



**Engineering World Health Summer Institute  
Nepal 2019  
Final Report**

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Nordic 5 Tech Alliance

VSN Nepal

## Executive Summary

This summer marked Engineering World Health's fourth Summer Institute in Nepal. The Institute was very successful- 24 participants worked in 16 hospitals throughout Nepal to complete a variety of projects aimed at improving healthcare delivery.

The 24 participants from the Nordic 5 Technical Alliance began the program at the Technical University of Denmark, where they took an intensive 3-week course in biomedical instrumentation. After completing the course, the group traveled to Kathmandu, Nepal, for 1 week of cultural and language training before departing for their hospital placements. While in the hospitals, participants worked in groups of 2 or 3. During their 5-week placements, **participants repaired 276 pieces of equipment worth an estimated US \$552,000<sup>[1]</sup>.**

Last year, some participants felt their hospitals lacked equipment needing repair. Thus, we expanded to new hospitals this year to ensure participants were kept busy and hospitals that needed us were serviced. This was a successful development, as all participants reported feeling needed and productive in their placement hospitals.

Nearly all groups completed a secondary project for their hospitals, working with a budget of \$100 USD per person, to address a hospital need outside of equipment repair.

When asked if they would recommend this program, the participants gave a unanimous "yes." The participant feedback gathered was very helpful to us as we continually work to improve this program. Many impactful, high-need repairs were made, and participants appreciated the challenges that come with working in a different culture.

We are grateful to all at DTU and who helped make this program possible and successful in the eyes of our participants and on-the-ground partners in Nepal.

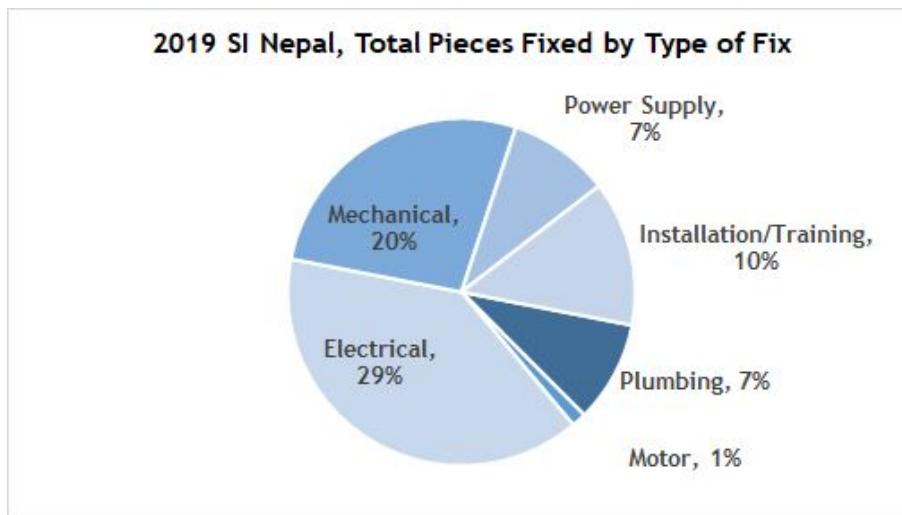
## Medical Equipment Repair

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 24 participants repaired or completed preventative maintenance on **276 pieces** of medical and hospital equipment, totaling approximately USD \$552,000<sup>[1]</sup> 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.

### Repairs by Type of Fix

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 only summarizes data from successfully repaired equipment.



## Repairs/Maintenance by Type of Equipment

The table below summarizes the types of equipment on which participants completed repairs. Nebulizers, oxygen concentrators, and manual blood pressure devices 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
Aspirator/Suction Machine	17	Nebulizer	36
Autoclave	8	Operating Table	3
Bed, delivery	3	Ophthalmoscope	1
Blood Electrolyte Analyzer	3	Otoscopies	6
Blood Pressure Device, Automatic	2	Oven, Lab	1
Blood Pressure Device, Manual	21	Oxygen Concentrator	26
Centrifuge (electric or hand operated)	7	Patient Monitor	17
Computer	1	Phototherapy	2
ECG	14	Printer	1
Electrosurgery Machine*	1	Pulse Oximeter	12
Fetal Stethoscope	2	Scale (laboratory and in wards)	2
Incubator (infant)	1	Stethoscope	3
Infant Warmer (Radiant or other)	3	Ultrasound machine (imaging)	3
Infusion Pumps	7	Ventilator	1
Lamp, examination	5	X-Ray Film View Box	4
Lamp, surgical	6	X-Ray Machine*	3
Microscope	4	Other	50

