Inclusion of Oral-Systemic Health in Predoctoral/Undergraduate Curricula of Pharmacy, Nursing, and Medical Schools Around the World: A Preliminary Study

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Abstract: There is increasing evidence that oral health is a critical component of overall health and that poor oral health may lead to initiation or exacerbation of chronic inflammatory diseases/conditions and adverse pregnancy outcomes. Added to this is an increasing awareness that among non-dental health care professions curricula (e.g., medicine, nursing, pharmacy, and allied health) there is an apparent lack of information regarding the interrelationships between oral health and overall health or recognition of the significance of oral health in achieving and sustaining general health outcomes. This study explored the amount of information related to oral-systemic science currently being taught in the predoctoral/undergraduate professional curricula of pharmacy, nursing, and medical schools in English-speaking universities around the world. The Oral-Systemic Health Educational Curriculum Survey was circulated online to associate or academic deans at medical, nursing, and pharmacy schools in universities across Canada, the United States, Europe, Asia, Australia, and New Zealand. The survey found that 53.7 percent of the respondents ranked the inclusion of oral-systemic science as somewhat important, 51.2 percent reported no or limited requirements to incorporate oral health education within their curricula, and 59.6 percent rated their current curricula in oral-systemic health as inadequate. The majority of students in these programs are not being instructed to examine the mouth, nor are they being taught how to perform an oral examination. Despite growing awareness of emerging evidence of oral-systemic relationships and recommendations that all health care providers should contribute to enhancing oral health, this knowledge base appears to be substantially deficient in the curricula of pharmacy, nursing, and medical students in many universities. This study provides the first formal documentation that the curricula of non-dental health care professions, specifically in medicine, nursing, and pharmacy, do not contain adequate content related to oral-systemic health.

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There is increasing evidence that oral health is a critical component of overall health and that poor oral health may lead to initiation or exacerbation of chronic inflammatory diseases/conditions and adverse pregnancy outcomes. There is also increasing awareness that among non-dental health care professions curricula (e.g., medicine, nursing, pharmacy, and allied health) there is an apparent lack of information regarding the interrelationships between oral health and overall health or recognition of the significance of oral health in achieving and sustaining general health outcomes.

In considering why non-dental health care providers lack this important body of knowledge, the general assumption has been that content specifically related to oral diseases and conditions as well as the potential effect of poor oral health on the rest of the body does not substantially exist in the curricula of the predoctoral/undergraduate programs of medical, nursing, and pharmacy students nor that of under-

graduate students of allied health care professions in general. A recent investigation of internal medicine trainees' level of knowledge and orientation in oral health, specifically in regard to periodontal disease and adverse health events, suggests that medical schools should provide more comprehensive training in oral/periodontal health.[1] To date, no comprehensive information has been published relative to the extent oral health content is being taught in the predoctoral/undergraduate curricula of disciplines outside of dentistry and dental hygiene. Indeed, there is a paucity of literature that identifies current teaching practices, curriculum delivery methods, and content as well as interprofessional education programs that focus specifically on oral-systemic health.

A number of factors contribute to a sense of urgency in determining the extent of this gap in knowledge and how non-dental health care educators view the importance of this body of knowledge in preparing future generations of non-dental health care providers (HCPs). First, there is renewed and more extensive understanding within the scientific community of the significance of oral health in achieving and sustaining overall health.[2,3] Unfortunately, this science base has been translated into consumer publications and mainstream media, but not included in the education, training, or clinical practice of HCPs.[4-13] Secondly, addressing oral diseases is becoming increasingly recognized as a critical component to disease management. There is greater awareness of the potential to decrease the threat of systemic inflammation, specifically through treatment of periodontal disease, and subsequently the potential to improve patient health outcomes in inflammation-driven disease states such as cardiovascular disease and diabetes.[14-20]

Thirdly, there is a major call for increased awareness of the significance of oral health and related competencies in the predoctoral education of HCPs.[21,22] One of the most compelling statements made by then-U.S. Surgeon General David Satcher in the highly publicized report *Oral Health in America*[23] was the need to change HCPs' perceptions of the importance of oral health and the challenge to HCPs to "be ready, willing, and able to work in collaboration to provide optimal health care for their patients."

In a 2008 report of the Association of American Medical Colleges, which advocated for oral health education for medical students, it was suggested that "specific oral-systemic health learning objectives can be created and matched with clinically relevant experiences to enhance oral health knowledge and the collaboration with dental schools" (p. 6).[21] In a position paper of the American Dietetic Association, it was acknowledged that nutrition is an integral component of oral health: "The American Dietetic Association supports the integration of oral health with nutrition services, education, and research. Collaboration between dieticians and dental professionals is recommended for oral health promotion and disease prevention and intervention" (p. 1418).[22]

The present study explored the breadth and depth of information related to oral-systemic science that is currently being taught in predoctoral/undergraduate HCP curricula and related teaching practices of medical, nursing, and pharmacy schools in English-speaking universities in four geographic areas. These areas were the United States and Canada, Europe, Asia, and Australia and New Zealand.

