

Design Projects List

BMET and Equipment Support Projects

Rough Terrain Equipment Transportation

- **The Need:** Although progress is being made, most hospitals in low-resource countries were designed and built decades before the widespread use of advanced medical equipment. Many of these hospitals have sprawling campuses with breezeways and other open spaces between buildings. Furthermore, BMET offices are often located in the engineering area of the hospital with other large equipment, such as the back-up generator and incinerator. This results in BMETs often needing to transport large, sensitive equipment long distances over broken pavement, dirt paths and even stairs to reach the workshop.
- **The Technology:** A low-cost device that can assist with the transportation of large, sensitive equipment, over rough terrain.
- **Specifications and Restrictions:** Designs should use only locally available supplies and manufacturing and be useful for a large variety of equipment, such as: Mobile surgical light, patient monitor on stand, anesthesia machine, ventilator, laboratory oven, oxygen tanks, etc.
- **Resources and Previous Work:**
 - [Hospital Need Report, 2017](#)

Raspberry Pi based Multi-Parameter Tester

- **The Need:** Hospital equipment technicians (BMETs) have a frequent need to measure temperatures, pressures, and flow rates of both liquids and gasses. Commercial devices can cost over \$2000 and are out of the budget range of low-resource training facilities. The development of extremely economical computers, such as the Raspberry Pi, created the opportunity to develop open source training tools.
- **The Technology:** Raspberry Pi and associated accessories, Integrated Display (Optional), Relevant resources for training
- Temperature, pressure, flow, etc... sensors (at least 2)
- **Specifications and Restrictions:** This device should be for education use, and is not intended for testing medical equipment in a healthcare setting.
- **Resources and Previous Work:**
 - [Low-cost Parameter Tester](#)

Oxygen Analyzer - Raspberry Pi

- **The Need:** In low-resource healthcare, oxygen concentrators are a low cost solution when expensive bottled gasses are not available. They are used extensively in EWH partner hospitals. However, oxygen concentrators have a limited lifespan and need continual testing. Furthermore an oxygen tester is extremely useful in troubleshooting problems in concentrators and other equipment, such as anesthesia machines. The development of extremely economical computers, such as the Raspberry Pi, created the opportunity to develop open source training tools. EWH is interested in developing a low-cost oxygen analyzer that can be used in the training of BMETs.
- **The Technology:** Raspberry Pi and associated accessories, Integrated Display (Optional)

There are several approaches that could be examined for measuring oxygen concentration. Previously, an EWH chapter utilized an oxygen sensor found with-in oxygen concentrators to develop a low cost testing device. Another proof of concept design used two zinc-air batteries in a simple electric circuit with an LED for indication. More testing is necessary to determine the functional range of the tester and the characteristics of the circuit with exposure to different oxygen concentrations over different time periods.
- **Specifications and Restrictions:** This device should be for education use, and is not intended for testing medical equipment in a healthcare setting. It should include relevant resources for training and have a similar interface to professional Oxygen testers used in healthcare
- **Resources and Previous Work:**
 - [PortO2 tester design](#)

Improving Oxygen Tank Security

- **The Need:** EWH has observed countless oxygen tanks that are not secured, transported, or filled safely. Education is a component, but often the resources and infrastructure are not available. There may be other reasons bottled gasses are frequently not properly secured, and EWH is interested in exploring this issue.
- **The Technology:** A design study of ways to improve oxygen tank security in low-resource hospitals. The goal of this design study should be to examine the unique conditions of low-resource hospitals and brainstorm new solutions for oxygen tank security. This study should include research on current oxygen and other bottled gas security in the healthcare setting.
- **Specifications and Restrictions:** This project is intended only as a design research project at this stage. Designs should use locally available supplies and manufacturing.
- **Resources and Previous Work:**
 - [2017 Hospital Need Report](#)

Equipment Surge Protection

- **The Need:** A problem facing much of the developing world is unreliable power grids. Power outages are common, but power surges cause the most damage to healthcare equipment. The issue is multiplied by many hospitals having older wiring, lack of grounding, and even the bypassing of integrated fuses due to lack of spares. The result is that parts of the powerboard or more sensitive components in the machine are ruined, requiring ordering of replacement parts that can cost hundreds of dollars and take months to arrive. Some hospitals are able to add additional protection to machines, in the form of an electro-mechanical voltage regulator or an uninterruptible power supply. However these are complex, expensive and often break or need other services.
- **The Technology:** EWH is interested in developing a low-cost surge protection device that can provide precise, reliable protection for an individual device.
- **Specifications and Restrictions:** This device is for developmental purposes only and should not be used on any critical medical equipment. It should alert the user when a surge has been detected, and possibly have the ability to automatically reset. It should also connect in a way that is easy for untrained users to install, such as standard wall plugs. Applicable to a wide range of devices: Centrifuge, patient monitor, small exam lights, etc.
- **Resources and Previous Work:**
 - [GA Tech Design Competition Proposal](#)

