



RESEARCH

Learning Without Borders: Qualitative Exploration of Service-Learning

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Introduction

For the last four years, pharmacy, physician assistant, pre-medicine, and nursing students enrolled or associated with Butler University's College of Pharmacy and Health Sciences (COPHS) and College of Liberal Arts and Science (LAS) have partnered with Barnabas Task to travel to the Dominican Republic (DR) for an annual medical mission trip. Barnabas Task, a nonprofit organization founded in Fort Wayne, Indiana, conducts multiple service trips every year with dental and medical professionals, as well as other volunteers, to the Dominican Republic, Cuba, or Guatemala. Barnabas Task's mission is

“community transformation through leadership development” (Barnabas Task, 2013), and they utilize community health evangelism (CHE) to accomplish this goal. During these mission experiences, students have the opportunity to assist medical providers through patient triage, medical scribing, and medication dispensing. Students also work directly with community leaders to educate them on public health topics including nutrition, exercise, smoking cessation, dental hygiene, and mosquito-borne illnesses. These community leaders can then educate others and spread the knowledge through grass roots. This philosophy of developing a relationship with host communities

mirrors the work of Olenick and Edwards (2016). Their article in *Nursing for Women's Health* concludes that short-term health missions are more effective when they focus on a "long-term commitment rather than a quick fix."

Students and volunteers work to form long-term commitments not only by educating community leaders in the DR, but also by working with local students who act as translators within the clinic. Most of the students who made the trip lacked fluency in Spanish, and all volunteers are therefore provided with a translator. Every clinic day, students from Oasis Christian School, which is a part of Santiago's private school system, help translate for the students and medical volunteers. Students from the local Catholic medical school, Pontificia Universidad Católica Madre y Maestra (PUCMM), also join the clinic daily to translate, triage patients, and fill prescriptions. Some students keep returning to the clinic even after they graduate medical school and volunteer as healthcare providers to help their community. This includes a provider who has made a commitment to visit the clinic quarterly to follow up with patients whose medications for chronic diseases such as diabetes and hypertension may require adjustments. Interactions with the DR students and providers adds another layer of collaboration, where students can learn from one another while caring for underserved populations.

To strengthen these long-term commitments, Barnabas Task turned to Butler University Fairbanks Center for Communications and Technology in 2015 with the goal of developing an electronic means of carrying medical information during the mission trips and accessing these records during future medical trips, thus starting the relationship between Barnabas Task and the Engineering Projects in Community Service (EPICS) course at Butler University. Computer science and software engineering students enrolled in this course meet biweekly to complete a "supervised team software project for a local charity or non-profit organization" (Linos, 2012). This relationship initiated the development of an Electronic Medical Records (EMR) application prototype, which runs as an iOS app. Students in the EPICS course collaborated with Barnabas Task to meet their needs to provide continuity of care and formed a relationship with healthcare students from COPHS to format the iPad application. Currently in the fifth semester of collaboration

between EPICS, Barnabas Task, and COPHS, the application continues to be updated and built upon and is now a stable prototype of a bilingual EMR that can preserve patient records, transcribe prescriptions to the clinic's pharmacy, and maintain medication inventory.

Data on the benefits of EMRs are plentiful. A systematic review published in September 2017 established how EMRs significantly improve documentation of clinical information and enhance quality outcomes in the long-term acute care setting (Kruse et al., 2017). Similar effects can be seen in the inpatient hospital setting. Khalifa and colleagues found that after EMRs had been implemented in their health system, there was "an increase in information access, increased healthcare professionals productivity, improved efficiency and accuracy of coding and billing, improved quality of healthcare, improved clinical management (diagnosis and treatment), reduced expenses associated with paper medical records, reduced medical errors, improved patient safety, improved patient outcomes and improved patient satisfaction" (Khalifa, 2017). A comprehensive review by Keasberry, Scott, Sullivan, Staib, and Ashby (2017) ascertained that EMRs enhance patient safety by including alerts about drug interactions and adverse drug reactions. The utilization of an EMR also improves patient outcomes by increasing to guideline recommendations. EMRs stateside improve hospital processes and patient care, which explains the DR clinic's need to obtain an EMR to improve clinic processes abroad.

