Collaborative Educational Experiences of Dental Hygiene and Audiology Students

Jennifer L. Brame, RDH, MS; Emma Gibbings, BS; Vicki Kowlowitz, PhD;
Nancy M. McKenna, PhD. AuD; Jane A. Weintraub, DDS, PhD

Abstract

Purpose: An innovative, collaborative interprofessional experience for dental hygiene and audiology students that included hearing assessments and a class lecture/discussion session was developed and implemented at the University of North Carolina, Chapel Hill. The purpose of this study was to evaluate whether the objectives were met for the initial educational experience and to identify areas for improvement.

Methods: Audiology students, under faculty supervision, provided hearing screenings for 33 senior dental hygiene (DH) students and 4 graduate (DHE) students. In a subsequent didactic session for the DH and DHE students, an audiology doctoral student presented on the following topics: overview of the audiology profession, interprofessional collaboration with audiologists, principles of noise-induced hearing loss, protective measures for hearing health, and techniques for communicating with patients with hearing loss. Class discussion followed the lecture presentation. Surveys on the screening and education session were completed by the students and changes in their perception of knowledge were assessed.

Results: Nearly half (49%) of the students indicated that this was their first hearing assessment. The vast majority (97-100%) agreed or strongly agreed that the experience was well-organized, contained important information for dental practice, and increased their understanding of the importance of collaboration and their comfort level in working with audiologists. Nearly all of the students (94%) recommended this experience be included in future curriculum. Significant changes were reported in students' knowledge of hearing assessments, noise induced hearing loss, and communication with patients with hearing loss (Wilcoxon Signed Rank Test, $p < 0.05$).

Conclusion: The educational objectives of this initial interprofessional collaborative experience were met. Participants reported that the didactic and experiential education was a valuable learning experience and it increased their knowledge about the audiology profession and hearing health for themselves and their patients.

Keywords: dental hygiene education, audiology, hearing assessments, interprofessional education, interprofessional collaboration

This manuscript supports the NDHRA priority areas, **Professional development: education** (occupational health and interprofessional collaboration).

Submitted for publication 7/26/18; accepted 12/5/2018

Introduction

Ineffective or inadequate communication between patients and health care providers may result in a plethora of complications including misdiagnosis, lack of understanding of treatment needs, failure to receive accurate informed consent for care, and miscomprehension of treatment recommendations. Incomplete communication can have a cumulative and damaging effect on the information passed between patient and provider. While treatment of patients with special needs has been broadly included in the Commission on Dental Education Accreditation (CODA) standards for dental hygiene education, the standards do not include specific details regarding patients with hearing impairments who may also have communication challenges.[1] This lack of specificity regarding individuals with hearing impairments can lead to inconsistent and perhaps limited experiences for students, both didactically and clinically.

Hearing loss and auditory symptoms, such as tinnitus (a ringing or noise in the ear), affects people of all ages. Approximately 2-3 out of every 1,000 children are born in the United States (U.S.) with a detectable degree of hearing loss.[2] The prevalence increases with age, with about 1% of the U.S. population between the ages of 20-39 years affected, 3% between 40-49 years, 11% between 50-59 years, 28% between 60-69 years,[3] and about 46% in those 70 years of age and older.[4] Hearing loss is associated with decreased quality of life independent of the auditory impairment, including increased risk of falls and dementia, and activity limitations which can lead to social isolation, anxiety and depression.[5-6] Given the high prevalence of hearing loss, especially among older adults, it is important for dental hygienists to learn strategies to effectively communicate with patients with hearing impairment.

Dental professionals themselves may be at increased risk of developing hearing loss or tinnitus due to noise exposure sustained during clinical practice.[7-9] While the potential for auditory effects from occupational exposure has been demonstrated in several studies, data are limited and often conflicting regarding the degree of risk for dental professionals, which may be affected by a variety of factors including duration of exposure, specific equipment used, and the setting and type of dental practice.[10-20] Studies suggest that the prevalence of hearing loss in dental professionals, based on self-report, is similar to national averages; however the prevalence of tinnitus has increased.[9] One of the early studies reported temporary threshold shifts in dental students after equipment use.[21] Current research suggests that these temporary threshold shifts may have long term consequences.[22] Literature regarding hearing loss prevalence among dental professionals should be enhanced to better support its origins and severity.

