NEEDS ASSESSMENT

MEDICAL EQUIPMENT MAINTENANCE

PERSONNEL AND TRAINING

Date: 12 July 2011

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Abstract

This needs assessment was performed to assess medical equipment maintenance capacity in Ministry of Health (MoH) hospitals in Zambia. A particular focus was paid to personnel and training needs in order to determine gaps in the current structure that can be addressed in part through the establishment of a biomedical engineering technologist diploma course in Zambia.

Six hospitals in four different provinces were visited, and semi-structured interviews were conducted with maintenance staff, senior administrators and senior equipment users. Provincial medical equipment officers (PMEOs) and the medical equipment specialist at the Ministry of Health were also consulted.

Effective equipment planning brings together a variety of stakeholders to oversee the management of medical equipment across its entire life cycle. Equipment planning at the hospitals assessed is generally reactive and does not effectively engage technical staff. It is, however, becoming more of a priority due in part to the establishment of medical equipment management committees at certain hospitals.

Simple equipment is procured directly by hospitals, while complex equipment is procured centrally through the MoH. There are concerns about the quality of simple equipment in the absence of a national regulatory agency for medical equipment. At some hospitals, more than half the equipment is donated. These donations rarely include any maintenance support (i.e. spare parts, manuals, training).

There are not enough personnel in post to manage and maintain the medical equipment found in the hospitals assessed. Furthermore, none of the current staff had any training in medical equipment prior to joining the MoH as medical equipment technologists and engineers. There is no mandatory induction program on medical equipment for new staff and therefore their training is highly dependent on their seniors' willingness and ability to mentor them.

The **key** recommendations for personnel and training based on this needs assessment are:

1. Create and fund posts for medical equipment technologists at all district hospitals

2. Develop a three year diploma course in biomedical engineering technology in Zambia

3. Upgrade the maintenance workshops that will host students from the diploma course

The structure of the equipment maintenance departments varies widely among hospitals. Those that report directly into senior administration have more input into equipment planning and budgeting decisions. The maintenance workload averages 40-65 job requests per week and none of the workshops are adequately resourced for the work. Departmental budgets tend to be spent entirely on emergency spare parts and other non-maintenance equipment activities.

Equipment users have limited confidence in the equipment maintenance staff in their hospitals. Their main concerns are lack of functional equipment and backups, lack of operating budget, slow response times from external service providers and limited user knowledge.

1 Introduction

This needs assessment was requested to determine the training and staffing requirements for medical equipment maintenance personnel in Zambian Ministry of Health (MoH) hospitals. It is the first deliverable for the Tropical Health and Education Trust (THET)'s biomedical engineering project in Zambia. The second project deliverable is the job profile and curriculum for a new course that aims to meet the training needs identified during this assessment.

2 Background

The World Health Organisation (WHO) estimates that at least 50% of medical equipment in developing countries is out of use [www.who.int/medical_devices]. This is due to poor planning, inappropriate donations, inadequate budgeting, lack of training and limited maintenance capacity. Effective medical equipment maintenance and management can greatly reduce this figure and contribute to effective service delivery and financial management in hospitals.

Medical equipment in Zambian MoH hospitals reflects this trend, however much progress has been made in the last decade towards more effective medical equipment management. This includes: the creation of the medical equipment specialist post at the MoH and provincial medical equipment officers (PMEOs), new posts for hospital engineers, the recent creation of standard equipment lists for health facilities (health posts, health centres and level 1 hospitals), and training opportunities offered through various technical cooperating partners.

Due in part to these efforts, a recent Japan International Cooperation Agency (JICA) study found that only 35% of medical equipment in three Zambian provinces is out of use [JICA/MoH: Health Capital Investment Support Project 2010 Annual Report, hard copy available from Mr. Bbuku].

The main technical cooperation project currently working with the MoH to strengthen medical equipment maintenance capacity is JICA's Health Capital Investment Support Project (HCISP). The project aims to improve the condition of medical equipment and infrastructure through targeted maintenance training and the creation of medical equipment management committees at hospitals. It is currently being piloted in Western, Eastern and Lusaka provinces.

