

Foot Screening Education and Tool to Increase Foot Exams for the Homeless

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Abstract

Comprehensive foot exams are essential assessments for those with cardiovascular and endocrine disorders. The performance of this type of screening can help to detect lower extremity disorders, thereby preventing long-term complications like infections and amputations. Homeless persons in Hawai'i are highly susceptible to lower extremity disorders due to unknown disease status, poor lifestyle, and harsh environment. They rely on their feet for survival and would benefit from having this assessment to sustain mobility and quality of life. The Hawai'i Homeless Outreach and Medical Education (HOME) project, a mobile-based clinic managed by the University of Hawaii John A. Burns School of Medicine, was ideal for providing this service. The purpose of this evidence-based quality improvement project was to provide training on how to do comprehensive foot exams to the medical students who performed patient assessments. The training was delivered via PowerPoint and was supplemented with a foot exam ID tool for portable use. Data was collected from pre-training and exit surveys to assess knowledge of comprehensive foot exams and the use of the tool. The results showed a 29.86% increase in students performing this exam and a significant shift in proficiency before training compared to after. Also, 94.4% of students taking the exit survey were able to name at least one component of the exam, and 70.0% were able to name all the exam components. Of these students, 73.3% claimed the tool helped them identify issues they would have overlooked, and all would recommend the tool for future rotating students. Lastly, 95% said the training was helpful. In conclusion, the project showed positive results and gave evidence for training continuation. Though limitations were found regarding project setting and personnel delivering the training, it was established that the training is essential to this population and should be available for future rotations at the HOME clinic.

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Foot Screening Education and Tool to Increase Foot Exams for the Homeless

Introduction

Foot conditions and disorders are prevalent concerns that can manifest through chronic illnesses like diabetes and hypertension, especially if these conditions go undetected or unmanaged for periods of time. These can increase the risks for trauma, infection, and amputations, and in turn, significantly increase patient morbidity and community healthcare costs (Muirhead, Roberson, & Secrest, 2011). This is especially true in homeless populations where mobility is linked to survival. Hawaii has a growing homeless population that is constantly on the move, and mobility is a function they cannot afford to lose. The environmental factors of warm and wet conditions combined with poor hygiene, ill-fitting footwear, and constant movement are prime factors for the development of debilitating foot problems (Maness, 2014; Muirhead et al., 2011; To, Brothers, & Van Zoost, 2016).

Hawaii's homeless are an ever-present topic in the local media and represent a steadily growing problem. From 2015 to 2018, the homeless population in Hawaii has increased from 45.1 individuals per 10,000 to 55.4 (Islander Institute, 2018), with a rough total of 4,448 homeless individuals on the island of Oahu alone during the state's most recent Point in Time count (Partners in Care, 2020). The populations found to be most at risk of homelessness are native Hawaiians/Pacific Islanders (NHPI) and those of multiracial background of which 82% identify in part as NHPI (Partners in Care, 2020). It is no surprise that diabetes parallels the homeless risk of this population and is also increasing among Pacific Islanders and other minorities, particularly Filipinos, who make up a large part of Hawaii's population (Uchima, Wu, Browne, & Braun, 2019).

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Undiagnosed and unmanaged chronic diseases eventually manifest as debilitating and costly conditions like amputations. The cost of hospital charges from lower extremity amputations in Hawaii averaged \$114,917 in 2014 (Amputee Coalition, 2019). Unfortunately, amputations due to diabetic complications are projected to rise among younger to middle-aged individuals (Geiss et al., 2019). Lower extremity amputations impede the mobility of a population whose survival is dependent on it and is associated with poor outcomes such as decreased quality of life, increased depression and anxiety, and increased mortality rates, reaching 70.9% three years after amputation (Girijala & Bush, 2018).

For many healthcare providers who care for the homeless community, foot problems may be the least of their concerns and are not always the primary issue their patients seek care. Consequently, many foot ailments that could be addressed and remedied are unintentionally ignored. Problems such as corns, blisters, calluses, wounds, and infections may go on for extended periods without proper attention and lead to much more significant complications. Patients themselves may think that these issues are trivial, or they may be too self-conscious to share them, which is why healthcare workers should take the time to address foot issues with those who are homeless (Packett, Oswald, Bronson, & Kraushar, 1991). Additionally, regardless of underlying disease status, proper attention to foot screening, hygiene, and education can prevent attenuating events, increase the quality of life, and lower community healthcare costs (Chen, Mitchell, & Tran, 2012; Packett et al., 1991; To et al., 2016).

Needs assessment

With the increase of homeless persons, there has been an increased need for healthcare services, mostly in the form of easily accessible clinics. Mobile clinics such as the HOME project (Hawaii Homeless Outreach and Medical Education) have been developed to address this

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growing healthcare need. Run through the John A. Burns School of Medicine (JABSOM), the HOME project is staffed by medical students and volunteer medical personnel. This mobile clinic visits various locations across Oahu and provides free vision services, chronic disease management, wound care, treatment of acute illnesses, and handles vaccines and medication administration. In the most recent Touchpoints on Homelessness report, the Hawaii HOME project was mentioned as a “bright point” for homeless individuals seeking non-emergency medical attention and is a critical factor in preventing costly future hospital visits (Thornton, Koshiba, & Lee-Ibarra, n.d.). While lower extremity skin disorders are common in the local homeless population, medical students may inadvertently miss footcare issues if they are not one of the chief complaints (J. Omori, H.O.M.E. Program Director, personal communication, January 23, 2020). These students also may not have had prior exposure to this population or have had encounters where such an assessment was performed. For this reason, there is a need to provide the students with systematic training in lower extremity assessment and foot care education and provide them with a tool to guide their assessments throughout their rotation.

Literature synthesis

Literature Review

Pubmed and CINAHL (Cumulative Index to Nursing and Allied Health Literature) databases were used to search the literature for articles on *foot screenings for homeless* and *foot screening tools*. Unfortunately, the terms *foot screenings AND homeless*, along with variations of both terms (*foot exams, foot care, homelessness, or houseless*), yielded few results pertaining to tools or the actual screening process. Articles mentioned the need for foot screenings to be performed and the types of foot conditions present in that population but did not help support the project. The search was expanded to include diabetic foot exams, diabetic foot screenings, foot

screening tools, foot exam tools, and foot screening guidelines due to limited results. Both database findings revealed a saturation of articles published between 2000-2020. Boolean phrases were added but, unfortunately, did not help to narrow down the number of citations. An attempt to specify studies performed in the United States reduced the number of results far too low for any synthesis to be made, as many studies were performed internationally, which suggested a need for more such measures to be implemented in the United States. Although the search was saturated, many articles of interest were not available through the University of Hawaii library system. They were requested, but many did not come back in time for consideration. A few source articles mentioned within the reviewed literature were also included in the synthesis. In total, 49 articles were reviewed.

Grading

The literature was graded using the John Hopkins Evidence Level and Quality Guide (Table 1). This system was chosen because it helps guide evidence grading and gives recommendations of the next steps in the EBP pathway. Permission to utilize evidence grading was obtained and is available upon request.

Table 1.

John Hopkins Level of Evidence and Number of Relevant Articles

John Hopkins Level of Evidence	Number of Articles (Total 49)
Level I: Experimental study, randomized controlled trial (RCT) Systematic review of RCTs, with or without meta-analysis	4
Level II: Quasi-experimental study, systematic review of a combination of RCTs and quasi-experimental, or quasi-experimental studies only, with or without meta-analysis	10
Level III: Non-experimental study, systematic review of a combination of RCTs, quasi-experimental and non-experimental studies, or non-experimental studies only, with or without meta-	13

analysis, qualitative study or systematic review with or without a meta-synthesis

Level IV: Opinion of respected authorities and/or nationally recognized expert committees/consensus panels based on scientific evidence. Includes clinical practice guidelines and consensus panels 5

Level V: Based on experiential and non-research evidence 17
Includes literature reviews, quality improvement, program or financial evaluation, case reports, opinion of nationally recognized experts(s) based on experiential evidence

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Literature Synthesis

Foot screening recommendations. Studies for the development of foot screenings and tools utilized recommendations from larger institutional bodies like the American Diabetes Association (ADA), the International Working Group for the Diabetic Foot (IWGDF), the International Diabetes Federation (IDF), and the Scottish Intercollegiate Guidelines Network (SIGN). Several guidelines for exam recommendations were reviewed (American Diabetes Association, 2019; Ibrahim, 2017; International Diabetes Federation, Sinclair, Dunning, & Colagiuri, 2013; Schaper et al., 2020, Scottish Intercollegiate Guideline Network, 2017). One systematic review compared ten guidelines (Cynthia Formosa, Gatt, & Chockalingam, 2016). The authors reported consistencies in the following areas recommended by all 10 guideline providers: peripheral neuropathy, peripheral vascular disease, inspection and provision of footwear, foot deformation, patient foot care education, and frequency of assessment and screening. However, the authors also mentioned numerous inconsistencies and identified that recommendations were based on low levels of evidence, if there was evidence at all. Amidst drawbacks, the authors recommended looking for commonalities among the guidelines when deciding what to incorporate in a foot exam. Another systematic review of 12 guidelines

concluded the same thing (Pérez-Panero, Ruiz-Muñoz, Cuesta-Vargas, & González-Sánchez, 2019).

