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Improving the Detection of Rheumatic Heart Disease in Children Residing in Samoa

Shay Harding

A project paper submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

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ABSTRACT

Improving the Detection of Rheumatic Heart Disease in
Children Residing in Samoa

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Rheumatic Heart disease (RHD) is the most common cause of heart related illness in individuals under 25 years of age and is a major health concern on the Pacific Islands of Samoa (Saxena et al., 2017). RHD related mortality among Samoan children is disproportionally high relative to the rest of the world; it is estimated to impact 10 out of every 1000 children there (Allen et al., 2017). The health care system in Samoa is limited in its resources, which impacts the timely diagnosis and treatment of RHD. Cardiac auscultation is a screening tool used in the identification of RHD. Rheumatic Relief is an organization that performs screenings for RHD using echocardiography and cardiac auscultation. The techniques used, although inexpensive, portable and rapid, do require individuals who are trained in cardiac auscultation.

Purpose: The aim of this project was the implementation of cardiovascular auscultation simulation designed to instruct humanitarian volunteers in proper technique.

Methods: An evidence based education program on cardiac auscultation was developed, which included an online module and an in person simulation session. 15 student participants completed an auscultation pre-test and a post-test following the education module. Students traveled to Samoa where they were supervised in auscultation techniques, in a clinical setting, as part of a larger rheumatic heart disease detection program.

Outcomes: Pre and post tests showed that the training was effective in teaching cardiac auscultation skills. In the field, participants were confident with auscultation skills and detected a significant amount of cardiac murmurs despite some difficult environmental circumstances.

Conclusion: Providing students with an evidence based cardiac auscultation training module does improve cardiac auscultation skills. However, cardiac auscultation alone is not adequate to diagnose RHD reliably and should be accompanied by echocardiography for accurate diagnosis.

Keywords: Rheumatic Heart Disease, cardiac auscultation, simulation, Samoa

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Improving the Detection of Rheumatic Heart Disease in Children Residing in Samoa

Rheumatic Heart Disease (RHD) continues to be a significant concern worldwide. It is the most common cause of heart disease in individuals under 25 years of age (Saxena et al., 2017) and accounts for 10% of all cardiac disease worldwide (Beaudoin et al., 2015). Approximately 32 million people worldwide suffer from the disease, and each year 275,000 people die from it (Vos, 2013).

RHD can have devastating and lasting effects on the mitral and sometimes aortic valves of the heart. Untreated group A streptococcal pharyngitis and subsequently rheumatic fever lead to RHD via an immune-mediated cross-reactivity between specific surface antigens on the surface of the strep bacteria and the M proteins of the heart valves. The resultant fibrosis and irreversible damage to the heart through this process are known as RHD.

Heart failure that results from RHD is associated with high morbidity and mortality rates (Beaton et al., 2017). Aortic stenosis and mitral valve regurgitation are among the most common valve problems seen in this disease (Beaudoin et al., 2015). For advanced or severe RHD, valve replacement surgery may be the only effective treatment. RHD commands attention worldwide because it increases the risk of stroke, heart failure, infective endocarditis, and premature death (Beaudoin et al., 2015).

Though relatively rare in developed nations, RHD is a major health concern in many underdeveloped countries, including the Pacific Islands of Samoa. Beaudoin et al. (2015) found the incidence of RHD in Samoa (3.2 per 1000 children), tenfold the rate found in the continental United States (Beaudoin et al., 2015). More recently, Allen et al. (2017) found an incidence of 10 per 1000 children in Samoa, a much higher rate than Beaudoin et al. reported.

Understanding the reasons for higher rates of RHD in Samoa as compared to other parts of the world requires further investigation. This discrepancy, however, might be explained by the lack of universally accepted best practices, roadblocks to education, and cultural health-seeking patterns. People who identify with the Samoan culture have been shown to seek more holistic remedies to illnesses. Additionally, they tend to seek medical care for illnesses much later than people in other cultures. For example, 66% of the patients diagnosed with RHD had no previous diagnosis of Rheumatic Fever (Beaudoin et al., 2015). This indicates that although these patients had Rheumatic Fever, they either did not seek medical attention, or they were mis-diagnosed.

