



**Engineering World Health January Institute  
2020 Cambodia  
Final Report**

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## Executive Summary

The 2020 Engineering World Health January Institute in Cambodia was a very successful program. This program, run in partnership with the University of New South Wales in Australia, hosted 29 participants from 4 different countries.

During the first month of the program, the participants underwent intensive language (Khmer), cultural, and technical training conducted at the University of Puthisastra in Phnom Penh. The technical training includes both lab and lecture, with weekly hospital visits to familiarize the participants with Cambodian hospital settings before they travel to their second month placements. Also during the first month, the group went on an excursion to Toul Sleng Genocide Memorial Museum and to the genocide memorial park at Choeung Ek to better understand some of the recent history of Cambodia.

After their training, participants were transported to our partner hospitals, located throughout Cambodia, where they worked alongside hospital staff in groups of 2 or 3 to repair equipment, assess the needs of the hospital, and complete a secondary project to provide for one of these needs. During their 4-week placement, participants worked in 14 public hospitals and **collectively repaired 250 pieces of equipment, worth approximately US \$500,000<sup>[1]</sup>, and completed 19 secondary projects.**

Equipment ranged in complexity from autoclaves to operating tables. Notable repairs include fixing a universal power supply (UPS), which allowed the hospital's imaging division to begin working again; converting a 40 year old lamp from the Soviet Union to use LED bulbs; and returning the hospital's largest autoclave (essential to hospital sanitation) back to working order.

The participant feedback was generally very positive, with most students reflecting on the positive impact they felt the program had on their placement hospital and themselves.

We are grateful to all who helped make this program not only possible, but a success in the eyes of our participants and our partners in Cambodia.

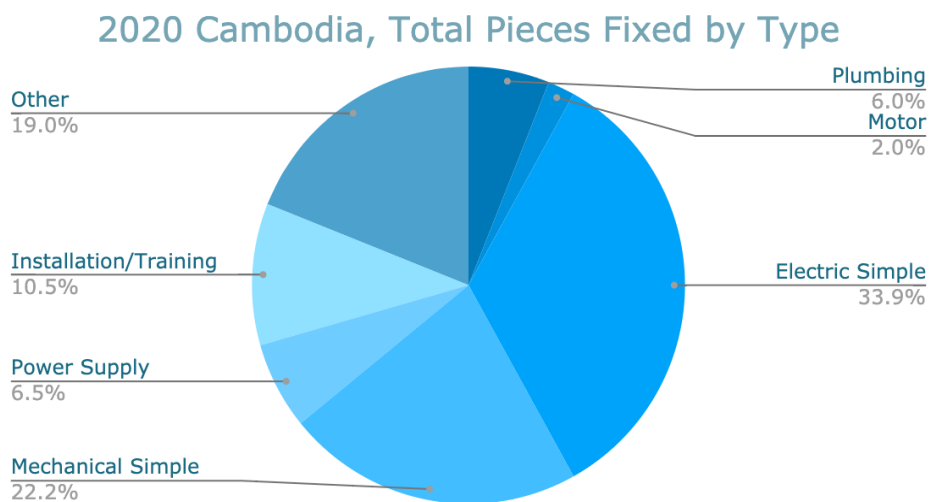
## Medical Equipment Repair

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 29 participants repaired or completed preventative maintenance on **250 pieces** of medical and hospital equipment, totaling approximately USD \$500,000<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 in one of the following categories. As is typical, 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. Aspirators, patient monitors, and surgical lamps 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. Some examples of “other” pieces of equipment include syringe pumps, blood collection monitors, or wheelchairs.