A previously published study also compared guidelines and concluded that screening recommendations and risk stratifications, though somewhat different, were highly accurate, but that healthcare institutions would benefit more if there were a unified system in place (Monteiro-Soares, Vaz-Carneiro, Sampaio, & Dinis-Ribeiro, 2012). Another systematic review/meta-analysis looked at screenings focusing on individual prognostic risk factors for diabetic ulceration among different cohorts (F. Crawford, Cezard, & Chappell, 2018). The authors found three risk factors were common among guideline recommendations and predictive of future ulcerations: a history of foot ulcers, inability to feel 10g monofilament, and absence of any pedal pulse.

Many unique articles presented good evidence supporting various exams and devices usually associated with sensory testing. They included physical exam of the lower extremities and sensory testing using a monofilament (Pham et al., 2000), the use of monofilament, tuning fork, and ankle brachial pressure index (ABI)(Shin, Seong, Lee, Kim, & Park, 2000), Michigan Neuropathy Screening Instrument (MNSI), ABI and optimal scaling combination (OSC) with MNSI and age (Chang, Peng, Chang, & Chen, 2013), qualitative waveform analysis and toe brachial pressure (Williams DT et al., 2005), paper grip test (Mahieu, Coenen, van Bommel, van der Zaag-Loonen, & Theuvenet, 2016), transcutaneous oxygen pressure (Zimny et al., 2001), and use of a neurothesiometer (Richard, Reilhes, Buvry, Goletto, & Faillie, 2014).

Literature reviews also saturated the search (Baker & Kenny, 2016; Farber DC & Farber JS, 2007; Kuhnke et al., 2013; Nather et al., 2018; Walker K, 2005). All articles reported that

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foot screenings were necessary in diabetes care, but the components reviewed and recommended differed depending on the guidelines chosen, preference, and place.

Foot screening tools. Foot screening tools included Inlow's 60-second diabetic foot screen (Murphy, Laforet, Da Rosa, Tabamo, & Woodbury, 2012), Amit Jain's triple assessment tool (Jain, 2018), the 60-second tool (Ayello, Sibbald, Ostrow, & Smart, 2012; Woodbury, Sibbald, Ostrow, Persaud, & Lowe, 2015), Healthy PEI foot screening tool (Mutch & Dewar, 2015), the Healthy foot screen (Persaud et al., 2018), the SCI-DC foot assessment tool and diabetic Risk Stratification and triage (Fay Crawford, Bekker, Young, & Sheikh, 2010; Leese et al., 2011), and the IDF Diabetic foot card (Ibrahim, 2017). Risk stratification guide associated with screening scores were provided to support most of the tools (Ibrahim, 2017; Leese et al., 2011; Murphy et al., 2012; Mutch & Dewar, 2015; Woodbury et al., 2015); however, both tool and risk stratification, though reliable, contained inconsistencies depending on which guideline was used for its creation. Commonalities among the tools were: the collection of medical history, inspection and identification of skin, nail, and foot deformities, and testing for neuropathy using a 10g monofilament. Differences included additional exams of checking pedal pulses, ankle reflex, range of motion, and vibrational sensation. The time to complete an exam was short, although some authors argue that actual screening times can take from 2 to up to 21 minutes for protocols reported to require 60-seconds and that risk stratification scores maybe too complicated (Woodbury et al., 2015). Two articles were pilot studies (Sibbald et al., 2019; Woodbury et al., 2015), while one communicated pilot intentions (Mutch & Dewar, 2015). Though there were differences among the tools and supporting evidence was lacking, basic components of the screenings and risk stratifications were similar and can be applied in practice.

Effectiveness of foot screening programs. Three quality improvement studies were included in the synthesis. All were published within the last three years and concluded that healthcare workers' education on how to conduct foot screenings increases their overall use (Allen, Van der Does, & Gunst, 2016; Gallman, Conner, & Johnson, 2017; Quach & Goldschmidt, n.d.). One of those studies implemented at the VA Portland Health Systems, also used a team-based approach along with electronic health record templates to increase the number of exams (Quach & Goldschmidt, n.d.). Another study also did an educational intervention that showed an increase in healthcare workers' knowledge but did not conduct a study to confirm an increase in clinical use (Olabisi, Fasanmade, Fatai, & Ekama, 2012). Most of the literature reported on the value and effectiveness of foot screenings due to the increase in identification of risk factors leading to deformities and neurovascular complications (Abu-Qamar, 2012; Bohchelien, Dimitrov, & Koeva, 2007; Macnee CL, Hemphill JC, & Letran J, 1996; Mutch & Dewar, 2015; Mwandri, 2012; Salvotelli et al., 2015; Shin et al., 2000; Yakub, Olamoyegun, Onilede, Babalola, & Adamu, 2015). The number of participants for each ranged from nine (Macnee CL et al., 1996) to three thousand five hundred ninety-one (Salvotelli et al., 2015), collected in one day or over several years, and included countries from all over the world. Some screenings reported using available tools (Mwandri, 2012; Woodbury et al., 2015; Yakub et al., 2015), and one reported on long-term hospital data showing that screenings reduce amputations and foot-related hospital admittance (Lavery LA, Wunderlich RP, & Tredwell JL, 2005).

Additionally, articles reported limitations of foot screenings due to problems with lack of compliance and follow-up from patients (Meijer, Links, Smit, Groothoff, & Eisma, 2001; Pinzur, Kernan-Schroeder, Emanuele, & Emanuel, 2001) and low participation of providers (Abu-Qamar, 2006; Alonso-Fernández et al., 2014). Some concerns on why providers did not perform

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routine foot exams included confusion of place of primary exam and who performs it (Abu-Qamar, 2006), the lack of uniform guidelines (C. Formosa, Chockalingam, & Gatt, 2019; Cynthia Formosa et al., 2016; Monteiro-Soares et al., 2012), and low billing return (Abu-Qamar, 2006; Alonso-Fernández et al., 2014).

Summary

Overall, the evidence for foot screenings according to John Hopkins evidence rating can be considered 'good,' but pilot studies and more randomized control trials to solidify its integration in practice were recommended. While most articles are low level, convergent evidence supports and emphasizes the importance of history, physical foot exam, the assessment of lower extremity circulation, sensation testing with a 10g monofilament, and at least annual evaluation for those with diabetes or other known risk factors. Also, tools available to guide screening, documentation, and risk stratification are mainly in agreement with one another. Still, slight variations inhibit universal usage, though the place of screening (country and office) can play a part in service. Additionally, the results of conducted foot screening programs and testimonies of experts attest that foot screenings are essential. Finally, due to providers' low screening and low follow-up by patients, proper training and education need to be given to staff and patients respectively to ensure compliance and prevention of worsening conditions.

Purpose Statement and PICO question

Early detection and management of foot disorders among homeless persons can be accomplished by enforcing routine foot exams regardless of diabetic history. Therefore, this project aimed to standardize the use of a diabetic foot exam within HOME project with the help of a portable foot exam tool. The PICO question was, will education and training in the use of a

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foot screening tool (I) help medical students (p) perform more foot screenings on clinic users (O), compared to if they didn't receive either prior to their rotation with HOME project (C)?

Conceptual Framework

The framework chosen to direct this project is the Knowledge-to-Action (KTA) framework (Graham et al., 2006) (Appendix A). The KTA framework was initially designed to promote translational research in an easy-to-read map consisting of 2 phases: The knowledge funnel and action cycle. The knowledge funnel shows how knowledge and its products are created and how this knowledge feeds into the action cycle where it is put into practice. Though a translational model, the authors state that the terms “knowledge transfer” and “implementation” seem to overlap in definition and are used to describe the process where research is put into practice. KTA does have implications for EBP in the form of the action cycle, which mentions key components of the EBP process and is considered relevant to this project. Permission for the use of the KTA framework was granted by its creator and is available upon request.

