

Dental, Dental Hygiene, and Graduate Students' and Faculty Perspectives on Dental Hygienists' Professional Role and the Potential Contribution of a Peer Teaching Program

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Abstract: The changing role of dental hygienists deserves dental and dental hygiene educators' attention. The first aim of this survey study was to assess University of Michigan dental, dental hygiene, and graduate students' and faculty members' perceptions of dental hygienists' roles; their attitudes and behaviors related to clinical interactions between dental and dental hygiene students; and perceived benefits of engaging dental hygiene students as peer teachers for dental students. The second aim was to assess whether one group of dental students' experiences with dental hygiene student peer teaching affected their perceptions of the dental hygiene profession. Survey respondents were 57 dental hygiene students in all three years of the program (response rate 60% to 100%); 476 dental students in all four years (response rate 56% to 100%); 28 dental and dental hygiene graduate students (response rate 28%); and 67 dental and dental hygiene faculty members (response rate 56%). Compared to the other groups, dental students reported the lowest average number of services dental hygienists can provide ($p \leq 0.001$) and the lowest average number of patient groups for which dental hygienists can provide periodontal care ($p < 0.001$). Dental students also had the least positive attitudes about clinical interactions between dental hygiene and dental students ($p < 0.001$) and perceived the fewest benefits of dental hygiene student peer teaching ($p < 0.001$) before experiencing peer teaching. After experiencing dental hygiene student peer teaching, the dental students' perceptions of dental hygienists' roles, attitudes about clinical interactions with dental hygienists, and perceived benefits of dental hygiene student peer teachers improved and were more positive than the responses of their peers with no peer teaching experiences. These results suggest that dental hygiene student peer teaching may improve dental students' perceptions of dental hygienists' roles and attitudes about intraprofessional care.

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Since 2000, when the first U.S. surgeon general's report on oral health was published, increased discussion of how to improve access to care for patients from underserved population groups has occurred.¹ A central question concerns the role that dental hygienists can play in meeting this need,²⁻⁴ with the discussion focusing frequently on the level of supervision required for licensed dental hygienists. Dental hygienists in the U.S. are licensed health care providers who work in many types of health care settings under varying levels of supervision depending on the licensing state's practice act.⁵ Catlett and Greenlee's overview of changes in levels of supervision structures for dental hygienists from 1993 to 2000 and again from 2001 to 2011 concluded

that most states had moved towards a decreased level of supervision for dental hygienists.⁵ This trajectory has a logical end point in the direct access model of care, which implies that dental hygienists can initiate treatment based on their assessment of patients' needs. In addition, under this model the dental hygienist can treat patients and maintain a provider-patient relationship without explicit authorization or presence of a dentist.⁶⁻⁸ However, for these changes in the profession to occur, it is imperative that practicing dentists recognize the vital role dental hygienists can play as part of the oral health care team. Therefore, ensuring that all members of the dental team have a comprehensive understanding of dental hygienists' professional roles and scope of

practice is crucial to provide the best possible care for all patients.⁹⁻¹¹

Meeting this goal requires that graduating dental students begin their careers with a clear understanding of dental hygienists' scope of practice. In 2011, Morison et al. reported that dental students did not fully understand the role of dental hygienists and were unsure when to refer a patient to a dental hygienist.¹² Their participating dental students agreed that intraprofessional and interprofessional education (IPE) was important for all future members of the oral health care team as a way to build teamwork, collaboration, and communication. That study concluded that such education is important in preparing dental team members for facilitating teamwork and reducing professional stereotyping. Increasing knowledge of the professional roles and scope of practice of all members of the dental team and eliminating stereotypes during students' education will hopefully encourage more collaborative practice after graduation.¹³⁻¹⁶

Introducing dental students to information about the role dental hygienists play as members of the dental team early during their preclinical education and again in later clinical settings has been found to help build intraprofessional relationships that will lead to enhanced collaborative practice in the real-world setting.^{10,13,17} However, in addition to providing didactic information, certain types of interactions in preclinical and clinical settings may be needed to reduce stereotyping and provide a deeper appreciation of dental hygienists' roles and scope of practice. This argument is supported by Intergroup Contact Theory.¹⁸ This theory originally focused on predicting reduction of prejudice among members of different racial groups, arguing that interactions would reduce prejudice and result in more positive race relations. In 1954, Allport further developed this argument by describing the type of contact needed to bring about positive change.¹⁹ He argued that interactions should center around four main principles: a common goal; fostering cooperation between group members; stressing the equal status of the groups; and having the full support of authority figures. Meta-analytic reviews of research concerning this theory have provided ample support for its value and stressed its benefits for interactions not only between members of different racial groups but of groups in general.^{20,21} In contacts between dental and dental hygiene students, an ideal intergroup collaboration could be constructed in which competent senior dental hygiene students serve as

peer teachers for dental students during their first year of education. Their interactions would center around a common goal to improve preclinical and clinical skills; it would consist of close cooperation and communication between the peer teachers and dental students; and dental hygiene students' status would not be lower than the dental students' status. In addition, it would be crucial to ensure that the authority figures in this collaboration—the graduate students and faculty overseeing these peer teaching activities—were supportive.

