Engineering World Health January Institute
2019 Uganda
Final Report

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Executive Summary

This year was Engineering World Health's second time holding a January program in Uganda, and this program was a general success. We expanded the number of hospitals we worked with in Uganda and completed a record number of equipment repairs. This program hosted 14 participants from the University of New South Wales, 2 participants from the University of Canterbury, and 8 participants from Makerere University. There were 12 male and 12 female participants.

During the first month of the program, the participants underwent intensive language, cultural, and technical training conducted at Makerere University. The technical training comprised lecture, lab, and hospital visits. The group took a tour of Kampala and watched a cultural dance troupe.

After the training, participants were placed in 13 hospitals throughout Uganda. During their time in the hospitals, the participants **collectively repaired over 500 pieces of equipment**, an EWH record for equipment repairs in a single program. Equipment ranged in complexity from clothing irons to oxygen concentrators. Notable, high impact repairs included an infant incubator for a hospital that had very few, an operating table that took about 10 hours of repair work, and repair of an infant weighing scale that hadn't been working for 4 years.

As this is one of our "younger" programs, we are still evolving the program to see what works best in Uganda. While our participant feedback was generally positive, we did receive helpful comments on ways that we can improve upon this program for future participants.

In summary, the Uganda January Institute was highly productive and an overall success. We are grateful to all who helped make this program possible.

Medical Equipment Repair

The 24 participants repaired 509 pieces of medical and hospital equipment, totaling approximately USD $1,018,000[1] of equipment repair service.

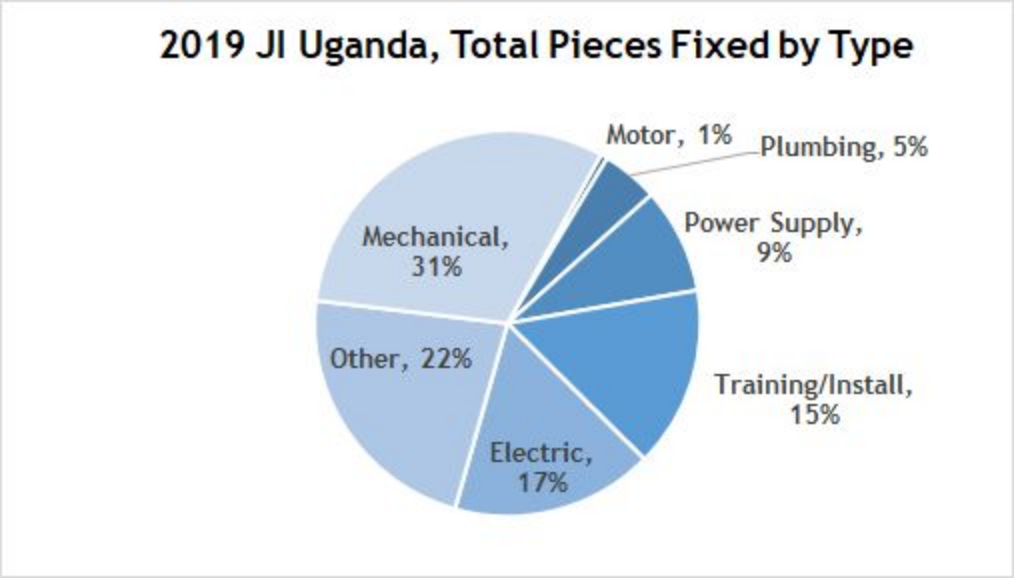
Repairs by Type of Equipment

Type of Equipment	Repair Total	Type of Equipment	Repair Total
Air Compressor	2	Operating Table	1
Air Conditioner	4	Ophthalmoscope	1
Aspirator/Suction Machine	32	Octoscopes	3
Autoclave	28	Oven, Lab	3
Automatic Voltage Regulator	17	Oxygen Concentrator	31
Bed, delivery	6	Patient Monitor	9
Blood Pressure Device, Automatic	21	Phototherapy	4
Blood Pressure Device, Manual	60	Pulse Oximeter	5
Centrifuge (electric or hand operated)	6	Scale (laboratory and in wards)	52
Computer	4	Shaker Machine	2
Dental Drilling Machine	2	Stethoscope	2
Fetal Stethoscope	2	Telephone	2
Furniture	20	Thermometers	2
Incubator (infant)	3	Ultrasound machine (imaging)	1
Infant Warmer (Radiant or other)	4	Vaccine Refrigerator	1
Infusion Pumps	2	Ventilator	4
Iron (for clothing)	3	Water Bath (laboratory)	5
Lamp, examination	7	Water Pump (for drinking water)	2
Lamp, surgical	12	X-Ray Film View Box	1
Microscope	3	X-Ray Machine*	2
Nebulizer	7	Other	131