Project Goals and Objectives

The main goal of this project was to increase the knowledge and use of foot exams among medical students who serve the homeless population in Hawai'i. SMART goals created for this project were to a) increase the number of foot examinations performed during a single clinical rotation through HOME as measured by a post-survey, b) increase awareness of foot health by medical students, also demonstrated through post-survey, and c) report the results of surveys to the HOME project director. The objectives to accomplish these goals were to a) develop a portable foot exam tool that can be utilized for students attending clinical that focuses on the homeless population, b) provide training and up-to-date resources on proper foot exam

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techniques to medical students, and c) create survey questions that properly assess tool use and changes in student knowledge of foot exams to validate continued use of tool and training.

Methods

Project Design

The project design consisted of three phases: pre-implementation and training, implementation utilizing the provided tool, and post-implementation. Due to the SARS-CoV-2 pandemic, the project was delayed due to project site logistics, physical restrictions, and corresponding personnel changes; therefore, the pre-implementation and training phase occurred in the fall rather than late summer. Thus, the initial delivery of the training at HOME project orientation did not happen, and the DNP student was instead required to present the project and training at each of the clinical sites. In response to the delay, the HOME program director served as the communicative liaison between the DNP student and the medical students. She sent out an introductory email to third- and fourth-year medical students (MS3 and MS4, respectively) one week before the DNP student would arrive at clinic sites. Initially, all medical students were to take the survey and training; however, the MS3s were the primary people responsible for providing patient assessments at the HOME clinic. The MS4s provided preceptor support, while the second years (MS2) served as clinic managers and did not have much direct patient contact. First-year students (MS1) were not present during the initial clinic visits. The DNP student attended several clinical sites over two weeks to introduce the project. Medical students had available time before the clinic opened to take the pre-training survey and watch the PowerPoint training. The survey was delivered via Survey Monkey and taken before students viewed the PowerPoint training. The survey assessed the student's knowledge of foot exams and how they felt about its importance in the homeless population (Appendix B). The training also introduced

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the portable foot exam card that would be available to them to perform the main components of a comprehensive foot exam (Appendix C). The foot screening tool was adapted from guidelines mentioned in the literature review and education material provided and used with permission from committee content expert Dr. Jaclyn Griffin. The survey and training materials were sent to all medical students (MS1-4) who would be rotating through the HOME clinic during the fall semester with instructions to take the survey first, watch the training and use the provided tool throughout the semester. The students were also told that the top 3 performers would get gift cards for their participation at the end of the project. This would be assessed via honor system at the end.

The implementation period extended over three months, from September to December. During this period, the students were asked to perform foot screenings on every patient seen and utilize the tool to help with assessment, education and remind them to think about follow-up appointments and referrals. Non-MS3 students could do initial inspections and were told this would be considered participation due to this project being primarily knowledge-based. An email reminder was sent every month to remind students to perform foot screenings and refer to the tool for help.

Upon semester completion, the DNP student again visited several clinical sites to collect responses for the exit-survey. The HOME director also sent the students a link to the exit-survey (Appendix D). Six questions were the same for both the pre-training survey and exit survey that confirmed performance and proficiency. Qualitative questions on the implementation process, usefulness of training and tool, and suggestions for improvements were also included in the exit survey. The post-survey was available for one month after rotation completion. Additionally, students were asked to respond with an estimation of how many foot exams they performed.

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Response was voluntary, and the top 3 performers received gift cards of their choosing. An exit interview was also conducted with the HOME director to report findings and retrieved feedback.

Training and Tool

As stated previously, training consisted of a PowerPoint presentation (Appendix E1 & E2). Information from the literature review and guidelines as well as materials provided by the content expert was utilized to develop the presentation and tool. The training flows like a SOAP note emphasizing patient history and habits, physical assessment, education, and provider plans. The foot screening portion was based on recommendations for the following: inspection of skin and nails, assessment of circulation, and the use of a Semmes-Weinstein 10g-monofilament to test sensation. Though recommendations in the literature also mentioned techniques and devices (ABI, tuning forks, neurothesiometers, biothesiometers, doppler, and ultrasound) to diagnose peripheral artery disease, their use was not available in this setting and too time-consuming for this population. Students were instructed to refer patients with deficiencies they could not address in the clinic. Also, training considered the differences in year and educational background of the medical students. The information was basic yet informative, so MS1s through MS4s could find value in training and participate in the minimal recommendations of a foot exam.

Participant protection

This project does not meet the criteria for IRB review. Information from surveys was done through an online platform and did not track individual demographics or IP addresses. Surveys completed were completely anonymous. Answers were not linked to individuals and responses did not affect participant grade. No patient demographics or data was collected for this project.

Measurements, Data Collection, and Evaluation Plan

Measurements. Measurements for the project were done via pre-training and post-rotation surveys. The utilization of ‘yes’ and ‘no’ questions as well as Likert-scale questions was used to assess levels of importance of the screening and tool. Additional exit-survey questions provided quantitative (Likert scale) and qualitative (open-ended) data, which gave feedback for training and tool sustainability.

Data Collection. The survey software, Survey Monkey, was utilized to generate surveys and provide analysis scores. Survey information and link were distributed by the DNP student and HOME project director via site visits and email, respectively.

Evaluation. As stated, survey questions provided to medical students included ‘yes’ and ‘no’ responses as well as Likert-scale and rating questions. Percentages and charts were provided by the chosen program to help with data analysis. Excel tools were also used to generate statistical information. The post-survey included the same questions as the pre-survey and a knowledge question to assess information retention and questions that provided qualitative data to support/oppose future training and tool provision. Responses to Likert-scale questions were also analyzed to compare changes in importance and proficiency regarding foot exams and to assess if the tool was useful. Additionally, qualitative questions were assessed for themes and analyzed for their frequency. Students were allowed one month from the end of rotation completion to complete the exit survey. All findings were communicated to HOME program director.

Results

Data were collected from surveys generated on Survey Monkey. The number of pre-training surveys was 37, and the number of exit surveys collected was 20. The pre-training

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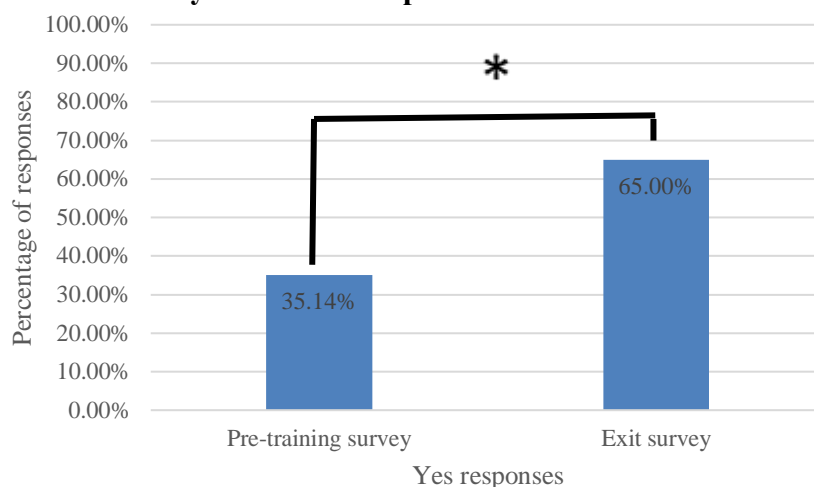
survey had six (6) questions, while the exit survey had 12, 6 of them being the same as the pre-training survey.

Pre-training and Exit survey comparison: Question 1-6

Question 1

Results showed a significant difference ($p=0.03$) in the performance of foot exams before training (35.14%) compared to after training and tool provision (65.00%) (Chart 1).

Chart 1. Have you done a comprehensive foot exam before?



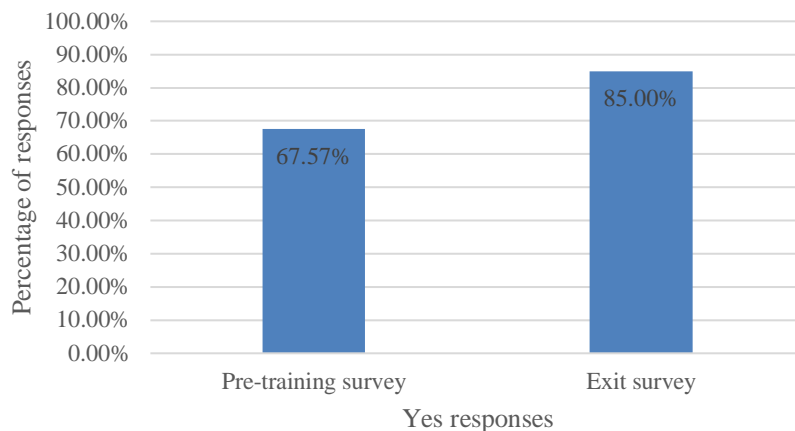
Question 2

Results for question 2 were not significant because respondents initially thought they would have enough time to perform the exams (Chart 2). The training only confirmed this belief.