Type of Equipment	Total	Type of Equipment	Total
Air Conditioner	1	Lamp, surgical	20
Anesthesia Machine	1	Laryngoscope	1
Aspirator/Suction Machine	21	Microscope	1
Autoclave	18	Nebulizer	3
Bed, delivery	2	Operating Table	2
Blood Bank Refrigerator	1	Ophthalmoscope	1
Blood Pressure Device, Automatic	9	Otoscopes	1
Blood Pressure Device, Manual	1	Oxygen Concentrator	10
Blood Pressure Monitor	3	Patient Monitor	22
Centrifuge	4	Pulse Oximeter	4
Defibrillator (automatic and manual)*	3	Scales (laboratory and in wards)	5
Distiller	2	Thermometers	6
Drying Machine	1	Transformer	4
ECG Machine	8	Ultrasound Machine (imaging)	2
Electrosurgery Unit (ESU)*	5	UPS (battery)	2
Fetal steth (fetoscope or Doppler)	9	Vacuum Extractor (for delivery)	4
Furniture	8	Ventilator	1
Glucose level kit (or glucometer)	1	Water Bath (laboratory)	1
Incubator (infant)	3	X-Ray Film Dryer	1
Infant Warmer	2	X-Ray Machine*	1
Infusion pumps	5	Other	37
Lamp, examination	13		

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

## Secondary Projects

In addition to their primary task of repairing medical equipment, EWH asks participants to identify other ways they can use their skills to benefit the hospital. Through conversations and interviews with hospital staff and directors, the participants identify a need in the hospital and complete a secondary project to address that need, working on a budget of \$100USD per person, as provided by EWH. This year, the groups completed a total of 19 projects across 14 hospitals.

### Hospital 1

This group completed two secondary projects. The first was to refurbish the hospital's waste bins and stools and return them to use.

The process involved spray painting the bins which had faded in color. They spray painted the bins green, then used a stencil to spray paint the words “General Waste” in Khmer onto each bin. Once the paint was dry, the participants lined each with a waste bag and placed it back in the hospital.



*Participant spray painting the bins*

A similar process was done with the stool refurbishment. The old stools were unstable, so nails were hammered into the supporting arches of the stools. The wooden stools were then sanded down to remove old paint and spray painted with a new coat of white.



*Stools before (right) and after (left)*

The participants' second project involved cleaning and completing maintenance in the hospital's workshop. This was an ongoing project throughout the participant's placement in the hospital.

Upon arrival, the participants noted that all of the equipment tools, spare parts, and components were placed all over the workshop and required organization and cleaning. As the participants worked, they regularly maintained the cleanliness and tidiness of the workshop. Various equipment, tools, and spare parts were organized into separate categories. The group also sorted two boxes of mixed probes, cables and tubing, separating into two categories: functional and broken. The workshop desk was also tidied and objects were placed in labeled boxes.

There was a shelving unit in the workshop that was old and unstable, swaying when touched. The group created drawings for a new one and paid a local welder to build the shelving unit, which was then installed in the workshop.

## Hospital 2

This group made a playground for children at the hospital. The children of hospital staff and patients are frequently at the hospital, but with nothing to do or distract them. The playground provides a safe place for the children to play.

The group included some educational elements: a hopscotch area where the children could learn numbers and a wall for height measurement.



*Final Project Presented to Director*

### Hospital 3

This group completed two projects. The first was cleaning the hospital's workshop.

The group reported that the workshop was rather dirty and unorganized. They spent a few days decluttering, organizing, and cleaning. They repurposed two surgical trolleys to use as shelves, repaired the workshop fridge, and bought two small containers to sort small parts.

Their second project was installing curtains in the maternity ward. The maternity ward had a room with two birthing beds right next to each other and no privacy. The group purchased and hung a curtain between the two beds to provide birthing mothers with privacy during their hospital stay.

### Hospital 4

This group had two secondary projects. The first was to clean and organize parts of the workshop, with their primary focus being the tool wall and the drawers in the workshop. They reorganized the drawers, separating parts and storing them in containers. They cleaned and repainted the tool rack. The boxes below the tool rack were cleaned out and reorganized.

The group reports that the project was productive and well received in the hospital. It also helped them complete equipment repair more efficiently, as finding parts for repairs became a significantly easier task.



