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Original Study

Otolaryngology in Medical Education: Hands-on Training at an SRFC Community Site Improves Medical Student Knowledge and Skills

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Abstract

Background: There are known otolaryngology education gaps and exposure inequalities in existing medical school curricula. It has been shown that students participating in otolaryngology instruction sessions emerge with increased knowledge and confidence in skills. The population our student-run free clinic serves is high-risk for head and neck cancers, and evidence has shown that clinical exams are a very effective tool for early detection of these lesions. In this study, our clinic offered head and neck cancer screening events to meet community needs as well as student training nights to meet student education needs.
Methods: Medical students of all training levels were invited to participate. Participating students first completed a pre-training interests and skills assessment survey and a knowledge test. Students then attended a training night led by otolaryngology residents that included an educational lecture and hands-on skills practice. Afterwards, students re-took the knowledge test. One week later, students participated in the live screening event at the clinic. Afterwards, students completed another interest and skills assessment survey.
Results: Sixty students attended our three student training nights. Pre-participation (n=53), 52.5% of students were interested in otolaryngology as a specialty, most students felt little to no confidence in performing a general head and neck exam (66%) or taking a head and neck cancer history (81%), and the average knowledge test score was 58% correct. The post-training (n=41) average knowledge test score increased to 78.3% correct, a statistically significant increase ($p < 0.001$). Post-event participation (n=20), most students reported increased interest in otolaryngology (75%), and improved confidence in performing an exam (95%) and taking a history (95%).
Conclusions: Participation in our student training night and head and neck cancer screening event increased students' interest in otolaryngology as a specialty, their confidence in otolaryngology physical exam skills and their knowledge about head and neck cancer.

Introduction

Student Run Free Clinics (SRFC) are health clinics operated by professionally supervised medical students, undergraduate students, and other pre-health professions trainees that aim to provide medical care to underserved populations within their local communities. Within those communities, SRFCs hold three primary functions: promote health equity, advocate for the needs of the people they serve, and serve as an educational tool for the medical students and

other volunteers that staff the clinic.[1] The educational value of SRFCs has been demonstrated by studies illustrating how participation improves students' understanding and evaluation of primary care complaints as well as knowledge about public health principles through projects such as vaccination and screening efforts.[2-4]

Additionally, SRFCs can provide exposure to subspecialty care. This is particularly important to note as current medical school curricula are in need of alternative experiences and training opportunities that facilitate exposure to subspecialty care. A recent survey of allopathic medical schools showed less than one in ten medical schools have a required clinical rotation in otolaryngology, or the study of diseases of the ears and throat, and just over half have a required preclinical otolaryngology module.[5] Furthermore, surveys of medical students and non-otolaryngology residents demonstrate a lack of confidence in otolaryngology skills and knowledge.[3,5-7] Together, these points suggest that United States medical school curricula may not provide sufficient education in otolaryngology, indicating opportunities for improvement and supplementation.

In 2022, the University of Cincinnati (UC) SRFC identified a need for head and neck cancer (HNC) screenings within the served patient population, who were both at risk for such cancers and more likely to have barriers to accessing screening. Tobacco use, alcohol use, and human papilloma virus (HPV) infection are well-known risk factors for HNC in all populations, but are factors known to be especially prominent in individuals of lower socioeconomic and minority status, such as those served by the UC SRFC.[8-10] Early detection of cancerous lesions improves survival rates and clinical exams are an effective method of screening, yet clinic leaders and personnel reported lack of time, resources and training to offer HNC screening as a routine part of care.[11] To address the problem, student leaders secured grant funding and established partnerships with the institution's Departments of Otolaryngology and Family & Community Medicine to offer HNC screening services.

The primary objective of the project was to screen patients for HNC and connect them with healthcare resources for follow-up. The secondary objectives were to evaluate the impact of participation in dedicated training sessions and HNC screening events on medical student participants' knowledge of HNC and otolaryngology skills as well as interest in working with vulnerable populations. The purpose of this manuscript is to report on our secondary outcomes and the process of starting an otolaryngology skills training night for medical students, and the primary outcomes will be reported on at a later date.