Methods

"Oral-systemic health" was defined in the study as the absence of any pathobiological process or risk factor emanating from the orofacial complex that may negatively impact the structure or function of an end organ and/or complicate the treatment or management of a systemic disease or condition including normal biological processes such as aging and pregnancy. (This definition was proposed by a working group of the University of Manitoba Faculty of Dentistry International Centre for Oral-Systemic Health comprised of Casey Hein, Anthony Iacopino, Doug Brothwell, and Dieter Schönwetter in October 2008.) More expansively, oral-systemic health refers to the absence of any pathobiological process or risk factor related to diseases or conditions of major organ systems external to the orofacial complex and normal biological processes such as aging and pregnancy that may negatively influence the structure, integrity, or function of the orofacial complex and/or complicate the treatment or management of a disease or condition of the orofacial complex. The bidirectional relationship between oral and systemic health is integral to ensuring overall health and as such contributes to the state of physical, mental, emotional, and social well-being necessary for an individual to enjoy life's possibilities and to adapt to life's challenges.

The Oral-Systemic Health Educational Curriculum Survey was developed by the authors and validated by several members of HCP Faculties. The survey, as well as the methodology, received ethical approval from the Research Ethics Board of the Uni-

versity of Manitoba. The survey was used to poll administrators responsible for curricula (e.g., associate or assistant academic deans) from medical, nursing, and pharmacy schools in universities across Canada, the United States, Europe, Asia, Australia, and New Zealand. Each administrator was contacted via e-mail with a short message describing the importance of the data and its potential utility. Administrators were then invited to complete the online survey. Names and e-mail contact information were derived using university websites of all English-speaking institutions that had a dental school to ensure some degree of homogeneity among institutions, specifically in terms of oral health education.

The survey was released online through QuestPro services. The online survey required respondents to complete information concerning the demographics of their institution, school, or program as well as specific questions concerning the importance, utility, adequacy, and depth and breadth of information related to oral-systemic health that is currently being taught in their predoctoral or undergraduate curricula. Survey questions included the following: How important is oral-systemic health in your program? Are there any requirements to incorporate oral health education within your current curriculum? Are your students taught to examine the mouth? How helpful would an educational module with background content in oral-systemic health be to your students? How adequate is your current curriculum relative to oral health?

Results

The survey yielded an overall response rate of 23 percent. Sixty-five percent (*N*=27) of the responses came from institutions in the United States, followed by 17.1 percent (*N*=7) from Canada, 9.8 percent (*N*=4) from Australia, 4.9 percent (*N*=2) from Great Britain, and 2.4 percent (*N*=1) from New Zealand (percentages do not total 100 percent because of rounding). Of those completing the survey, their disciplines were pharmacy (41.5 percent, *N*=17), nursing (39 percent, *N*=16), and medicine (19.5 percent, *N*=8).

Using a five-point rating scale (1=not at all important to 5=very important), the inclusion of oral-systemic science was rated as somewhat important by 53.7 percent of all respondents across the three disciplines (M=2.14; SD=0.68). A one-way ANOVA (medicine, nursing, pharmacy) did not reveal statistically significant differences among the three disciplines.

Three questions probed requirements to incorporate various aspects of oral-systemic health education into the curriculum. When asked "Are there any requirements to incorporate oral health education within your current curriculum?," 51.2 percent of the respondents replied at the lower end of the five-point scale: 1=not at all (26.8 percent) and 2=a little (24.4 percent). A one-way ANOVA (medicine, nursing, pharmacy) revealed no statistically significant difference among the three disciplines. When asked whether students are instructed to examine the mouth and taught how to perform an oral examination, the responses indicated that the majority of students (greater than 50 percent of the institutions represented) have not been instructed to examine the mouth nor are they taught how to perform an oral examination. One-way ANOVAs (medicine, nursing, pharmacy) revealed statistically significant differences among the three disciplines on whether students are instructed to examine the mouth and taught how to perform an oral examination. As expected, both medicine and nursing scored higher than pharmacy in teaching students to perform oral examinations.

There was a strong perceived utility of an educational module dedicated to oral-systemic science for students across all three disciplines. Less than 4.9 percent of the respondents considered the inclusion of oral-systemic content in their curricula as not at all helpful. A one-way ANOVA (medicine, nursing, pharmacy) revealed statistically significant differences among the three disciplines on the perceived utility of educational modules on oral-systemic health. The nursing discipline appears to view the importance of an educational module on oral-systemic health as more helpful than either medicine or pharmacy. The current curriculum in oral-systemic health across all three non-dental disciplines was predominantly (59.6 percent) rated as less than adequate. Differences across disciplines existed. Bonferroni t-tests demonstrated that the nursing respondents view their current programs as more adequate than those in pharmacy ($t<.05$).