There is a need to educate oral health professional students on the risks of noise exposure, in addition to providing guidance for caring for patients with hearing loss. Audiologists are trained to provide services regarding the identification, assessment, diagnosis, treatment, and prevention of hearing loss and balance disorders and are key members of the interprofessional management team for individuals with hearing loss.[23] As hearing health specialists, audiologists were ideal collaborative partners for a new curriculum initiative designed to engage dental hygiene and audiology students at the University of North Carolina, Chapel Hill. Objectives of this interprofessional experience included baseline hearing assessments for undergraduate and graduate dental hygiene students, and an informational session including an overview of the audiology profession, collaboration with audiologists, noise-induced hearing loss and protection, and communicating with patients with hearing loss. The purpose of this study was to assess the quality and effectiveness of this new educational experience and to facilitate future curriculum improvement for the undergraduate and graduate dental hygiene education programs.

Methods

Collaborative Education Experiences

Project planning began with faculty members in the Audiology Program and the School of Dentistry (SOD) at the University of North Carolina, Chapel Hill. Objectives for the collaboration were to provide undergraduate (DH) and graduate (DHE) students with additional information and awareness related to noise-induced hearing loss and management of patients with hearing loss through a combination of clinical and didactic experiences. Hearing screenings, defined as a hearing test conducted at a fixed level to identify further comprehensive audiometric testing needs, were selected as the interprofessional clinical activity. Members of the faculty planning group designed the program to begin with the auditory screenings, based on the hypothesis that personal learner engagement might provide important context and readiness for the subsequent educational didactic session.

Senior DH and DHE students received an email detailing the program; interested students were provided with an opportunity to schedule an auditory screening. Students were informed that participation in the auditory screenings was voluntary, and that involvement had no impact on course grades. This pilot project was reviewed by the Institutional Review Board (IRB) at the University of North Carolina, Chapel Hill and was determined to be exempt. Five first-year audiology students in the School of Medicine's Clinical Doctorate in Audiology Program, supervised by one third-year audiology doctoral student and one faculty audiologist, performed the screening portion of the activity. All screenings were offered during a three-hour block of time on the same day, during a time that did not conflict with classes or clinics. Screening stations were set-up in a quiet seminar room.

Participants were screened at the level of 20 dB HL at frequencies of 1000, 2000, 4000, and 6000 Hz using conventional pure-tone audiometry. Otoscopy was performed prior to pure-tone audiometry and participants were informed immediately of any abnormal findings. If a participant did not pass at one or more frequency in either ear, tympanometry was also performed to assess function of the middle ear. An optional video otoscopy station was set up for interested participants to view their own ear canals. Students were provided with instructions in advance of the screening and their questions were

addressed. Informed consent was attained by volunteering and participating in the auditory screening.

A didactic presentation was delivered by a third-year audiology doctoral student during the required undergraduate DH course, special care in dentistry, one week following the auditory screening. The special care in dentistry course is designed to provide content for providing care to patients with special treatment considerations. Graduate DHE student participants were invited, but not required, to attend the class session. The following content was included in the presentation: the audiology profession, anatomy of the ear, prevalence of hearing impairment, components of the audiogram, consequences of hearing loss, types and levels of noise, types of hearing protection, work-related risks for dental professionals, effective communication for patients with hearing impairment, and how and when to make appropriate referrals to an audiologist. Students were engaged during the presentation and time was provided for questions and discussion.

Evaluation of Collaborative Education Experiences

Student surveys were created by the program collaborators to collect anonymous feedback from the DH and DHE students following the screening and didactic experiences. The purpose of the student feedback was to provide data to support the sustainability and expansion of the project, with suggestions on what to keep or change, and recommendations for the overall delivery, time allocated, and content for future students.

Participants were asked to rate their level of knowledge about the profession of audiology, hearing assessments conducted by an audiologist, noise-induced hearing loss, and communicating with patients who have hearing loss both prior to and following these educational experiences using a 4-point Likert rating scale from "not knowledgeable at all" to "very knowledgeable." Students were asked to rate statements regarding the quality and value of the experience using a 4-point Likert scale from "strongly disagree" to "strongly agree." Content area included questions on whether the audiology screening was well organized, a valuable learning experience, and contained important information for dental practice. Participants were asked if the activities increased their understanding of the importance of collaborating with other health professionals and if their comfort levels had increased for future collaborations with audiologists. Some of the survey questions were based on a similar project by James et al.[24] The survey also included two open-ended questions asking students to indicate the most and least valuable aspects of this interprofessional education (IPE) experience. Surveys were reviewed by non-participant dental hygiene students and members of the planning committee and were revised prior to distribution.