We conducted a thorough search and determined that there are no similar efforts currently described in the literature. However, there are publications that discuss collaborations and active learning as well as the benefits of these types of interactions. A group at the University of Wisconsin created interprofessional groups that served both a local community and a global community in Malawi. They concluded that students had increased their level of understanding in values and ethics, roles and responsibilities, and teamwork as a result of the experience (Dressel et al., 2017). Johnson and Howell (2017) also discuss the benefits of service-learning and interprofessionalism. Healthcare students from different programs including pharmacy, medicine, physical therapy, and nursing traveled to Ecuador for a service-learning opportunity. The authors explain how the students had to work through communication barriers both with their patients

and with other healthcare professionals, all of whom spoke a different language. Increasing cross-cultural and interprofessional learning will be crucial in the future due to the diversifying healthcare system. A nursing cultural simulation developed by Carlson et al. (2017) connected nursing students in Hong Kong and Sweden and ultimately ascertained that the intercultural experience developed collaborative skills, including communication, between the two groups of students as they worked to complete a case study. In our literature review we found plenty of interprofessional articles; however, the literature lacks information on students from different colleges collaborating on a project to better the community they plan to serve. Professionals in the healthcare field are being exposed to a wide array of people with different educational backgrounds, and it is important to confront these language and knowledge barriers.

This study was developed in order to (a) assess how information technology affects clinic processes, (b) identify student learning and cultural awareness when collaborating with students from different colleges and globally, and (c) understand how global missions are viewed by the communities being served.

Methods

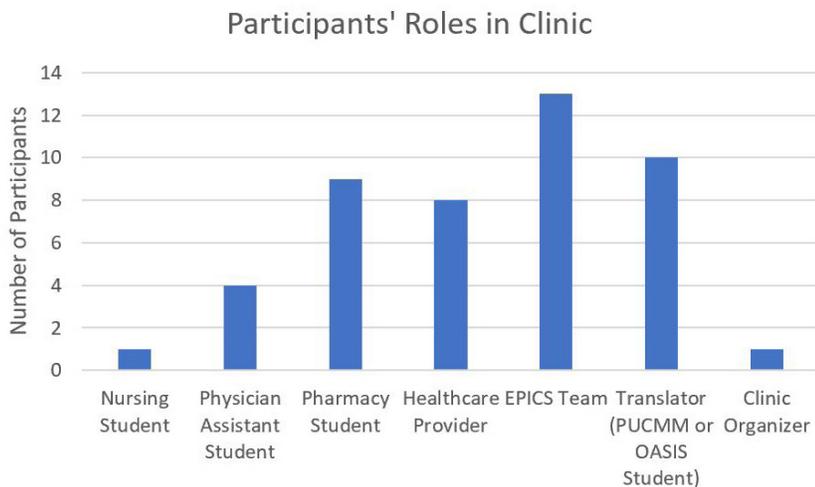
When commencing this project we hypothesized that students would gain knowledge about how to work with other professionals, increase their skills within their various areas of expertise, and develop cross-cultural awareness while helping to improve a community's health with the creation of an EMR. The institutional review board approved the anonymous survey that was sent to all sixty-five volunteers who worked in the underserved clinic in the DR and the EPICS students who helped develop the EMR but were unable to go to the DR. Using Qualtrics (Qualtrics, Provo, UT, May 2017), an online survey platform, the survey was created to consist of multiple choice and free response questions regarding demographics, role in the project, and experience in the clinic. Utilizing skip logic, participants answered questions written specifically for their role in the clinic (for example, healthcare student; computer science student; translator; etc). The original survey questions are listed in appendix 1. Results from the open-ended questions on the survey

were analyzed based upon common themes and similar wording found throughout the participants' answers. The institutional review board also approved an anonymous quality survey all patients at the clinic eighteen years of age and older had the opportunity to take. Those who participated answered four questions about their time spent in the different stations of the clinic, whether they would recommend the clinic to their friends or family members, and whether they believed the clinic brought hope to the community. If an entire family came to the clinic, one person from the family could complete the survey for their household. In total, 95 patients completed the survey using SurveyMonkey.