Multiple efforts are being made to reduce the incidence and effects of this disease in Samoa; however, they face several challenges. Efforts to prevent RHD in Samoa include encouraging people to seek medical attention early and then comply with prescribed antibiotic therapy. There are also efforts to improve the availability of care and antibiotics to prevent RHD.

Along with prevention, children must receive the proper screening to help minimize the mortality and morbidity associated with this disease. RHD detection requires healthcare providers with specialized skills in cardiac auscultation and echocardiography. Samoa's healthcare system lacks the resources to properly educate and train their providers regarding cardiac auscultation (Braden, 2006).

To help with screening and treatment, Rheumatic Relief (RR) was organized. In the last three years, RR (a U.S. based non-profit) has partnered with the Samoan Health Ministry and screened over 11,000 school-age children in Samoa (Allen et al., 2017). RR depends on volunteer cardiologists, echocardiography technicians, and Brigham Young University (BYU) undergraduate students to administer the screening process.

Cardiac auscultation is an important part of this screening and is often the first step in detecting a cardiac murmur related to RHD. Using an inexpensive, portable, and rapid form of RHD assessment, individuals can be taught to perform cardiac auscultation and detect the nuances of cardiac sounds. These individuals must be capable of reliably distinguishing between normal and abnormal auscultation sounds.

RR combined forces with undergraduate students at BYU, studying biology and public health, and educated them on cardiac auscultation techniques. The students use these skills in Samoa to screen for heart murmurs.

In past years, one hurdle has been that these students have had little to no experience with cardiac auscultation before their study abroad. Listening to each other's hearts has been their only educational experience. RR has identified that it is essential for participating students to receive an in-depth education on cardiac auscultation.

RR requested that an education process be developed, utilizing the resources available at BYU. The Mary Jane Rawlinson Geertsen Nursing Learning Center Simulation Lab on BYU's campus was utilized by the students for the acquisition of the required skills. Simulation is an effective way to provide this education. A recent meta-analysis illustrated the importance of simulation in medical training (McKinney, Cook, Wood, & Hatala, 2013). Simulation-based education is not only effective but an important modality for education for auscultation skills (McKinney et al., 2013).

Students that go to Samoa to help with screenings need to understand normal heart sounds as well as be able to reliably detect heart murmurs that are commonly associated with RHD. Thus, the purpose of this project was to develop and utilize high quality, low-cost

auscultation simulation to teach cardiac auscultation skills to participating undergraduate students of BYU.

Methods

This project was broken into three stages: the development, implementation, and evaluation stages.

Development

The development stage began by meeting with the RR organization. We discussed their expectations for the project and reviewed content that needed to be included in the cardiac auscultation education module. We also discussed the participating students' knowledge base. This information helped us develop an education module tailored to the students' needs.

Following this meeting, we began to develop the online education module by utilizing evidence-based practice. This module was based on the students' educational needs for cardiac auscultation and covered several topics to provide the students with a basic understanding of the heart. We included information on heart anatomy, the cardiac cycle, complications of RHD, and how it affects the heart. We also covered cardiac murmurs and anatomical auscultation sites with associated sounds. An online learning platform was used to develop the online portion of the education module. This program allowed participants to view the education module and provided them with a base knowledge necessary for successful cardiac auscultation.

The final part of the development phase focused on preparing the in-person education session. The objective of the in-class portion of this training was to provide students with supervised auscultation practice to improve auscultation skills for both normal and abnormal heart sounds. To accomplish this objective, we used auscultation manikins with both normal and abnormal heart sounds. Preparing the in-class education portion involved coordinating with the

Mary Jane Rawlinson Geertsen Nursing Learning Center to reserve their simulation lab for one evening, securing equipment, and preparing the auscultation manikins.