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

## Repairs by Hospital

The below chart breaks down the repairs by hospital group. Some groups worked in more than one hospital or clinic, leading to lower items touched per hospital than groups that spent all of their time in one place.

Hospital	Items Touched	Repaired	Abandoned	Repair Percentage
Hospital 1	13	8	5	62%
Hospital 2	21	12	16	43%
Hospital 3	15	9	6	60%
Hospital 4	25	10	15	40%
Hospital 5	7	6	1	86%
Hospital 6	45	22	23	49%
Hospital 7	16	13	3	81%
Hospital 8	28	19	9	68%
Hospital 9	28	23	5	82%
Hospital 10	16	13	3	81%
Hospital 11	55	47	8	85%
Hospital 12	10	10	0	100%
Hospital 13	31	24	7	77%
Hospital 14	15	11	4	73%
Hospital 15	41	31	10	76%
Hospital 16	32	18	14	56%
<b>Total</b>	<b>405</b>	<b>276</b>	<b>129</b>	<b>68% avg</b>

## 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, then are given a budget of \$100 per person to use in a creative way to provide for that need.

### Hospital 1

This group's secondary project consisted of improving upon a previous group's water pump system to provide the hospital with filtered, softened water for the autoclaves. Using a tank that previous participants provided for the hospital, this group built a tap system connected to the building's water supply. They made two holes in the tank, one at the bottom and one in the middle: the bottom hole is used to drain out sediments; the middle hole transports water to be used. The plumbing system they created allows for waste water from the filter to be reused with regular water. The softened water will fill the bucket to be used by the hospital. They also provided the hospital with quick-start guides to ensure continued proper use. This is a project that can be built upon in future years: the group advised that if valves and a pump are installed, the hospital can have additional reserves of softened water.



Hospital tech installing piping; Finished upgraded tank

## Hospital 2

This group talked with the hospital administration and decided to continue the hand sanitation station project from 2017. The group reported that some stations were beginning to decay, some were being used as trash receptacles, and the ones still in good working order were nearly out of sanitizer. The group freshened up the existing stations with new alcogel and new posters, and made four more that are to be put in the Operation Departments and Emergency Room.

They obtained materials, painted the boards the same blue color as the existing stations so the staff immediately knows what the stations are. The group also provided additional laminated instructions in large print. From all reports the staff were pleased with the project.

The group took on an additional, smaller secondary project in updating the condom box. The box was damaged and only had English writing beside it. The group improved the box and added a sign in English and Nepali.



Assembling the hand sanitizer holders



Installing one of the stations



The hospital's BMET happy to have a new hand sanitizer station

### Hospital 3

On this group's first day in the hospital, they were given a tour by the technician staff. Among the rooms they visited was the B.M.E.A.T. room. This room is used by the technician staff, where they store tools, machines, medical equipment, both medical and electrical spare parts, and more. It was a nice room, but everything was thrown inside with no system or organization. The room was so full that the door only opened half way without any possibility to walk inside. This group realized there were several times when spare parts or electrical components were needed, and a lot of them were stored somewhere in this room, but were difficult to access. Thus, cleaning this room became their secondary project. They bought similar shelves to add to what was already inside the room. They organized items into boxes and labeled them for ease of future use. In the end, the group found a lot of equipment, spare parts, and other components useful to the hospital, in addition to leaving the BMETs with an organized store room.

### Hospital 4

As their secondary project, this group prepared the dentist ward for the new dentist. The hospital had no dentist during the previous 8 months, so the dentist's ward had fallen into disrepair. The group cleaned the ward, threw out trash, and made general cosmetic improvements so it will look nice and be fully functional for the new dentist, who is set to arrive shortly after the end of the EWH program. They also made an x-ray corner with a chair and the x-ray machine.