Respondents provided various comments about the adequacy or inadequacy of their current curricula relative to the inclusion of oral-systemic health (categorized in Table 1). Respondents were also asked to say what it would take to enlist the support of their faculty to engage in collaborative development of an educational module about the oral cavity focusing

Table 1. Comments from respondents regarding the adequacy or inadequacy of their current curricula relative to inclusion of oral-systemic science

Comments from Those Who Perceive Their Curricula as Adequate	Comments from Those Who Perceive Their Curricula as Inadequate
We recognize that oral health is an integral/important part of health.	We have a limited range on this important topic.
Oral health is discussed in the over-the-counter/nonprescription medication courses.	Currently are looking to expand oral health in the curriculum.
Partnership with the dental school has helped.	We do not teach much content on this subject.
Assessment/care of the mouth is taught with simulation lab experience.	We teach minimal examination/diagnostic skills; however, the ability to triage is important to our students.
We think our curriculum is adequate, but we don't have outcome data specific to these objectives.	No time.
Information on oral-systemic health is spread across several classes.	Lack expertise in this subject matter.
Oral-systemic science is discussed in infectious disease and neurology.	Oral-systemic science is not clearly defined in our curriculum.
Students get adequate content on oral health care as related to nonprescription medications as defined in the United States.	Our curriculum is built on wholeness care. Including more on oral health would help to fulfill this mission. This would provide the means for our undergraduate and graduate students to be more proficient in assessing oral health and teaching about oral health.
The curriculum is heavily oriented towards clinical practice: oral health is part of daily nursing interventions and expected of students on placement.	The growth in information on the importance of oral health has not been reflected in changes to our curriculum.

on the importance of oral health in ensuring overall health. The responses to this question were broadly related to overcoming internal obstacles and various other obstacles to change (categorized in Table 2).

Respondents were also asked about their perception of the importance of specific oral health topics in predoctoral/undergraduate programs. Responses are listed by rank order in Table 3. The top seven of the forty-one topics related to oral-systemic health scored above 2.5 (the midpoint) on a scale that rated importance of the topic (not at all important=1, a little important=2, somewhat important=3, and very important=4). The oral-systemic health topics perceived to be of the greatest importance (top seven) are as follows: oral anatomy, basic science in immunology and host response, evidence of a relationship between periodontal disease and respiratory diseases, periodontal disease, dental caries, effect of inappropriate dietary practices on the oral cavity, indications for prophylactic antibiotics prior to dental procedures to minimize the threat of subacute bacterial endocarditis, and evidence of a relationship between periodontal disease and atherosclerosis-induced diseases. The lowest six topics scored below 2.0 (not at all important) on the rating scale and were (starting with lowest ranking) the potential of bisphosphonate therapy to induce osteonecrosis of the jaws, inflammatory cascade of events that occur in systemic exposure to infection of oral origin, biochemistry, oral microbiology/oral biofilm, oral pathology, and oral manifestations of nutritional deficiencies.

Of the forty-one oral health topics, only nine demonstrated statistically significant differences among the three disciplines. Table 4 shows those variables with mean comparisons. Overall, medicine and nursing demonstrated statistically significant higher importance scores than pharmacy on topics of biochemistry and pharmaceuticals and other therapies commonly used in treating systemic conditions that may compromise oral health or patients' compliance with treatment. Nursing demonstrated statistically significant higher importance scores than pharmacy on topics of craniofacial development, effect of excessive alcohol on the oral cavity, effect of genetic influence on the oral cavity, inflammatory cascade of events that occur in systemic exposure to infection of oral origin, inherited or congenital disfigurements/

Table 2. Responses to question: what would it take to enlist your teaching staff in a collaborative project in the development of an educational module about the oral cavity that focuses on the importance of oral health in ensuring overall health?

Internal Obstacles	Other Obstacles
Lack of interest among faculty; difficulty in identifying faculty interested in participating.	Absence of accreditation standards, professional requirements, or competencies related to oral-systemic science.
Curriculum committee would have to be convinced.	Lack of opportunities for interprofessional collaboration with dental schools.
Lack of teaching resources.	Lack of evidence of outcomes of oral health interventions.
Lack of money for buy-out of faculty time.	Lack of appreciation for the relevance of oral-systemic science within discipline.
Lack of faculty incentives.	Lack of opportunities for students from various non-dental health disciplines to work with dental and dental hygiene students to move the material from theory to practice.

impairments, and modification in care for patients with special needs who have salivary gland dysfunction. Pharmacy scored higher on soft tissue lesions of the oral cavity than nursing. The means for these discipline differences are shown in Table 5.