In addition to the theoretical support Intergroup Contact Theory provides for engaging dental hygiene peer teachers, extensive educational research has shown the benefits of peer teaching in general. "Peer education" and "peer teaching" refer to situations in which student teachers engage in educational interventions with their peers.²²⁻²⁴ "Peer teaching" is a term often used to describe interactions in which the teacher and the learner share experiences that create a kinship between them.^{22,23,25} Educational research has found benefits for both the learners and the teachers in peer teaching.²⁵ One explanation, described in the cognitive congruence hypothesis, is that a smaller difference (learning, age, etc.) between students and teachers can result in a better level of understanding.²⁵⁻²⁸ The same studies found that peer or near peer teachers can create a safe learning environment and help learners navigate challenging curricula.

In addition, researchers have demonstrated that peer or near peer teaching has helped socialize students to interact with other health care providers with whom they will collaborate in the future.^{13-15,17,29} Developing a well-thought-out and -managed peer or near peer teaching program can therefore enhance the collaboration between members of the dental team and thus contribute to meeting accreditation standards that require dental and dental hygiene graduates to be able to work in an intraprofessional team.^{30,31} Other studies have found that peer teaching can increase students' awareness concerning each team member's professional role and responsibility and foster a culture of mutual respect.^{15-17,22,28,29,32}

Based on the arguments of the Intergroup Contact Theory¹⁸⁻²¹ as well as extensive educational research on the benefits of peer teaching, we developed a program at the University of Michigan that introduced competent senior dental hygiene students as peer teachers for first-year dental students (D1) in preclinical settings and second-year dental students (D2) in clinical settings. The aims of this study were to first assess these dental hygiene, dental, and gradu-

ate students' and faculty members' perceptions of dental hygienists' roles; their attitudes and behavior related to clinical interactions between dental and dental hygiene students; and their responses concerning benefits of engaging dental hygiene students as peer teachers for dental students. After implementing the peer teaching program, the second aim was to evaluate the change in the dental students' perceptions from before to after the experience regarding dental hygienists' scope of practice and the value of peer teaching. In addition, we compared the responses of dental students who experienced dental hygiene peer teaching to those who did not.

Methods

This study was determined to be exempt from oversight by the Institutional Review Board for the Behavioral and Health Sciences at the University of Michigan (HUM#00088723) on May 5, 2014. The study involved two parts. Part 1 had a correlational design and consisted of baseline assessments of the students' and faculty members' responses before the peer teaching intervention. Part 2 had a pre-post intervention, quasi-experimental design. The design was quasi-experimental rather than experimental because no random assignment of students to the intervention was possible.

Surveys were distributed to dental hygiene students in all three years; dental students at the beginning and end of the first year and once to those in the second, third, and fourth years; graduate students in dental and dental hygiene programs; and dental and dental hygiene faculty members. This university's dental hygiene program accepts students after successful completion of one year of college and thus refers to the three years as DH2, DH3, and DH4.

The survey was developed by the authors and pilot-tested with five dental hygiene faculty members who did not teach in the predoctoral dental curriculum. After receiving feedback from these pilot subjects, a final version of the survey was developed and administered. All dental and dental hygiene students were given paper and pencil surveys at the end of regularly scheduled class periods after being informed about the study by the principal investigator (MM). All paper surveys were returned anonymously with no identifiable personal information. Since senior dental students spend considerable time in community-based education and have minimal presence in didactic courses, a recruitment email was

sent to all senior dental students who had been on rotations on the day their peers received the paper survey in class. They were informed about the study and asked to respond by using a weblink to an anonymous web-based survey. This approach ensured that no student could respond to both the paper survey and the web survey. Graduate students and faculty members received a recruitment email that informed them about the research and asked them to access the survey with a weblink provided in the message. The web-based responses were downloaded from the website and imported into an SPSS file.

Key Features of Peer Teaching Program

During the second semester (winter term) of the D1 year, dental students take a preclinical course in the fundamentals of periodontics. This course consists of two parts: students work on typodonts in a simulation lab (three hours per week for seven weeks), and they work on student partners practicing instrumentation and assessment skills in the foundation clinic (also three hours per week for seven weeks). Dental hygiene students were present at all times in both of these settings as part of the Peer Teaching Program (PTP). In addition, they were involved as peer teachers in the first semester (spring term) of the D2 year, when dental students again work on student partners in the foundation clinic during a rotation called "Perio Simulation" (Perio S) (three hours per week for four weeks). During this D2 rotation, dental students complete a prophylaxis on classmates from start to finish, using all the skills they learned the previous semester. It is important to understand that the dental hygiene student peer teachers were present in all classes at all times during which the dental students participated in these experiences. As peer teachers, the dental hygiene students were involved in explaining the appointment process, demonstrating instrumentation skills, and helping to answer a variety of questions regarding instrumentation skills, processes, assessment, and use of the electronic health record.