Chart 2. Do you think you have enough time in your assessment to do this exam?

ns

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Question 3 and Question 4

Results of questions 3 and 4 showed no significant changes as respondents believed that foot screenings are important to the homeless population and that a tool would aid in their assessment (Chart 3 & Chart 4).

Chart 3. I believe that foot exams are important to the homeless population.

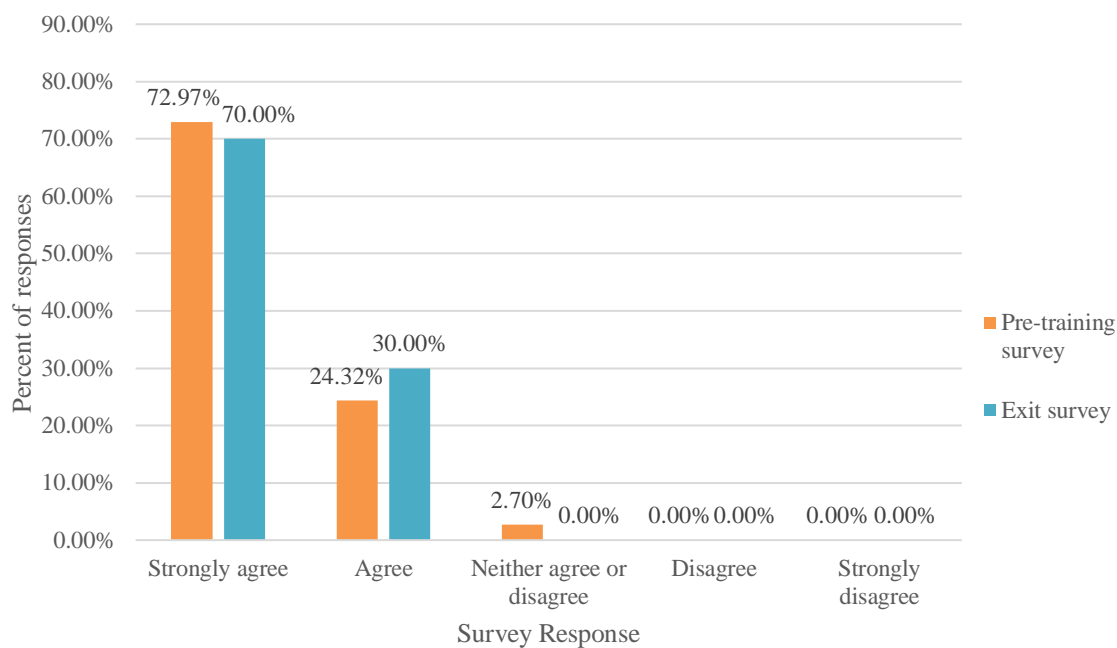
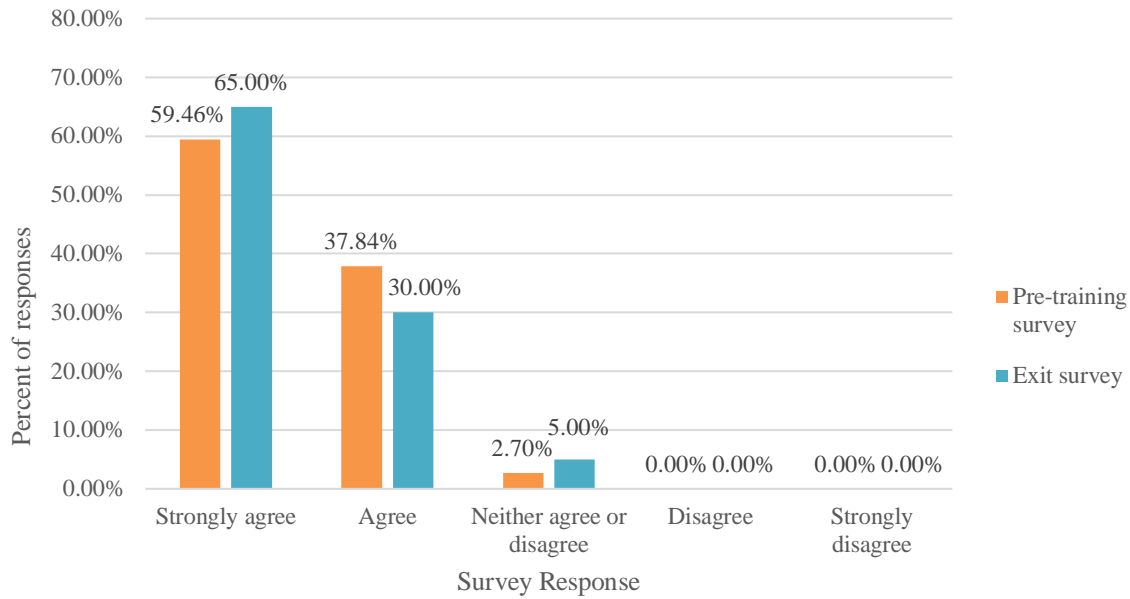


Chart 4. I believe that a portable tool can help me remember the components of a foot exam.

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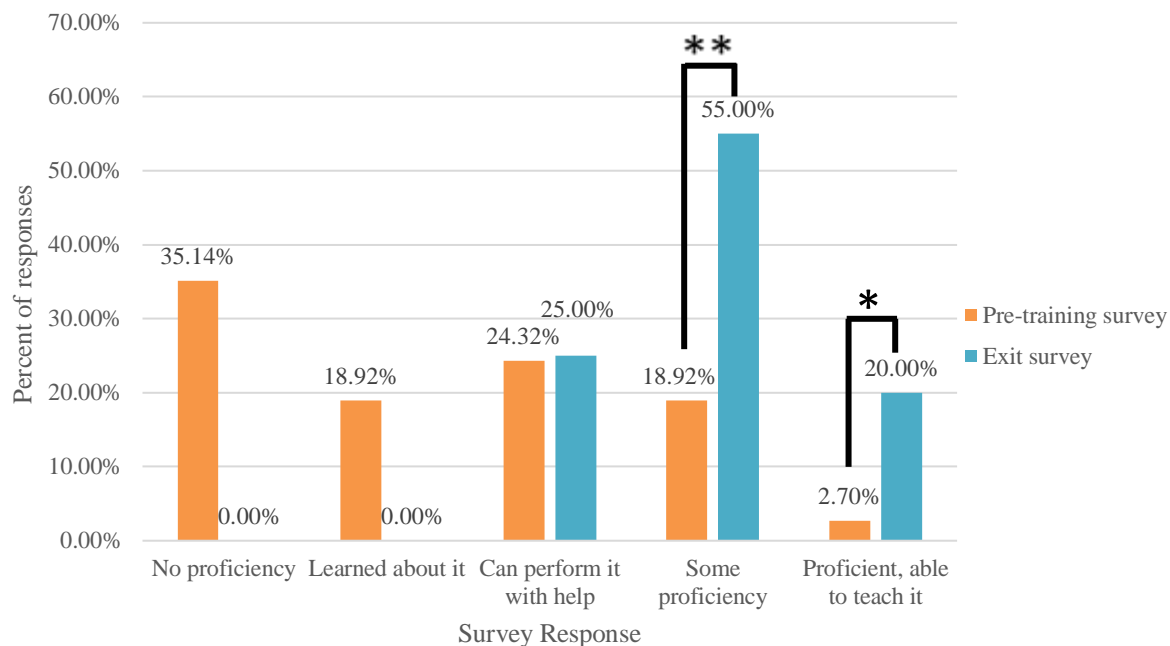


Question 5

Results of question 5 showed an increase in proficiency in performing foot exams (Chart 5). Before training, students' confidence level varied, with most of the respondents rating their proficiency as none, having learned about it, or needing help to perform the exam. The exit survey showed a shift in confidence where there was a significant increase in the ranking of students having some proficiency ($p < 0.01$) and being proficient ($p = 0.02$).

Chart 5: Rate your proficiency on performing a complete foot exam.