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

Repairs by Hospital

Hospital	Pieces Touched	Repaired	Abandoned	Repair Percentage
Hospital 1	19	14	5	74%
Hospital 2	65	52	13	80%
Hospital 3	175	143	32	82%
Hospital 4	50	36	14	72%
Hospital 5	59	45	14	76%
Hospital 6	32	21	11	66%
Hospital 7	50	38	12	76%
Hospital 8	45	39	6	87%
Hospital 9	18	17	2	94%
Hospital 10	5	4	1	80%
Hospital 11	16	12	4	75%
Hospital 12	37	21	15	57%
Hospital 13	94	67	27	71%
Total	**665**	**509**	**156**	**77% avg**



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.

Hospital 1

This group designed and built two oxygen tank trolleys to facilitate the safe transportation of heavy pressurized tanks. After assessing the needs at the hospital, it was evident that the facility was lacking a safe way to transport its pressurized oxygen tanks. This need for a trolley to safely transport the tanks was recognized by senior nursing staff and the hospital director.

After some research on different types of oxygen trolleys, dimensions, and weight specifications, a design was produced using CAD. Materials were purchased and brought to a local welder to construct two trolleys, using the designs provided. When the trolleys were finished, it was evident that the height dimension for the handles was not accurate. However, after successfully testing the trolleys, the hospital director approved their use at the hospital. Overall, the project was a success, as the oxygen tank trolleys achieved their purpose and were welcomed to the hospital with satisfaction.

Hospital 2

The staff at the general ward of this hospital requested waterproof bed sheets, as they did not have any. This is a necessity at hospitals so that blood and other bodily

fluids do not soak into the mattresses. This would greatly help hygiene/ sanitation at the hospital and enable infection control. The students returned to Kampala to find PVC paint and the mackintosh covers, had them made into sheets by a tailor, then transported them back to Gombe. They then printed “MPIGI HC IV EWH 2019” on all of them using a screen and PVC paint. The participants noted that this process enabled them to build a stronger relationship with their landlord, as he was very passionate and great at art.

Hospital 3

This group’s project was welding metal drip stands, drug trolleys, screens and beds which needed repair. They organised a local welder through contacts they made at the hospital to come and work with them to complete the work. They bought raw materials (metal bars and welding sticks) and payed for labour. Overall they were able to fix many different items for the hospital.

Hospital 4

At Entebbe General Hospital there was no way to procure distilled water to be used in medical equipment, so rain water was used instead. This is damaging to equipment and can cause infections easily, so as a secondary project this group decided to create a water distiller for use in critical departments.

Their distiller design consisted of a 7L pressure cooker, 1000W hot plate, copper tubing and a 20L bucket for condensing. They removed the pressure valve from the lid of the pressure cooker and inserted one end of the copper tubing into this, then sealed it with o-rings, epoxy, and silicon. They then coiled the remaining tubing to be placed into the condensing bucket and secured this with a zip-tie at the top of the

bucket. It took two attempts at condensing the steam to find a successful method. They used a paint bucket which was made of stronger plastic and used a small drill to create the hole instead of a blade (used in the first attempt), which created a more uniform hole without applying excess pressure. They sealed the tube in the hole with epoxy and then silicon. They encountered the problem of water getting trapped in the condensing tube. This was caused by the coil running ‘uphill’ in places and reducing the flow of water. They fixed this by ensuring the coil in the bucket was constantly descending.

Distiller

Hospital 5

For their secondary project, this group cleaned and reorganised the main hospital toolshed for the general technician. They first removed all the items in the shed and placed them outside temporarily, so that they could hose down and dust every surface of the building’s interior. They then designed an organising table, constructing it from repurposed wood from a frame found inside the toolshed. They removed many nails from the existing frame and then reused them, but also used some nails bought from a local hardware store. They then sanded the table down and placed it opposite the workshop entrance. Finally, they sorted through all the equipment in the toolshed and disposed of anything unnecessary.