Methods

In this Institutional Review Board-approved non-human subjects study, students were invited to participate in both HNC training nights and screening events. Students were eligible to participate if they were enrolled at the University of Cincinnati College of Medicine, and there were no exclusion criteria.

To promote student learning and ensure patient safety and quality of care, medical students were required to participate in an otolaryngologist-led training session prior to involvement in any screening event. At screening events, students were supervised by otolaryngology residents and attending physicians.

Prior to training, students filled out a survey with questions regarding demographic information, prior experience with otolaryngology, self-assessment of skills needed for a HNC screening exam, and interest in working with vulnerable populations and also took a pre-training assessment on HNC knowledge. Prior experience with otolaryngology was defined to include self-reported extracurricular experiences, such as shadowing, research or clinical electives, that were completed beyond the basic curriculum all students receive at the end of their first year at our institution. Students then attended the training night involving an informational lecture presented by otolaryngology residents followed by a resident-guided skills session addressing key elements of the otolaryngology exam and flexible laryngoscopy, which is a procedure done to examine the internal anatomy of the pharynx. The informational lecture covered head and neck anatomy, head and neck cancer epidemiology, the reasoning behind screening, cancer risk factors and risk reduction strategies, concerning

symptoms, a brief overview of the workup of concerning lesions, and a thorough overview of how to do a focused physical exam of the head and neck. The skills training consisted of three stations: one to practice physical exams with gloves, head lamps, dental mirrors and tongue depressors; one to practice flexible laryngoscopy on a simulation model; and one to practice flexible laryngoscopy on a live resident volunteer who had been numbed with lidocaine spray and was able to assist with identifying anatomy. One hour after completion of the training night, students filled out a post-training knowledge assessment. Pre- and post-training knowledge questions were identical.

The screening event was held in October of 2022 in the same location as the UC SRFC. Student volunteers helped patients complete intake paperwork asking about HNC risk factors, prior screening and prevention history, and a short patient knowledge survey. Students then accompanied the patient to an otolaryngology resident screening station where intake paperwork was reviewed and a thorough screening exam was performed, supervised by attending physicians. Afterward, the student and resident discussed the findings with the patient and facilitated a conversation about next steps including any necessary follow up at the otolaryngology clinic or elsewhere. If indicated, a flexible laryngoscopy exam could be performed on site, led by the resident physicians. After completing all examinations, the student guided the patient to check out, where educational materials were provided and reviewed and plans for follow-up were confirmed.

After participation in this event, students completed a post-event survey asking about current interest in otolaryngology, comfort with physical exam skills, confidence in knowledge-based tasks, and ability and interest in working with vulnerable populations.

The survey questions used for students to self-assess skills as well as multiple-choice questions used to objectively assess student knowledge are included in Table 1 and Table 2, respectively. All surveys were reviewed and edited by the clinic's supervising faculty as well as senior otolaryngology residents at the University of Cincinnati Medical Center. PowerPoint (v16.66.1, Microsoft, Redmond, WA) slides used in the informational lecture as well as complete versions of surveys can be provided to interested parties upon request.

Table 1. Skills self-assessment survey questions

Questions*
How confident are you in your ability to perform a general head and neck cancer screening history?
How confident are you in your ability to perform a head and neck cancer screening history?
How confident are you in your ability to perform a head and neck cancer screening exam?
How confident are you in your ability to determine next steps after an abnormal head and neck cancer screening exam?
How confident are you in your ability to counsel patients on head and neck cancer prevention?

**Five answer choices for each question were available: not at all, slightly, moderately, quite, and extremely*

Table 2. Knowledge test questions

Questions*
What are the two most important risk factors for head and neck cancer?
Infection by which of the following increases the risk of developing head and neck cancers?
Head and neck cancers make up about what percentage of cancer diagnoses in the United States?
What is the most common type of head and neck cancer?
Which of the following is the most common anatomic location for head and neck cancer to appear?
In what age group are head and neck cancers typically diagnosed?
Do males or females have an increased risk of developing head and neck cancer?
Which of the following are symptoms concerning for head and neck cancer?
Which of the following activities can best lower the risk of head and neck cancer?
Which of the following anatomic locations should be inspected when doing a head and neck cancer screening exam?
What is the survival rate for head and neck cancers detected early in stage I or stage II?
What is the most appropriate next step after a patient has a positive head and neck cancer screening exam?

