Engineering World Health Summer Institute
Dominican Republic 2019
Final Report

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Executive Summary

We first began working in the Dominican Republic in May 2018, holding a 3-week Campus to Country program in partnership with the University of Portland and the Catholic University of America. That program was a success, so we chose to return to the Dominican Republic for our 9-week Central American Summer Institute program in 2019. Given the data and feedback collected, it appears that this program went very well, being beneficial to students and hospitals alike.

We had 9 participants: 2 male and 7 female. Six were undergraduates, 1 a graduate student, and 2 were post-graduate; they carried passports from 4 different countries.

Unlike our other programs, where the participants are centrally located for the first month and dispersed for the second, these participants stayed with homestay families in Santiago throughout the duration of the program. During the first four weeks of the program, the group underwent intensive technical and language (Spanish) training conducted at ALPI. Their technical training included both lab and lecture, with one weekly visit to a Santiago hospital to provide the participants with supervised hands-on experience before beginning their hospital placements.

After their training, participants were split into 4 groups and began work in one of our two partner hospitals, both located in Santiago. During their 5-week placements, **participants repaired 120 pieces of equipment worth approximately US $240,000[1]. Equipment ranged in complexity from patient monitors to operating tables.**

The participants seemed to have many notable, high impact repairs, as multiple groups said a doctor or nurse was thrilled when they returned a piece of equipment to service. One group recalled having 1 hour to fix a bed while a patient was up, and they managed to finish it in 30 minutes, which made the patient very happy.

In summary, our data and feedback indicate that this program had a positive impact on our participants and the Dominican Republic healthcare system. We are grateful to all who helped make this program a success.

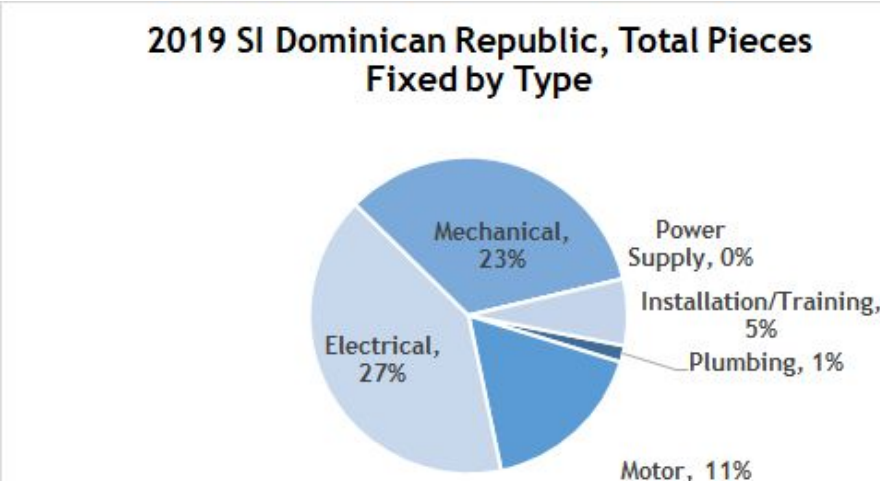
Medical Equipment Repair

Our participants' main objective during the Institute program is to complete hospital equipment repair and maintenance. The training portion of the program prepares them to complete these repairs in a low-resource setting. Once the training is complete, participants are placed in small teams in our partner hospitals with EWH-provided toolkits to complete as many repairs as possible. Participants do not repair every piece of broken equipment that they encounter, which is to be expected, as there are many barriers to equipment repair. The most common barriers we see are lack of parts and repairs which require more advanced knowledge.

The 9 participants repaired or completed preventative maintenance on 120 pieces of medical and hospital equipment, totaling approximately USD $240,000[1] of equipment repair service. We ask participants to complete a "Work Summary Form" during their time in the hospital to document the pieces of equipment they encounter, the reason the piece of equipment is broken (e.g, power supply issue, blown fuse, etc.), and if the repair is successful. Their repair work, as taken from the Work Summary Forms, is summarized below.

<u>Repairs by Type of Fix</u>

Participants indicate the main reason for the item being out of service from the following categories. This year, mechanical and electrical issues were the main issues seen in the broken equipment (which is common across our programs). This chart summarizes data only from successfully repaired equipment.