Results

Of the 65 clinic volunteers who were sent the survey, 51 elected to complete it for a response rate of 78.5%. The specific roles for each of the responses are illustrated in Figure 1. Starting with student learning, knowledge was gained through this experience through the various collaborations. The EPICS team, healthcare professionals, and Dominican volunteers all had participants who reported their top learning experience was in communication. Three out of five of the EPICS team members stated their top two non-technical learning experiences were in communication and teamwork. Students are also retaining the knowledge from this experience, as five out of five responses by the EPICS team stated they have used the knowledge gained in this course outside school or in another class. One EPICS member conveyed the importance of this class being able to "bridge the gap between those who are very technical, with little healthcare experience, and healthcare clinicians who possess little technical expertise." Examining the development of technical skills, all of the EPICS students grew in both Xcode (Apple's software development environment) and Swift (Apple's programming language) (Apple, 2018). One EPICS student gained experience in setting up an onsite clinic with WiFi to make sure the EMR application could work within the clinic and the iPads could communicate with one another. Not only did EPICS members learn technical skills to be used in their future careers, but students also reported an improvement in their Spanish and an increase in knowledge about the Dominican healthcare

FIGURE 1: Role in clinic



system and culture. Similarly, half of the healthcare students reported an increase in knowledge about the Dominican culture, lifestyle, and healthcare system as one of their top three learning experiences. Not only did American students learn from the Dominican students, but four of the six Dominican students who took the survey noted that one of the benefits of the clinic was being able to practice their English, while three of six students stated their main benefit from the clinic was refining their medical skills with the collaboration of American and Dominican providers.

The survey also included questions about the students' experiences in intercultural and interprofessional relationships. Five out of six EPICS students reported a positive interaction when working with students with a healthcare background. One student, when asked to comment on his or her overall experience with the COPHS and EPICS students, remarked that it "was extremely fulfilling to witness how the efforts of a variety of students can put their knowledge and skills together to make something special happen." Eleven out of thirteen healthcare students reported a positive experience when collaborating with the EPICS team and one stated specifically that the EPICS team is "important for our clinic running smoothly."

While healthcare students, the EPICS team, and Dominican students gained great knowledge while working together, so did the healthcare professionals who helped run the clinic. Half of the providers stated there was a benefit to working in a different scope of practice in a

different culture and stated that their biggest challenge was language barriers between their patients and sometimes their translators. However, the EMR application may have reduced this language barrier by means of prototype through an English-Spanish toggle. All of the providers who took the survey would be interested in using the application in the future. Three out four healthcare providers stated that the application improved the efficiency of the clinic, and one of the providers stated that the EMR improved patient safety by forgoing legibility issues of doctor's handwriting and by allowing the provider to see previous visit history and ascertain a past medical history.

Improving clinic operations was important, but so was seeing the hard work come to life. From one of the EPICS students who attended the trip: "There aren't any words to put in for the experience of the trip. It was incredible and even better on our end to see the work we put in over the semester at work in real time helping people in need. It really gives us a different perspective. It has made me want to go back again next year."

Both healthcare and EPICS student teams appreciated the each other's knowledge base and were able to learn from one another. Seven out of seventeen students from EPICS and future healthcare providers suggested there be more meetings between the two student teams to allow more communication and form better relationships and to improve collaboration on the application prior to the trip. One student conveyed his or her suggestion for improved interactions by stating: "I wish the healthcare students could have had a larger impact when it came to some of the formatting in the app." Another stated, "we could have been helpful when it came to inputting drug names and formatting it the way that most resembles a prescription."

One example of the collaboration between the two groups was a simulation clinic on Butler University's campus before heading to the DR. One EPICS student stated: "Witnessing and collaborating with the students who would actually be using the application was vital. We were able to together identify the most effective and efficient designs for the app, as well as locate bugs

throughout the app that we may not have otherwise noticed.” Four of thirteen healthcare students who attended the simulation said the simulation helped students learn how to use it before traveling to DR and six out of thirteen healthcare students noted there was value in the simulation because it worked out issues beforehand and allowed the EPICS team to add more features to application. More collaboration is necessary because while 10 out of 16 users of the EMR said it was a positive experience, five out of the 16 said there was need for improvements. While the EMR needs improvement, all of the 13 healthcare students who took the survey stated that their overall experience was positive.

Finally, knowledge was gained through this experience but so were friendships.

“The trip felt like a once-in-a-lifetime experience. It was incredible to witness both teams’ work and preparation pay off. Our group of students formed a tight-knit group with relationships that will likely last a lifetime. We were also able to form friendships with people there and share our cultures with one another. I greatly enjoyed the activities outside of the clinic—they provided inspiration on how we can continue to make a difference.”

