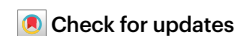


# Changing the landscape of global health with Engineering World Health

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Engineers need to meaningfully engage in global health by developing solutions that work in the low-resource environments that are a reality for many health-care professionals and patients around the world. Engineering World Health, founded in 2001, aims to inspire, educate and empower the biomedical engineering community to improve health-care delivery around the world.

## Saving equipment is saving lives

According to the World Health Organization (WHO), an estimated 1.8 billion people, or 24% of the world's population, live in fragile contexts that are challenged in delivering quality essential health services<sup>1</sup>. The disparity in health-care service is partly owed to the lack of adequate medical equipment that is essential to diagnosing diseases, sterilizing tools and performing surgery. Unfortunately, potentially lifesaving equipment is often in an unusable state and needs repairs, additional parts or even power cords. In addition to voltage and power supply issues, a lack of access to consumables or a lack of instruction manuals can render donated medical equipment unusable. If usable, donated equipment eventually falls out of service, and is then discarded or stored. As you read this, millions of pieces of donated critical medical equipment, including oxygen concentrators, infant incubators and patient monitors, are lying abandoned in hospital 'graveyards' in low- and middle-income regions<sup>2</sup>.

In addition to supply chain issues to secure replacement parts and lack of access to technical support from manufacturers, hospitals in low-resource regions face major challenges in accessing skilled biomedical equipment technicians, who can install, repair and maintain the equipment they rely on to treat patients. As a result, the quality of care that they are able to provide is limited.

**Engineering World Health** (EWH) was founded in 2001 by Dr. Robert Malkin and Dr. Mohammed Kiani to improve the health-care infrastructure of clinics and hospitals around the world. As professors at the University of Memphis in Tennessee, they started **EWH institute programmes** and encouraged university students to engage by providing abroad programmes for students and young professionals in STEM fields, who have a desire to use their skills for good.

## Students work with local hospitals

EWH participants receive intensive hands-on technical and language training before serving as volunteer biomedical equipment technicians at hospitals in their host regions (Fig. 1). They collaborate with local hospital staff to repair medical equipment and strengthen the

health-care technology situation of the facility, improving their ability to provide quality care to patients in need. On average, participants are able to repair 75% of broken equipment, leaving hospitals with dozens of repaired machines worth hundreds of thousands of dollars, and thus, a tangible benefit to the hospital. Moreover, EWH volunteers provide translated instruction manuals, training guides and spare parts.

Since 2004, over 1,200 volunteers have made over 13,000 equipment repairs in low-resource hospitals; the value of their work and repairs is estimated to be worth over US \$26 million. Importantly, participants often leave this experience with a changed mindset on how to approach engineering.

## Outside the box engineering

Summer EWH participants often find that they are challenged in unexpected ways; working with few resources at their disposal forces them to be creative and truly think outside the box to solve real-world problems. This past summer, a group of students repurposed disused IV poles to create hand sanitizer stations at their placement hospital. Another example are blood pressure cuffs, a frequently used item that is typically discarded at the end of its lifespan. In the USA, a blood pressure cuff is not an item that a technician will repair – it will simply be replaced because it is relatively inexpensive. In rural parts of Uganda, however, these cuffs can be difficult to locate. EWH volunteers have found that if they are unable to source a replacement, a punctured cuff can be patched using a bicycle tube patch kit. Although this is not seen as a long-term solution, it can keep a patient monitor in use until a replacement cuff is able to be sourced from a larger city. In a small clinic that might only have one patient monitor, this can make all the difference. These problem-solving skills will ultimately make them better engineers in their future careers in research and development or manufacturing.

In reality, most engineering students do not end up working in global health directly, and do not see global health as a viable career path, but instead, often turn towards higher-paying opportunities in corporate, tech and industrial sectors. However, engineers, no matter the role, have a part to play in improving health-care delivery around the world. Engineers can make a real impact on global health by considering challenges posed in low-resource settings in their designs and by striving for greater accessibility. How many power surges can your design handle before failing? Will it hold up outside of a sterile, temperature-controlled operating room? Does it have too many parts that need frequent replacing making it unusable if these parts cannot be imported? We must begin to design with the whole world in mind, developing solutions that work in challenging environments.

However, to create long-term impact on low-resource health-care systems, we also need to strengthen local capacity to keep critical medical equipment in service.



**Fig. 1 | Local training as part of the Engineering World Health summer programme.** An engineering student works with a local biomedical engineering trainer to repair an infant incubator during Engineering World Health's 2022 Summer Institute in the Dominican Republic.

### Local training programmes

Increasing local capacities of repairing medical equipment is a sustainable solution to reduce the amount of out-of-service equipment in low-income regions. EWH summer programmes provide opportunities for volunteers to assist in this effort; however, biomedical engineering technician training programmes remain limited in low-resource regions. In partnership with the [General Electric Foundation](#), Duke University, in-country educational institutions, and local Ministries of Health, EWH completed biomedical engineering technician training programmes in Rwanda, Honduras, Ghana, Cambodia, Nigeria and Ethiopia, from 2009 to 2016, teaching local public hospital workers and students to become fully qualified biomedical engineering technicians. These programmes saw out-of-service equipment fall by almost half after teaching hospital staff to do troubleshooting and basic repairs<sup>3</sup>.

In 2022, after a pause on in-person programmes owing to the COVID-19 pandemic, EWH has successfully concluded its first summer institutes in two years with a renewed commitment to increasing local capacity through the inclusion of host-country students in our training programmes. Fifteen of the forty students who participated in our open enrollment programmes in Guatemala and Rwanda were local students pursuing STEM degrees. The students were recruited in partnership with local universities and supported by EWH thanks to support from those who have generously contributed to our scholarship fund.

### Next-generation engineers

EWH provides students with a pathway of opportunities to gain engineering skills, while learning about – and improving – global health. Our global network of over 30 university chapters enables students to connect with their peers abroad, compete in EWH's annual design competition, and organize events centered around low-resource health care and engineering with a purpose. To date, over 500 high school and university students from around the world have participated in [EWH's innovative virtual programmes](#), working on international teams to develop solutions to global health challenges. Virtual programmes included teams from Uganda, Cambodia, Australia, the Middle East and the USA. Our outreach initiatives have supported over 1,000 young engineers in Title I K-12 schools with free hands-on STEM learning

opportunities designed to teach global health concepts through real-world engineering applications.

Investing in the next generation of engineers and health-care professionals is more important than ever as the world faces unprecedented global health challenges. By encouraging more students to pursue STEM, by making engineering more accessible to more students, and by inspiring students and young engineers to think outside the box and use their skills for good, we can make strides in improving health-care delivery across the globe.

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Published online: 19 January 2023

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### Acknowledgements

We would like to acknowledge the EWH founders, R. Malkin and M. Kiani, for their dedication to our mission and their continued support of Engineering World Health. We would also like to extend our sincerest thanks to the staff, Board, partners, students and volunteers who make our programmes possible.

### Competing interests

The authors declare no competing interests.

### Related links

**Engineering World Health:** <https://ewh.org>

**EWH's Institutes:** <https://ewh.org/the-institutes/>

**EWH's innovative virtual programmes:** <https://ewh.org/the-institutes/virtual-programs/>

**General Electric Foundation:** <https://www.ge.com/sustainability/ourphilanthropy>