The senior dental hygiene student peer teachers were selected by a faculty committee and had to fulfill the following four inclusion criteria. First, they had to be in good academic standing with a cumulative GPA of 3.0 or higher. Second, their clinical grades in each semester had to be a B+ or higher. Third, they could not have any incompletes in a clinical course, and finally, they had to be on track to fulfill all clini-

cal requirements in their current clinical course. All the dental hygiene students who were selected had been taught by the same faculty members who are involved in teaching dental students as preclinical and clinical instructors. In addition, meetings before each class took place in which the principal investigator met with the peer teachers and carefully reviewed the most important aspects of the upcoming educational experience. This faculty member was always present during the peer teaching to supervise and answer questions.

Survey and Statistical Analysis

The survey consisted of four parts. The first part asked respondents such questions as year and program in which they were enrolled or the program in which faculty members taught. Part 2 concerned the role of dental hygienists as members of the dental team. From a list of 14 procedures, respondents were asked to select the treatments they believed dental hygienists can provide. They also indicated for which patient groups dental hygienists could provide periodontal care.

Part 3 of the survey consisted of seven questions that asked how well dental and dental hygiene students were currently integrated in the dental clinics while providing patient care. These items were in a Likert scale format with response options from 1=strongly disagree to 5=strongly agree. In addition, all students were asked on average how many times a week they were actively involved in intraprofessional patient care with each other, how often they saw a mutual patient, and which assessment procedures the dental student performed prior to referral to dental hygiene students. The final questions in this section investigated interactions between dental and dental hygiene students when a mutual patient was scheduled for a comprehensive examination and prophylaxis on the same day.

Part 4 was different for the groups who had the PTP and those who did not. For the latter group, questions were asked about *potential* benefits of dental hygiene peer teaching. Questions were asked to help determine from which peer teaching experiences dental students did/could benefit most. For students with PTP experiences, questions regarded how valuable this program had been for them and if there were any benefits to their clinical education; for students without the experiences, these questions were posed as hypotheticals. Factor analyses were performed with the rating scale questions to identify which items

should be used to construct indices. Cronbach's alpha inter-item consistency coefficients were computed to assess the reliability of these indices. The items had face validity.

Paper and pencil data were entered into a data file in SPSS for Windows, Version 22 (IBM Corp., Armonk, NY, USA). The data from the web-based survey were downloaded from the website as an Excel file and imported into SPSS. Descriptive statistics such as frequency distributions, percentages, means, and standard deviations were computed to provide an overview of the responses. Inferential statistics such as chi-square tests and univariate analyses of variance were used to test whether there were differences between the responses of different groups. Factor analyses (Extraction Method: Principal Component Analysis; Rotation Method: Varimax Rotation) were used to determine which items loaded on certain factors to determine which indices could be created. Cronbach's alpha inter-item consistency coefficients were computed to provide information about the reliability of the constructed indices. Indices were created by either totaling the sum of positive responses to yes/no questions or by averaging responses to the Likert items that loaded on specific factors identified in the factor analyses. A p-value of <0.05 was designated the level of significance.

Results

Survey respondents were 57 dental hygiene students (DH2: 25; DH3: 20; DH4: 12), 476 dental students (D1 beginning of academic year: 108; D1 end of year: 103; D2: 99; D3: 102; D4: 63), 28 graduate students, and 67 faculty members. Response rates for the dental hygiene classes ranged from 60% to 100% (DH2: 100%; DH3: 91%; DH4: 60%), and response rates for the dental student classes ranged from 56% to 100% (Table 1). The 28 graduate students came from six graduate programs: one program in dental hygiene, and five in dentistry. The response rate for the graduate students was 28%. The overall response rate for the faculty members was 56%: 11 of the 67 faculty respondents were on the dental hygiene faculty, and 54 were dental faculty members.

Table 2 shows the responses to questions about the dental hygiene scope of practice of the responding dental hygiene, dental, and graduate students and faculty members who had *not* experienced PTP. The data from the D2 students and from the D1 students at the end of the winter term were not included because

Table 1. Overview of respondents' characteristics

Characteristic	Number	Percentage
Type of respondent		% of Total Respondents
Dental hygiene students	57	9%
Dental students	476	76%
Graduate students	28	5%
Faculty members	67	11%
Year of educational program		Response Rate by Student Group
DH2	25	100%
DH3	20	91%
DH4	12	60%
D1 beginning of year before peer teaching	108	100%
D1 end of year after peer teaching	103	97%
D2 beginning of year after peer teaching	99	97%
D3	102	90%
D4	63	56%
Graduate students' year in program		% of Graduate Respondents
First	11	44%
Second	5	20%
Third	9	36%
No answer	3	
Graduate program		% of Graduate Respondents
Dental hygiene	7	27%
Periodontics	6	23%
Orthodontics	5	19%
Pediatrics	5	19%
Endodontics	2	8%
Prosthodontics	1	4%
No answer	2	
Faculty (total)	67	67/120
Dental hygiene	11	faculty=56%
Dental	54	response rate
Faculty teaching in		% of Faculty Respondents
Classroom only	4	6%
Clinic only	29	45%
Both classroom and clinic	32	49%
Years of teaching		% of Faculty Respondents
0 to 5 years	22	34%
6 to 10 years	12	19%
11 to 20 years	16	25%
More than 20 years	15	23%

Note: Percentages may not total 100% because of rounding. This university's dental hygiene program accepts students after successful completion of one year of college and thus refers to the three years as DH2, DH3, and DH4.

both of those sets of data came from students who *had* experienced the PTP.