Two areas that remains poorly addressed to date are adequate numbers of maintenance staff, and specialised training for staff in biomedical engineering (encompassing the maintenance and management of medical equipment) prior to joining the workforce. Currently, there is no biomedical engineering technology qualification available from Zambian educational institutions; maintenance staff have academic qualifications either in electronics/electrical engineering or a less relevant discipline, and learn about medical equipment 'on the job'.

3 Methodology

This needs assessment was performed by Miss Shauna Mullally (THET biomedical engineer consultant), with support from Mr. Tsibu Bbuku (medical equipment specialist, Directorate for Clinical Care and Diagnostic Services, MoH). Mr. Bbuku selected six hospitals for needs assessment visits to represent a mix of service levels, urban/rural settings and sophistication of equipment.

Hospital visits were conducted between 24th May and 3rd June 2011. Between four and eight hours were spent at each hospital. The questionnaire (first page in Appendix A) formed the basis of semi-structured interviews with maintenance staff, administrators and senior equipment users. Tours were conducted to see the equipment in use in each hospital, as well as the maintenance workshops.

3.1 Hospital profiles

The hospitals visited for this needs assessment are presented in Table 1. Three of the hospitals are HCISP participants (UTH, Lewanika and Senanga), which has increased the profile of medical equipment management with senior decision makers in these hospitals.

Table 1: Hospital profiles

Hospital	Level / Province	Services	Bed capacity	Bed occupancy
Monze	2 / Southern / rural	General Surgery Obstetrics and gynaecology Ophthalmology Orthopaedics	274	72%
Livingstone	2 / Southern / urban	General Surgery Obstetrics and gynaecology Paediatrics Ophthalmology Orthopaedics Rehabilitation Dental	325	40%
Lewanika	2 / Western / urban	General Surgery Obstetrics and gynaecology Paediatrics Ophthalmology Orthopaedics Psychiatry Dental	273	49%
Senanga	1 / Western / rural	General Surgery	120	55%

		Obstetrics and gynaecology		
Ndola Central Hospital (NCH)	3 / Copperbelt / urban	General Intensive care Surgery Obstetrics and gynaecology Paediatrics Ophthalmology Orthopaedics Psychiatry Dental Ear, nose and throat (ENT)	510	68%
University Teaching Hospital (UTH)	3 / Lusaka / urban	General Intensive care Surgery Obstetrics and gynaecology Paediatrics Ophthalmology Orthopaedics Psychiatry Dental Ear, nose and throat (ENT) Cancer	1873	64%

3.2 Medical equipment profiles

The equipment profiles of the hospitals are presented in Table 2. There is little to no standardisation of equipment (i.e. a standard manufacturer and model for a certain device), making maintenance more challenging. Due to varied levels of detail and completeness of equipment inventories, the total number of devices and proportion that are out of service are estimates for some hospitals.

Table 2: Medical equipment profiles

Hospital	Number of devices – % out of service	Specialised equipment	Most frequent breakdowns
Monze	250 – 15%	Radiology (fixed, mobile x-ray) Fluoroscopy (duo diagnostic) Ultrasound Endoscopy Diagnostic analysers (laboratory)	Autoclaves O2 concentrators Blood pressure machines Operating tables Resusitaires
Livingstone	220 – 15%	Radiology (fixed, mobile x-ray) Fluoroscopy (duo diagnostic) Ultrasound Diagnostic analysers (laboratory) Anaesthesia and ventilation	Suction machines BP machines O2 concentrators Anaesthesia machines Mortuary tables

Lewanika	250 – 35%	Radiology (fixed, mobile x-ray) Fluoroscopy (duo diagnostic) Ultrasound Diagnostic analysers (laboratory) Anaesthesia and ventilation Theatre	Suction machines BP machines Infant incubators O2 concentrators Laboratory incubators Autoclaves
Senanga	185 – 10%	Radiology (fixed, mobile x-ray) Ultrasound Diagnostic analysers (laboratory) Theatre	BP machines O2 concentrators Autoclaves Resusitaires
NCH	680 – unknown *	Radiology (fixed, mobile x-ray) Ultrasound Diagnostic analysers (laboratory) Anaesthesia and ventilation Theatre *Commencing haemodialysis soon*	BP machines Suction machines Autoclaves Vital signs monitors Anaesthesia machines Operating theatre lamps
UTH	1600 – unknown	Radiology (fixed, mobile x-ray) Fluoroscopy (duo diagnostic) Ultrasound Diagnostic analysers (laboratory) Anaesthesia and ventilation Theatre (specialised) Haemodialysis Magnetic resonance imaging CT scanner Nuclear medicine	Suction machines Ventilators Autoclaves Infant incubators Anaesthesia machines Resusitaires