Implementation

Implementation of this education was accomplished in three steps. First, students were provided a link to an online module and were asked to complete a pretest assessment and an education assignment before the in-class education session. The faculty for the RR program agreed to make this module a part of their course and assigned points for its completion.

Second, we conducted an in-class education and auscultation practice session. All students that went to Samoa as a part of this program were required to attend this session. They received instruction and practiced cardiac auscultation and murmur identification on the manikins. We divided students into four small groups and provided guided instruction on cardiac auscultation of normal heart sounds and sounds associated with RHD. Four instructors taught a pre-determined set of auscultation skills. Both the online module and the in-class education occurred in the Winter semester of 2019.

Third, after completion of the cardiac auscultation education, students traveled to Samoa to begin screenings. There, the first author and the RR organization oversaw and mentored students in these efforts. This ongoing education allowed for reinforcement of auscultation skills as students learned to auscultate the heart sounds of live patients.

Evaluation

In this final stage of the project students were evaluated in two ways. First, after hands on training, students were given a post-test to evaluate education gained during the in person and online training. These findings were compared to their pre-test score to objectively assess student learning. The second method of evaluation involved direct supervision of these students in

Samoa by the first author and RR. This provided supervisors the opportunity to observe students and give feedback regarding the effectiveness of the skills taught in the simulation education. These critiques will inform improvements in the next iteration of the module.

This method of evaluation was performed by the following process: All children screened in Samoa first visited a pre-screening auscultation station where the participating students who had completed the education would listen to and flag children thought to have audible murmurs. The children identified as having audible murmurs received full comprehensive echocardiograms. Children who were not flagged with a murmur visited a second station where the trained volunteer echo-technicians with RR performed a focal echocardiogram to rule out RHD. Any children identified as having RHD during the focal echocardiogram also received a comprehensive echocardiogram. Full comprehensive echocardiograms were not completed on all children due to the sheer number of children being screened and because RHD can be seen and diagnosed by the focal echocardiograms that were being performed. All children diagnosed with RHD by echocardiography were auscultated afterwards by a cardiologist to determine if there was an audible murmur. This helped evaluate the students' skill level by determining if students missed any murmurs in the pre-screening stations. Not only was this method helpful in identifying the effectiveness of student education but also provided valuable insight into the viability of auscultation as a means of detecting RHD. RR gave the names and results of the children diagnosed with RHD to the Ministry of Health of Samoa, who handled follow up care and treatment.

Results

A total of 15 students participated in the on-line module and attended the in-person education and simulation course. Their pre and post-test scores were compared using a paired T-

test. Using this comparison, the data showed that the mean assessment score improved significantly ($t=-5.43$, $p=<0.001$) from the pre-test assessment ($M=47\%$, $SD=0.15$) to the post-test assessment ($M= 81.67\%$, $SD=0.23$) (figure 1).

There were 2117 Samoan children screened, both by auscultations, performed by students, and by focal echocardiograms, performed by trained echo-technicians. Of these, 32 (1.51%) were diagnosed with RHD by echocardiography. Of note, comprehensive echocardiograms were not routinely performed, as RHD can be accurately diagnosed by a rapid focal method. Cardiologists confirmed a murmur in six (18.75%) of the patients with RHD. The students participating in auscultation correctly identified a murmur in 66.67% (n=4) of these children in the pre-screening auscultation station. Of the children identified as having murmurs by the cardiologist, 33.33% (n=2) were missed by the students in the pre-screening auscultation station.

In addition to the 32 persons diagnosed with RHD, five children were incidentally diagnosed with a congenital defect during the screening process, including three with a ventricular septal defect, one with an atrial septal defect, and one with a patent ductus arteriosis. Most (n=4) of these defects were initially identified during the auscultation screening as the students correctly detected a murmur. RR presented the information of any children found with congenital or RHD cardiac defects to the Ministry of Health of Samoa for treatment.