Overall, the graduate students evaluated the importance of the role of dental hygienists as members of the oral health care team less favorably than all other groups (on a five-point scale from 1=least important to 5=most important: graduate students 4.43; dental hygiene students 4.99; dental students

4.72; faculty 4.90; $p < 0.001$). When asked about 14 procedures that dental hygienists can provide, the four groups differed significantly in numbers of responses for 13 of the 14 tasks listed, with dental students being consistently least likely to select each of these procedures. When a sum score of the 14 possible yes answers was computed, the dental students' average sum score was lower than those of

Table 2. Responses concerning dental hygienist's role as member of dental team among those who had not experienced the program, by respondent type

Survey Item	Dental Hygiene Students (N=57) Mean	Dental Students (N=274 ^a) Mean	Graduate Students (N=28) Mean	Faculty Members (N=67) Mean	p-value
Importance of role of dental hygienist on dental team ^b	4.99	4.72	4.43	4.90	<0.001
Dental hygienists can provide:	% Yes	% Yes	% Yes	% Yes	
Assessment-related					
Periodontal charting	98%	87%	96%	100%	0.001
Oral cancer screening	93%	65%	79%	83%	<0.001
Exposure of radiographs	93%	86%	100%	100%	0.001
Sum of 3 yes: Mean (SD)	2.84 (0.49)	2.38 (0.85)	2.75 (0.52)	2.82 (0.38)	<0.001
Conventional treatment-related					
Dental prophylaxis	97%	88%	100%	100%	0.001
Periodontal maintenance	98%	85%	96%	100%	<0.001
Scaling/root planing	100%	75%	86%	97%	<0.001
Taking alginate impressions	72%	72%	96%	88%	0.003
Placing dental sealants	81%	57%	89%	91%	<0.001
Sum of 5 yes: Mean (SD)	4.47 (0.82)	3.77 (1.2)	4.68 (0.67)	4.77 (0.56)	<0.001
Pain control					
Nitrous oxide sedation	88%	43%	64%	86%	<0.001
Administration of local anesthesia	97%	55%	79%	95%	<0.001
Sum of 2 yes: Mean (SD)	1.84 (0.45)	0.98 (0.82)	1.42 (0.84)	1.81 (0.43)	<0.001
Additional responsibilities					
Fabrication of temporary crown	33%	22%	57%	43%	<0.001
Restoration adjustment	33%	16%	39%	32%	<0.001
Placement of temporary crown	25%	24%	57%	42%	<0.001
Amalgam carving	25%	18%	32%	21%	0.253
Sum of 4 yes: Mean (SD)	1.16 (1.6)	0.80 (1.2)	1.86 (1.6)	1.27 (1.5)	<0.001
Procedure: sum of 14 yes ^c Mean (SD)	10.32 (2.5)	7.92 (3.0)	10.71 (2.6)	10.62 (2.1)	<0.001
Dental hygienists provide periodontal treatments for					
Healthy patients	68%	89%	100%	100%	<0.001
Patients with gingivitis	72%	82%	100%	100%	<0.001
Patients with mild periodontitis	97%	73%	93%	98%	<0.001
Patients with severe periodontitis	88%	42%	61%	85%	<0.001
Patients in orthodontics	72%	61%	89%	100%	<0.001
Patient: sum of 5 yes ^d Mean (SD)	3.96 (1.3)	3.47 (1.5)	4.43 (0.84)	4.83 (0.42)	<0.001

^aOnly data from dental students who had not experienced dental hygiene peer teaching (D1 beginning of year, D3, and D4 students) were included.

^bResponse options ranged from 1=not at all to 5=very important.

^cThe procedure sum score ranged from 0 to 15.

^dThe patient sum score ranged from 0 to 5.

all other groups (Means: dental students 7.92; dental hygiene students 10.32; graduate students 10.71; faculty 10.62; $p < 0.001$).

The respondents were also asked for which patient groups dental hygienists can provide periodontal treatment (prophylaxis, periodontal maintenance, and scaling and root planing). In their responses, the dental students were less likely than the dental

hygiene and graduate students and faculty members to report that dental hygienists can provide treatment for patients with mild and severe periodontitis, as well as for patients receiving orthodontic treatment.