* Note: a very comprehensive inventory at NCH is currently underway by students from the UK who are participating in a Health Link through Guys and St. Thomas Trust (GSST) in London.

4 Findings

4.1 Equipment planning and acquisition

The equipment planning cycle ideally brings together a wide range of stakeholders (ex: maintenance staff, administrators, senior equipment users, procurement, finance) to make evidence-based decisions on the management of medical equipment at each stage in its life cycle. The acquisition of new medical equipment, either through procurement or donation, is a key function of such a group of stakeholders.

To date, equipment planning has been fairly weak and ad hoc in the visited hospitals, due in large part to limited budgets and low awareness among senior decision makers of the importance of engaging technical staff in equipment planning decisions. Most interviewees used words like ‘fire fighting’ and ‘emergency’ to describe how a budget is allocated for planning activities, including the procurement of new equipment and spare parts for repair.

The level of engagement between administrators and senior equipment maintenance staff varies widely among the visited hospitals; at some the two have almost daily contact regarding equipment and maintenance issues, while at others there is very little interaction and the maintenance staff do not contribute substantially to the equipment planning process.

New equipment required to deliver services is outlined in each hospital's annual action plan, which forecasts services over a three year period, broken down into activities and associated budgets. Most plans reviewed list the lack of functional equipment as a key weakness and threat to service delivery.

Typically, administrators consult the heads of clinical areas (ex: nursing, radiology, laboratory) when preparing the plan on required equipment in their areas. However maintenance staff are not generally consulted on specific maintenance requirements for required equipment (i.e. training, spare parts) and therefore no separate budget line is allocated for maintenance.

HCISP hospitals are now working with an 'equipment development plan' template which aims to feed into hospitals' action plans, and project both maintenance and operating costs for required equipment.

Recommendations for planning:

- Introduce a medical equipment management committee at each hospital to engage stakeholders and oversee planning activities across the entire life cycle of medical equipment
- Include maintenance activities and budgets for new and existing equipment directly in action plan
- Use the MoH's newly created standard equipment lists for planning purposes

4.1.1 Procurement

Generally, hospitals tend to procure minor equipment (ex: blood pressure machines, pulse oximeters) directly themselves, while major items (ex: x-ray machines, theatre equipment) are procured in bulk by the MoH and distributed to the hospitals. Minor equipment tends to be procured on an emergency basis to replace equipment that is irreparable. Spare parts, maintenance manuals and maintenance training are rarely included in the initial procurement.

The threshold value for hospital procurement is correlated with the size of the hospital. Livingstone General Hospital's threshold value is Kw 50 million authorised by the medical superintendent and up to Kw 500 million authorised by the hospital tender committee. Hospitals do generally consult the MoH for any major items that are within their threshold.

One of the biggest concerns voiced by maintenance staff and administrators is the quality of new minor equipment and the vendors who provide them. This can have serious implications for patient safety, and occurs for the following reasons:

1. Procurement policies often dictate that price is the main selection criteria
2. Equipment maintenance staff are often shut out of the procurement process early on
3. There is no regulatory agency to govern equipment and service providers in Zambia

Interviewees said it is not uncommon for new equipment to arrive at the hospital over the weekend, meaning that maintenance staff don't have the opportunity to examine the contents of the delivery and either accept or reject it in the presence of the vendor's agent.

There are also cases of poor communication and planning between hospitals and the MoH for newly procured larger equipment, although generally the provincial medical equipment officers (PMEOs) are in close contact with the MoH regarding upcoming deliveries and installations of new equipment. Major equipment also tend to be from globally recognised equipment suppliers (ex: Phillips, Siemens) and are generally of a higher quality.

