Shadowing Biomedical Engineers - Training to Repair/Recycle Medical Equipment for the Developing World

Engineering World Health Northwestern
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Background

Engineering World Health (EWH) at Northwestern seeks to promote sustainable healthcare. One of our primarily activities is to repair medical equipment on campus that can then be delivered to developing nations. This prevents old medical equipment from going to waste and also offers an extremely low cost solution for medical equipment in developing countries. On campus, we work with a team of undergraduate students, graduate students and professors to repair equipment.

The TriMedX foundation was formed from the TriMedx healthcare equipment services company. It was originally formed to complete mission trips of a team of professional engineers to hospitals abroad which had broken medical equipment. Since then, the foundation has expanded to also repairing and evaluating equipment in the US before it is shipped out, ensuring that when devices reach the hospitals in need that they are in working condition. Certain weekends, TriMedX company employees travel from all over the US to Indianapolis to help evaluate hundreds of pieces of equipment.

Our Trip

9 members of Northwestern’s EWH travelled to Indianapolis, the headquarters of the TriMedX foundation, from April 9-11, 2010. We met professional engineers at the TriMedX warehouse and split up in teams to work on different pieces of equipment. We were able to learn how to evaluate and repair a number of pieces of equipment we had yet to work with on campus in addition to learning basic information to make repair sessions on campus more efficient. Below are examples of three pieces of equipment that were worked on during the repair session.

Non-Invasive Blood Pressure Monitors

Non-invasive blood pressure monitors (NIBPS), were surveyed on our trip to Indianapolis. The NIBPs were all the same model, and close to thirty units were available for evaluation and repair. In order to evaluate the NIBPS, we learned about the diagnostic tests that the technicians would perform on the equipment. Groups of three students paired up with a technician and learned how to troubleshoot and run the diagnostic tests.

After the NIBPs were evaluated, those marked for repair were taken aside and the problems were further examined. In order to do this, one student and technician paired up on the equipment and searched for the mechanical or electrical problem on the device. Learning about these types of problems was interesting and led to developing skills to bring back to evaluate and repair our own NIBPs on campus.

Infant Incubators

There were three infant incubators present of the same model. These incubators had to be checked to make sure the temperature, environment, and regular mechanics of the devices were working. This was very relevant to work on campus as there was no special testing equipment for the incubators. First, the different features of the unit were tested. It was made sure that when the temperature was turned up, the unit was actually heating, and to the level specified on the screen.
Additionally, the different mechanical movements of the bed were tested to ensure they were functioning properly.

Parts were missing from the different units. It was quickly determined that one of the units was non-functional as it was missing parts and also seemed to have a substantial defect. Parts from this non-functional unit were used to complete a different unit. The technical engineer shadowed for this part had previously worked with functional and thus went through what he would do in actual hospitals.

Defibrillators

There were 60 of the same model defibrillators that needed to be evaluated and possibly repaired. These defibrillators also had an ECG, which allowed for synchronized defibrillation in which the patient is defibrillated in sync with their sinus rhythm (i.e. where a QRS wave would normally be). Thus, the three features being tested were if the ECG was working, if the voltage output of the defibrillator was correct, and if the sync function was working. We learned how to use testing equipment designed to look at these functions.

For the ECG, a simulator ECG was connected to the defibrillator unit. This allowed for a controlled and known ECG signal, and thus it was possible to determine whether or not the output of the defibrillator’s ECG was correct.

In order to test the voltage, the two paddles were charged and placed on metal pads. When the voltage was released, the tester equipment displayed the voltage released, and we were able to match this to the specifications of the equipment. Since the voltage was being released into the metal pads of the tester equipment, the evaluator was put at no risk.

Finally, in order to test the sync function, a heart rhythm was simulated to the unit much liked the ECG testing. The voltage was held from the paddle, and it was visually determined whether or not the defibrillator was discharging in sync or not. In order to do this, the heart rhythm used was very slow but regular.

Of the 60 defibrillators tested through this method, 56 were determined to be fully functional. We determined that the 4 non-functional units had loose power sources, which caused them to seem as if they were completely non-functional. These were set aside for future repair.

Testing the defibrillators was especially important for us because we had not received prior training on these machines. Thus, when we received a defibrillator on campus, we had no idea how to test it. Although we do not have tester equipment on campus, we can contact hospitals around the area which will have tester equipment and ask if we can use it.

General Repair

In general, members were able to take home different techniques for testing different pieces of equipment with and without tester equipment. Members were able to start a dialogue with different technicians who had been on mission trips abroad in which they had limited testing equipment as well.
The system that TriMedX has set up for their repairs includes placing tags on equipment. Green means it is completely ready to go, yellow means there is work to be done, and red indicates the unit is non-functional but parts from the units can be used to repair other units. The tag system works very well as different people look at the equipment at different times.

The system on campus has been improved to incorporate this idea. Although we had been keeping repair logs of pieces of equipment, we had been placing them in a binder instead of presenting them with the equipment. This has helped repair sessions become more efficient on campus.

Since the trip, two repair sessions have taken place on campus. In these, many of the skills learned were passed on to other members of the group. Currently, we are working on obtaining donated tester equipment and also contacting biomedical technicians around the area through the TriMedX foundation to come to our repair sessions.