Table 3 provides an overview of attitudinal and interaction-related responses regarding current clinical interactions between dental hygiene and dental students from those dental and dental hygiene

Table 3. Attitudinal and interaction-related responses concerning integration of dental hygiene students in clinical activities among those who had not experienced the program, by respondent type

Survey Statement	Dental Hygiene Students 3 & 4 (N=32)	Dental Students 3 & 4 (N=165)	Graduate Students (N=28)	Faculty Members (N=67)	p-value
Attitudes about current interactions^a					
Dental hygiene students are well integrated with dental students in clinics.	Mean 2.31	Mean 2.25	Mean 3.65	Mean 2.66	<0.001
I am comfortable speaking/interacting with dental hygiene students when patient care is directly involved.	3.78 ^b	3.68	3.43	3.11 ^b	0.001
I am comfortable speaking/interacting with dental hygiene students when patient care is NOT directly involved.	3.16 ^b	3.62	3.57	3.30 ^b	0.036
Current interaction index (Cronbach's alpha=0.661) ^c	3.08	3.19	3.56	3.01	0.005
Number of interactions in average week between dental and dental hygiene students					
When actively involved in patient care.	1.00	0.39	2.32	1.20	<0.001
When seeing a mutual patient.	0.90	0.33	1.44	1.48	<0.001
Activities completed by dental student prior to referral to dental hygiene student					
Total procedures (out of 13)	4.60	8.51	10.75	10.24	<0.001
Dental students' behavior when working with dental hygiene students on a mutual patient:					
I asked dental hygiene student to help perio chart during exam.	% Yes 38% ^d	% Yes 28%	% Yes 89%	% Yes 98%	<0.001
I asked dental hygiene student to leave during the exam.	16% ^d	6%	5%	2%	0.047
I explained my assessments and findings to dental hygiene student after the exam was complete.	16% ^d	28%	100%	95%	<0.001
I did none of the above because I do not like to work with dental hygiene students.	56% ^d	9%	n/a	n/a	<0.001
I did none of the above because I did not know dental hygiene students were available to see my prophy or periodontal patients.	34% ^d	45%	n/a	n/a	0.177
Attitudes about increasing interactions^a					
Dental hygiene students should be more integrated with dental students in clinics.	Mean 4.53	Mean 4.04	Mean 4.35	Mean 4.27	0.011
I could learn a lot by assisting a dental hygiene student during one of my VICS assists.	4.16 ^e	2.35	3.43	3.59 ^e	<0.001
Dental students could benefit from collaboration and interactions with dental hygiene students.	4.62	3.86	4.13	4.38	<0.001
Dental hygiene students could benefit from collaboration and interactions with dental students.	4.75	4.07	4.22	4.37	<0.001
Increasing interaction index (Cronbach's alpha=0.745) ^f	4.52	3.60	4.07	4.14	<0.001

^aResponse options ranged from 1=disagree strongly to 5=agree strongly.

^bDental hygiene students and faculty members were asked to respond to what they perceived as the dental students' comfort level in these two situations.

^cThe current interaction index was computed by averaging responses to these three items.

^dDental hygiene students were asked to respond as to whether the dental students had asked them these questions or provided explanations to them and as to their perceptions of dental students' reasons in the fourth and fifth questions.

^eDental hygiene students and faculty members were asked to rate what they perceived as the dental students' ability to learn in this situation.

^fThe increasing interaction index was computed by averaging responses to these four items.

students (DH3 & 4, D3 & 4), graduate students, and faculty members who had *not* experienced the PTP. The graduate students were on average more positive

than all other groups. However, the dental students had on average the lowest responses to the question about how many times per week they chose to inter-

act in a clinic setting with a student who was not in their program. In response to the question of which procedures on which they collaborated with dental hygiene students when seeing a mutual patient, only 28% of the dental students reported asking a dental hygiene student to help with periodontal charting during the exam, and the same percentage said they explained their assessments/findings to the dental hygiene student after the exam was completed. There was an interesting disconnect between the dental and dental hygiene students about the reasons interactions did not occur. In the two groups, 45% of the dental students and 34% of the dental hygiene students stated that collaboration between the two groups did not take place because the dental students were unaware that dental hygiene students were available for patient referrals. However, while only 9% percent of the dental students reported they did not collaborate because they did not like working with dental hygiene students, 56% of the dental hygiene students perceived that the dental students felt that way.

Furthermore, when the dental students were asked to choose from a list of 13 procedures they completed prior to the patient referral to a dental hygiene student, they indicated that they completed an average of 8.51 of these procedures. In comparison, the dental hygiene students indicated the dental students only completed an average of 4.60 of the 13 possible pre-referral procedures. Graduate student and faculty respondents reported that dental students completed on average significantly more procedures prior to referral (10.75 and 10.24, respectively). In response to questions concerning increasing clinical interactions between dental hygiene and dental students, dental students were on average least positive of all the groups.

Table 4 provides an overview of responses concerning the potential benefits of PTP as perceived by those who had not participated in the program. The responses showed that the dental students were least positive when compared to all other groups. When asked from which of 15 procedures dental students could benefit while being mentored by a dental hygiene student peer teacher, dental students chose only an average of 5.61. In contrast, the dental hygiene student, graduate student, and faculty respondents choose significantly more procedures from which dental students could benefit by having dental hygiene student peer teachers.

Table 5 shows the D1s' and D2s' responses concerning their experiences with the PTP. A total of 97% of D1 students and 88% of D2 students had

a dental hygiene student peer teaching experience in a clinical setting. The majority of these dental students had actively sought out support from, received explanations about procedures from, and been given hands-on instruction by the dental hygiene peer teachers. When asked how helpful, skilled, and knowledgeable the dental hygiene student peer teachers had been, the average responses of both groups of dental students were very positive, with average scores ranging from 4.11 to 4.68 (on a five-point scale from 1=lowest to 5=highest). However, the D1 students' evaluations were consistently more positive than the D2 students' evaluations.

