**Challenges supporting Clinical Engineering Initiatives in**

**Low- and Middle-Income Countries (LMIC)**

M.E. Poulin1, W. Gentles2 and M-A. Janvier3,4,5

1 Island Health, Biomedical Engineering, Victoria, Canada

2BT Medical Technology Consulting, Toronto, Canada

3Children’s Hospital of Eastern Ontario, Clinical Engineering, Ottawa, Canada

4Department of Systems and Computer Engineering, Carleton University, Ottawa, Canada

5Department of Mechanical Engineering, University of Ottawa, Ottawa, Canada

Abstract— **Two case studies are discussed regarding the support of clinical engineering initiatives in Ghana. One is the support of clinical engineering best practices at hospitals sites in northern Ghana including the introduction of Computerized Maintenance Management Systems (CMMS) capabilities. The second is the support of the donation of hemodialysis units to Komfo Anokye Teaching Hospital Hospital in Kumasi, central Ghana. Challenges to overcome with these initiatives include the time and effort to convince senior leadership and clinical engineers regarding the benefits of clinical engineering best practices, identifying and fostering local champions for the initiatives, and recognizing that ongoing support is needed to keep these initiatives moving forward to sustainment. Supports include ongoing training webinars, mini-conferences and discussion forums. Support for implementation and transport of donated technology is also critical to ensure the success of the donation. All support must be provided in a culturally sensitive manner and an understanding of the infrastructure limitations with a focus that the local clinical engineering champions must be the driving force of the initiatives.**

.

Keywords— Clinical Engineering, LMIC, Donations, Medical Technology

INTRODUCTION

Two case studies discuss the challenges to support clinical engineering initiatives in Ghana. One is the support of clinical engineering best practices at hospitals sites in northern Ghana including the introduction of Computerized Maintenance Management System (CMMS) capabilities. The second is the support of the donation of hemodialysis units to the Komfo Anokye Teaching Hospital in Kumasi central Ghana.

**Case study 1:** The International Outreach committee of CMBES has been supporting a Ghana Medical Help (GMH) initiative for the last 9 years to help foster and develop good clinical engineering practices at hospitals in norther/rural Ghana. The initiative has included providing vital signs monitors for the sites, tool kits for clinical engineers and training on clinical engineering best practice and practical equipment training. One of the main initiatives the past few years has been the introduction and use of a CMMS.

**Case study 2:** Children’s Hospital of Eastern Ontario (CHEO) has recently been involved with the donation of 20 hemodialysis devices (surplus from the province of Ontario) to the Komfo Anokye Teaching Hospital in Kumasi Ghana. Marie Ange Janvier reached out to the CMBES international committee members, Martin Poulin and Bill Gentles, to gain insights on who in Ghana to engage and what things to consider to make this donation a success.

When supporting an LMIC, it is essential to partner with the recipient country to ensure medical technology is what is needed and that the supports are in place to implement and support the users indefinitely [1,2,3,4]. This support could be training or spare parts or test tools to support the technology being donated.

Challenges

Case Study 1: Introduction of CMMS to clinical engineers in northern/rural Ghana

CMBES International Outreach committee chair, Bill Gentles created a Microsoft Access based CMMS to trial in Ghana to orient clinical engineers to its benefits. The structure and unique fields were developed in consultation with clinical engineers in Ghana to ensure their unique needs were being met.

Clinical engineers and local champions were identified by local GMH leadership. Thanks to modern video chat capability, remote communication was facilitated to actively listen and brainstorm on the development and implementation of the CMMS. However, LMIC’s are often hampered by wireless connectivity so many meetings are stop and go as network connectivity resumes. Consequently, many meetings over several months ensued before a workable CMMS was developed and tested.

GMH supported the purchase of a bar code/label printer to create equipment control numbers including the label cartridges. This type of support including the homegrown $0 CMMS are essential for LMIC’s who don’t have the resources to support commercial grade CMMS’s.

Some of the other challenges of implementing a simple CMMS is the laptop and software application Microsoft Access, which are often not available on older machines. Many of the clinical engineers have access to a laptop, but the application software is often free versions without the full capability to properly run Microsoft Access or other applications. Most of the clinical engineers engaged had a mobile phone and wireless communication as the primary means of connecting to the internet versus wired connectivity. For these reasons, GMH has been supporting the development of an open source, cloud-based, browser agnostic CMMS that will not be dependent on a particular tablet or phone to run.

It is essential to have local initiative to move these projects forward. Clement Appiah Anokye of the Bolgatanga Hospital was one of the key clinical engineers who initially adopted the practice of tracking equipment with labels and implementing the CMMS. He did a great job tagging devices and entering the inventory information into the simple CMMS, but after 2 years he moved on to other opportunities and his replacements do not have the same enthusiasm to use the system. Individuals and champions in the country are key to moving forward and sustaining these initiatives. This project has been hampered by key individuals moving on from their positions with no one to take their place. Ideally, replacements would be identified prior to their departure.