A separate survey was created by the audiology faculty and the third-year doctoral student for distribution to the first-year audiology students who facilitated the screenings with the goal of quality improvement future audiology student participants. Questions were replicated from a larger survey used throughout the audiology program for interdisciplinary screening experiences. Survey questions focused on the value of the experience and suggestions for improvement and the statements were rated on 5-point Likert scale from "not valuable" to "very valuable." Participants were also given the opportunity to suggest future interdisciplinary activities with the dental hygiene program. As the first- year audiology students did not participate in the didactic session, their survey focused solely the screening experience. and was administered electronically immediately following the activity. Survey completion was voluntary and responses were confidential.

Dental hygiene and DHE students were asked to complete a post-program survey and provide feedback following the didactic session. The survey was disseminated electronically via Qualtrics® survey software (Provo, UT) using an anonymous link; completion was voluntary and consent was attained by completion of the survey. The Wilcoxon Signed Rank Test was used to analyze participant's reported retrospective ratings before and after the educational experience.

Results

Participation in the auditory screenings was high; a total of 37 (n= 33 DH; n= 4 DHE) auditory screenings were completed yielding participation rates of 94% and 67%, respectively. A total of 35 students (n= 32 DH; n= 3 DHE) completed the post-program survey for response rates of 94% and 50%, respectively. Eighteen participants indicated this was their first hearing assessment supervised by an audiologist. Eligibility, participation and response rates are shown in Table I.

Table I. Frequency and distributions of DH and DHE student participation in the auditory screening, didactic session, and post-survey

	DH students	DHE students	All
Enrolled	34	6	40
Received Auditory screening	33	4	37
Attended Didactic Session	30	0	30
Completed Survey	32 (94%)	3 (50%)	35 (87.5%)

The vast majority (97%) of the participants agreed or strongly agreed that the auditory screening session was a valuable learning experience. Furthermore, all (100%) of the respondents felt that the didactic lecture component lecture component contained important information for dental practice and nearly all (94%) would recommend that this learning experience be included in the dental hygiene curriculum. When considering the value of this experience from an interprofessional perspective, all (100%) respondents agreed or strongly agreed that this experience increased their understanding of the importance of collaborating with other health professionals. Responses related to level of agreement for the screening and/or lecture experiences are shown in Table II.

Table II. Percentage of DH and DHE students who rated each item "agree" or "strongly agree" *

	n	%
Students who participated in the Audiology Screening (n=33)		
The audiology screening experience was well organized.	33	100
The audiology screening activity was a valuable learning experience.	33	97.0
Students who attended the Audiology Lecture (n=30)		
The audiology lecture contained important information for dental practice.	30	100
All student participants (n=35, DH n=32; DHE n=3)		
This experience increased my understanding of the importance of collaborating with other health professionals.	33**	100
This experience will increase my comfort level when collaborating with audiologists in the future.	33**	100
I would recommend that this audiology learning experience be included in the Dental hygiene curriculum.	35	94.3

* Based on a four-point rating scale: strongly agree, agree, disagree, and strongly disagree

** Total number of responses to question n=33

Respondents' self-assessment of their knowledge levels prior to and following the audiology intervention revealed changes in knowledge perceptions. Table III displays the results from the Wilcoxon Signed Rank Test demonstrating statistically significant changes in students' knowledge perceptions ($p < 0.05$) based on their experiences with the project.

Open ended questions allowed DH/DHE students to add qualitative feedback. Participants were asked to provide the least valuable aspects of the audiology experience and to describe how the quality can be improved. One participant stated, "I had to miss another class/commitment, so having multiple days to choose from for screenings would be great," while another felt "everything was valuable." When asked to share the most valuable aspects of the screening and lecture, comments included "how to communicate with patients with hearing loss," "discovering your level of hearing," "familiarity with audiology screening process and information on noise-induced hearing loss," and "knowing the repercussions of not wearing hearing protection."