Repairs/Maintenance by Type of Equipment

The table below summarizes the types of equipment on which participants completed repairs. Patient and delivery beds, infant incubators, and ventilators made up the greatest percentage of successfully completed repairs. “Other” also made up a large percentage, which is typical, as participants often encounter a number of devices not included in our provided list, or are unsure how to classify an item.

Type of Equipment	**Total Pieces**	**Type of Equipment**	**Total Pieces**
Air Compressor	2	Lamp, examination	2
Aspirator/Suction Machine	3	Nebulizer	2
Bed, delivery	24	Operating Table	1
Ceiling Fan	1	Ophthalmoscope	1
Centrifuge	4	Patient Monitor	5
Control Switch Panel	2	Projector	1
ECG	4	Laboratory Scale	3
Electrosurgery Machine*	1	Ventilator	6
Furniture	1	X-Ray Machine*	1
Incubator (infant)	16	Other	10

*User training and/or low voltage and peripherals repairs only

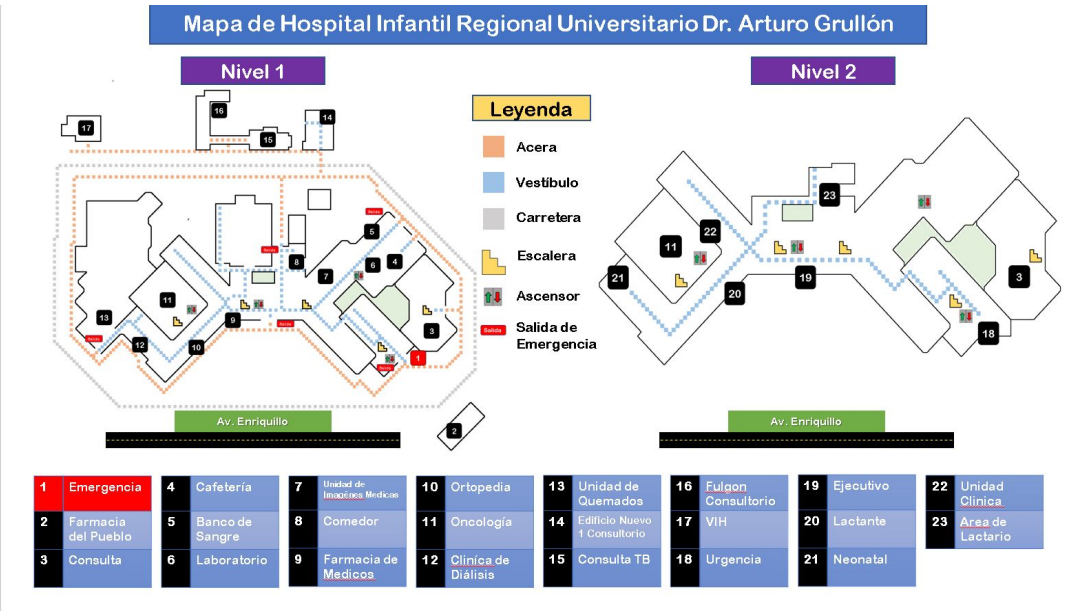
Secondary Projects

Each team is encouraged to complete a secondary project for their hospital during their placement. Through interviews with hospital staff, the participants identify a need in the hospital and find a creative way to meet that need.

Group 1

This group's secondary project was creating a map and directions for the hospital. The group spoke with security guards, BMETs, and nurses, and then wrote down anecdotes of things they saw occurring or that they experienced themselves. When they first arrived at the hospital, they noticed several lost patients in the hospital, and saw that people (including themselves) were frequently asking for directions. Since there are many Haitians who come for medical treatment to the Dominican Republic, many patients do not speak Spanish, so they had an especially difficult time finding their destination. Additionally, the hospital is currently under construction, leading to many incorrect signs.

The group proposed their idea to the hospital's BMET, who loved the idea, as he had a similar vision for the hospital. The BMET wanted to paint arrows, footprints, or lines around the hospital to lead people to their destination. The group adapted his ideas to make them work with the construction in the hospital, specifically making signage that could be moved along with the changes in the hospital. They made maps of the hospital, printed on cardstock and had them laminated, then hung them throughout the hospital.