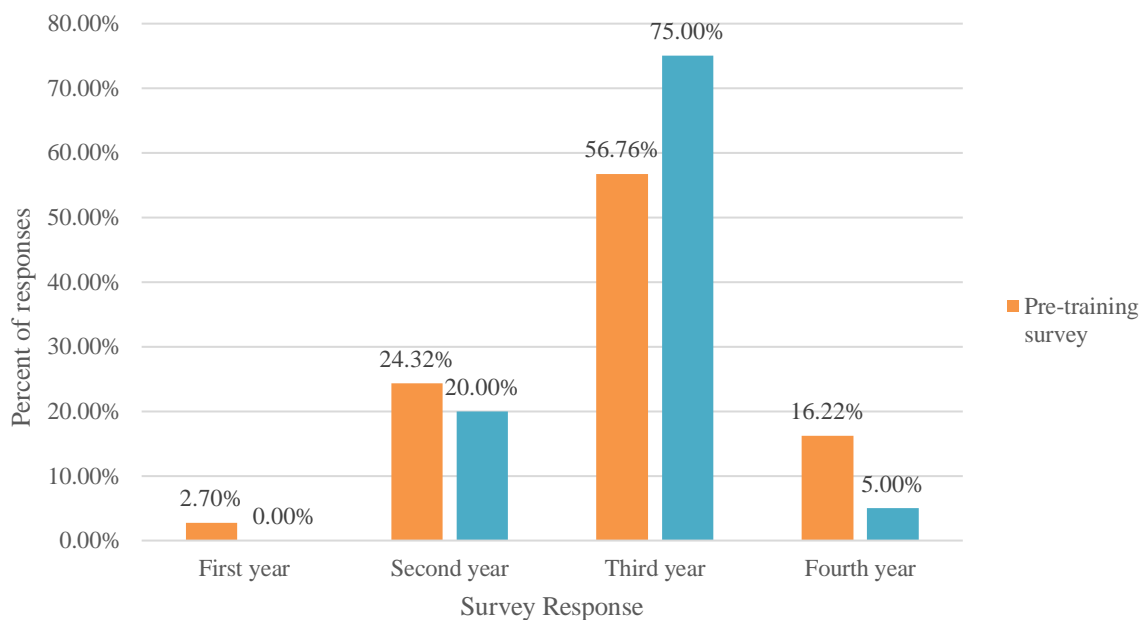
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Question 6

This question evaluated medical student's year. Due to the primary role of the MS3s compared to the other years, separate data tables were generated to identify differences in significance (Appendix F1-F5). Those tables showed similar trends between the pre-training survey and the exit survey, though there were slight differences in significance for question 5.

Chart 6: What year of medical school are you in?



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Additional exit survey questions

The exit survey contained 4 qualitative and 2 yes or no responses to get additional project feedback in addition to the matched questions. In total, 20 people responded; however, some questions were skipped (Appendix G).

Question 7: What are the three components of a diabetic foot exam?

This question was meant to assess the retention of training knowledge. 9 (50%) respondents correctly stated the three components of a foot exam: inspection, circulation, and sensation. At the same time, another 5 (27.8%) responded with similar terminology translating to the same assessments which would otherwise be performed. In total, 14 (70%) participants identified the correct three components of a foot exam. However, 15 (83.3%) respondents mentioned the word ‘sensation’ in their answers, and all but one response mentioned at least one foot exam component (94.4%).

Question 8: Did you use the tool? If you did, how often, and if you did not, please explain why.

8 (44.4%) respondents reported they did not use the tool. Reasons included being a manager with limited patient care, precepting, taking it off their ID badge, not needing it because they memorized how to perform the exam, and because it was the medical assistant’s role. For the remaining respondents, the number of times they used the tool varied from weekly to monthly and when they had time to complete a full foot exam.

Question 9: If you used the tool, were you able to identify issues that you would have otherwise missed? Please name the most common disorder seen.

11 (73.3%) respondents reported the tool helped them to identify issues they would have overlooked. The most common disorder seen was diabetic neuropathy. Other responses wrote the tool reminded them to check for capillary refill and other problems like ulcers and deformities.

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Question 10 and 11

These questions required yes or no responses. Question 10 asked the students if they would recommend the tool to other medical students doing a rotation with the HOME project, and question 11 asked if the training was helpful. Responses showed that even though some respondents did not use the tool, 100% agreed that it would help other medical students doing this rotation, and 19 (95%) respondents said yes, the training was helpful.

Question 12: Do you have any suggestions for improvement of the tool or the training material provided?

Respondents had no suggestions for improvement for tool or training; however, there were suggestions of where the information or training can be implemented in the future. One suggestion was to make the training a mandatory session at orientation. Another suggestion was to create a quiz deck in the program Anki, which is popular with medical students. Lastly, one respondent suggested that the training should be directed to the volunteers instead of the medical students because “patients do not want additional time to assess a problem they do not have.”

Discussion

The results showed a positive correlation between foot exam training with the tool and an increase in exam performance, proficiency, and knowledge retention of exam components. Though the number of exit surveys collected was less than the collected pre-surveys, Chart 1 and Chart 5 display a significant difference in action and proficiency, respectively, before training compared to the end of the rotation. These results mirrored what was seen in the literature. Other analyses showed certain beliefs remained unchanged, as seen from Charts 2 and 3, but the training may have helped to solidify them. Qualitative data revealed the training was helpful, and most students who took the training were able to recall the components of a foot exam.

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Surprisingly, most students (83.3%) remembered the ‘sensation’ component, and the tool helped them identify neuropathies in their patients. However, even though 100% of the exit survey respondents claimed the tool would help students in this rotation (also see Chart 4), many of them (44.4%) did not use it or did not need to use it after the training. This may attest to the completeness of the training or simplicity of the exam itself, indicating the tool should be available but used voluntarily. The DNP student observed that the medical students already had many attachments to their ID badges, and the addition of one more may have been too much. Overall, the project’s goals and objectives were met, and results conveyed the training effectiveness in increasing the medical student’s knowledge and performance of foot exams.

Limitations

As stated, due to the SARS-CoV-2 pandemic, the project was adjusted due to logistics and physical restrictions delaying implementation. Initially, training was planned for the HOME orientation, where the DNP student would introduce the project to all medical students rotating through the clinic. The pre-training survey would be requested from all medical students increasing participation number. Instead, communication of the project was done through email and by in-person presentations by the DNP student, thus limiting project participation and data collection. Also, the medical students did not have a set schedule to attend the clinic, and some did not have in-person experience. Many medical students encountered initially were not seen at the end, which may account for the lower number of exit surveys collected as many surveys collected were completed in person. Furthermore, it is reasonable to consider that some students may not have found the training or tool helpful and chose not to participate in the exit-survey, thus skewing the results more favorably.

Implications and future recommendations

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The results from this project stresses the importance of training medical students on how to perform foot exams and how to identify lower extremity disorders. In turn, this increases the performance of exams thus allowing for early detection and, hopefully, early intervention of any abnormalities. Several recommendations are discussed to increase the intervention's effectiveness.

Firstly, a discussion with the HOME project director and site visitation revealed that the MS3s perform the physical assessments. MS2s serve as managers, and MS4s help with precepting. MS1s mainly do vitals but were not present during the site visits and did not start their HOME project rotation until a few weeks after. Therefore, training should be reserved for the MS3s only. Upon further investigation, the HOME project is not a separate rotation but is a part of the MS3s family medicine rotation. Thus, students do not get graded at HOME project sites. Instead, they have a separate outpatient clinic and are graded there. Unfortunately, the training meant to benefit the homeless population should thus be implemented in a different, more structured setting where students can be monitored and graded in hopes that the practice of foot exams translates over to HOME clinics. Additionally, while the HOME project director agreed that the training supplements the site rotation and that the students should know how to perform the screening, due to a constant change of personnel, there was no physician champion on-site to monitor the medical students and ensure that they were performing the screening consistently. This further supports training implementation in a more structured setting where formal evaluation can occur.

Another sustainability suggestion made by participants is to incorporate the training into the MS3s student orientation. As stated, this was the initial plan. Ideally, the training would be done in-person with a live demonstration of how to do a foot exam, then have the students

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perform it on their own in a see-one-do-one fashion. Site visitations would follow up the training in the following week to assess correct performance. To remedy the new online PowerPoint format, a few of the students mentioned a list of readings they had to do before their HOME rotation. They suggested the training be placed there for the next group of rotating students. The DNP student contacted the coordinator of their family medicine rotation to incorporate this for the future.