No hospitals assessed have a formal policy for procurement of medical equipment. The MoH has a centralised procurement plan that is updated annually. This plan includes input from hospitals and provincial offices.

Recommendations for procurement:

- Draft a policy for medical equipment procurement at the hospital level (based on a standard template provided by the MoH)
- Include technical staff in the hospital procurement process until the point of selection, to advise on maintenance requirements, technical and quality specifications
- Engage the MoH and cooperating partners to begin using other countries' approved equipment supplier lists (for example, South Africa's is a public document) while working towards establishing a regulatory agency for medical equipment in the longer term

4.1.2 Donations

Most hospitals estimate that at least one third of their equipment base are donations. Monze, which is a mission hospital, receives almost all of its equipment as donations from mission partners abroad. The level and quality of pre-donation consultation varies widely between hospitals and donors. There is a trend towards better consultation prior to the donations although there are still cases of donated equipment arriving with no prior warning at hospitals.

The MoH has supplied hospitals with equipment donation guidelines [MoH Equipment Donation Guidelines, hard copy available from Mr. Bbuku], based on those provided by the World Health Organisation (WHO). Ideally, donations should address the following sustainability issues prior to shipment:

1. Availability of qualified users

2. Demonstrated clinical need and benefit
3. Adequate infrastructure support
4. Availability of maintenance support and services
5. Regulatory compliance (if applicable)
6. Approved source of operating budget
7. Standardisation with other equipment

Most interviewees indicated that only the first two issues tend to be discussed with donors or among hospital staff prior to donation. While donations sometimes arrive with user manuals, they rarely to never arrive with maintenance manuals or spare parts. Further, there is generally no training or support offered to maintenance staff by the donors.

Interviewees also stated that the guidelines tend to be used more when hospitals approach donors for a specific equipment need identified in their action plan than when donors contact hospitals with equipment they are looking to donate. There is still, quite understandably, a hesitancy to reject any unsuitable donations for fear of offending donors and not receiving future donations.

Recommendations for donations:

- Adhere to the MoH's guidelines on equipment donations
- Proactively approach donors with needs outlined in the action plan and include maintenance resources and activities in the donation negotiations
- Approach equipment donation organisations (ex: MedShare, REMEDY) for sustainable donations

4.2 Personnel and training

4.2.1 Personnel

Table 3 presents the personnel profile of dedicated medical equipment maintenance staff at the visited hospitals. The hospital engineers are not dedicated medical equipment maintenance staff but oversee different maintenance areas (i.e. electrical, refrigeration, plumbing). They are included in the table as all who were interviewed spend the majority of their time working on medical equipment.

The approved staff numbers are derived from the MoH's approved structures and staffing levels [MoH: Approved Organisation Structures and Staffing Level for Ministry of Health, hard copy available from MoH Human Resource department]. Note that often posts that are approved and listed in the document are awaiting budgeting and are therefore not filled. For example, there are eleven posts approved for the biomedical engineering department at UTH but currently only four full-time staff members in post.

Table 3: Personnel profiles

Hospital	Approved staff – actual staff in post	Job title	Qualifications (B Sc = bachelor of science, AC = advanced certificate)
Monze	3 – 2	Hospital engineer	B Sc (civil engineering)
		Medical equipment technician	AC (electrical)
Livingstone	3 – 2	Hospital engineer	B Sc (mechanical)
		Medical equipment technician	Diploma (electronics)
Lewanika	2 – 2	Medical equipment technician	Diploma (electrical)
		Medical equipment technician	AC (electrical)
Senanga	1 – 1	Electrical technician	Diploma (electrical)
NCH	3 – 3 *	Senior medical equipment technologist	Diploma (mechanical)
		Medical equipment technologist *	Diploma (electrical)
		Medical equipment technician *	AC (electrical)
UTH	11 – 4 **	Senior medical equipment technologist	Diploma (electronics)
		Medical equipment technologist	B Sc (electro-mechanical), Burundi
		Medical equipment technologist **	AC (electrical)
		Medical equipment technician	Crafts (electrical)

Notes: * two of the three staff at NCH are still under the Central Board of Health conditions and pay scale, and ** one of the UTH staff members is currently on a three year study leave to receive a diploma in electrical engineering.