Discussion

Using a paired t-test, the data showed that the cardiac auscultation education and simulation resulted in significant improvement from pre- to post-test evaluation ($p<0.001$), with a 34.7% increase in average scores. The findings of this study were consistent with a systematic review and meta-analysis of a simulation-based medical education done in 2013. This meta-

analysis compared 13 studies, of single group pre-post comparisons, consisting of physicians, nurses, medical students, residents, physician assistants, and nursing students. Similar to our results, these authors concluded that simulation-based medical education was effective and showed significant improvement in pre-post scores (McKinney et al., 2013).

This study was unique, however, because the education was additionally evaluated on how it influenced real-world practice. Several weeks following the simulation and education, the students were able to use their newly acquired knowledge and skills in Samoa by screening with cardiac auscultation more than two thousand children on the island of Savaii. This evaluation further confirmed not only the effectiveness of the improvement of knowledge but also the effectiveness of the education on performing the associated skills. Fifteen students with no prior experience or knowledge, in a screening station pre-echocardiogram, correctly identified 66.67% (n=4) of children diagnosed with RHD that had audible murmurs. These results were confirmed by expert cardiologists. What further makes that number significant is that these auscultation stations were performed during varying levels of fatigue, and unplanned environmental stresses, such as noise, heat, and wind.

It is noteworthy that two thirds of audible RHD murmurs were correctly identified by undergraduate students during these screenings. This speaks to the effectiveness of the education simulations. However, it also shows there is room for improvement in training. Further studies are needed to explore whether education modules can be structured in a way that can train individuals to identify murmurs with the same accuracy as a trained cardiologist.

Only 6 of 32 (19%) of children diagnosed with RHD had an audible murmur. This was confirmed by a cardiologist listened for a murmur on every child with a positive finding of RHD by echocardiogram after they had been through the first two screening stations. This is

significant because it shows that cardiac auscultation alone is not an effective means of screening or diagnosing RHD. RHD was definitively diagnosed with echocardiogram results. Standard guidelines for diagnosing RHD is an echocardiogram (Remenyi et al., 2012). This is because many children with RHD may not have disease advanced enough to hear an audible murmur and could be missed with auscultation alone. It remains important to consider the whole picture when assessing for and considering RHD, including a comprehensive history and physical, assessing other symptoms, auscultation, and echocardiography. Auscultation is one of the tools that help with diagnosis.

Correctly identifying murmurs was also associated with incidental findings of congenital heart disease. As mentioned, in the auscultation screening stations in Samoa, there were five incidental findings of children with congenital heart defects. Some of these congenital defects may have been missed by the specific, rapid echocardiograms if children had not also been screened by auscultation. Between 4 and 13 per 1000 births have congenital heart defects in the general population worldwide (Marelli et al., 2014). Although not the initial purpose of the project, the skills of the students performing auscultation proved extremely valuable at identifying these children with congenital heart defects. This shows that the auscultation skills taught were not only valuable tools in detecting RHD but were also paramount in detecting other abnormalities that warranted more comprehensive echocardiograms for these five children.

The names and test results of children identified with cardiac disease were given to the Ministry of Health of Samoa. RR facilitated the transfer of relevant diagnostic information of those affected to the Samoan government so that specific treatment could be pursued depending on the severity of each case. Those with mild severity would be put on an antibiotic regiment to prevent the disease from causing further heart dysfunction. Those with more severe cases need to

have arrangements made through the Samoan Government to travel to other neighboring countries, such as New Zealand, Australia, or India and be seen by medical professionals to surgically repair or replace affected heart valves ("Echocardiographic screening and follow-up," n.d.). Treatment was not tracked as part of this project and the specific patient outcomes are unknown.