Discussion

Respondents from medicine, nursing, and pharmacy were in agreement that the inclusion of oral-systemic health in predoctoral/undergraduate curricula is somewhat important. It appears that there are no or very few requirements at the present time to incorporate oral-systemic health into the predoctoral/undergraduate curriculum of students in medicine, nursing, and pharmacy in many universities in the United States, Canada, Great Britain, Australia, and New Zealand. Responses to our survey suggest that the majority of predoctoral students from these three disciplines are not being instructed to examine the mouth nor are they taught how to perform an oral examination. However, medical and nursing students seem to receive this teaching more often than do students of pharmacy, which would be expected for clinical disciplines. The finding that pharmacy scored higher on soft tissue lesions of the oral cavity than nursing is surprising; a possible explanation is that pharmacists are often in the position of counseling patients for relief of pain or palliation of oral soft tissue lesions.

With few exceptions, the responding administrators in these three disciplines strongly perceived the utility of an educational module dedicated to oral-systemic health for their students. Nursing respondents viewed the importance of an educational module on oral-systemic health as more helpful than either medicine or pharmacy. Respondents from all three disciplines rated their current curricula in oral-systemic health as predominantly inadequate; however, the nursing respondents viewed their current curricula in oral-systemic science more favorably than did pharmacy.

A number of obstacles must be overcome to enlist support for collaborative development of an educational module that focuses on the importance of oral health in ensuring overall health. Internal obstacles that must be addressed include such factors as the lack of interest among faculty and difficulty in identifying faculty interested in participating; curriculum committee(s) that would have to be convinced of the importance of inclusion of oral-systemic health; lack of teaching resources; lack of money for buy-out of faculty time; and lack of faculty incentives to participate. Other obstacles include the absence of accreditation standards, professional requirements, or competencies related to oral-systemic health; lack of opportunities for interprofessional collaboration with dental schools; lack of evidence of improved patient outcomes after oral health interventions; lack of appreciation for the relevance of oral-systemic health within the discipline; and lack of opportunities for students from various non-dental health disciplines to work with dental and dental hygiene students to move the material from theory to practice.

Table 3. Rank-ordered list of how important each oral health topic was perceived to be for respondents' predoctoral/ undergraduate program

	Not At All	A Little	Somewhat	Very	Total	Missing	Mean (STD)
Oral anatomy							
Frequency	2	1	12	17	32	9	3.38 (.83)
Percentage	4.9%	2.4%	29.3%	41.5%	78.0%	22.0%	
Basic science in immunology and host response							
Frequency	3	6	7	15	31	10	3.10 (1.04)
Percentage	7.3%	14.6%	17.1%	36.6%	75.6%	24.4%	
Evidence of a relationship between periodontal disease and respiratory diseases							
Frequency	4	6	9	13	32	9	2.97 (1.06)
Percentage	9.8%	14.6%	22.0%	31.7%	78.0%	22.0%	
Periodontal disease							
Frequency	3	9	10	10	32	9	2.84 (.99)
Percentage	7.3%	22.0%	24.4%	24.4%	78.0%	22.0%	
Dental caries							
Frequency	3	9	8	10	30	11	2.83 (1.02)
Percentage	7.3%	22.0%	19.5%	24.4%	73.2%	26.8%	
Effect of inappropriate dietary practices on the oral cavity							
Frequency	5	10	8	9	32	9	2.66 (1.07)
Percentage	12.2%	24.4%	19.5%	22.0%	78.0%	22.0%	
Indications for prophylactic antibiotics prior to dental procedures to minimize endocarditis							
Frequency	7	5	13	7	32	9	2.62 (1.07)
Percentage	17.1%	12.2%	31.7%	17.1%	78.0%	22.0%	
Evidence of a relationship between periodontal disease and atherosclerosis							
Frequency	3	13	11	5	32	9	2.56 (.88)
Percentage	7.3%	31.7%	26.8%	12.2%	78.0%	22.0%	
Evidence of a relationship between periodontal disease and adverse pregnancy outcomes							
Frequency	8	6	11	6	31	10	2.48 (1.09)
Percentage	19.5%	14.6%	26.8%	14.6%	75.6%	24.4%	
Oral manifestation of Crohn's disease							
Frequency	5	11	12	4	32	9	2.47 (.92)
Percentage	12.2%	26.8%	29.3%	9.8%	78.0%	22.0%	
Oral manifestations of hematologic conditions							
Frequency	5	12	9	5	31	10	2.45 (.96)
Percentage	12.2%	29.3%	22.0%	12.2%	75.6%	24.4%	
Soft tissue lesions of the oral cavity							
Frequency	7	11	7	7	32	9	2.44 (1.08)
Percentage	17.1%	26.8%	17.1%	17.1%	78.0%	22.0%	
Oral manifestations of hyperparathyroidism							
Frequency	5	12	11	4	32	9	2.44 (.91)
Percentage	12.2%	29.3%	26.8%	9.8%	78.0%	22.0%	
Effect of tobacco on the oral cavity							
Frequency	6	12	9	5	32	9	2.41 (.98)
Percentage	14.6%	29.3%	22.0%	12.2%	78.0%	22.0%	
Modification in care for special needs patients with immune system dysfunction							
Frequency	4	15	10	3	32	9	2.41 (.88)
Percentage	9.8%	36.6%	24.4%	7.3%	78.0%	22.0%	
Effect of genetic influence on the oral cavity							
Frequency	5	17	3	6	31	10	2.32 (.98)
Percentage	12.2%	41.5%	7.3%	14.6%	75.6%	24.4%	