Often maintenance staff work as a group, particularly at the level 2 hospitals (Monze, Livingstone, Lewanika). It is common for a refrigeration technician, electrical technical and medical equipment technologist to troubleshoot an autoclave together. Technical areas of responsibility are often blurred, due to lack of staff. For example, the approved structure for Senanga level 1 hospital for all maintenance staff is:

- 1 x medical equipment technologist
- 1 x electrical technician
- 1 x refrigeration technician
- 1 x carpenter
- 1 x plumber
- 1 x outdoor servant

In reality, only the electrical technician post is filled (at the GSS12 grade). The post holder covers all maintenance areas himself, with occasional help from the district's medical equipment technician. He is a diploma holder and therefore qualified for the medical equipment technologist post (at the MS08 grade), however due to budget restrictions he fills a lower post.

Some interviewees expressed low levels of motivation at work due to lack of resource and support. Those who have participated recently in the HCISP workshops, however, feel their profile within the hospital has been raised. They are particularly motivated by HCISP activities

that are visible to other hospital staff, such as inventories, delivering user care training sessions and the medical equipment management committees.

Generally, the equipment maintenance staff interviewed are intelligent, dedicated individuals who often work overtime and on-call without compensation because they feel a sense of responsibility for hospital services and the patients themselves. A thorough review of medical equipment posts and grades, including career progression opportunities, is very much needed.

Specific recommendations for personnel are presented in Section 6.

4.2.2 Training

None of the equipment maintenance staff had any training on medical equipment prior to joining the workforce (with the exception of one UTH staff member who is originally from Burundi), as shown in Table 3. While some have qualifications in electrical/electronic engineering, others have less applicable academic backgrounds such as civil engineering.

Specific training on medical equipment therefore happens 'on the job', and is highly dependent on both the skill of senior maintenance staff and their willingness to mentor junior staff members. There is no formal induction program that all new staff members receive on medical equipment, and no protected funding for the costs associated with training new staff members (i.e. travel to other workshops, training materials). A two-four week 'conversion course' for new staff was established at the UTH workshop in the 1990s, but has not been consistently offered for new staff due to lack of funding from individual hospitals.

Many of the current staff have benefitted from different training opportunities sponsored by technical cooperation partners. These are presented in Table 4.

Table 4: Technical cooperation-sponsored training

Course / qualification	Year(s)	Venue(s)	Technical cooperation partner / sponsor(s)
B Sc (biomedical engineering)	1980s, 1990s	Germany, Netherlands, Sierra Leone	JICA (Japan) GTZ (Germany) CFTC (Commonwealth) WHO
Medical equipment maintenance	1990s	India	India
KANDO project – medical equipment management	1995-1998	Zambia	DFID (UK)
X-ray and theatre equipment maintenance	2005-2009	Zambia, Netherlands	ORET (Netherlands)
HCISP project – medical equipment maintenance	2010-present	Zambia	JICA (Japan)

While many of the senior staff are excellent mentors to new recruits, there is a clear need both for a standard induction training program for new staff and for formal qualifications in biomedical

engineering technology (which encompasses both equipment maintenance and equipment management).

Specific recommendations for training are presented in Section 6.

4.3 Medical equipment maintenance department

4.3.1 Department structure

The structure of the medical equipment maintenance department within the hospital was different at almost every hospital visited, including the reporting authority for the department.

Only the teams at the two level 3 hospitals (UTH and NCH) exist as separate departments, as opposed to being part of a larger maintenance department. The team at Lewanika is grouped with the environmental health technologists (EHTs) and directly reports into the senior EHT, which is not felt to be an appropriate reporting arrangement. The technician at Senanga also oversee all other maintenance areas (i.e. electrical, plumbing, refrigeration) and effectively *is* the entire maintenance department.

Some senior medical equipment maintenance staff report directly into senior administrators, while others report into a maintenance manager or hospital engineer. Those who report directly into senior administrators tend to have more input into equipment planning and meet with senior decision makers more regularly.

4.3.2 Workload

Maintenance teams visited all report a workload of between 40 and 65 job requests per week. The majority have some record keeping system for job requests, although some are not kept up-to-date. These job requests are all for repairs (i.e. corrective maintenance).