### Hospital 5

Per the nurses' request, this group made buckets for needle disposal to be placed around the hospital. Previously the hospital had been using one-time use containers



made from cardboard. The nurses wanted some new buckets in plastic, safer for the nurses, patients, and others who may encounter the boxes.

The group noted that it was hard to find buckets in the right size, so they bought five sets of three buckets in different sizes. The two biggest sizes were used as buckets, and the group made lids from the smallest set. They laminated the instruction paper for durability and attached the paper with screws to the bucket.



Old cardboard container; completed new containers

### Hospital 5

Due to the high volume of repairs that demanded this group's attention, they bypassed a full secondary project for a few smaller secondary tasks. These main tasks were completing carpentry work and painting items around the hospital with the local technicians. This work included making a stand for a white board, stands for pulse oximeters in the emergency department, shelves, and a table.



Participant working on the carpentry projects

## Hospital 6

This group created a “Quick-Start Guide” for the Carina Ventilator that was donated by NepalMed. The staff didn’t know how to connect the hoses nor how to operate the device. The group says this project went very well. They were able to teach the anesthesiologist and two medical students how to operate the ventilator by showing videos and their Quick-Start Guide.



Promi checking the ventilator settings in order to write the guide

## Hospital 7

This group’s secondary project was to paint a patient ward. The beam and poles were not painted before, which makes it susceptible to rot and damage from moisture and other environmental elements. This should help the wood used to construct the building last longer and not rot because of rain and a moist environment.



Painting in progress

## Hospital 8

The hospital staff requested user training and preventative maintenance instructions for oxygen concentrators, incubators and phototherapy units. In response, this group made a presentation for the technicians and nurses. The presentation gave an overview of the equipment, instructed how to use it, and how to complete preventative maintenance, then finished with hands-on practice on the equipment. The presentation was held in English with a Nepalese translator for everyone to understand. The group also provided printed instructions to put on the equipment as a reminder of how to use and maintain it. The instructions were translated to Nepali.



Preventative maintenance presentation; Agnete showing nurses how to use an incubator

To facilitate regular completion of preventative maintenance, the group decided to create an app for smartphones. That makes it easier for the technicians to keep track of the preventative maintenance that needs to be completed around the hospital. The app includes a calendar with notifications that remind the technicians to check specific equipment according to different intervals (daily, weekly, monthly, etc.).

The group said: “The idea is that making preventative maintenance instructions on paper will work in the beginning, but may get lost/forgotten/destroyed etc, so it is more “sustainable” to keep it electronically. All the technicians at the health center have smartphones that can download and use the app. We asked the hospital staff about the idea, and they really liked the thought of it being on the phone rather than on paper.”

Regarding the creation of the app, they added “Making an entire app turned out to take a lot of time. It is functional, but to improve the design and the functionality we need more hours to develop it.”

### Hospital 9

This group renovated the broken beds and tables in the maternity ward. The maternity department sees many patients every day, typically averaging about 30 women, currently pregnant or with newborns, to each room. After speaking with nurses and the head of nursing, they came to the conclusion that the highest need was repairing the beds and tables. With the help of the hospital’s technicians they were able to repair and paint most of the beds in the ward.



Before



Project in process; the red and white finished beds

### **Participant Debriefs and Hospital 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. Overall, the participants' feedback was very positive. Some of the biggest challenges - as we typically see - were the heat in southern Nepal and the language barrier. Adjusting to the new culture was also challenging for most participants. Participants had great things to say about their experience in the hospital and generally found their work rewarding. Below are a few quotes from participant feedback:

“The happiness when returning machines and watching the patients using it at once was very satisfying.”

“I really enjoyed the people I got to work with, including my partner, medical students at the hospital, and the technician. I am very satisfied with the amount of devices that I got to work with even though I couldn't fix all of them. I feel that I got a lot of experience and knowledge about medical instrumentation by doing the practical work compared to theoretical work in school.”

Many participants reported that the hospital staff and administration were very pleased with their work and their contributions over the summer.

## **Acknowledgements**

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