Finally, through verbal interviews, the DNP student discovered medical students were not introduced to comprehensive foot exams during their family medicine rotation didactics or in their endocrine sections. The results of the study clearly showed the students benefited from the training and tool. Therefore, the DNP student engaged in discussions with HOME managers, third-year medical students, and second-year medical students about where this training would help them the most. Due to the inability to identify a physician champion for the training, it was decided that the training would be made available in the manager's site, where protocols for HOME are located. The training was also made available to the MS3s and MS2s through their shared google drives. If students wish to use the tool, a printable version can be found within the PowerPoint training. The extra foot exam ID cards and monofilaments were also placed in vitals bins in the HOME project RV for future use.

Conclusion

The performance of foot screenings for homeless persons is necessary to their survival, and exams performed at a mobile health clinic may provide the best opportunity for these screenings to occur. Though studies assessing the long-term effects of these screenings are rare, there is evidence that a proactive approach is better than none. In conclusion, the project showed positive results and gave evidence for training continuation; however, consistency and

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sustainability remain challenging. Potential improvements include implementing the training in a different setting and recruiting a physician champion to assess performance. Research studies should also be considered to evaluate the long-term effects of foot exams in the homeless population, which may help establish a standardized format.

This evidence-based quality improvement project showed that the training could be delivered effectively in a quick and simple format with adequate knowledge retention. Both the training and tool proved effective and were recommended, thus supporting its continued existence at the HOME clinic. Finally, the project showed promising results indicating that foot exam training may be implemented at other facilities. With proper integration, it can help sustain the quality of life for Hawaii's homeless.

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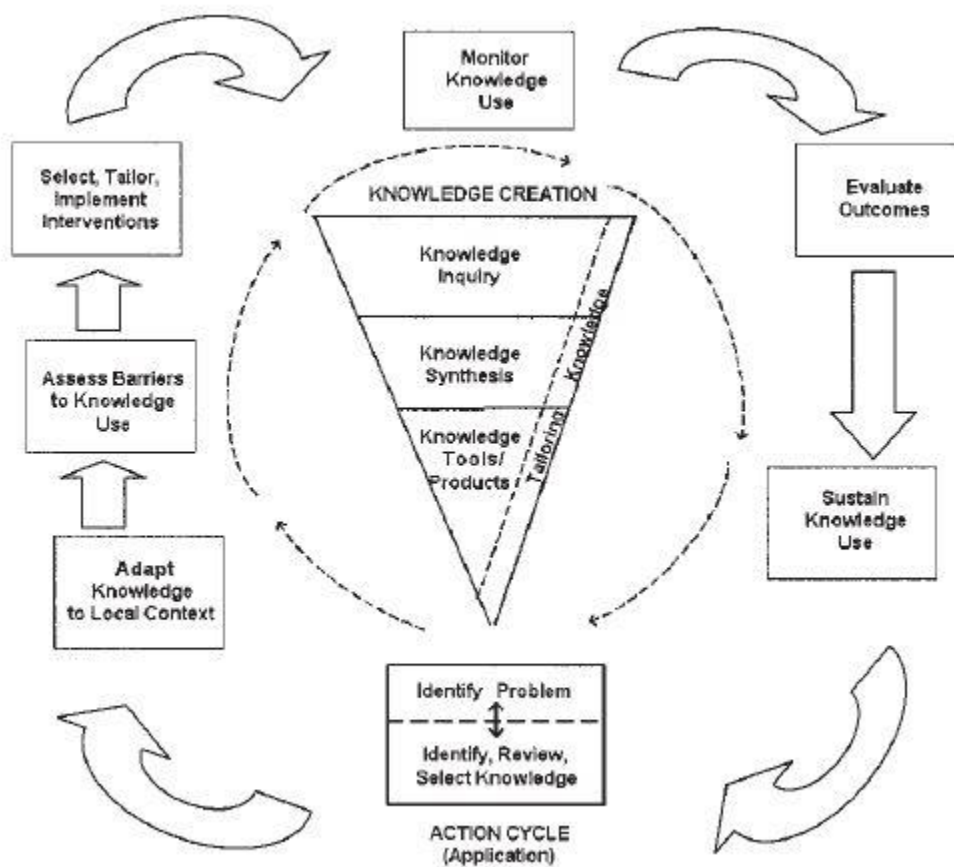
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Appendix A.



Graham et al. (2006). Knowledge to Action Framework.

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Appendix B.

Pre- Training Survey

	Yes	No
Have you done a foot exam before?	<input type="checkbox"/>	<input type="checkbox"/>
Do you think you have enough time in your assessment to do this exam?	<input type="checkbox"/>	<input type="checkbox"/>

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
I believe that foot exams are important to this patient population?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I believe that a portable tool can help me to remember the components of a foot exam.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	1 (no proficiency)	2	3	4	5 (able to teach)
Rate your proficiency on performing a complete foot exam?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What year of medical school are you in?

Appendix C.

Quickie Foot Exam

Inspection

- Skin – clean, intact, dry, hydrated, check for calluses, ulcerations, amputations
- Nails- groomed, well-kept. Look for fungal infections, unruly growth, rams horns
- Foot deformities – bunions, Charcot foot, prominent metatarsal heads, hammer toes

Circulation

- Color
- Temperature
- Capillary Refill Time
- Edema present? Pitting?
- Pulses:
 - Posterior Tibial
 - Dorsalis Pedis

Sensation

Use 10-g Semmes Weinstein monofilament

- Remove pt socks, have them lie back
- Instruct pt to close eyes/cover them
- Hold filament perpendicular to foot, put pressure until filament bends to a C-shape.
- Ask pt. to respond with 'yes' if pressure felt.

Front



Monofilament areas
Most abnormalities
● seen here
● Other
● recommended sites

Education

- Inspect feet daily
- Change socks daily
- Have doctor/podiatrist cut nails
- Use well fitted shoes
- Factors that increase risk of disorders: diet, smoking, alcohol, exercise
- Follow-up with doctor visits
- Take medications as prescribed

Referrals?

Follow-up?

For more information please visit: [webpage]

Back

Appendix D.

<u>Exit Survey</u>					
	Yes	No			
Have you done a foot exam before?	<input type="checkbox"/>	<input type="checkbox"/>			
Do you think you have enough time in your assessment to do this exam?	<input type="checkbox"/>	<input type="checkbox"/>			
	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
I believe that foot exams are important to this patient population?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I believe that the portable tool helped me to remember the components of a foot exam.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1 (no proficiency)	2	3	4	5 (able to teach)
Rate your proficiency on performing a complete foot exam?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What year of medical school are you in?					
What are the three components of a diabetic foot exam?					
Did you use the tool? if you did, how often and if you did not, please explain why.					
If you used the tool, were you able to identify issues that you would have otherwise missed? Please name the most common disorder seen.					
Would you recommend the use of this tool for students working with this population?					
Do you have any suggestions for improvement of the tool or the supplement material provided?					

Appendix E1.

PowerPoint Training

<https://drive.google.com/file/d/1rS9u8cL-OQXKjX16YTIAITRjoVz1RC9B/view?usp=sharing>

Appendix E2

Narrative for training

Aloha, my name is Mika Tanji and I am a nurse practitioner student at the University of Hawaii. Thank you for taking part in this training on how to perform a comprehensive foot exam. It is a short training aimed to provide you with the basics on foot screenings that you will be asked to perform during your rotation with HOME project. With that, let's get started.

Just a reminder, please make sure you take the survey before moving on to the training. It is the same survey that was previously sent to you in an email, but if you haven't taken it yet, you can find it by clicking the link on the screen.

We'll start off with some background and justifications. The focus of this training is not only for our homeless population but it is also to help students become more confident in performing an assessment, to practice doing a type of screening and just be comfortable with thinking about next steps and more importantly convincing our patients to take those steps with us. And speaking of steps, this training focuses on foot health for this population. Homeless rely on their feet to take them from shelter to food and sweeps keep them constantly moving. For the last point in time count, there were 4,453 homeless persons on Oahu alone that is not counting those who did not want to be interviewed so the count is actually much higher. Now, when we think about homelessness, we think about what we don't know since many are sporadic healthcare users. Medical history may be shoddy, and many chronic diseases are undiagnosed or not managed very well. Diabetes is on the rise especially among Hawaiians and Pacific Islanders as well as other minorities like Filipinos and as we all know, amputations are expensive. So because we do not know their history or if we will ever see them at the clinic again it would be good practice to perform foot screenings on all homeless individuals regardless of disease history.

The objectives of this training is to provide tools and resources to support routine foot exams for homeless individuals, to identify and perform key components of a comprehensive foot exam, to increase confidence in performing these exams and to prove that these exams can be done in a quick yet thorough manner.