While most teams have some preventive maintenance procedures and schedules, their ability to actually carry out preventive maintenance is severely limited by inadequate funding for the spare parts and consumables required for the work. None of the teams have an adequate budget to perform a full preventive maintenance program that would help prevent breakdowns.

4.3.3 Workshop resources

None of the workshops visited are adequately equipped with the resources necessary to perform maintenance work. These resources include tools, test equipment, spare parts, maintenance manuals, and adequate workbench, storage and training space. The UTH workshop is by far the most well equipped, and the teams at the three HCISP hospitals now have some basic test equipment (ex: electrical safety analyser, patient simulator) and high quality tool kits.

This is a particular concern for workshops that will host biomedical engineering technology students on work term attachments in the future (i.e. UTH and NCH). It is vital that these workshops are both well resourced and have staff willing and able to mentor student trainees.

4.3.4 Budgeting

Budgets for all maintenance activities range between Kw 5 million and Kw 10 million per month, and are generally correlated with the size of the hospital. Some medical equipment maintenance budgets are part of a larger 'maintenance' budget that is allocated by the hospital engineer, while others are specifically for medical equipment. Senior administration is the signing authority in all cases, with some being countersigned by the hospital engineer.

Virtually all of the medical equipment maintenance budget is spent on spare parts for emergency repairs. None of the budgets were reported as adequate for the work. There is no room currently in the budgets for any proactive procurement of commonly used spare parts, tools, test equipment or training materials. Furthermore, the medical equipment maintenance budget is often used for other equipment-related activities, such as the renovations required for a new x-ray installation, which leaves no money even for emergency spare parts.

Recommendations for medical equipment maintenance departments:

- Senior staff members should have regular meetings with senior administrators, whether or not they are the direct reporting authority
- Departments should have their own budget line for medical equipment maintenance, separate from a larger maintenance budget
- Workshops need to be better resourced, in order to be more functional and to raise staff morale

4.4 Equipment users

At each hospital, senior nursing, radiology and laboratory equipment users were interviewed about their biggest challenges with both the equipment and the maintenance services in their area. The most common challenges identified are:

1. Lack of user understanding to operate and care for equipment
2. Poor service from external contractors (particularly for laboratory equipment)
3. Lack of operating budget and supply chain for consumables and reagents
4. Lack of backup for critical equipment
5. Cost of spare parts (particularly for laboratory and radiology equipment)

Lack of user knowledge to operate and care for medical equipment is a large cause of equipment breakdowns and misuse. Responsibility for this must be shared between senior equipment users and the maintenance team. The HCISP is piloting a user maintenance

program for twenty-two commonly used types of medical equipment, with shared responsibility between users and maintenance staff.

Many of the senior equipment users do not have a high level of confidence in the maintenance services within their hospital, recognising that the staff lack adequate training and resources to perform their job effectively. Some want more regular contact with the maintenance staff; it is recommended that they make more of an effort to do 'walk around' inspections to check in with users on the state of equipment within their areas.

The majority of radiology equipment and some theatre equipment is under service contract with Phillips, established through the ORET project. All major diagnostic analysers in the laboratories are under MoH managed service contracts with Biogroup, Scientific Group and Becton Dickinson.

Few senior users know the schedule for preventive maintenance performed by external service contractors, or the terms and conditions of the contracts. The average response time for contracted services is between 7 and 14 days for a first visit to diagnose the problem. For laboratory analysers that do not have a back up, this can severely impact service delivery. Furthermore, the in-house maintenance team is rarely involved when external service contractors are on site.

Recommendations for senior equipment users:

- Engage maintenance staff and co-run training on equipment operation and care
- Obtain copies of maintenance contracts and work engage maintenance staff to monitor the preventive maintenance schedules and terms and conditions of the contracts
- Advocate for life-cycle costing for new equipment

5 Recommendations

5.1 Personnel

Staffing models from Ghana and South Africa (who have similar disease burden and equipment profiles and have invested considerably in medical equipment management and training in the last decade) recommend the following:

- Minimum of one medical equipment technologist at district (level 1) hospitals, supported by technicians
- Minimum of one engineer and one medical equipment technologist at provincial (level 2) hospitals, supported by technologists and technicians
- Minimum of one engineer and two senior medical equipment technologists at central (level 3) hospitals, supported by technologists and technicians

The staffing of dedicated medical equipment maintenance personnel is not adequate at any of the hospitals assessed. The figures in Table 5 are the number of dedicated medical equipment maintenance staff that each hospital requires hospital to ensure equipment is well maintained, based on the hospital size, equipment profile and number of work orders per week.