(continued)

Table 3. Rank-ordered list of how important each oral health topic was perceived to be for respondents' predoctoral/ undergraduate program *(continued)*

	Not At All	A Little	Somewhat	Very	Total	Missing	Mean (STD)
Modification in care for special needs patients with hormonal imbalances							
Frequency	4	15	9	4	32	9	2.31 (.78)
Percentage	9.8%	36.6%	22.0%	9.8%	78.0%	22.0%	
Effect of diabetes on the oral cavity							
Frequency	8	11	8	5	32	9	2.31 (1.03)
Percentage	19.5%	26.8%	19.5%	12.2%	78.0%	22.0%	
Evidence of a relationship between periodontal disease and diabetes							
Frequency	8	10	9	4	31	10	2.29 (1.01)
Percentage	19.5%	24.4%	22.0%	9.8%	75.6%	24.4%	
Modification in care for patients undergoing treatment for head and neck cancer							
Frequency	5	15	10	2	32	9	2.28 (.87)
Percentage	12.2%	36.6%	24.4%	4.9%	78.0%	22.0%	
Modification in care for special needs patients with chronic kidney disease							
Frequency	4	16	10	2	32	9	2.28 (.81)
Percentage	9.8%	39.0%	24.4%	4.9%	78.0%	22.0%	
Oral physiology							
Frequency	8	12	8	4	32	9	2.25 (.98)
Percentage	19.5%	29.3%	19.5%	9.8%	78.0%	22.0%	
Modification in care for special needs patients with salivary gland dysfunction							
Frequency	6	15	8	2	31	10	2.19 (.88)
Percentage	14.6%	36.6%	19.5%	4.9%	75.6%	24.4%	
Craniofacial development							
Frequency	7	16	6	3	32	9	2.16 (.88)
Percentage	17.1%	39.0%	14.6%	7.3%	78.0%	22.0%	
Modification in care for special needs patients with neurologic dysfunction							
Frequency	8	13	9	2	32	9	2.16 (.88)
Percentage	19.5%	31.7%	22.0%	4.9%	78.0%	22.0%	
Oral manifestation of diabetes							
Frequency	8	12	10	1	31	10	2.13 (.85)
Percentage	19.5%	29.3%	24.4%	2.4%	75.6%	24.4%	
Inherited or congenital disfigurements/impairments							
Frequency	8	14	8	2	32	9	2.12 (.87)
Percentage	19.5%	34.1%	19.5%	4.9%	78.0%	22.0%	
Oral manifestation of female sex hormones							
Frequency	9	10	13	0	32	9	2.12 (.83)
Percentage	22.0%	24.4%	31.7%	0	78.1%	22.0%	
Modification in care for special needs patients with sensory impairment							
Frequency	5	16	6	1	28	13	2.11 (.74)
Percentage	12.2%	39.0%	14.6.0%	2.4.0%	68.3%	31.7%	
Oral manifestations of HIV							
Frequency	9	11	11	0	31	10	2.06 (.81)
Percentage	22.0%	26.8%	26.8%	0	75.6%	24.4%	
Oral-facial pain management							
Frequency	9	15	6	2	32	9	2.03 (.86)
Percentage	22.0%	36.6%	14.6%	4.9%	78.0%	22.0%	
Pharmaceuticals and other therapies that may compromise oral health							
Frequency	3	9	10	10	32	9	2.03 (.78)
Percentage	7.3%	22.0%	24.4%	24.4%	78.0%	22.0%	

(continued)

Table 3. Rank-ordered list of how important each oral health topic was perceived to be for respondents' predoctoral/ undergraduate program *(continued)*