For the D1 students, data were available from the beginning of the academic year prior to any dental hygiene student peer teaching experiences and from the end of the winter term after the PTP experiences. The D1 student responses concerning the number of procedures dental hygiene students can provide and the number of types of patients they can treat significantly increased over this time (Table 6). In addition, these students were significantly more positive concerning the benefits of the PTP at the end of the term than at the beginning.

When the responses of the D1 and D2 students after their experiences with the PTP were compared with the D3 and D4 students' responses, the D1 and D2 students had significantly more positive attitudes towards current and increasing interactions between dental and dental hygiene students. In addition, these students saw on average more benefits of peer teaching and evaluated peer teaching more positively than did the D3 and D4 students. However, the D3 and D4 students were more likely than the D1 and D2 students to know that dental hygiene students can provide procedures related to pain control and other treatments such as the fabrication and placement of a temporary crown and restoration adjustments.

Discussion

In 2010, the World Health Organization published a "framework for action on interprofessional education and collaborative practice."³³ This document emphasized the benefits of interprofessional collaboration (IPC) for providing care and improving patient outcomes. Parallel to this international emphasis on IPC, the U.S. Patient Protection and Affordable Care Act that was signed into law in 2010 also argued for a change from discipline-dependent care to IPC.³⁴ For the dental hygiene profession, this

Table 4. Responses concerning potential benefits of dental hygiene student peer teacher experience among those who had clinical experience but had not participated in the program, by respondent type

Survey Item	Dental Hygiene Students ^a (N=32)	Dental Students ^a (N=165)	Graduate Students (N=28)	Faculty Members (N=67)	p-value
Dental students could benefit from dental hygiene students' peer teaching when performing:	% Yes	% Yes	% Yes	% Yes	
Communication-related behavior					
Medical/dental history	88%	27%	71%	73%	<0.001
Patient communication	81%	42%	82%	82%	<0.001
Motivational interviewing	81%	40%	71%	81%	<0.001
Oral hygiene instructions	94%	66%	93%	94%	<0.001
Nutritional counseling	84%	39%	82%	87%	<0.001
Sum of 5 yes: Mean (SD)	3.74 (1.6)	2.12 (1.8)	4.00 (1.6)	4.16 (1.4)	<0.001
Assessment-related behavior					
Extraoral examinations	75%	24%	61%	64%	<0.001
Intraoral examinations	75%	22%	61%	63%	<0.001
Oral cancer screenings	81%	22%	64%	74%	<0.001
Periodontal assessment	86%	46%	79%	84%	<0.001
Dental radiographs	50%	40%	61%	76%	<0.001
Sum of 5 yes: Mean (SD)	3.28 (1.7)	1.55 (1.7)	3.25 (2.3)	3.61 (1.7)	<0.001
Treatment-related behavior					
Treatment planning	50%	18%	61%	45%	<0.001
Local anesthetic	63%	19%	61%	61%	<0.001
Prophylaxis	97%	69%	86%	91%	<0.001
Caries prevention	69%	30%	75%	74%	<0.001
Scaling and root planing	91%	57%	75%	91%	<0.001
Sum of 5 yes: Mean (SD)	3.33 (1.6)	1.94 (1.5)	3.57 (1.8)	3.62 (1.5)	<0.001
Sum of 15 yes responses: Mean (SD)	10.35 (4.1)	5.61 (4.6)	10.82 (5.4)	11.42 (4.4)	<0.001
Average peer teaching evaluations ^b	Mean	Mean	Mean	Mean	
How helpful could dental hygiene peer teachers be for dental students?	4.38	3.04	3.61	3.91	<0.001
How knowledgeable could dental hygiene peer teachers be?	4.53	3.37	3.50	3.76	<0.001
How skilled could dental hygiene peer teachers be in demonstrating instrumentation?	4.50	3.53	3.59	4.10	<0.001
How helpful could dental hygiene peer teachers be in answering questions?	4.44	3.27	3.70	3.82	<0.001
How much do you like the idea of being instructed by dental hygiene peer teachers in the clinic? ^c	4.72	3.02	3.59	3.94	<0.001
Average peer teaching score	4.54	3.26	3.55	3.90	<0.001

^aOnly data from DH3, DH4, D3, and D4 students are included because those students had actual clinical experiences and no peer teaching experiences.

^bResponse options ranged from 1=not at all to 5=very much. Respondents were not actually evaluating the program, but were providing their responses hypothetically.