While the application and learning is important for the students, for healthcare professionals the patient is the top priority, and for engineers the customer is the top priority. To ensure our patients were satisfied and to see how an EMR effects clinic processes we interviewed 95 patients to assess where there is room for improvement with our application and clinic in the future. Figures 2–5 represent how patients responded when asked about the amount of time it took to enter the clinic, register at the clinic, see the physician or healthcare provider, and receive their medications. Responses concerning the amount of time it took to enter the clinic were the most evenly distributed of the four figures, ranging from “very fast” to “normal” amount of time. The amount of time to be registered as well as to see a provider were very similarly distributed, with only a small percentage of patients reporting “too long” of a wait. The amount of time to receive medications followed a similar distribution to

FIGURE 2: Time to Enter Clinic

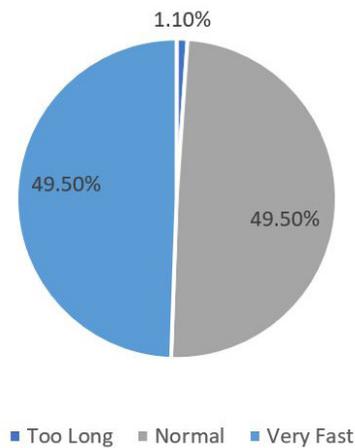


FIGURE 3: Time to Register

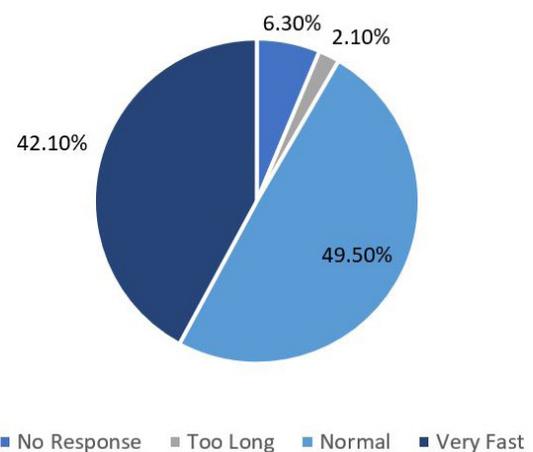


FIGURE 4: Time to See Provider

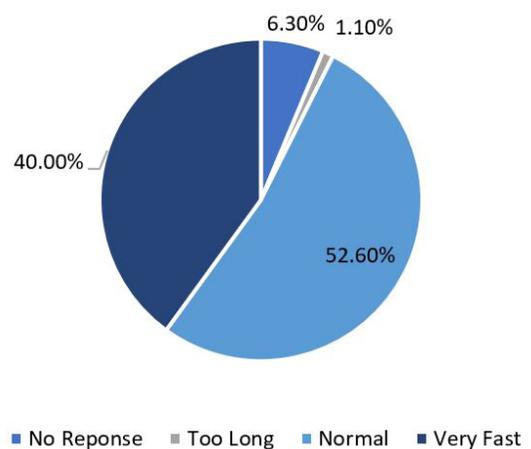
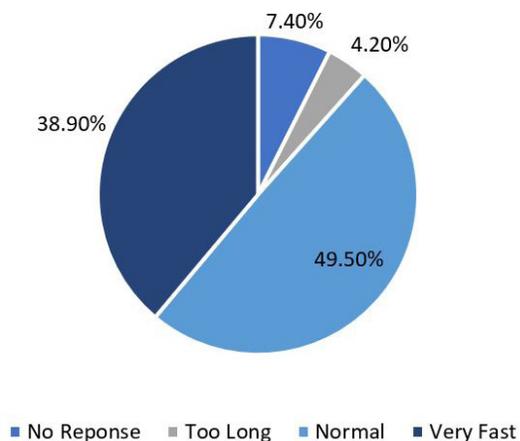


FIGURE 5: Time to Receive Medication



Figures 3 and 4; however, it was the largest report of “too long” a wait. Patients were also asked if they had attended the clinic previously, which 46 out of the 95 patients who completed the survey had. Of the 60 patients who responded to the question about whether this clinic brings their community hope, all answered “yes” and all 95 patients who answered the survey said they would recommend this clinic to their friends and family.

Discussion

The professional world becomes more intertwined each day with professionals obtaining multiple degrees, technology advancing at a rapid pace, and the increased need for multiple professionals to be working together to achieve a common goal. Students with healthcare or computer science backgrounds will work together once they enter their careers, because healthcare is constantly in conjunction with, and reliant on, technology. Learning about other disciplines through collaboration towards a mutual goal helps prepare students of both colleges and disciplines to better communicate with people who have different educational backgrounds.