**Each question was multiple-choice. All questions had at least 1 correct answer, and some questions had multiple correct answers. For those questions with multiple correct answers, students were allowed to select more than one answer choice.*

Table 3. Demographic factors (N=53)

Demographic	Participants, n (%)
Level of training	
M1	30 (56.6)
M2	8 (15.1)
M3	10 (18.9)
M4	2 (3.8)
MSTP	3 (5.7)
Gender	
Male	20 (37.7.)
Female	33 (62.3)
Age	
20-24	30 (56.6)
25-29	21 (39.6)
30-34	2 (3.8)

M1: first-year medical student; M2: second-year medical student; M3: third-year medical student; M4: fourth-year medical student; MSTP: Medical Scientist Training Program.

Table 4. Top specialty of interest (N=53)

Specialty	Participants, n (%)
Otolaryngology	14 (26.4)
Internal medicine subspecialty*	7 (13.2)
Non-otolaryngology surgical subspecialty†	6 (11.0)
Family medicine	4 (7.5)
Pediatrics	4 (7.5)
Dermatology	2 (3.7)
Emergency medicine	2 (3.7)
Anesthesia	1 (1.8)
General Surgery	1 (1.8)
Internal Medicine	1 (1.8)
Med-Peds	1 (1.8)
Neurology	1 (1.8)
Obstetrics and gynecology	1 (1.8)
Ophthalmology	1 (1.8)
Psychiatry	1 (1.8)
Radiation oncology	1 (1.8)
Radiology	1 (1.8)
Undecided	4 (7.5)

**Represents hematology oncology (5), cardiology (1), pulmonology (1); †Represents cardiothoracic surgery (1), neurosurgery (2), orthopedic surgery (1) and plastic surgery (2).*

All data was analyzed using descriptive statistics. Additionally, the knowledge test questions were scored and then underwent bivariate analyses of paired sample t-tests and Cohen's d using SPSS (v28, IBM, Armonk, NY).

Results

Demographics

A total of 60 students attended three student training nights. Fifty-three students filled out the pre-training interest survey and knowledge test (88.0% response rate), and 41 students filled out the post-training knowledge test (77.0% response rate). Thirty-two students attended the screening event and 20 students filled out the post-event interest survey (62.5% response rate). Demographic data is listed in Table 3. Most participants were in their first year of training (56.6%), were female (62.3%) and had a mean age of 24.6 years. Most students reported their leading motivation for participation was to practice clinical skills (43.4%), but a large number also wanted increased exposure to otolaryngology (34.0%).

Specialty Interest

Participants' specialties of interest are listed in Table 4. Most students were interested in otolaryngology (26.4%), although there was a wide range of specialty interests represented (22). Of students wanting to enter internal medicine subspecialties (13.2% of total students), the most common specialty was hematology-oncology (71.4% of students interested in internal medicine subspecialty, 9.4% of total students). Only otolaryngology as a specialty choice increased in frequency of student interest between pre-training and post-event, with 66.0% reporting a moderate or great interest initially and 75.0% of students reporting more or much more interest after the screening event.