^cNon-dental student respondents were asked to report their perceptions of dental students' attitudes.

paradigm shift happened at a time when increasing efforts in the U.S. began focusing on ensuring that dental hygienists can work in a “direct access” model. This model implies that dental hygienists can initiate treatment based on their assessment of patients' needs, can treat patients, and can maintain a provider-patient relationship without explicit authorization

or presence of a dentist.⁶⁻⁸ One prerequisite of the successful transition to IPE, IPC, and ultimately the direct access model of care for dental hygienists in the U.S. is to ensure that other health care providers have a solid understanding of the scope of practice of the dental hygiene profession. An important aspect of this process is to build mutual intraprofessional

Table 5. Responses concerning dental students' experiences with dental hygiene students' peer teaching: D1s in Foundation Clinic and D2s in PerioS Rotation

Survey Question	D1 N=103	D2 N=99	p-value
Description of peer teaching experience			
Did a dental hygiene student peer teacher interact with you during your clinical work?	97%	88%	0.017
Did you ask them to interact with you?	87%	81%	0.179
Did they explain procedures?	97%	93%	0.170
Did they show you hands-on what to do?	98%	88%	0.007
Would you have liked more support from them?	82%	n/a	–
Evaluation of peer teaching experience			
How helpful was this dental hygiene peer teaching for you?	Mean 4.50	Mean 4.11	0.004
How knowledgeable were the dental hygiene peer teachers?	4.61	4.29	0.004
How skilled were the dental hygiene peer teachers in demonstrating instrumentation?	4.68	4.29	<0.001
How helpful were the dental hygiene peer teachers in answering questions?	4.63	4.27	0.002
How much do you like the idea of being instructed by dental hygiene peer teachers?	4.65	4.20	<0.001

Note: Response options to the second set of questions ranged from 1=not at all to 5=very much.

understanding between dental and dental hygiene students and practitioners.

The first objective of this study therefore was to establish a baseline assessment of dental hygiene, dental, and graduate students' and faculty members' perceptions of dental hygienists' professional role. In addition, attitudes and behaviors related to clinical interactions between dental hygiene and dental students were examined. It is quite encouraging that all four groups perceived the role of dental hygienists as members of the oral health care team positively. However, a more specific analysis of the respondents' knowledge concerning which services/treatments a dental hygienist can provide showed a different picture. While dental hygiene and graduate students and faculty were well informed about dental hygienists' professional tasks related to conventional therapies, assessment, and pain control procedures, the dental students were much less likely to have this basic understanding of dental hygienists' scope of practice. This finding is consistent with a previous study that found dental students were not optimally informed about dental hygienists' scope of practice.¹² It is therefore crucial to find ways to increase dental students' knowledge concerning the professional roles and scope of practice of dental hygienists, in hopes of encouraging them to engage in intraprofessional care after graduation that benefits both groups of practitioners and their patients.¹³⁻¹⁵

The findings of our study support Alfano's argument that educators must go beyond classroom-based efforts to promote intraprofessional practice³⁵

and suggest that one way to do so is to use dental hygiene student peer teachers in dental students' clinical settings early on during their education. Although didactic peer teaching efforts have been shown to result in a better level of understanding,²³ finding ways to engage students in clinical interactions with other health care providers will help future providers work in a more interprofessional manner.¹³⁻¹⁵ Clinic-based IPE has been described by other authors as a crucial component in all IPE efforts in the health professions.^{17,35} Peer teaching is one of those "beyond the classroom" interactions that can increase students' awareness concerning the professional roles of team members from other disciplines and thus contribute to creating a culture of mutual respect.^{15-17,23,27} The peer teaching strategy utilized in this study consisted of having senior dental hygiene students interact with first-year dental students in a simulation lab and a foundational clinic setting and with second-year dental students in a foundational clinic. While the dental students who had not been exposed to PTP were on average only neutral about the benefits of dental hygiene student peer teachers, the dental students who had experienced peer teaching were on average very positive concerning their experiences. When we compared the first-year dental students' knowledge regarding the dental hygienists' scope of practice from before to after having been engaged in the PTP, the results were rather encouraging: the students' responses had improved quite considerably.

However, a comparison of the D1 and D2 students' responses after the PTP with the D3 and

Table 6. Comparison of mean scores of D1 students before and after peer teaching, D1 and D2 students after peer teaching, and D3 and D4 students who had no peer teaching experiences

Survey Item	D1 Before	D1 After	D1/D2 After	D3/D4 None
Importance of role of dental hygienist as a member of the dental care team ^a	4.81	4.77	4.77	4.72
Procedures a dental hygienist can provide				
Sum of yes responses to 3 assessment-related questions	2.20	2.52**	2.51	2.49
Sum of yes responses to 5 conventional treatment-related questions	3.24	4.27***	4.21	4.12
Sum of yes responses to 2 pain control-related questions	0.78	0.74	0.69	1.11***
Sum of yes responses to 4 questions about additional responsibilities	0.67	0.28**	0.35	0.88***
Sum of yes responses to all 14 questions	6.89	7.82**	7.76	8.60**
Dental hygienists provide periodontal treatments for				
Sum of yes responses to 5 patient groups listed	2.70	4.25***	4.12	3.98
Attitudinal indices				
Index "Attitudes towards current interactions" (alpha=0.661) ^b	3.65	3.57	3.48	3.19***
Index "Attitudes towards increased interactions" (alpha=0.745) ^c	4.04	4.20	4.13	3.59***
Benefit of peer teaching-related responses				
Sum of yes responses to 5 communication-related benefits	2.83	3.39*	2.97	2.12***
Sum of yes responses to 5 assessment-related benefits	2.31	3.00*	2.60	1.55***
Sum of yes responses to 5 treatment-related benefits	2.28	3.07**	2.80	1.93***
Sum of yes responses to all 15 potential benefits	7.42	9.47**	8.39	5.61***
Peer teaching evaluations ^d				
How helpful were/could be dental hygiene peer teachers for dental students?	3.81	4.55***	4.38	3.04***
How knowledgeable were/could be dental hygiene peer teachers?	3.60	4.63***	4.48	3.37***
How skilled were/could be dental hygiene peer teachers in demonstrating instrumentation?	3.70	4.65***	4.51	3.53***
How helpful were/could be dental hygiene peer teachers in answering questions?	3.68	4.65***	4.48	3.27***
How much do you like the idea of being instructed by dental hygiene peer teachers in the clinic?	3.74	4.66***	4.46	3.02***
Average peer teaching evaluation score ^e (Cronbach's alpha=0.943)	3.68	4.64***	4.72	3.26***