Beyond communication, other lessons learned through this experience included collaboration and teamwork. This project began through collaboration, as Barnabas Task has been collaborating since 2008 with people from varying cultures to facilitate CHE. Butler University began helping staff and supplying clinics in 2014, and the EPICS team was introduced in 2015 to create the EMR application (Barnabas Task, 2013). Similar to the

mission trip described by Dressel et al. (2017), students reported an increase in their teamwork skills. The application continually evolves as innovative ideas develop from communication and teamwork between the EPICS and healthcare students. To improve both this learning experience and the application, the EPICS and healthcare teams need more collaborative meetings and communication, which have been set up via live simulated clinic days in the United States. The team views the application working in real time and can modify the application before arriving at the clinic. The need for more simulations was reiterated in the survey results: almost half of students wanted an increase in the number of meetings between the two groups prior to the trip. More meetings will allow for the healthcare students to help update the prescribing and diagnostics parts of the application and to provide recommendations for further clinical functions in the prototype application, including drug interaction reporting and other patient safety features.

It is important that the students gained knowledge from this collaboration, but ultimately the goal is to help the patients in the DR. An EMR application is warranted for helping track past medical records; over half of the patients who took the survey reported being seen in the clinic previously. With patients returning each year, there is clearly a need for the clinic, and the clinic is being utilized as routine care for many people. The application allows past medical records to be viewed, to see progression of disease states and to ensure that the patient is receiving the best care possible. The application improves patient safety by allowing allergies to be documented and viewed through their prior visit history. The support for EMRs improving patient safety has been shown in the work of Khalifa (2017), as there were fewer occurrences of medical error. Providers can also access medication histories to track clinical progression. Not only does the application help prevent medication errors, it also improves the processes of the clinic. Patients are quickly registered and triaged and then sent to see a provider, without the hassle of paper charts. Only two of the 95 patient respondents commented that any step of the clinic took too long. Future development and evolution of the application could help further streamline clinic processes and improve patient satisfaction.

Not only is the application evolving, but so is the EMR EPICS project. There has been a growing number

of EPICS students interested in the collaboration with healthcare students. The EMR project continues to attract new and returning Computer Science and Software Engineering (CSSE) students, who find this project intriguing and realize the potential it has for experiential learning. The EMR project has spanned over six consecutive semesters and has currently attracted and engaged 35 CSSE students. The trip teaches students to collaborate with students of different educational backgrounds and helps students discern their future career paths. One of the EPICS students changed his major after exploring his passion for computer programming while working on the EMR project. All participants in the application collaboration group reported some form of educational growth.

Beyond their own education, this experience also exposes students to the education styles of the Dominican Republic. Medical school in the DR takes six years to complete as opposed to the eight years required to achieve a medical degree in the United States. Cultures differ not only in education but also in communication styles and language. Learning to respect the cultures and healthcare systems of other countries will help students become more adaptable and knowledgeable as they embark on their future careers. It is also beneficial to familiarize oneself with other cultures, because many medical professionals are obtaining their degrees abroad, while still wishing to practice in the United States. This trend was voiced by many of the medical students who acted as the group's translators during the clinic in the DR. As of 2006, approximately 25% of physicians practicing in the United States obtained their medical degree abroad, a number that has been increasing since the 1960s (Boulet, Cooper, Seeling, Norcini, & McKinley, 2009). Not only are physicians with different educational backgrounds practicing medicine in the United States, there has also been an increase in the number of foreign-born United States citizens. With almost 13% of the United States' population being born in another country, providers will be encountering patients with a variety of backgrounds (Singer, 2013). It is important for healthcare providers to adapt and be knowledgeable of cultures different from their own. Cultural awareness is the main experience gained from clinics where US and DR students volunteering together.

In the future, it would be beneficial to continue to track patient surveys to ensure that the application keeps improving patient satisfaction and clinic efficiency. However,

it is reassuring to see that a majority of patients did believe that their wait times were acceptable and that the clinic is currently working at an efficient pace. Looking forward, it would also be appropriate to start examining clinical outcomes of patients, as the EMR is able to track them on a yearly basis to see whether medical interventions are making a long-standing impact on patients' disease states. As Kruse et al. assert (2017), EMR systems can improve quality outcomes for patients in the acute setting. Data collected from the DR clinic could be examined to determine whether these same improvements can be repeated. Overall, the collaboration between healthcare students and computer science students has led to the production of a functioning, affordable EMR application prototype to improve patient safety and satisfaction. It has also expanded technical and communication skills for students across Butler's campus and among the DR students that Butler University connects with while in the DR. The goals of this project in the future would be to keep improving the application and eventually provide access to the application to other non-profit organizations to help them serve their patient population.