Table III. Percentage of DH and DHE students who self-assessed their level of knowledge "moderately knowledgeable" or "very knowledgeable" *before* and *after* the audiology screening and/or lecture*

Level of knowledge about:	Before	After	p value
Students who attended the screening and/or lecture (n=35)			
The audiology profession	2.9%	85.7%	0.00
Students who participated in the audiology screening (n=33)			
Hearing assessment conducted by an audiologist	3.0%	84.8%	0.00
Students who attended lecture (n=30 DH)			
Noise induced hearing loss	3.3%	93.3%	0.00
Communicating with patients who have hearing loss	40.0%	93.3%**	0.00

* Based on a four-point rating scale: strongly agree, agree, disagree, and strongly disagree

** Prior to screening and didactic sessions, 40% of the students rated "moderately knowledgeable", while after, 43.3% rated "very knowledgeable."

Results from the separate audiology student survey provided additional data related to the value of the experience and suggestions for quality improvement. Four of the five audiology students (n=4) completed the survey for a response rate of 80%. When asked to rate their perceived value of this screening experience, 75% stated that it was somewhat or very valuable. Open ended suggestions regarding future interprofessional experiences included "having a dental school supervisor present to keep students moving through quickly and quietly," "the opportunity to screen more students," and "a small room for discussing results." Positive comments included "the flow of the screening went very well… It was nice having the Firefly™" (Firefly Global, Beaumont, MA); a wireless video otoscope that captures and stores high quality images/video of ear canal and tympanic membrane to a computer for patient education. Insightful comments were also collected regarding presentations/experiences that

the audiology students would be interested in receiving from the dental program and included "info on how to care for our teeth, myths about teeth care," "teeth whitening," and "a discussion about craniofacial abnormalities that both audiologists and dentists would likely serve." A final open-ended question asked for additional thoughts related to the experience. One participant suggested, "having a meet and greet with different professional health programs would be helpful in developing communication outside of disciplines."

Discussion

Hearing loss is multifactorial and complex and can result in varying effects on individuals' communication function and quality of life. Poor communication in healthcare settings related to hearing impairment can be especially problematic and may have significant adverse consequences similar to those related to low health literacy.[25] Missed or misunderstood healthcare information can lead to improper compliance with medications, scheduling and keeping requested appointments, preventive and pre- and post-surgical and other care instructions. Healthcare practitioners who understand the effects of hearing loss and use appropriate communication strategies can provide better patient care and facilitate audiology referrals if needed.[26-27]

Interprofessional collaboration in health care is critical as diagnoses and treatment are multifaceted and include a team of patient care providers. Teaching dental hygiene students necessary skills for appropriate care of patients with hearing loss may be more successful if IPE is part of the course design. Literature supports that interprofessional training of health care students can lead to the subsequent formation of collaborative practices following graduation.[24,28] Interprofessional collaborative practice, supported by the World Health Organization (WHO), provides a team-approach to person-centered care, leading to enhanced patient outcomes and improved quality of care.[29] However, learning how to care for patients using a team approach needs to be taught as part of the health care professional education curriculum.

Learning with students from other health care disciplines who care for patients with hearing impairments may also serve to provide an improved understanding of the various professional roles and responsibilities, including one's own, in providing comprehensive care for this population. These learning experiences could result in increased in communication and referrals between professions, increasing the individual providers' expertise and overall quality of patient care. Studies with physical therapy and audiology students using an interprofessional case-based learning experience in the education of vestibular disorders demonstrated gains in confidence attributed to the collaborative learning design.[30] In another study James et al. aimed to promote hearing health through a collaborative IPE experience focusing on hearing assessments conducted by audiology and physician assistant students.[24] Results from this study indicated that offering interprofessional learning opportunities significantly improved perceptions of achievement of interprofessional collaborative sub-competencies that included increased knowledge of the other's profession.

Understanding that hearing loss is an occupational risk for dental professionals can serve as a powerful preventive measure. If dental professionals are aware of the potential risks for hearing damage and loss, they may be more likely to recognize the early signs of hearing changes and also incorporate preventive measures, including the use of protective hearing devices during procedures with high noise levels and purchasing high-quality equipment that emits lower noise levels. Currently, little is known regarding the level of education that dental professionals receive during their training regarding noise-induced hearing damage. Goncalves et al. found the majority of dentists in their study had no training about noise and hearing thresholds and only half were knowledgeable about the harmful effects of noise on health.[8] It is essential to include more comprehensive information about work-related injuries, beyond musculoskeletal disorders, to better prepare current and future clinicians with strategies to prevent the development and progression of hearing damage accumulated by exposure to frequent and high noise levels.