As with any initiative, having key administrative leaders supporting the initiatives is also key. GMH has an executive director physician in Ghana who is critical to conversing with Ghana Health services executives to ensure these clinical engineering initiatives are supported. Before introducing the CMMS initiative at the pilot sites, letters of support addressed to hospital administrators were sent from the GHS executive leadership team.

It’s very important to listen and be aware of cultural needs and protocols in the country to ensure your initiative has ongoing support. It takes time to establish a rapport/trust relationship with clinical engineering and health executive community. In addition to remote communication, attending on site at annual conferences helps to reinforce those trust relationships. Partnering with a Non-Government Organization currently working on similar initiatives in the country where relationships already exist would be a simpler means to move forward. It’s also important to recognize that any initiative is going to take funding. The NGO’s may be able to provide funds or share resources that are needed such as video call connectivity, on-site training at conferences/events or infrastructure needs.

It takes many years before the fruits of your assistance are realized so patience and resilience are needed. It takes regularly scheduled meetings to discuss resolution of problems and to brainstorm alterative solutions. To change the culture to adopt clinical engineering best practices involves lots of training and conversations with the support community to convince them of the benefits; particularly, the use of a CMMS. The reality is that a lot of effort is required at the front end to setup a CMMS including creating the ECN labels, applying them, and updating the database with the inventory information. The adopters of the CMMS need ongoing training and orientation. One recommendation is to create a user group on a forum such as “What’s App” so clinical engineers can ask questions. Monitoring of this forum also takes effort and dedication.

Case Study 2: Donating Hemodialysis Units to Komfo Anokye Teaching Hospital, Kumasi, Ghana

An opportunity arose to donate surplus hemodialysis units in Ontario that were being removed from service through a standardization initiative. Through international connections, it was learned that Kumasi Hospital was in need of more machines, and they have the same make/model; although, the line voltage in Ghana is 230 volts, whereas the Ontario machines operate on 115 volts. To make the donation successful, a few key objectives were needed.

The first objective was to identify a local clinical engineering champion in the country through the IFMBE organization. The individual identified was Mr George Boadu, who became the key leader of this project.

The second objective was to identify the most cost-effective means to transport the devices. This proved to be a challenge, but it was found that Collaboration Sante International (based in Quebec) has decades of experience working in the African continent and sends containers of medical equipment and supplies twice monthly. Hence, this was the transportation method chosen by Childrens Hospital of Eastern Ontario (CHEO). Komfo Anokye Teaching Hospital will provide the funds to transport the equipment.

The third objective was to work with the local champion and the dialysis manufacturer to ensure there would be adequate support in the form of parts/supplies and training. We were able to locate resources for training in the region for the technologists to support the equipment and we found sources for parts and supplies as the host hospital already has the same brand of equipment. It was also confirmed that the same supplies currently being used at the Komfo Anokye Teaching Hospital could be used with the donated equipment. A step transformer was identified to convert the voltage in each device to Ghana’s voltage on the donated dialysis equipment. Another key component of the project was to determine the correct water connectors from the Reverse Osmosis (RO) water system to the dialysis equipment. CHEO is sourcing this part from the manufacturer to make sure the dialysis equipment can connect to Ghana’s RO water system.

CHEO plans to further support the implementation by planning a trip with their personnel to help install the dialysis machines and offer quick troubleshooting guidance. This in turn will help support and enhance the local technologists’ knowledge of the devices. The hope is that the additional support will encourage the site to be self-sustaining and will increase the life cycle of the donated devices.

CONCLUSIONS

Supporting clinical engineering development in LMIC’s is challenging. Be prepared to be patient and in for the long haul if you want to make an impact. Cultural differences and timelines do not always align; hence, delays and gaps in communication may occur.

Prepare to spend a lot of time training and orienting executive leadership and clinical engineers regarding the benefits of best practice such as tracking inventory and service information in a CMMS.

Creating momentum among the clinical engineering community can be achieved through ongoing webinars, support group forums and having champions in the country/location where you are working.

Large medical device donations to a LMIC require logistics support to transport the technology in a cost-effective manner. Additional support including training, technical documentation and parts are also essential. Having a champion clinical engineer in the country is also critical to ensure success and self-sustaining support of the devices. Be prepared to offer remote support as needed for an extended time.

REFERENCES

1. B. Bradley, C. Yoon, S. Zahedi, Y. Adusei-Poku, W. Gentles, "A Study Of Medical Equipment Donations: Recipient Experiences", Presented at CMBEC39, Calgary, Alberta, Canada, May 2016.
2. B. Bradley, W. Gentles, " A Study of the Challenges of Donating Medical Equipment to Developing Countries" Presented at IUPESM 2015/CMBEC38, Toronto, Canada, June 2015.
3. N. Adjabu, B. Bradley, W. Gentles, S. Mirzazadeh, "A Study Of Medical Equipment Donations From Canada To Developing Countries" Presented at AHT2014, London, England, September 2014.
4. S. Mirzazadeh, B. Bradley, W. Gentles, Y-L. Cheng, "Improving the Effectiveness of Medical Equipment Donations from Canada to Developing Countries: A Survey", Presented at CMBEC37, Vancouver, Canada, May 2014.