We will be treating this training like a SOAP note starting with subject and objective findings. Patients who utilize HOME project often present with acute issues like illnesses, wounds, or may get their medication distributed there or they might just want free stuff. In any case, their history can tell you a lot. Take their chief complaint, OLD CART it or OPQRST it then ask about other medical conditions and how they manage it. Ask about medications and assess diet/exercise/hygiene. Ask about vaccines especially if they are drug users. Then you can slip in

FOOT EXAMS FOR HOMELESS

questions about mobility and how important it is to them what foot care habits do they have if they have any, and do their shoes fit properly. Then if they do have known foot issues, do they see a podiatrist? For the first and second years who haven't really talked to patients, I have provided some pointers in the note section that may help you.

Foot exams should be conducted at least annually for diabetics, but because we don't know how often we will see these people we will try to exam them as often as we can if it means they come 2 months later because they are sleeping rough and they are not in the best conditions. So, we want to perform these foot exams as best as we can and as often as we can. Foot exams consist of 3 components: Visual inspection, circulation, and sensation.

Then once you have addressed their chief complaints, tell them you would like to exam their feet. For inspection, you can learn a lot about your patient simply by observation. They may be hesitant to take their shoes off but you can remind them just how important their feet are to their quality of life and survival and that it would be great for your learning to screen their feet. When you look at their skin you want to assess if color of lower extremities are appropriate for their race and that there are no discolorations of rash or infection, intact, dry. Don't forget to look at the bottom of the foot as well as the heels and in between toes. Nails, you want to look at color and growth. Then see if there are any deformities present like ulcers, hammer toes or calluses. In addition, to these you can also check their gait. It's not part of the screening but seeing them walk can tell you a lot about bone structure, pain, possible wounds or injuries.

Checking Circulation requires the palpation of the lower extremities. You want to assess color if its red (infection or wound), blue/pale circulation is less than adequate. You want to feel the temperature if its hot warm or cold and you want to check for Capillary refill time requires you to look at nail beds and push down to blanch and observe time of return blood flow. Return blood flow should be less than 3 secs. If there is edema or fluid build up, you want to grade pitting. Lastly, you want to feel 2 pulses: the posterior tibial and dorsalis pedis and note if it is uneven, diminished, bounding or not present.

To test sensation there are a number of devices that can be used but the most recommended and the most cost effective for a mobile clinic is the Semmes-Weinstein 10g monofilament. It means that if used properly it applies 10grams of pressure. This filament tests for loss of protective sensation and will be available for you to use in clinic. They are disposable and should be limited to one per patient to reduce the transfer of any infection. Have you patient lean back and close their eyes, so they don't cheat. Test the filament on their hand so they know what to expect and instruct them to say 'yes' when they feel it. Proceed to perform the test on their feet. Hold the filament perpendicular to their foot and apply enough pressure on the tip until the filament bends to a C shape. Again, ask the patient to respond with a 'yes' when they feel the sensation. If they do not respond, the area is noted with a negative and considered as an area of risk to address in your notes and should be referred to a specialist. The next slide shows a sample of a complete foot exam that is possible to do in a matter of minutes.

Even if you do not have a chance to perform a foot screening, education about foot health and hygiene should always be discussed. As stated before, homeless persons rely on their feet for survival and self-care plays a big part in the identification and prevention of abnormalities.

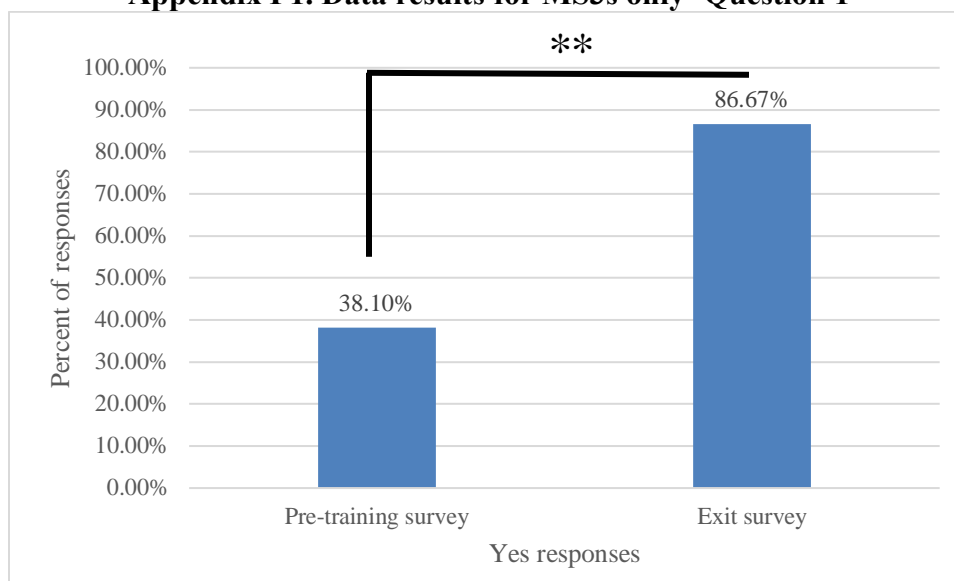
FOOT EXAMS FOR HOMELESS

Inspection of feet should include looking at soles and heels. A mirror can help them to do this. Socks should be changed daily and should be dry. Diabetics need to have their nails cut by a doctor/podiatrist and shouldn't do it on their own. If they don't have diabetes but their nails look funky or thick a referral may be your best bet. Also, take the time to do a shoe assessment and recommend places they can get replacements should they need. Slipper use is commonplace but those with foot issues, though it is hot, may benefit from having a covered foot to protect. Education about diet/exercise/smoking/alcohol/drug use can be preventative for a lot of things and should be discussed. And finally, stress that their health is important and a part of taking care of themselves is to make sure they follow-up with their doctor appointments and that they take their medications as prescribed.

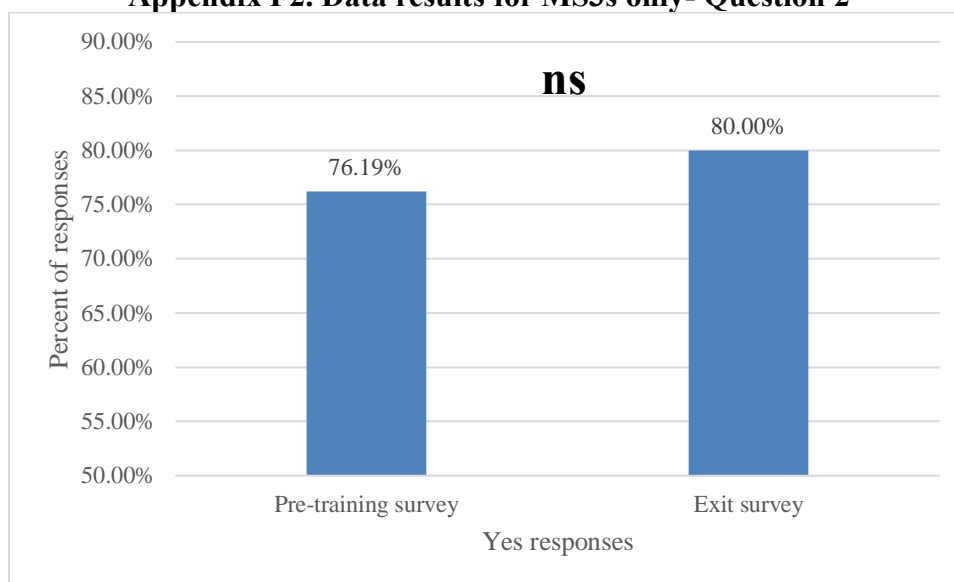
When planning, address the identified issues and assessments performed and think about treatments you can provide in clinic like foot care, wound cleaning and giving medication. If issues are too complicated to address in clinic, make sure to give appropriate referrals. Follow-up appointments should be reasonable and for foot exams, they should be performed annually for those with diabetes but more frequently for those who have existing issues.

For your rotation with HOME project, you will be given a Quickie foot exam portable ID card to help you remember the key components of a foot exam. Your challenge will be to perform a foot exam, as best as you can, on every patient you see in clinic and to use the tool to help you along the way. A link to this presentation is also available on this ID card for remote access and should you want to share it. At the end of your rotation you will be asked to take an end-survey that will allow you to give feedback on the tool, training, and the frequency you were able to perform this exam. Don't worry, your grade will not be affected by your responses, but please remember to take the survey as it guides future trainings. In addition, other resources and tools have been provided in the following slides for your review. This ends the training and Mahalo for taking the time to go through it. Aloha, and good luck with the rest of the year!!