Acknowledgement

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About the Authors



Courtney Cox (clcox1@butler.edu) is a current pharmacy student at Butler University and has traveled to the Dominican Republic three times with the team. After graduation in May 2018, she hopes to pursue a career that allows her to continue to work with an underserved population both in the United States and abroad.



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for community service and experiential learning. Before joining Butler, he was the Chairperson of the Computer Science department at Tennessee Technological University.

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Demographics

1. **Is this your first experience with Barnabas Task?**
 - a. No
 - b. Yes
2. **How many times have you worked with Barnabas Task?**
 - a. 1-2 times
 - b. 3-5 times
 - c. 6 or more times
3. **What was your role with the EMR app?**
 - a. Healthcare Student
 - b. Healthcare Provider
 - c. EPICS Team
 - d. Translator (PUCMM or OASIS Student)
 - e. Clinic Organizer
4. **Describe your major.**
 - a. Pharmacy
 - b. Physician Assistant
 - c. Nursing

EPICS Team

5. **Why did you select this project? What was your motivation behind selecting this project?**
6. **Name the top three non-technical learning experiences that you took away from the EMR project.**
7. **Name the top three technical learning experiences that you took away from the EMR project.**
8. **Comment on your overall assessment and grading of your performance throughout this project.**
9. **Did you participate in the trip to the DR?**
 - a. No
 - b. Yes
10. **Comment on your overall trip experience.**
11. **What did you learn from the PUCMM/OASIS students while working in the clinic?**
12. **Comment on the amount of time spent on devotions and reflection.**
13. **Did your faith change or grow? Comment on this.**
14. **Were you interested in going on the trip to the DR?**
15. **What prevented you from going on the trip?**
16. **Comment on your experiences of interacting with the healthcare students.**
17. **What suggestions do you have to improve the way the two teams interacted?**
18. **Did you participate in the EMR simulation in March?**
 - a. No
 - b. Yes
19. **What value did you find in this simulation?**

20. **How have you used the knowledge and skills from this course outside of the classroom?**

Healthcare Students

21. **Why did you decide to participate in this trip?**
22. **Name the top three learning experiences that you took away from this experience.**
23. **Comment on the amount of time spent on devotions and reflections.**
24. **Did your faith change or grow? Comment on this.**
25. **Comment on your experience with the EPICS team (those that went on the trip and those that did not).**
26. **What suggestions do you have to improve the way the two teams interacted?**
27. **Comment on your overall experience in the DR.**
28. **What did you learn from the PUCMM and OASIS students while working in the clinic?**
29. **Comment on your experiences using the EMR app to automate the patient care process in the DR.**
30. **What did you like about the EMR app? What would you improve or change?**
31. **Did you like the text boxes used for diagnosis?**
 - a. No
 - b. Yes
32. **Did you participate in the EMR simulation?**
 - a. No
 - b. Yes
33. **What value did you find in this simulation?**

Healthcare Providers

34. **What is your role and capacity of involvement in the clinic? Comment on your previous involvement with Barnabas Task medical clinics.**
35. **Comment on any benefits and challenges you had from your participation in this clinic.**
36. **Did you utilize the EMR app?**
 - a. No
 - b. Yes
37. **Describe your overall experience and impression of the EMR app. How did you find it useful? How could it be improved?**
38. **How do you think the app affected patient care?**
39. **Would you be interested in using it in the future?**
 - a. No
 - b. Yes

Clinic Organizer

- 40. What is your role and capacity of involvement in the clinic?**
- 41. Comment on any benefits and challenges you had from your participation with this clinic.**
- 42. Did you utilize the EMR app?**
- a. No
 - b. Yes
- 43. Describe your overall experience and impression of the EMR app. How did you find it useful? How could it be improved?**
- 44. Would you be interested in using it in the future?**
- a. No
 - b. Yes

Translators (PUCMM or OASIS students)

- 45. What was your role in the clinic? Comment on any previous experiences with Barnabas Task.**
- 46. Comment on any benefits and challenges you had from your participation in the clinic.**
- 47. What did you learn from the American students?**
- 48. Did you use the EMR app?**
- a. No
 - b. Yes
- 49. Describe your overall experience and impression of the EMR app. How did you find it useful? How could it be improved?**
- 50. Would you be interested in using it in the future?**
- a. No
 - b. Yes