*EWH participant with the tool rack; participants sorting the drawers*

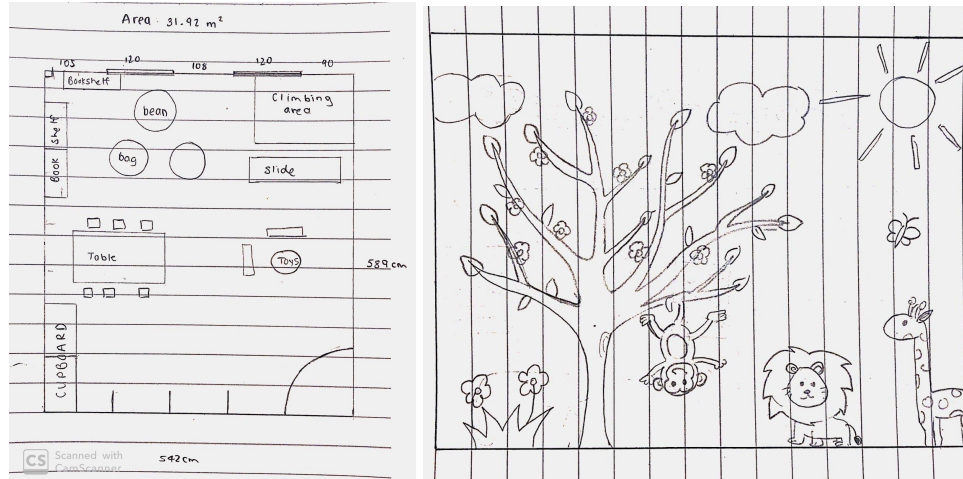
This group's second secondary project was improving the seating options in the hospital. When the participants arrived at their hospital placement, they found there were not enough shaded areas around the hospital for visitors and staff. The designated seating area outside Medicine Ward A, consisting of 11 benches, was situated directly under the sun, leading patients, families, and staff to sit uncomfortably on the curb underneath large trees or lie under the benches to get away from the sun. For their secondary project, this group decided to provide shade to the bench area so the space could be used more comfortably. This was done by installing patio parasols around the seating area.

Five commercial patio parasols and stone bases were purchased. The bases were heavy enough to fix the large parasol to the ground and could withstand large winds. Four were placed outside the bench area by Medicine Ward A and another was kept as a spare in case an issue occurred with the current four. The group reported that their project was immediately effective, as post installation of the first parasol a mother promptly migrated her family sitting on the curb to the bench.

### Hospital 5

This group completed two secondary projects. The first secondary project consisted of revamping the children's playground within the main building of the hospital.





*Layout of children's playground; mural draft*

The first step in renovating the area was to strip the damaged and cracked paint off the walls. The group initially started chipping the old paint off with two scrapers and a few tools from the EWH toolkit. The group found these methods to be inefficient, so decided to hire renovators to complete this project. It took the renovators one afternoon to finish the whole wall.



*Manually chipping off old and cracked paint; the renovators arrive*

The group then spent one and a half days painting the mural. This included copying their plan onto a large scale wall and mapping out the composition using pencil. Afterwards, using the three primary colors along with white and black paint, the colors required for the painting were mixed and used to produce the mural.

The climbing wall was another major aspect of the project. The cushioning section of the climbing wall was bought and ordered in Siem Reap and delivered to the hospital. This did not come with the structure that holds the climbing wall up, hence needed to be made separately. The participants drew a design, ensuring the angle of the wall was appropriate for the main age group of the children in the hospital. Safety hazards were considered. The drawing was then brought to the welders who built the structure.



*Climbing wall design; climbing wall installed with help of hospital staff*

All the other equipment and supplies for the children's playground such as chairs, posters, string, coloring books and pencils, bean bags, and toys were locally purchased and transported back to the hospital. After cleaning the area, the supplies were placed and installed to finish off the playground.



*Before Renovation*



*After Renovation*

The group's second secondary project involved building waste trolleys for the cleaners to transport large amounts of garbage bags to the waste area efficiently and conveniently.

The waste trolley was designed and then given to the welders to construct. The trolley was constructed using steel square bars for the frame. The base of the trolley was a large metal sheet. The frame was then fenced off with metal grid panels to prevent the garbage bags from falling out. Four 12cm diameter wheels were then attached.



*Design of waste trolley; finished product*

## Hospital 6

This group completed four secondary projects, all occurring concurrently:

1. Sewing mattress covers to replace damaged ones. The group reported this to be the most time consuming project.

2. Cleaning and refurbishing a very old and dirty kitchen where patients were cooking and dining regularly.
3. Creating department icons and installing them on the corresponding areas on the hospital map, helping those who could not read Khmer find their direction more easily.