Table 5: Required staffing levels for hospitals assessed

Hospital	Required number of dedicated staff	Job title breakdown
Monze	4	1 x Hospital engineer
		1 x Medical equipment technologist
		2 x Medical equipment technicians
Livingstone	6	1 x Hospital engineer
		2 x Medical equipment technologists
		3 x Medical equipment technicians
Lewanika	6	1 x Hospital engineer
		2 x Medical equipment technologists
		3 x Medical equipment technicians
Senanga	2	1 x Medical equipment technologist
		1 x Medical equipment technician
NCH	10	1 x Hospital engineer
		1 x Chief medical equipment technologist
		2 x Senior medical equipment technologists
		3 x Medical equipment technologists
		3 x Medical equipment technicians
UTH	12	1 x Hospital engineer
		1 x Chief medical equipment technologist
		2 x Senior medical equipment technologists
		4 x Medical equipment technologists
		4 x Medical equipment technicians

These figures, combined with guidance from Ghana and South Africa, can be extrapolated to other MoH hospitals to determine ideal staffing levels across Zambia. From these projections, the most urgent need for staffing is posts for medical equipment technologists. At a minimum, there should be one medical equipment technologist in every district hospital.

5.2 Training

The most urgent level of training required is for medical equipment technologists. A three year diploma course in biomedical engineering technology is needed in Zambia to address this urgent need. The program should have two workplace attachments: one in a central hospital (ex: UTH or NCH) with a dedicated biomedical engineering department, and the second in a smaller provincial or district hospital in a general maintenance department.

The ‘conversion course’ at UTH for all new staff who do not have a qualification in biomedical engineering technology should also be mandatory, supported by a centrally allocated budget.