Although the sample size of children being screened was large, the sample size of students learning the skill of auscultation was quite small. In addition, being in a single study site with a homogenous population are other factors that may limit the generalizability of the study. There were also several potential confounding factors. The noise being among the most important. Auscultation is a skill of subtle sound variance, and there was no lack of ambient noise during screening. At any time, dozens of children were in the same room with concrete echoing floors, laughing, playing, and being children. There were no walls, which left the screening area open to environmental noise. At two locations construction being done outside left students competing with sounds of construction equipment as they tried to auscultate heart sounds. This is a possible explanation for the one-third (n=2) of children that had audible murmurs that were missed at the auscultation screening stations, and makes the high rate of correctly identifying murmurs even more convincing. Other confounding factors include fatigue from long hours of screening, quality of some of the stethoscopes and the subjective nature of auscultation even by a skilled cardiologist.

Further research is recommended to confirm findings in larger sample sizes of students and working with various populations. As technology advances, further studies are also recommended to evaluate which methods and technologies are most effective in teaching auscultation. A suggestion to improve the next iteration of the education program might be to

include more examples for students to hear normal vs abnormal heart sounds. Instead of focusing on properly identifying what each murmur is by naming which valve is affected, systolic vs diastolic, and stenosis vs regurgitation, the students would benefit more from learning the vital auscultation sites and just be able to identify normal vs abnormal heart sounds. The only way to effectively do this is to hear many more examples and recordings of normal heart sounds vs murmurs of all types. Given the circumstances of screenings in Samoa, it would be helpful to practice auscultation with some ambient noise in the background instead of a completely quiet room.

Conclusion

The purpose of this project was to help RR and be a part of the screening process of thousands of Samoan Children by teaching basic cardiac auscultation to a group of undergraduate college students with no prior education or skill in cardiac auscultation. After meeting with RR, an online education module was created for students to view and practice, and the in-class session was held to further teach the skills, answer questions, and allow students to practice auscultation skills on manikins in a simulation lab. Students correctly identified 66.7% of murmurs in Samoan Children with Rheumatic Heart Disease and also identified incidental findings of congenital heart defects. As a stand-alone assessment, cardiac auscultation is not diagnostic, but it can aid in identifying children with RHD and congenital heart defects and is an integral part in the screening for RHD. Similar interventions of utilizing cardiac auscultation simulation labs along with other developing technologies, perhaps with more emphasis on practice and more examples of normal vs abnormal heart sounds instead of an in-depth physiologic murmur identification, should be considered in efforts to improve auscultation skills to identify RHD.

REFERENCES

Allen, M., Allen, J., Naseri, T., Gardner, R., Tolley, D., & Allen, L. (2017). A rapid echocardiographic screening protocol for rheumatic heart disease in Samoa: A high prevalence of advanced disease. *Cardiology In The Young, 27*(8), 1599-1605. doi:10.1017/s1047951117000907

Beaton, A., Aliku, T., Dewyer, A., Jacobs, M., Jiji, J., Longenecker, C. T., . . . Jiang, J. (2017). Latent rheumatic heart disease: Identifying the children at highest risk of unfavorable outcome. *Circulation, 136*(23), 2233-2244. doi:10.1161/CIRCULATIONAHA.117.029936

Beaudoin, A., Edison, L., Introcaso, C. E., Goh, L., Marrone, J., Mejia, A., . . . Van Beneden, C. (2015). Acute rheumatic fever and rheumatic heart disease among children-American Samoa, 2011-2012. *MMWR: Morbidity & Mortality Weekly Report, 64*(20), 555-558.