Limitations and Future Plans

This initial project involved one cohort of DH, DHE and audiology students and therefore, the findings may not be generalizable to other groups of students. However, because of the very favorable results, the team plans to continue these didactic and audiology screening activities for subsequent dental hygiene and audiology cohort groups. Additional project benefits included collaboration among faculty from two disciplines, establishing new networking opportunities and possible future collaborative efforts. Increased collaboration and the development of interprofessional educational designs can be applied to other health professions programs, with the ultimate goal of increasing student learning experiences, improved personal health awareness of students' and ultimately better patient outcomes. Future plans also include an opportunity for the audiology students to visit the dental hygiene clinic to learn more about the dental hygiene profession.

Conclusion

This initial interprofessional educational activity was rated very favorably by the majority of the participants. Students reported increased levels of knowledge regarding the provision of dental hygiene care to patients with hearing impairment and regarding the profession of audiology. Participants also reported increased levels of comfort in collaborating with audiologists. From a personal health standpoint, dental hygienists and other oral health professionals are exposed to loud noises in clinical environments. Providing DH and DHE students with a baseline hearing screening can play a key role in identifying early issues related to hearing impairment and set the foundation for the use of protective measures to preserve hearing health throughout ones' professional career.

Jennifer L. Brame, RDH, MS is an associate professor, director of the graduate dental hygiene education program and interim director of the dental hygiene program in the Department of Periodontology, Adams School of Dentistry; ***Emma Gibbings, BS*** is a doctoral student in the Division of Speech and Hearing Sciences; ***Vicki Kowlowitz, PhD*** is an evaluation, teaching and learning consultant; ***Nancy M. McKenna, PhD. AuD*** is a clinical associate professor in the Division of Audiology and Hearing Sciences; ***Jane A. Weintraub, DDS, PhD*** is an adjunct professor of health policy and management, Gillings School of Global Public Health and the Alumni Distinguished Professor of dental ecology, Adams School of Dentistry; all at the University of North Carolina, Chapel Hill, NC.

Corresponding author: Jennifer L. Brame, RDH, MS; Jennifer_Brame@unc.edu

References

1. Commission on Dental Accreditation. Accreditation standards for dental hygiene education programs. [Internet]. Chicago: Commission on Dental Accreditation; 2018 Feb [cited 2018 Oct 23]. 44p. Available from: https://www.ada.org/~/media/CODA/Files/dental_hygiene_standards.pdf?la=en.
2. Vohr B. Overview: infants and children with hearing loss—part I. Ment Retard Dev Disabil Res Rev. 2003;9:62–4.
3. Hoffman HJ, Dobie RA, Losonczy KG, et al. declining prevalence of hearing loss in US adults aged 20 to 69 years. JAMA Otolaryngol Head Neck Surg. 2017 Mar1;143(3):274-85.
4. Dillon CF, Gu Q, Hoffman H, Ko CW. Vision, hearing, balance, and sensory impairment in Americans aged 70 years and over: United States, 1999-2006. NCHS Data Brief 2010 Apr;(31):1-8.
5. Chisolm, TH, Johnson, CE, Danhauer, JL, et al. A systematic review of health-related quality of life and hearing aids: final report of the American Academy of Audiology task force on the health-related quality of life benefits of amplification in adults. J Am Acad Audiol. 2007 Feb;18:151-83.
6. Chien W, Lin FR. Prevalence of hearing aid use among older adults in the United States. Arch Intern Med. 2012 Feb;172:292–3.
7. Bali, N., Acharya, S., Anup, N. An assessment of the effect of sound produced in a dental clinic on the hearing of dentists. Oral Health Prev Dent. 2007;5:187-91.
8. Goncalves CG, Santos L, Lobato D, et al. Characterization of hearing thresholds from 500 to 16, 000 Hz in dentists: a comparative study. Int Arch Otorhinolaryngol 2015 Apr;19:156-60.
9. Myers J, John AB, Kimball S, Fruits T. Prevalence of tinnitus and noise-induced hearing loss in dentists. Noise Health. 2016 Nov-Dec 18(85):347-54.
10. Burk A, Neitzel RL. An exploratory study of noise exposures in educational and private dental clinics. J Occup Environ Hyg. 2016 Oct 2; 13(10): 741–9.
11. Theodoroff S, Folmer R. Hearing loss associated with long-term exposure to high-speed dental handpieces. Gen Dent. 2015 Jun;63(3):71–6.
12. Messano GA, Petti S. General dental practitioners and hearing impairment. J Dent. 2012 Oct; 40:821-8.
13. Daud M, Noh N, Sidek D, et al. Screening of dental staff nurses for noise induced hearing loss. B-ENT. 2011;7(4):245–9.
14. Khaimook W, Suksamae P, Choosong T, et al. The prevalence of noise-induced occupational hearing loss in dentistry personnel. Workplace Health Saf. 2014 Sep;62(9):357–60.
15. Tarsitani G, Bellante DeMartiis G, Petti S, et al. Environmental comfort in 2 Roman dental clinic complexes. An Ig. 1996 Jan-Feb; 8(1):93-101.
16. Choosong T, Kaimook W, Tantisarasart R, et.al. Noise exposure assessment in a dental school. Saf Health Work 2011 Dec;2(4):348-54.