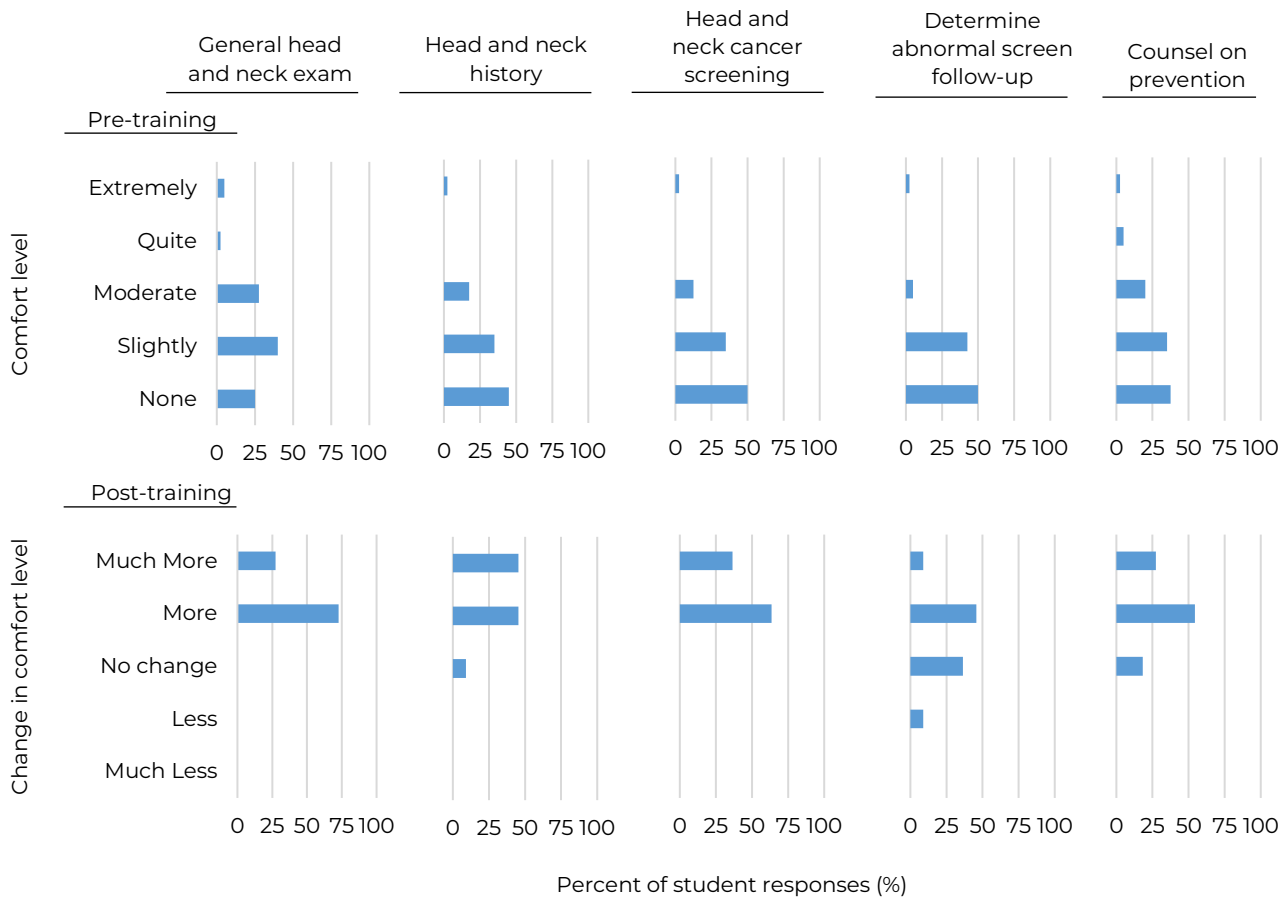
Otolaryngology Contact

Most students had no prior otolaryngology experience (83.0%). Additionally, before the training night, only 35.9% of students stated feeling quite or extremely comfortable reaching out to the otolaryngology department. After the screening event, the majority (85.0%) reported feeling more or much more comfortable.

