsevier's practical guide to the evaluation of clinical competence. 1st ed. Philadelphia: Mosby/Elsevier; 2008. p. 1-29.
16. Van Dyke TE, van Winkelhoff AJ. Infection and inflammatory mechanisms. *J Clin Periodontol.* 2013;40Suppl:S1-7.
17. Burzynski NJ, Rankin KV, Silverman S Jr, et al. Graduating dental students' perceptions of oral cancer education: results of an exit survey of seven dental schools. *J Cancer Educ.* 2002;17(2):83-84.
18. Rankin KV, Jones DL, McDaniel RK. Oral cancer education in dental schools: Survey of Texas dental students. *J Cancer Educ.* 1996;11(2):80-83.

19. Cannick GF, Horowitz AM, Drury TF, et al. Assessing oral cancer knowledge among dental students in South Carolina. *J Am Dent Assoc.* 2005;136(3):373-378.
20. Yellowitz JA, Horowitz AM, Drury TF, Goodman HS. Survey of U.S. dentists' knowledge and opinions about oral pharyngeal cancer. *J Am Dent Assoc.* 2000;131(5):653-661.
21. Cox JR. Enhancing student interactions with the instructor and content using pen-based technology, YouTube videos, and virtual conferencing. *Biochem Mol Biol Educ.* 2011;39(1):4-9.
22. Kumar RK, Velan GM, Korell SO, et al. Virtual microscopy for learning and assessment in pathology. *J Pathol.* 2004;204(5):613-618.
23. Subramanian A, Timberlake M, Mittakanti H, et al. Novel educational approach for medical students: improved retention rates using interactive medical software compared with traditional lecture-based format. *J Surg Educ.* 2012;69(4):449-452.
24. Marsh KR, Giffin BF, Lowrie DJ Jr. Medical student retention of embryonic development: Impact of the dimensions added by multimedia tutorials. *Anat Sciences Educ.* 2008;1(6):252-257.
25. Stegeman CA, Zydney J. Effectiveness of multimedia instruction in health professions education compared to traditional instruction. *J Dent Hyg.* 2010;84(3):130-136.
26. Snyder J. CODA and dental hygiene's changing world. *Access.* 2012;26(10):18-19.
27. Mertz E, Grossman P. Alternative practice dental hygiene in California: Past, present, and future. *J Calif Dent Assoc.* 2011;39(1):37-46.
28. NGA paper: the role of dental hygienists in providing access to oral health care. National Governors Association [Internet]. 2014 [cited 2014 Jan 8]. Available from: <http://www.nga.org/cms/home/nga-center-for-best-practices/center-publications/page-health-publications/col2-content/main-content-list/the-role-of-dental-hygienists-in.html>
29. Policy manual. American Dental Hygienists' Association [Internet]. 2012 Jul 30 [cited 2013 June 9]. Available from: [http://adha.org/resources-docs/7614\\_Policy\\_Manual.pdf](http://adha.org/resources-docs/7614_Policy_Manual.pdf)
30. American Dental Association Survey Center. 2009-2010 survey of allied dental education. American Dental Association [Internet]. 2011 [cited 2013 November 6]. Available from: [http://www.agd.org/files/webuser/website/membership/vol.%201\\_academic%20programs\\_enrollment\\_graduates.pdf](http://www.agd.org/files/webuser/website/membership/vol.%201_academic%20programs_enrollment_graduates.pdf)
31. Akl EA, Maroun N, Klocke RA, et al. Electronic mail was not better than postal mail for surveying residents and faculty. *J Clin Epidem.* 2005;58(4):425-429.
32. Leece P, Bhandari M, Sprague S, et al. Internet versus mailed questionnaires: A randomized comparison. *J Med Internet Res.* 2004;6(4):39-54.
33. McCabe SE, Boyd CJ, Couper MP, et al. Mode effects for collecting alcohol and other drug use data: Web and U.S. mail. *J Stud Alcohol.* 2002;63(6):755-761.
34. Lusk C, Delclos GL, Burau K, et al. Mail versus internet surveys: determinants of method of response preferences among health professionals. *Eval Health Prof.* 2007;30(2):186-201.