Braden, V. (2006). Current issues in healthcare in Samoa "making-do with what is available". *School for International Training Gradute Institute.* Retrieved from https://digitalcollections.sit.edu/isp_collection/339

Echocardiograhic screening and follow-up. (n.d.). Retrieved from https://biology.byu.edu/rheumatic-relief/echocardiographic-screening-follow-up

Marelli, A. J., Ionescu-Ittu, R., Mackie, A. S., Guo, L., Dendukuri, N., & Kaouache, M. (2014). Lifetime prevalence of congenital heart disease in the general population from 2000 to 2010. *Circulation, 130*(9), 749-756. https://doi-org.erl.lib.byu.edu/10.1161/CIRCULATIONAHA.113.008396

McKinney, J., Cook, D. A., Wood, D., & Hatala, R. (2013). Simulation-based training for cardiac auscultation skills: Systematic review and meta-analysis. *Journal of General Internal Medicine, 28*(2), 283-291. doi:10.1007/s11606-012-2198-y

Remenyi, B., Wilson, N., Steer, A., Ferreira, B., Kado, J., Kumar, K., . . . Zuhlke, L. (2012). World heart federation criteria for echocardiographic diagnosis of rheumatic heart disease – An evidence-based guideline. *Nature Reviews Cardiology, 9*(5), 297-309. https://doi-org.erl.lib.byu.edu/10.1038/nrcardio.2012.7

Saxena, A., Desai, A., Narvencar, K., Ramakrishnan, S., Thangjam, R. S., Kulkarni, S., . . . Sukharamwala, R. (2017). Echocardiographic prevalence of rheumatic heart disease in Indian school children using world heart federation criteria – A multi site extension of rheumatic study. *International Journal of Cardiology, 249*, 438-442. doi:https://doi.org/10.1016/j.ijcard.2017.09.184

Vos, T., (2013). Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: A systematic analysis for the global burden of disease study 2013. (2015). *Lancet, 386 North American Edition(9995),* 743-800. https://doi-org.erl.lib.byu.edu/10.1016/S0140-6736(15)60692-4

APPENDIX

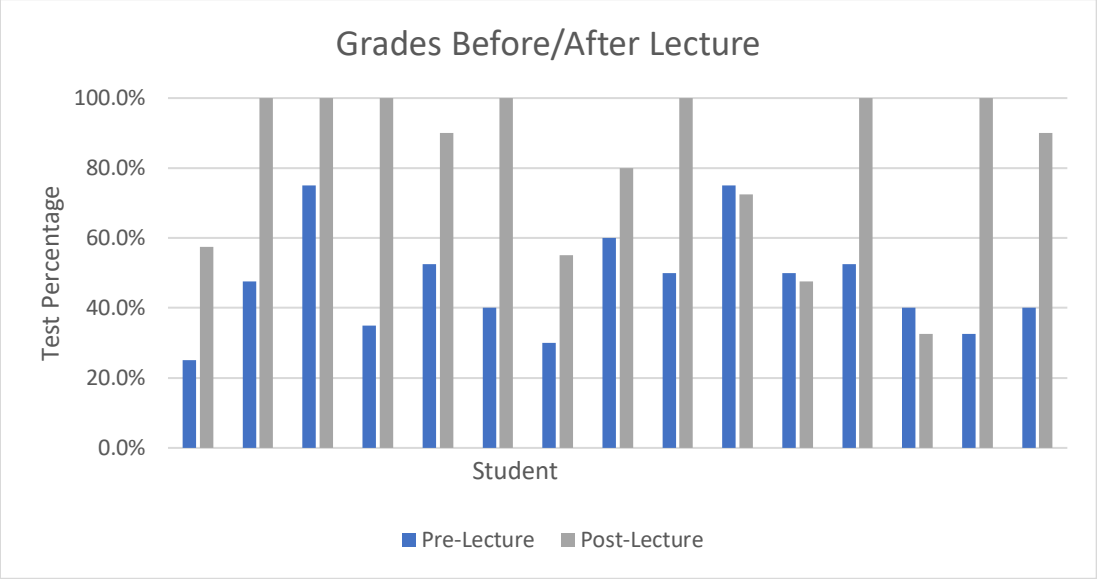

Figure 1. Illustrates the pre and post-test scores of the 15 students who watched the prepared online module and attended the cardiac auscultation simulation and education course.