Confidence in Otolaryngology Skills

Student confidence prior to the training night

Figure 1. Comfort level pre- and post-training



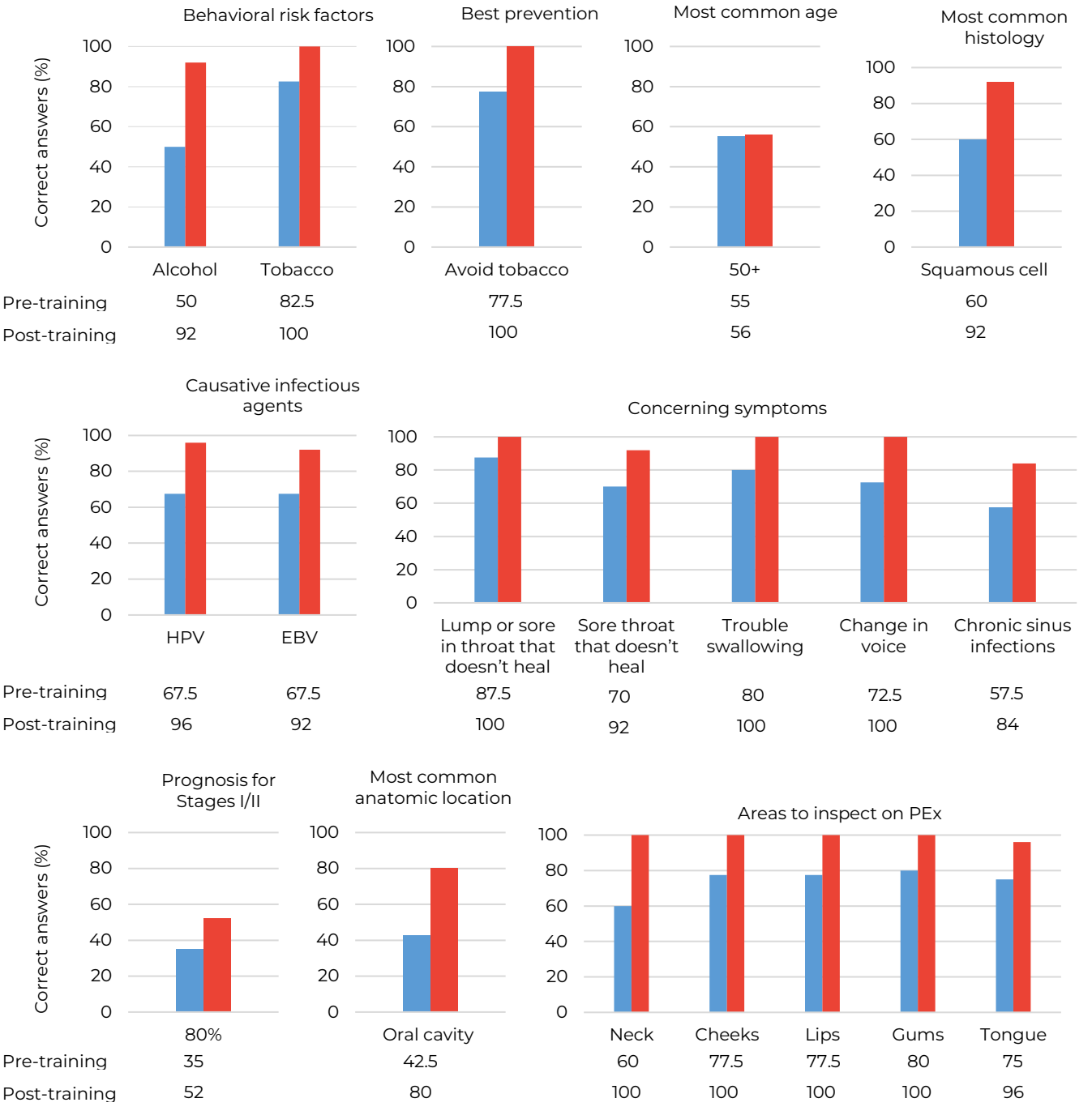
and after the screening event are listed in Figure 1. Before the training event, most students felt little to no confidence in their ability to perform a general head and neck exam (66.0%), take a HNC history (81.2%), perform a HNC screening exam (84.9%), determine appropriate next steps after an abnormal head and neck screening exam (88.6%), or counsel a patient on HNC prevention (73.6%). After the screening event, 100% of students felt more or much more confident in their ability to perform a HNC screening exam, 95.0% of students felt more or much more confident in their ability to perform a general head and neck physical exam and take a HNC history, and 85% of students felt more or much more confident in their ability to counsel on HNC prevention. Regarding ability to determine next steps following an abnormal screening exam, 55.0% of students felt more or much more confident and 5.0% reported feeling less confident.