Once the maps were hung, they realized there were a few problems with the project, which they discussed with the nurses and staff in the hospital. In the following days, they took these recommendations and problems into account. They were able to fix almost all of the problems before leaving.

Group 2

This group made patient restraints for the hospital's ICU. Initially, the hospital used cloth or gauze to hold the patients in beds to prevent them from moving while doing checks or to keep the IV tubes in place. While the ties worked, they were uncomfortable for the patient and left bruises, and could even lead to blockage of blood vessels. The group consulted with a doctor in the hospital, and she agreed that a more comfortable restraint would be a good solution.

The group used material from antibacterial curtains. The hospital's tailoring and laundry department helped sew the restraints. They made 48, four for each of the twelve beds in the ICU. Although they will rarely need to be used all at once, this allows for extras in the case of losses or damages. The group also provided them with a box to store the restraints.

Group 3

After observing that many of the operating tables in use suffered damage due to user error, the group proposed a device to modify the OR tables in order to prevent this damage. After consulting with hospital leadership, they opted to

create and place warnings in the operating rooms to prevent this recurring damage. Additionally, they provided an informational training session for the staff to ensure awareness of the correct storage space in the operating room and how to prevent damage to this equipment in the future.

Group repairing operating table

Group 4

This group made an infant incubator guide for nurses and doctors in the neonatal unit. The guide explains how to put plastic covers correctly on the sides of the incubator, as the group noticed that after the cleaning process, the staff would sometimes reassemble the unit incorrectly, allowing for air flow into the incubator. This could be a problem because the temperature inside the incubator has to stay in a defined range, while the air outside (in the neonatal unit) is colder because of the air conditioning in the hospital. Therefore, it is important to avoid air passing from outside to inside the incubator when the baby is under treatment. The head nurse of the neonatal unit liked the group's idea and encouraged them to proceed.

While working on the incubators in the warehouse, the group found out that many incubators were missing spare parts. They scavenged as many spare parts as possible from the broken incubators in the storage room and put them in the

incubators that were in use. They then attached a guide to each incubator to make users aware of the importance of these spare parts, which are used to cover the windows of the incubator. They made the guide in Spanish, had the OTGC (a fluent Spanish speaker) proofread their translations, then printed and laminated the guide and tied one to each incubator. Lastly, they did a group demonstration for the nurses of neonatal area.

Participant Debriefs and Feedback

Engineering World Health seeks not only to assist the hospitals in which our participant volunteers work, but also to influence the volunteers' own development as engineers and as global citizens. Our participant feedback was very positive. When asked if they would recommend the program, all participants answered "yes." Some of the words used to describe the program were authentic, impactful, cultural, inspiring, and unique. Laura, our On-the-Ground-Coordinator, and Dr. Larry Fryda, our instructor, received excellent feedback and very high praise from the participants. The language barrier and homesickness were most mentioned as the greatest challenge in the program. We found that while the pre-departure literature is very good, it could be fine-tuned in some places, and the students continue to want more hands-on experience in the training month of the program.

Generally, the feedback the students gave showed how much the program impacted them. A few select quotes:

"When working on a broken device...I took the time to try different solutions and I learned new things from every attempt I made. I tried many solutions to repair the equipment before giving up. I really liked this work approach. I think it's extremely informative, even in other contexts of life."

"The gratitude on the faces of the nurses and doctors after the fix is something I will always bring in my heart."

"I know that [this program] has given me a life-long interest in other countries and cultures and has given me a better idea of what I want my career to be like."

"My perspective has forever changed - I love learning a different language, and I love speaking and working with other people. I now know I want to keep doing things like this, and hope to do something like this professionally."

Acknowledgements

The On-the-Ground-Coordinators was Laura Fernández Terrón. The course was taught by Dr. Larry Fryda. Language and cultural training were provided by Instituto American ALPI. Thank you everyone who helps make this program, and Engineering World Health, successful.

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[1] EWH estimates the mean value of each repair at USD$2000