Hospital 6

Their Secondary Project was to renovate the Female Ward, as it is in the worst state of all the wards, which impacts both the patients and the equipment. The ceiling

boards were missing and damaged in many places. The walls on the inside and outside were damaged and old. The group felt that negative perception of the importance of maintenance in the ward led to the equipment being neglected. The administrator of the hospital has had this concern and suggested this project himself. Almost every single piece of equipment in this ward required repair and had been repaired the previous year due to similar problems.



Before

The proposed renovations involved replacing the missing and damaged ceiling boards before painting the ceiling. The next step was to sand and repaint the walls on the inside and outside of the Ward. The students posted their project on XXXX and raised funds to cover the excess costs.

Coordinating such a large scale renovation required a lot of time. With any renovations hidden costs are a big issue, so this group suggests teams attempting this sort of secondary project start the evaluation process early so you have a set budget to fundraise and are aware of the full cost early, while considering a worst-case analysis.

The group was careful to inform the administrator and relevant staff of plans and progress at every interval so that they caused minimal disruption to patients. This is also something they would advise other teams to consider, as they found it crucial to ease the progress of the project.

The project took longer than expected, but was an overall good result that the hospital was grateful for. The initial estimation of 4 days quickly turned into over a week's work, which meant patients were displaced for longer, although the head of the female ward assured the group this was not an issue.

They were fortunate enough to raise 1,356 NZD which is 3,375,415 UGX (US $922). They spent 2,564,300 UGX on the female Ward and 831,000 UGX on spare parts. After photos included below:



Hospital 7

This group's secondary project was to install harness chains for oxygen cylinders throughout the hospital. Oxygen cylinder use is highly prevalent throughout hospitals, however the safe practices associated are sometimes not. Oxygen cylinders are highly pressurized, thus pose a high level of danger when damaged. It is not uncommon to find oxygen cylinders stored without any restraints. Combine this with a fast-paced environment and accidents are more likely to occur. The group decided to use Dyna bolts and a hook screw as the fixings. Installation in the emergency ward went particularly well. Although repeated visits were necessary, they were able to install the chains next to each bed, which was important as the emergency ward is small, busy, and a major user of oxygen cylinders. For the other wards, limited space and window placement made it so the chains could not be installed in the originally

planned manner. Instead, they focused on installing the chains at the oxygen cylinder storage areas for each ward.

Installed Chains

Hospital 8

This group's secondary project was to organize the on-site oxygen plant and the engineering workshop at their hospital. They chose this project because the oxygen plant had no way of keeping track of regular maintenance and had only a basic system of organizing oxygen cylinders. The workshop was not fully organized under the 5S system and its task management was fairly impermanent.

They organized the oxygen cylinders in different places in the plant so that it was easy to tell which cylinders were filled and which were empty. These places were then labelled so that it became clear which groups of cylinders were full, empty, and faulty, respectively. As other hospitals or other healthcare providers in the area must travel to this plant in order to refill their oxygen tanks, visitors often come to and interact with the plant, even when they are not aware of the organization system. So they also labelled the machinery in the plant so it was clear which parts could pose more potential risk or danger. It also helped to clarify which parts needed maintenance.

They created a noticeboard which tracked maintenance so that the hospital staff could easily keep track of when required maintenance was done. The engineering team did not have a way of recording regular needed maintenance. The only records kept within the plant were records of tank fillings. The group decided it was necessary to create a noticeboard so that it was clear to any person entering the plant whether maintenance had been done regularly. The board also meant that the records would be kept in one place and not moved or potentially lost.

They made two more noticeboards to be put up in the engineering workshop, so that there would be a more central and permanent focus on the 5S system. The other noticeboard assisted the engineering department to have a more reliable space for tracking tasks, something central to the effectiveness of the team as a whole.

They group also reorganized the workshop in order to set a status quo under the 5S system. This meant that the hospital's engineering team did not have to reorganize themselves, but could instantly start following the new organizational system. Thus, the transition to a more organized space was fairly smooth; there was very little disruption to the regular working of the department. The technicians were able to instantly interact with a neater workshop and use the space more effectively.

Oxygen plant after secondary project: labels on all tanks and machinery, including on outlets.

Noticeboard and organized space.

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 generally very positive. Some of the words used to describe the program were fascinating, enlightening, cultural, eye-opening, and challenging. We found we could improve the flow of instruction and the pre-departure information. Students remarked that the most valuable part of the program for them was having an "experience that [I] cannot have elsewhere," gaining a "great set of skills to take with me along my professional career," and "living in such a different culture was something I really appreciated."

Acknowledgements

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