Head and Neck Cancer Knowledge

The mean number of correct answers pre- and post-training was 7 (58.0%) and 9.4 (78.3%) respectively out of a possible 12. This was found to be a statistically significant increase in scores ($p<0.001$) and the effect size was medium at 0.592 (95% CI 0.261-0.917).

The percentage of correct answers to the knowledge questions before and after training are presented in Figure 2. Most questions showed improvement including identification of alcohol and tobacco as high-risk behaviors, identification of HPV and Epstein-Barr virus (EBV) as viruses that can cause cancer, identification of concerning symptoms, and identification of important areas to examine during physical exam. Few questions had low correct responses both pre-training and post-training. Questions that did not demonstrate improvement included the most common age of diagnosis (68.0% pre-training correct,

Figure 2. Percentage of correct answers to knowledge questions pre- and post-training



HPV: human papillomavirus; EBV: Epstein-Barr virus; PEx: physical exam.

63.4% post-training correct) and survival rate for HNC if diagnosed early in stage I or II (42.0% pre-training correct, 58.5% post-training correct).

Vulnerable Populations

Regarding working with vulnerable populations on the pre-training survey, the majority of students (84.9%) stated they were quite or extremely interested, but the most common (43.4%) answer regarding ability to care for vulnerable populations was feeling only moderate confidence. After the screening event, the

majority of students indicated more or much more interest (70.0%) and confidence (75.0%) in working with vulnerable populations.

Discussion

SRFCs hold value for both the communities they serve and the student learners who staff them. Together, SRFCs across the country provide care to over 140,000 patients annually.[12] The students providing that care have the opportunity to apply knowledge, practice skills and gain exposure to subspecialties that may not otherwise be emphasized in traditional curricula. For this project, the invitation to participate in the SRFC HNC screening training night was open to any medical student with any specialty interest or experience level at University of Cincinnati. While otolaryngology was the most represented specialty of interest, there were 21 other specialties represented, suggesting that such events hold value for students with a wide range of specialty interests.

Attendance from a group of students interested in primary care is encouraging as up to one fifth of adult visits and up to one half of pediatric visits to primary care providers are for otolaryngology-related complaints.[13-15] Despite this fact, studies have shown that many primary care residents do not feel adequately trained from medical school to address such complaints and desire more training on related topics.[16-18] Prior studies demonstrate that residents in non-otolaryngology specialties score the same on an otolaryngology knowledge quiz as fourth year medical students and only slightly higher than second year medical students.[19,20] These findings importantly highlight that medical school may represent the most significant, and potentially only, training that non-otolaryngology residents receive in otolaryngologic workup and examination. However, a survey administered to United States medical schools found that the majority teach otolaryngology during the anatomy lab curriculum and provide a lecture during the first year of training without requiring any clinical exposure in later years.[5,16] Furthermore, as of 2017, a third of schools reported no mandatory preclinical otolaryngology clinical skills training.[5] Thus, the quality and variety of otolaryngology-related curricula and experiences in medical school is crucial.

Despite the relative lack of otolaryngologic training opportunities in medical school, there is a demand for it. Given 83% of participants in this study had no prior otolaryngology experience and 75% reported increased interest in otolaryngology as a specialty after attending the training session, this intervention served to increase exposure to the field and thereby positively impact students

The UC SRFC HNC training and screening event proved beneficial to student's physical exam skills. Prior to the training night and screening event, there were low rates of confidence in physical exam skills. This is in keeping with other studies that have also revealed medical students' lack of confidence in such skills.[3,5-7] This is particularly noteworthy, as studies comparing students' self-assessment of their skills to scores from professional evaluators have shown students' own assessments to be accurate or even over-estimated.[21,22] In this study, 100% of students reported feeling more confident in completing a cancer-focused physical exam and 95% reported increased confidence in both taking a history and in performing a general head and neck exam. This data adds to growing evidence that dedicated otolaryngology education sessions combined with hands-on practice improves student confidence in skills.[3]