	Not At All	A Little	Somewhat	Very	Total	Missing	Mean (STD)
Effect of excessive alcohol on the oral cavity							
Frequency	13	9	7	3	32	9	2.00 (1.01)
Percentage	31.7%	22.0%	17.1%	7.3%	78.0%	22.0%	
Traumatic lesions of the oral cavity							
Frequency	4	4	4	12	29	4	2.00 (.85)
Percentage	9.8%	9.8%	9.8%	29.3%	70.7%	9.8%	
Oral manifestations of Paget's disease							
Frequency	10	13	8	1	32	9	2.00 (.84)
Percentage	24.4%	31.7%	19.5%	2.4%	78.0%	22.0%	
Oral manifestations of nutritional deficiencies							
Frequency	11	12	8	1	32	9	1.97 (.86)
Percentage	26.8%	29.3%	19.5%	2.4%	78.0%	22.0%	
Oral pathology							
Frequency	11	12	8	1	32	9	1.97 (.86)
Percentage	26.8%	29.3%	19.5%	2.4%	78.0%	22.0%	
Oral microbiology/oral biofilm							
Frequency	11	14	6	1	32	9	1.91 (.82)
Percentage	26.8%	34.1%	14.6%	2.4%	78.0%	22.0%	
Biochemistry							
Frequency	12	13	6	1	32	9	1.88 (.83)
Percentage	29.3%	31.7%	14.6%	2.4%	78.0%	22.0%	
Inflammatory cascade of events that occur in systemic exposure to infection of oral origin							
Frequency	13	13	4	2	32	9	1.84 (.88)
Percentage	31.7%	31.7%	9.8%	4.9%	78.0%	22.0%	
The potential of bisphosphonate therapy to induce osteonecrosis of the jaws							
Frequency	14	10	7	0	31	10	1.77 (.81)
Percentage	34.1%	24.4%	17.1%	0	75.6%	24.4%	

Note: Percentages in four levels of importance may not equal "Total" percentages because of rounding.

Table 4. Bonferroni t-test: mean differences among medicine, nursing, and pharmacy respondents on importance of oral health topics

Dependent Variable	Discipline (I)	Discipline (J)	Mean Difference (I-J)	Std. Error	Sig.
Biochemistry					
	Medicine	Nursing	.846	.353	.069
		Pharmacy	1.667*	.347	.000
	Nursing	Medicine	-.846	.353	.069
		Pharmacy	.821*	.234	.004
	Pharmacy	Medicine	-1.667*	.347	.000
		Nursing	-.821*	.234	.004
Craniofacial development					
	Medicine	Nursing	-.038	.465	1.000
		Pharmacy	.767	.457	.313
	Nursing	Medicine	.038	.465	1.000
		Pharmacy	.805*	.308	.042
	Pharmacy	Medicine	-.767	.457	.313
		Nursing	-.805*	.308	.042

(continued)

Table 4. Bonferroni t-test: mean differences among medicine, nursing, and pharmacy respondents on importance of oral health topics *(continued)*

Dependent Variable	Discipline (I)	Discipline (J)	Mean Difference (I-J)	Std. Error	Sig.
Effect of excessive alcohol on the oral cavity					
	Medicine	Nursing	.038	.520	1.000
		Pharmacy	1.033	.512	.158
	Nursing	Medicine	-.038	.520	1.000
		Pharmacy	.995*	.344	.022
	Pharmacy	Medicine	-1.033	.512	.158
		Nursing	-.995*	.344	.022
Effect of genetic influence on the oral cavity					
	Medicine	Nursing	-.333	.516	1.000
		Pharmacy	.633	.503	.656
	Nursing	Medicine	.333	.516	1.000
		Pharmacy	.967*	.346	.028
	Pharmacy	Medicine	-.633	.503	.656
		Nursing	-.967*	.346	.028
Inflammatory cascade of events that occur in systemic exposure to infection of oral origin					
	Medicine	Nursing	-.135	.408	1.000
		Pharmacy	.983	.401	.062
	Nursing	Medicine	.135	.408	1.000
		Pharmacy	1.118*	.270	.001
	Pharmacy	Medicine	-.983	.401	.062
		Nursing	-1.118*	.270	.001
Inherited or congenital disfigurements/impairments					
	Medicine	Nursing	-.038	.445	1.000
		Pharmacy	.833	.438	.201
	Nursing	Medicine	.038	.445	1.000
		Pharmacy	.872*	.295	.018
	Pharmacy	Medicine	-.833	.438	.201
		Nursing	-.872*	.295	.018
Modification in care for special needs patients with salivary gland dysfunction					
	Medicine	Nursing	-.115	.418	1.000
		Pharmacy	.786	.414	.204
	Nursing	Medicine	.115	.418	1.000
		Pharmacy	.901*	.281	.010
	Pharmacy	Medicine	-.786	.414	.204
		Nursing	-.901*	.281	.010
Pharmaceuticals and other therapies that may compromise oral health					
	Medicine	Nursing	.442	.385	.778
		Pharmacy	1.150*	.378	.015
	Nursing	Medicine	-.442	.385	.778
		Pharmacy	.708*	.255	.029
	Pharmacy	Medicine	-1.150*	.378	.015
		Nursing	-.708*	.255	.029
Soft tissue lesions of the oral cavity					
	Medicine	Nursing	.481	.520	1.000
		Pharmacy	-.817	.512	.364
	Nursing	Medicine	-.481	.520	1.000
		Pharmacy	-1.297*	.345	.002
	Pharmacy	Medicine	.817	.512	.364
		Nursing	1.297*	.345	.002

*Mean difference is significant at the 0.05 level.