For the first project, the group noticed that most of the beds did not have mattresses, so patients were sleeping on wood. This could be rather uncomfortable, especially for patients who were injured. The group decided to sew mattress covers to replace the damaged covers, aiming to increase the comfort of the beds. The group purchased high quality materials at a local market. They borrowed a sewing machine from their homestay and hospital to sew the covers.



*Sewing the covers; the finished cover*

For the kitchen renovation, the group removed all rubbish and abandoned wood plates, then cleaned the entire area. The kitchen was built in 1959, when charcoal and wood was primarily used to cook food, thus there were many areas and holes to place charcoal and wood. As cooking methods have changed, these holes are no longer utilized, leading them to be filled with rubbish and insect nests. The group cleaned these areas and sealed all holes with concrete. They also re-cemented the cooking bench, making it smooth and accessible for people to use their own cookers. They also repainted the walls and the bench. Finally, they brought a shelf so people could store their food and bottles.



*Before; after*

For the third project: the group occasionally met people who were asking for directions in the hospital, but the participants could not help them due to language barrier. The group interviewed the hospital staff and found that many of them noted the difficulty of finding directions when moving between the departments. Therefore, the group decided to put simple icons representing each department on the map making it more understandable when people did not know the department names.

### Hospital 7

This group's secondary project was improving the condition of the pediatric area. To do this, they did the following: replaced broken taps, installed a ceiling fan, painted interior walls including a feature wall, and cleaned the entire space.



*Before*



*After*

The group additionally created quick start guides for the taps, as the hospital's BMET informed them that the taps are quickly broken due to user error. The group reports that the kitchen's state has been dramatically improved and will be enjoyed for years to come.

### Hospital 8

This group's secondary project was to refurbish the Department of Infectious Diseases and to paint tires which were being used as pots for plants. The refurbishment included replacing the mosquito nets in the Department of Infectious Diseases and painting the doors a coat of white due to exterior damage. In total, they replaced 8 mosquito nets, painted 6 doors, and painted 21 sets of tire planters.



*Repairing a door; installing planters*



*EWH participants with hospital staff*

### Hospital 9

This group's secondary project was to install shower curtains and signs for the shower areas. Before, the shower areas didn't have doors, so others could see into the shower. This would cause discomfort for any patients utilizing these showers.



*Shower area before; and after*

### Hospital 10

This group's secondary project consisted of three parts: refurbishing of old signposts, creating a large print map to be posted publicly in the hospital, and numerous small maps for reference throughout the hospital.

To create the maps, the group used 3D modelling software called Trimble Sketchup. An approximation of hospital dimensions was taken from Google maps, and thus a 3D model was created. The numbering of the buildings was completed by the hospital director. Digital copies of both small and large maps were presented to the hospital and small issues rectified before printing. Final digital copies of the maps were provided to hospital administrators.

Hospital signs were refurbished by a local signmaker. New directional arrows were placed by the director on the old signs.

The group reported that the hospital director was very impressed and delighted at the placement of a new map and signs.



*EWH participants and hospital staff with the new map; participants and technician with new signs*

## Hospital 11

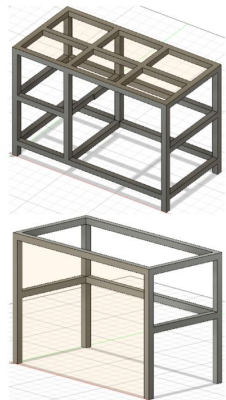
This group's secondary project was to clean and organize the workshop space, specifically by designing and installing tables to help organize the space.





*Workshop before; and after*

The tables were designed with the intent to allow each piece of equipment to be identified, as well as to provide a bench top area to work on while standing up. The tables were successful in achieving this. The group reports that the project was well received and utilised straight away.



*Table design; and installation*

## **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 this year was very positive. Some of the words used to describe the program were interesting, eye-opening, invaluable, rewarding, and life-changing. Most participants found the most challenging parts of the program to be the culture shock and the difficulty of

repairing equipment in a low-resource setting. Many participants stated how the program helped them grow, both as an engineer and personally, and their increase in confidence after completing the program.

### **Acknowledgements**

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