Equipment and Instrumentation Projects

Sterilizer Tester - Monitor

- **The Need:** Autoclaves are the most common way to sterilize medical tools, gowns, and other instruments used in healthcare. Autoclaves use steam and pressure over a set period of time to achieve this. To ensure that a sterilizer is thoroughly sterilizing its contents, the technician needs to know that the specific minimum threshold temperature was reached and for how long it was maintained during a particular sterilization cycle. Classic sterilizer testing techniques (such as Bowie-Dick test cards) are disposable and can, in addition to being too expensive, be very hard to find in resource poor settings.
- **The Technology:** A reusable, reliable but low cost means of testing steam sterilizers; Data acquisition and reporting of time and temperature (optional)
- **Specifications and Restrictions:** This technology is intended only as a design research project and should not be manufactured for healthcare use without following proper regulations.
- **Resources and Previous Work:**
 - [Systematic Approach of Autoclave Qualification: A Review](#)
 - [UMN Design Competition Proposal 2023](#)

Solar distillation and sterilization unit for water

- **The Need:** Distilled water is one of the most important resources at a hospital. Not only is it used in numerous lab tests, but it should be used in the large steam autoclaves needed for sterilizing medical tools and other equipment. If distilled water is not used, mineral deposits destroy the autoclave over time from corrosion. Many smaller health facilities and in some cases large hospitals do not have access to enough distilled water and spend considerable capital on autoclave maintenance and replacement.
- **The Technology:** A low cost, solar distillation unit built from local materials; Pressure cookers are an easily accessible technology
- **Specifications and Restrictions:** This technology is intended only as a design research project and should not be manufactured for healthcare use without following proper regulations; Produce enough distilled water for small hospital/large clinic
- **Resources and Previous Work:**
 - [Hospital Need Report](#)

Oxygen concentrator for low-resource settings

- **The Need:** In low-resource healthcare, oxygen concentrators are a low cost solution when expensive bottled or piped gases are not available. They are used extensively in EWH partner hospitals. However, oxygen concentrators have a limited lifespan due to the zeolite crystals used for nitrogen sequestration becoming ineffective over time. Small, mobile oxygen concentrators must be serviced by the manufacturer to replenish the zeolite. Typically it is more economical to buy a new concentrator than manage replenishment of the zeolite. In larger hospital or manufacturing scale concentrators, the zeolite is replaceable. Furthermore, because of the depletion of zeolite, concentrators are often built to only last a few years. Poor quality cases, connections and wiring are continual problems in low-resource hospitals.
- **The Technology:** An oxygen concentrator designed specifically for low resource settings, with features that included increased durability and ability to replenish zeolite canisters.
- **Specifications and Restrictions:** This technology is intended only as a design research project and should not be manufactured for healthcare use without following proper regulations.
- **Resources and Previous Work:**
 - Video about oxygen concentrators: <https://youtu.be/SQySL7FXcKw>

Low Power Blood Pressure Assist Device

- **The Need:** While many philanthropic studies focus on “high-profile” killers such as HIV and malaria, the primary cause of death throughout the developing world still stems from issues related to the heart. The WHO has begun to seriously consider the growing number of hypertensive patients throughout the world. A major barrier to tackling this health care challenge is recording consistently accurate blood pressure measurements.
- **The Technology:** A low cost, easy-to-use device to assist a minimally-trained person in taking the blood pressure using a sphygmomanometer. The device should easily mechanically connect to the existing sphygmomanometer (clamp around the tubing, for example) that amplifies the pressure signal. With the signal now visible, the oscillatory BP method is possible with a standard sphygmomanometer. This eliminates the need to be trained to identify Korotkoff sounds (the oscillatory use of a sphygmomanometer does not require a stethoscope).
- **Specifications and Restrictions:** This project is intended only as a design research project at this stage and should not be manufactured for healthcare use without following proper regulations. The user should be able to identify at least systolic pressure without training (only picture instructions). Ideally the user should be able to identify diastolic pressure with minimal training.
- **Resources and Previous Work:**
 - [Sphygmomanometers](#)

Hardened automatic blood pressure machine

- **The Need:** Non-invasive blood pressure machines are now available for about \$25 at some drug stores and on-line shops. The expectation is that they would be used once or twice per day at home (about 300-600 cycles per year). These devices will last many years when used according to expectations. However, when these are donated to the developing world, they are used 24 hours per day, seven days per week (about 5000-10,000 cycles per day). The devices last only a few weeks in these conditions.
- **The Technology:** A low-cost, automatic blood pressure cuff designed for low resource settings. Longevity should match other hospital grade equipment while using minimal power. The device should be wall powered, potentially with a battery backup system. The pumping aspect of current automatic cuffs require considerable energy and complexity and could be an area for further innovation.
- **Specifications and Restrictions:** This technology is intended only as a design research project and should not be manufactured for healthcare use without following proper regulations.
- **Resources and Previous Work:**
 - [Hospital Need Report](#)