Table 5. Mean rankings of medicine, nursing, and pharmacy respondents on importance of oral health topics

		N	Mean	Std. Deviation
Biochemistry				
	Medicine	4	3.00	.816
	Nursing	13	2.15	.689
	Pharmacy	15	1.33	.488
	Total	32	1.88	.833
Craniofacial development				
	Medicine	4	2.50	1.000
	Nursing	13	2.54	.877
	Pharmacy	15	1.73	.704
	Total	32	2.16	.884
Effect of excessive alcohol on the oral cavity				
	Medicine	4	2.50	.577
	Nursing	13	2.46	1.127
	Pharmacy	15	1.47	.743
	Total	32	2.00	1.016
Effect of genetic influence on the oral cavity				
	Medicine	4	2.50	1.000
	Nursing	12	2.83	.937
	Pharmacy	15	1.87	.834
	Total	31	2.32	.979
Inflammatory cascade of events that occur in systemic exposure to infection of oral origin				
	Medicine	4	2.25	.500
	Nursing	13	2.38	.961
	Pharmacy	15	1.27	.458
	Total	32	1.84	.884
Inherited or congenital disfigurements/impairments				
	Medicine	4	2.50	.577
	Nursing	13	2.54	.877
	Pharmacy	15	1.67	.724
	Total	32	2.12	.871
Modification in care for special needs patients with salivary gland dysfunction				
	Medicine	4	2.50	.577
	Nursing	13	2.62	.768
	Pharmacy	14	1.71	.726
	Total	31	2.19	.833
Pharmaceuticals and other therapies that may compromise oral health				
	Medicine	4	2.75	.500
	Nursing	13	2.31	.751
	Pharmacy	15	1.60	.632
	Total	32	2.03	.782
Soft tissue lesions of the oral cavity				
	Medicine	4	2.25	.500
	Nursing	13	1.77	.832
	Pharmacy	15	3.07	1.033
	Total	32	2.44	1.076
The potential of bisphosphonate therapy to induce osteonecrosis of the jaws				
	Medicine	4	2.25	.500
	Nursing	12	2.08	.900
	Pharmacy	15	1.40	.632
	Total	31	1.77	.805

In our study, the topics related to oral-systemic health that were perceived by the disciplines of medicine, nursing, and pharmacy to be the most important were related to diseases of the oral cavity that are the most prevalent—specifically, periodontal disease and caries, both of which are highly relevant in achieving and sustaining overall health. It is also interesting to note that, of the top seven topics, three of these topics were related to periodontal disease and the relationship of periodontal disease to systemic disease states. Since educators from human nutritional sciences (e.g., dietetics) were not surveyed, it is noteworthy that the effect of inappropriate dietary practices on the oral cavity ranked so high. Of those topics that were ranked as low in importance, the perception may be that many of these topics are adequately covered with basic science courses and/or various topics may not be perceived as clinically relevant to the non-dental health care disciplines.

This study provides the first formal documentation that the predoctoral/undergraduate curriculum of non-dental health care professions, specifically in medicine, nursing, and pharmacy, does not contain adequate content related to oral-systemic health. However, there are a few limitations to this study. It was based on a small sample size, and the response rate was low. Also, representation of responses from the three disciplines was skewed, making comparison across them difficult. Future research endeavors in this area of education research should capture a larger representative sample. A strategy to enlarge the sample size would be to identify key champions in each discipline who would have access to reliable and appropriately positioned contacts at universities around the world. This strategy may increase the response rates from the various disciplines. Second, this survey focused on only three of the non-dental health professions. It would be useful for future research to seek responses from other disciplines within the greater health care community, such as occupational therapy, physical therapy, and human nutritional sciences among others.

Various professional associations, governmental agencies, and the insurance industry acknowledge that mounting evidence of oral-systemic relationships will require the integration of oral-systemic health into the curriculum of pre-licensure HCPs. This will require didactic foundational information as well as interprofessional clinical immersion experiences to fully incorporate and sustain new models of integrated oral-systemic care. There is an increasing number of mandates to develop models of interprofessional education that stimulate positive learning experiences of students from multiple health care disciplines.[24] Increased education in oral health within HCP predoctoral/undergraduate curricula will provide the requisite knowledge for interprofessional education that brings together students from a wide range of disciplines to collaborate with dental and dental hygiene students on patient-centered models of care specific to co-morbid diseases and conditions related to the oral cavity. As education in HCP disciplines becomes enriched by inclusion of oral-systemic science, we can expect that physicians, nurses, pharmacists, and the health care community at large will increasingly integrate this body of knowledge in their critical assessment of patients, factoring oral health into overall case management. The expectation is that, ultimately, this will positively impact patient health outcomes.