There are well-known medical student knowledge gaps regarding HNC including identification of HPV as a cancer-causing virus, chronic alcohol use as a significant behavioral risk factor, and concerning symptoms warranting further workup.[3,19,20,23-27] Our study revealed statistically significantly increased HNC-focused knowledge on post-training surveys, and similar studies have shown promising knowledge retention as far out as 3 months.[3] Importantly, we saw marked improvement on questions most important for clinical practice beyond otolaryngology such as behavioral risk factors, cancer-causing viral agents, common anatomic locations, concerning symptoms, mitigating risk, and where to inspect on physical exam. A strong foundation of knowledge on these topics will help students in any clinical setting identify patients requiring an otolaryngology referral or a more thorough head and neck exam. Some

questions, however, did not demonstrate improvement after participation, including the most common age and gender of patients developing head and neck cancer. Although the lack of knowledge gained on these topics is discouraging, this content is not imperative to clinical practice, especially for the medical student level. As such these topics may not have been a significant area of focus for students as they prepared for and worked at the screening event. Furthermore, given our screening event saw a wide range of ages and more females than males, it could be that their perception of patients at risk was influenced by their experience.

Student participants reported increased confidence in knowledge-driven skills, including determining next steps after an abnormal screening exam, with 55% of students feeling more confident after participation. Although a significant portion of students demonstrated an increase in confidence in this skill, 5% of students reported decreased confidence. The decreased confidence reported by some participants may have been due to an increased appreciation of their own limitations in the care of complex issues like head and neck cancer or because many of the patients screened also had additional concerns that were discussed during their screening. Regardless, these figures illustrate the value of such educational initiatives as an opportunity to show students their own limitations and opportunities for growth. Additionally, despite the self-reported confidence, 100% of students did select the correct choice of "refer for specialist follow-up" as the next best step after an abnormal screening exam, indicating they did, indeed, know the next steps. Furthermore, more than three-quarters of students felt more or much more confident in counseling patients on reducing risk of HNC after participation. We are also reassured that this increase in confidence is sound, as 100% of students correctly answered the knowledge question about how to lower risk, compared to 77.5% of students that correctly answered it on the pre-training survey.

Student participants reported a strong interest in working with vulnerable populations with 84.9% quite or extremely interested prior to participation. Yet the majority also responded that they were moderately confident in their ability to work with vulnerable populations. This is similar to data on resident physicians, which suggests that volunteer rates in underserved communities fall drastically after medical school.[28] Both interest and confidence further increased after the screening event. While we do not assume a one-time participation in a training and screening event is enough to make a lasting long-term impact on a student's desire to serve underserved populations, we hope that participation may encourage students to pursue similar opportunities in the future.

Limitations of this project include a relatively small sample size that continued to decrease with each survey. Although there is not a clear reason for the attrition seen in this study, it is consistent with attrition seen in similar, survey-based studies with medical student participants and is important to consider as a potential source of bias. Additionally, we only assessed alterations to overall comfort and interest levels rather than asking students to respond more specifically, impeding the extent of our statistical analyses. Also, there was self-selection intrinsic to the nature of the study which may have influenced our results. Participation in the training night and screening event was voluntary, so students that enrolled may have been more likely to enroll because of prior experience or interest in the field. Second, slightly over a quarter of participants reported previous interest in otolaryngology which may have introduced bias into survey responses on confidence in exam techniques as well as knowledge about HNC and key risk factors. That said, we had insufficient data to eliminate potential confounders using subgroup analyses. For example, stratifying by previous exposure, training level or specialty interests may be beneficial, and we would encourage future studies to incorporate such analyses.

Finally, we believe the framework for this project is cost-effective and accessible for any SRFC interested in implementing screening projects. Although the flexible laryngoscopy simulation training was an added benefit for our trainees, this content was not covered in our pre-/post-training evaluations and the training materials were supplied by our institution's otolaryngology department. If supplies are not available, this portion of the training could be omitted, and skills

training could instead focus solely on the physical exam.

Conclusion

Participation in a two-step student training night and screening event was beneficial to medical students' exposure to otolaryngology, confidence in otolaryngology skills and knowledge about HNC. Furthermore, it increased student interest and self-efficacy in the future care of vulnerable populations. In the future it is important to better classify what each student training level is gaining from these types of events to better tailor them to varying student needs.

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Disclosures

The authors have no conflicts of interest to disclose.

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