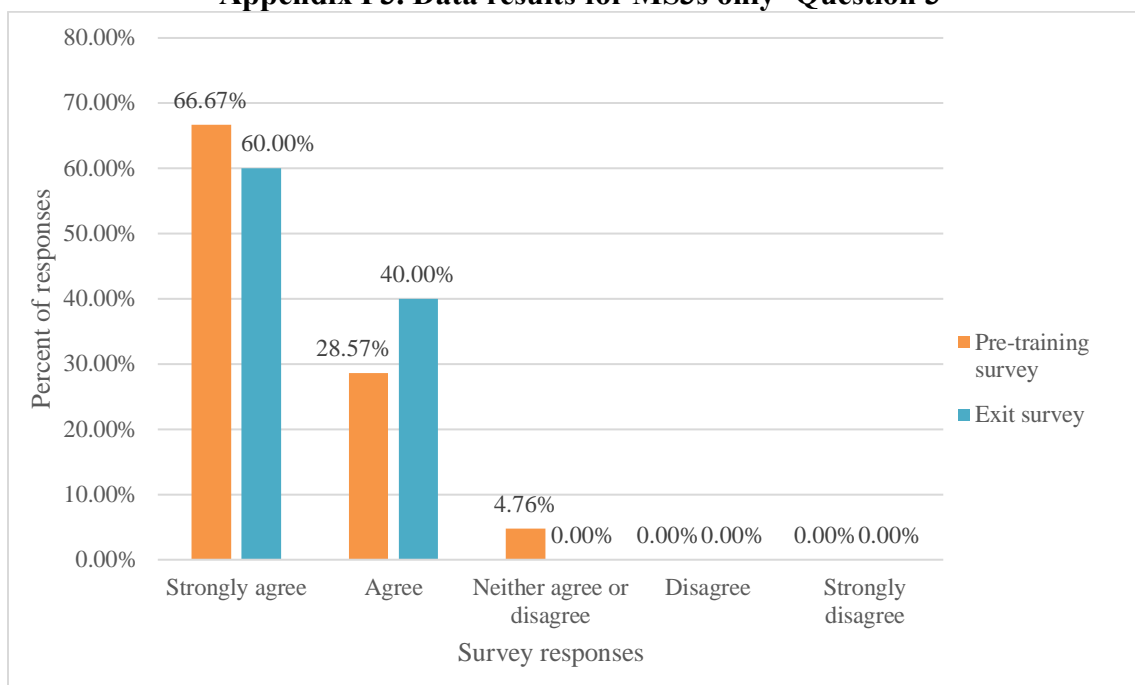
Appendix F1. Data results for MS3s only- Question 1



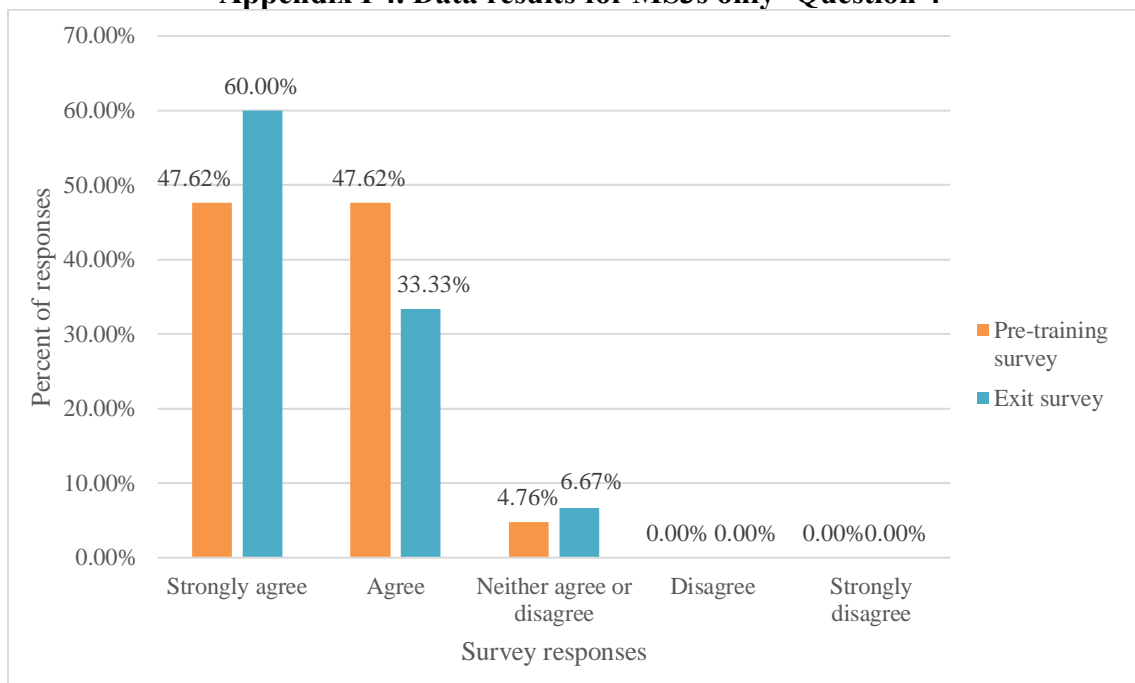
Appendix F2. Data results for MS3s only- Question 2



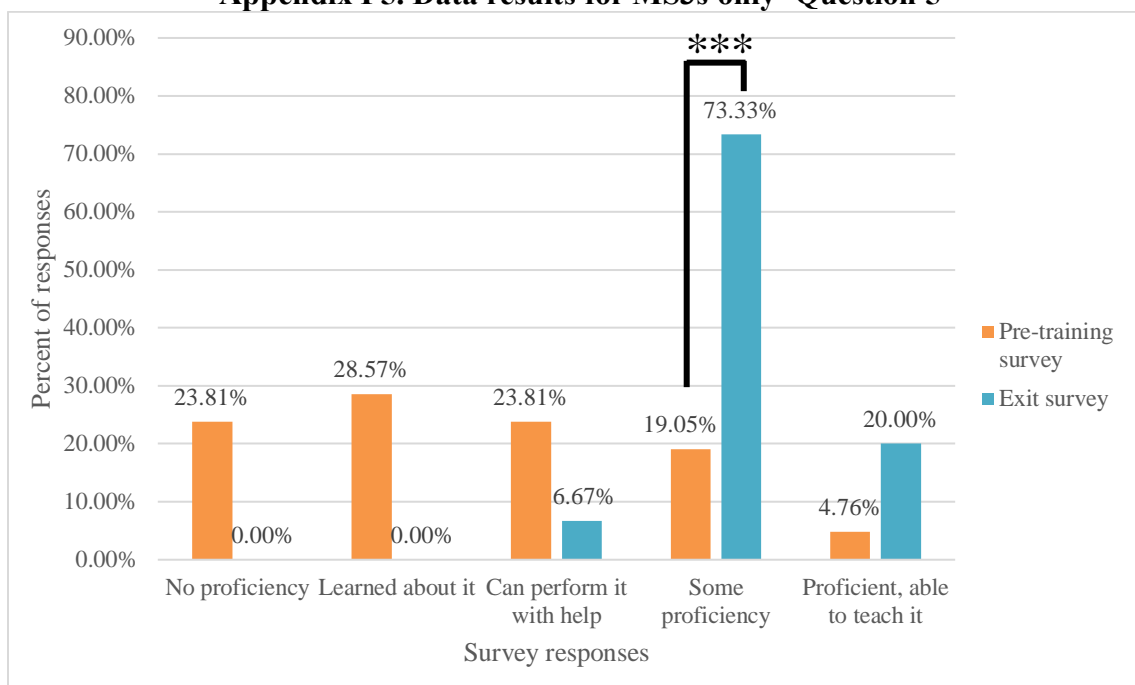
Appendix F3. Data results for MS3s only- Question 3



Appendix F4. Data results for MS3s only- Question 4



Appendix F5. Data results for MS3s only- Question 5



Appendix G. Exit survey question7-12 breakdown.
Additional Exit Survey Questions

Question	Responses (%)	Skipped (%)
7. What are the 3 components of a diabetic foot exam?	18 (90)	2 (10)
8. Did you use the tool? If you did, how often and if you did not, please explain why.	18 (90)	2 (10)
9. If you used the tool, were you able to identify issues that you would have otherwise missed? Please name the most common disorder seen.	15 (75)	5 (25)
10. Would you recommend the use of this tool for students working with this population? Yes 20 (100%) No 0 (0%)	20 (100)	0 (0)
11. Was the training on how to perform a comprehensive foot exam at the beginning of the semester helpful? Yes 20 (95%) No 1 (5%)	20 (100)	0 (0)
12. Do you have any suggestions for improvement of the tool or the training material provided?	15 (75)	5 (25)