It may be instructive to provide a basic description of oral-systemic interprofessional education at the University of Manitoba as well as a comparison with the only other attempts thus far at creating an oral health curriculum for non-dental health professions students (University of Washington School of Medicine and New York University School of Nursing).[25-27] At Manitoba, the goal is to use foundational one-hour curriculum modules in oral-systemic science to provide basic content in each of the other health care disciplines. The modular menu offers some flexibility for each disciple to incorporate content areas its leaders perceive as most important in a time-efficient manner. The menu provides comprehensive coverage of the most relevant oral-systemic topic areas and is meant to prepare students for capstone clinical experiences in which they co-manage patients from intake and screening, through treatment, and during follow-up care. Students from the various health care disciplines will view the material in a self-study and facilitated learning format prior to interprofessional clinical experiences within the final year of their curricula. Currently, students from dentistry, dental hygiene, medicine, nursing, and pharmacy are co-managing patients at designated clinics in this fashion. This includes multidirectional referral and reinforcement of health and wellness messages, especially for the prevention and management of chronic inflammatory diseases such as diabetes, cardiovascular disease, and arthritis. Data are being collected to track health outcomes and to determine any beneficial effects of this health care model.

At the University of Washington School of Medicine, an oral health curriculum has been created that includes some oral-systemic content organized

within a vertical approach. The oral-systemic content is far from comprehensive and has been fragmented for inclusion in each of the four prelicensure years. The content is delivered as an elective during the first two years, so not all students receive the information. Patient care is modeled within clinical clerkships in the third and fourth years; however, this care is delivered within an "adjacent silo" approach for medicine and dentistry using medical-dental faculty teams. This is likely to limit the retention and clinical application of the oral-systemic content and potential benefits for health outcomes. At New York University, the nursing curriculum has recently incorporated some clinical experiences in oral health supervised by nurse practitioners. Although the stated goal is true interprofessional collaboration and practice, there is no formal didactic or foundational component in oral-systemic science for nursing students, and learning experiences are limited to clinical observation in "adjacent silo clinics" where dental students refer patients to nurse practitioners in the faculty practice for management of systemic conditions and where nurse practitioners refer patients with obvious oral health problems for care in the dental clinics. Thus, there is little collaborative interaction and minimal involvement of students in comprehensive treatment planning and patient management.

It may also be instructive to briefly mention some major barriers associated with development and implementation of oral-systemic interprofessional education as these appear to be universal for educators engaged in similar initiatives. These barriers can be divided into three categories (administrative, faculty, and student). The administrative barriers consist of scheduling issues (adjusting disparate academic and class calendars for several health professions to facilitate joint learning and patient care activities), funding issues (faculty champions require relief from other duties to spend the significant amount of time needed to adequately participate in development and implementation), and external issues (ensuring adequate communication with and support from professional associations, regulatory bodies, health care systems, and community stakeholders). The faculty barriers consist of acceptance issues (recognizing the value of interprofessional education/training approaches and willingness to change personal teaching and supervisory methods to accommodate this new paradigm), bias issues (preconceived notions regarding the importance of other health care professions to comprehensive patient care), and career advancement issues (many academics have already defined areas of focus/scholarly activity and are hesitant to dilute their efforts to an area with unproven benefit). The student barriers consist of workload issues (attaching value to what initially may be independent self-directed and elective interprofessional experiences within an already overcrowded curriculum), relevance issues (interprofessional education/training are disconnected from current practice models, and silo-based approaches continue to occur simultaneously within the curriculum), and patience issues (interprofessional experiences tend to be completed in small-group interactive sessions that require longer periods of time than traditional approaches to which students are accustomed).

Conclusions

In this study, we surveyed various English-speaking universities around the world to gain an understanding of the extent to which oral-systemic relationships are being taught in non-dental health care providers' predoctoral/undergraduate curricula, specifically, in medicine, nursing, and pharmacy. Deficiencies in these non-dental health care professions' curricula regarding the inclusion of oral-systemic health were identified as trends that currently exist in these disciplines. Despite the calls for inclusion of this knowledge base in disciplines outside of dentistry and dental hygiene, these curricula appear not to contain adequate content related to oral-systemic health. Our findings may provide the foundation for further research studies regarding oral-systemic health curricula and interprofessional education programs that focus on oral-systemic content in schools of medicine, nursing, and pharmacy.

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