6 Acknowledgements

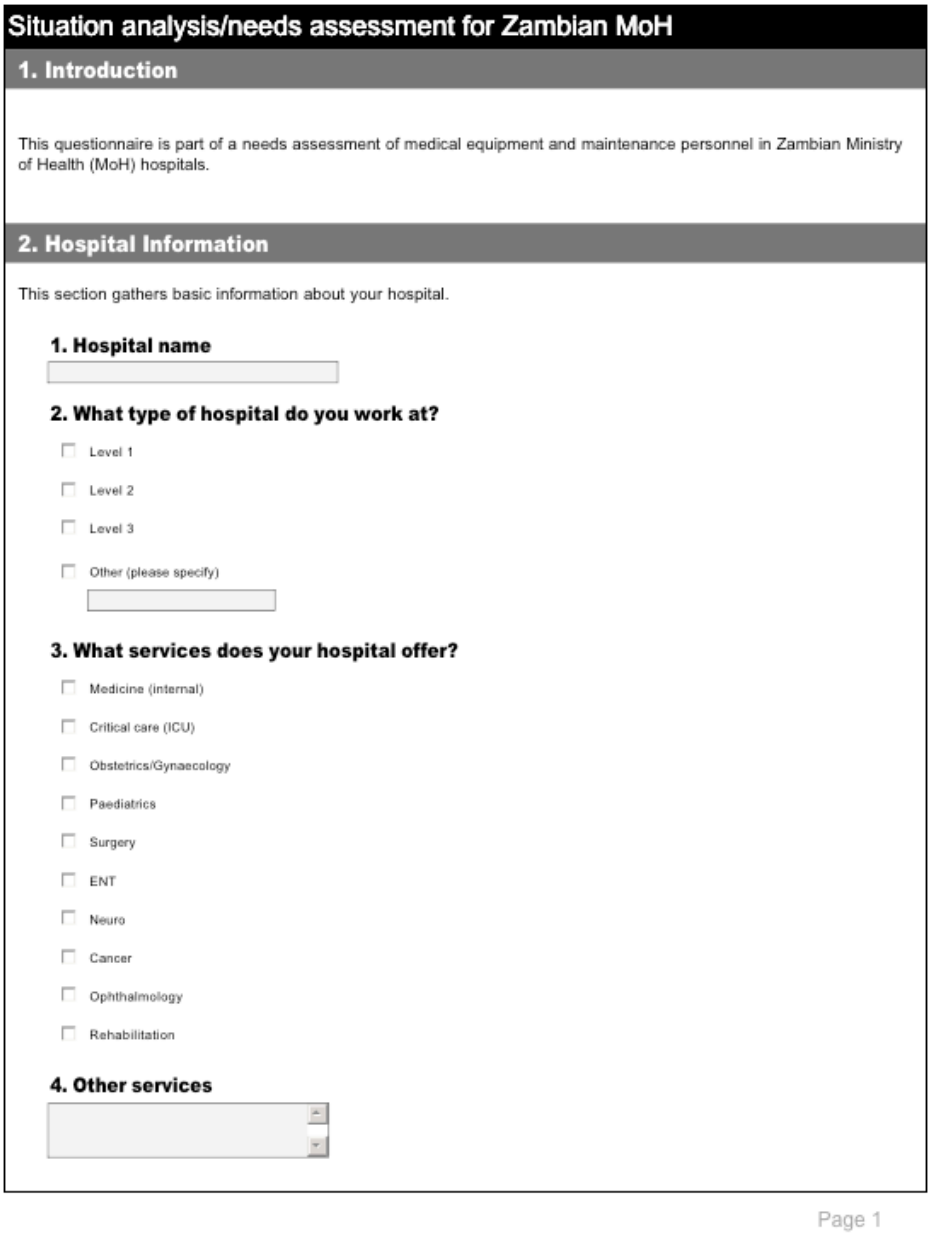
The following individuals and organisations have supported this needs assessment and the wider THET biomedical engineering project in Zambia:

- Mr. Bbuku (medical equipment specialist at the MoH) and other MoH staff
- Emily Measures (Zambia programme manager, THET) and other THET staff
- DFID (UK)
- All needs assessment interviewees, who are listed in Appendix B

Thank you all for your support.

Appendix A: Questionnaire

The full questionnaire and dataset can be produced upon request.



Situation analysis/needs assessment for Zambian MoH

1. Introduction

This questionnaire is part of a needs assessment of medical equipment and maintenance personnel in Zambian Ministry of Health (MoH) hospitals.

2. Hospital Information

This section gathers basic information about your hospital.

1. Hospital name

2. What type of hospital do you work at?

- Level 1
- Level 2
- Level 3
- Other (please specify)

3. What services does your hospital offer?

- Medicine (internal)
- Critical care (ICU)
- Obstetrics/Gynaecology
- Paediatrics
- Surgery
- ENT
- Neuro
- Cancer
- Ophthalmology
- Rehabilitation

4. Other services

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Appendix B: List of interviewees

The following individuals generously donated their time during needs assessment interviews and hospital tours:

Monze Hospital	Mr. Sekani Tembo Mr. Chirwa Goodson Mrs. Vida Mugwagwa Dr. Banda
Livingstone Hospital	Mr. Polite Hamaleka Mr. Zulu Gibson Mr. Derek Mayungo
Lewanika Hospital	Mr. Charles Kalangwa Mr. Joseph Mphande Mr. Peter Zongola Mr. Martin Mwanangombe Mr. Kennedy Kamayoyo
Senanga Hospital	Mr. George Segwidi Mr. Kenneth Shingalili Mr. Sitwala Machobani Mr. Mubu Wamunyima
Ndola Cental Hospital	Mr. Lupiah Kampenyele Mrs. Natasha Kampenyele Mr. Constantino Mutale Mr. Jacob Chilufya Mr. Ian Nyanga Mrs. Esther Ngoma Dr. Mubikayi Mrs. Lynette Hampande
University Teaching Hospital	Mr. Edward Musakanya Mr. Angelo Ntahomvukiye Dr. Kasonka Dr. Chikoya