^aResponse options ranged from 1=disagree strongly to 5=agree strongly.

^bThe attitudes towards current interactions index was computed by averaging the responses to items a-c.

^cThe attitudes towards increasing interactions index was computed by averaging the responses to items d-g.

^dResponse options ranged from 1=not at all to 5=very much. For students who participated in the peer teaching program, the evaluation questions asked for their actual perceptions of the experience; for students who had not participated, these questions were posed as hypotheticals.

^eAverage peer teaching evaluation score was computed by averaging responses to the five single items.

*p<0.05; **p<0.01; ***p<0.001

D4 students' responses showed that the two groups did not differ significantly in the sum of assessment and conventional treatment-related tasks of dental hygienists. Additionally, the D3 and D4 respondents had an even better understanding of dental hygienists' pain control-related scope of practice and of additional responsibilities than the students in the first two years. This could be due to the fact that the PTP did not involve any information about dental hygienists' additional responsibilities or pain control therapies above and beyond conventional dental hygiene therapies. Therefore, future peer teaching efforts should include information about pain control

and additional tasks that fall within the dental hygiene scope of practice.

In this study, we followed the four principles of the Intergroup Contact Theory¹⁸⁻²¹ and created a program in which dental hygiene and dental students 1) worked on a common goal and 2) interacted cooperatively and 3) in which dental hygiene students were respected in the same manner as dental students and 4) had the full support of graduate student and faculty authority figures. These interactions went beyond traditional IPE or intraprofessional clinic-based efforts to using a paradigm in which more advanced students from one discipline engaged in clinical peer

teaching of novice learners from another discipline. Having dental hygiene students engage in these efforts proved to be a successful way to demonstrate to beginning dental students the expertise and scope of practice of the dental hygiene profession.

In addition to these results, it is interesting to consider the dental students' open-ended answers after their peer teaching experiences. One student stated, "They [dental hygiene student peer teachers] were very helpful and nice, very informative, and have a different perspective on the procedures and which techniques they use." Other students noted, "They are very helpful because they have specialized experience in matters of the gingiva"; "I would strongly support any available teaching from dental hygiene students given how knowledgeable and rigorous their program is. I trust their consult"; and "I benefitted a lot by learning from the peer teachers. It was nice learning from a peer rather than an instructor." These comments support findings in other studies that showed the benefits of utilizing peer teachers to provide alternative learning opportunities,^{27,36} including having an impact on students' perceptions of the professional roles of other providers.^{9,13,37,38}

This research had several limitations. First, data were collected in only one dental school and one dental hygiene program. It is possible that other programs have organizational structures that demand more interactions between dental and dental hygiene students. Generalizations of the findings should therefore be made with caution. Second, only survey data about peer teaching activities were collected. It would have been interesting to also collect observational data in the clinics to assess interactions between dental and dental hygiene students in general and between dental students and dental hygiene student peer teachers specifically. Future research should include observational data. Also, individual state laws govern dental hygienists' scope of practice, and the procedures mentioned in this study were limited to the Michigan dental practice act. Informing dental students about this state's dental hygiene practice act in comparison to practice acts from other states could be useful. Finally, combining our two aims in one study (one assessing participants' attitudes at one point in time and the other as a pre-post study measuring the impact of an intervention delivered to a subset of the participants) resulted in sets of data that were not always exactly parallel and thus sometimes challenging to compare. We have acknowledged these differences in the notes accompanying the tables, but future research should

take note of the potential for complications in this type of study design.

Conclusion

As the scope of dental hygienists' practice evolves in the U.S., it is crucial that all members of the oral health care team as well as providers from other disciplines are aware of dental hygienists' professional roles and responsibilities. This study found that dental students were less aware than graduate students and faculty members concerning the professional tasks that dental hygienists can perform and the patient groups for whom they can provide periodontal care. It is therefore important to educate all future dental providers about the dental hygiene scope of practice early on. Engaging dental students in clinic-based interactions with dental hygiene peer teachers in our study resulted in more positive evaluations of the dental hygienists' scope of practice and professional role. Ultimately, this education should set the stage for more positive future interactions between dental hygienists and dentists, which is crucial in times of changing the scope of the dental hygiene profession and the paradigm shift to intra- and interprofessional care.

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