17. Chopra A, Thomas BS, Mohan K, Sivaraman K. Auditory and Nonauditory Effects of ultrasonic scaler use and its role in the development of permanent hearing loss. Oral Health Prev Dent. 2016;14(6):493-500.

18. Merrell HB, Claggett K. Noise pollution and hearing loss in the dental office. Dental Assist J 1992; 61(3):6-9.

19. Wilson JD, Darby ML, Tolle SL, Sever JC. Effects of occupational ultrasonic noise exposure on hearing of dental hygienists: a pilot study. J Dent Hyg 2002 Fall; 76(4):262-9.

20. Lazar A, Kauer R, Rowe D. Hearing difficulties among experienced dental hygienists: a survey. J Dent Hyg 2015 Dec; 89(6): 378-83.

21. Bowman DC, Blanchet LJ, Doemling DB. Temporary auditory threshold shift from following sophomore operative technique laboratory. J Dent Educ. 1980 May 44(5): 261–3.

22. Kujawa, SG, Liberman, MC. Synaptopathy in the noise-exposed and aging cochlea: primary neural degeneration in acquired sensorineural hearing loss. Hear Res. 2015 Dec; 330(Pt B):191–9.

23. American Academy of Audiology. Scope of practice [Internet]. Reston: American Academy of Audiology; 2004 [cited 2018 Mar 10]; [about 3 screens]. Available from: https://www.audiology.org/publications-resources/document-library/scope-practice

24. James J, Chappell R, Mercante DE, Gunaldo TP. Promoting hearing health collaboration through an interprofessional education experience. Am J Audiol. 2017 Dec 12;26(4):570-5.

25. Cudmore V, Henn P, O'Tuathaigh CMP, Smith S. Age-related hearing joss and communication breakdown in the clinical Setting. JAMA Otolaryngol Head Neck Surg. 2017 Oct 1;143 (10):1054–5.

26. Iezzoni LI, O'Day BL, Killeen M, Harker H. Communicating about health care: observations from persons who are deaf or hard of hearing. Ann Intern Med. 2004 Mar 2;140(5):356–62.

27. Henn P, O'Tuathaigh C, Keegan D, Smith S. Hearing impairment and the amelioration of avoidable medical error: a cross-sectional survey. J Patient Saf [Internet]. 2017 Feb 16 [cited2018 Sept 10]; [Epub ahead of print]. Available from: https://insights.ovid.com/crossref?an=01209203-900000000-99541.

28. Pecukonis, E, Doyle, O, Bliss, D. Reducing barriers to interprofessional training: promoting interprofessional cultural competence. J Interprof Care. 2008 Aug; 22(4), 417–28.

29. World Health Organization. Framework for action on interprofessional education and collaborative practice [Internet] Geneva: WHO Press; 2010 [cited 2018 Aug 1]. 64p. Available from: https://apps.who.int/iris/bitstream/handle/10665/70185/WHO_HRH_HPN_10.3_eng.pdf;jsessionid=F624158ACB33F451759F27A68243CF4F?sequence=1.

30. Trommelen RD, Herbert L, Nelson TK. Impact on physical therapy and audiology students of an interprofessional case-based learning experience in education of vestibular disorders. J Allied Health. 2014 Winter; 43(4):194-200.