



**Health Promotion and System
Strengthening Project (HPSS)**

**Progress and Impact Evaluation of the Health Technology
Management Interventions of the HPSS Project**

November 2018 – April 2019

Evaluation Team:

Ally Kebby Abdallah, Component Leader, HPSS Project

Suniva Haule, HTM Specialist, Consultant

Dr. George Ruhago, Health Economist, Consultant

Reinhold Werlein, HTM-Specialist, Consultant, Team Leader

Basel, May 2019

For

Swiss TPH



Swiss Tropical and Public Health Institute
Schweizerisches Tropen- und Public Health-Institut
Institut Tropical et de Santé Publique Suisse

Associated Institute of the University of Basel

Abbreviations

| | |
|----------------------|--|
| AIDS | Acquired Human Immunodeficiency Syndrome |
| AMLO | Administration Manual for Local Office |
| AMR | anti-microbial resistance |
| CBO | Community Based Organization |
| CCHP | Comprehensive Council Health Plan |
| CHF | Community Health Fund |
| CHF Iliyoboreshwa | Improved Community Health Fund |
| CHMT | Council Health Management Team |
| CHSBs | Council Health Service Boards |
| CUHAS | Catholic University of Health and Allied Sciences |
| DAC | District Advisory Committee |
| DHFF | Direct Health Facility Financing |
| DFF | Direct Facility Funding (for health facilities) |
| DHIS2 | District Health Information System 2 |
| DMO | District Medical Officer |
| DPA | District Project Assistant |
| DPO | District Project Officer |
| FFARS | Facility Financial Accounting and Reporting System |
| GHSC | Global Health Supply Chain Program |
| HCW | Health Care Worker |
| HFGC | Health Facility Governing Committee |
| HIV | Human Immunodeficiency Virus |
| HP | Health Promotion |
| HPSS | Health Promotion and Systems Strengthening (Project) |
| HSSRC | Health System Strengthening Resource Centre |
| HTM | Health Technology Management |
| ICU | Intensive Care Unit |
| ILS | Integrated Logistics System |
| IMIS | Insurance Management Information System |
| KOFIH | Korean Foundation for International Healthcare |
| LGA | Local Government Authorities |
| MoF | Ministry of Finance |

| | |
|-----------|--|
| MoHCDGEC | Ministry of Health, Community Development, Gender, Elderly and Children |
| MoU | Memorandum of Understanding |
| MSD | Medical Stores Department |
| MTP | Mid-term Planning |
| NACTE | National Council for Technical Education |
| NTA | National Technical Awards |
| NCD | Non-Communicable Diseases |
| NHIF | National Health Insurance Fund |
| NSC | National Sanitation Campaign |
| NSMIS | National Sanitation Information Management System - |
| ODF | Open-Defecation-Free |
| OPD | Out Patient Department |
| PHC | Primary Health Care |
| PORALG | President's Office – Regional Administration and Local Government (since 2016) |
| PPM | Planned Preventive Maintenance |
| PPRA | Public Procurement Regulatory Authority |
| PV | Prime Vendor |
| RAB | Regional Advisory Board |
| R&R | Report & Request |
| SCIH | Swiss Centre for International Health, at the Swiss TPH |
| SDC | Swiss Agency for Development and Cooperation |
| SJUT | St John University of Tanzania |
| SOP | Standard Operating Procedures |
| SRF | Sanitation Revolving Fund |
| STG | Standard Treatment Guidelines |
| Swiss TPH | Swiss Tropical and Public Health Institute |
| TASAF | Tanzania Social Action Trust Fund |
| TFDA | Tanzania Food and Drugs Authority |
| TTCIH | Tanzanian Training Centre for International health |
| UMATA | Usafi wa Mazingira (sanitation project) |
| VCT/CTC | Voluntary Counselling and Testing / Care and Treatment Clinic |
| VHW | Village Health Worker |
| WASH | Water, Sanitation and Hygiene |

Table of Contents

| | |
|---|-----------|
| Abbreviations | i |
| 1 Introduction | 1 |
| 2 Rationale | 2 |
| 3 Approach of the analysis | 2 |
| 4 Approach and Activities of the Project | 2 |
| 4.1 Management System | 5 |
| 4.2 Technical Personnel, Training | 8 |
| 4.3 Infrastructure for maintenance | 10 |
| 4.4 Additional activities | 11 |
| 5 Results, Achievements | 12 |
| 5.1 Management | 12 |
| 5.2 Technical Inventory | 13 |
| 5.3 Personnel and training | 13 |
| 5.4 Workshops | 14 |
| 6 Impact | 14 |
| 7 Economic considerations | 18 |
| 7.1 Cost of establishing maintenance systems | 18 |
| 7.2 Benefits of establishing maintenance system | 22 |
| 8 Recommendations for Continuation | 22 |
| 8.1 Identified shortcomings | 22 |
| 8.2 Consolidation | 23 |
| 8.3 Capitalisation | 25 |
| 8.4 Operationalisation support | 25 |
| 8.5 Sustainability | 25 |

Tables

| | |
|--|----|
| Table 1 Health Facilities in Dodoma Region in 2011 | 4 |
| Table 2 Health Facilities in Dodoma Region in 2018 | 5 |
| Table 3 Activities and cost related to inventory | 5 |
| Table 4 Management meetings | 7 |
| Table 5 Training for managers | 8 |
| Table 6 Training courses for technician | 9 |
| Table 7 Training for users | 10 |
| Table 8 Renovation of workshops | 10 |
| Table 9 Tools provided to technician and workshops | 10 |
| Table 10 Computers for openMedis | 11 |

| | |
|--|----|
| Table 11 Equipment registered and number of interventions | 13 |
| Table 12 Existing technicians/artisans in the Regions | 13 |
| Table 13 Workshops in the Regions | 14 |
| Table 14 Regular inspection of building and equipment by a technician (HPSS Follow Up Health Facility Survey 2018) | 15 |
| Table 15 Regular inspection of building and equipment by a technician (HPSS Health Facility Survey 2012) | 15 |
| Table 16 Availability of yearly preventive plan at health facilities..... | 16 |
| Table 17 Availability of yearly budget for maintenance and repair | 17 |
| Table 18 Total Cost of the HTM interventions in Dodoma Regions up to 2018 | 20 |
| Table 19 The average annual cost of implementing the HTM interventions in Dodoma Region..... | 21 |

Figures

| | |
|---|---|
| Figure 1 Technology Management Cycle..... | 3 |
| Figure 2 Maintenance Pyramid | 4 |

1 Introduction

Since 2011 SDC is funding the Health Promotion and System Strengthening Project in the Dodoma Region. The Swiss Centre for International Health (SCIH) of the Swiss Tropical and Public Health Institute (Swiss TPH) in Basel is the executing agency for the implementation of the project.

While the main emphasis of the project focuses on the aspects of health promotion and health financing, “health system strengthening” is not complete without strengthening the management of infrastructure, equipment, supplies and essential drugs.

This had already been underlined in the World Health Report 2000, stating:

... without functioning facilities, medical equipment, and medicines, it does not matter if the knowledge, skills and staff levels are high. The delivery of services will still be poor.

Today, delivery of modern health care is largely depended on adequate and functioning health care technologies, including adequate health care infrastructure (buildings and installations) and in particular adequate and functioning medical equipment.

As the situation analysis in 2011 confirmed the total absence of any systematic and efficient infrastructure and equipment management systems in the Dodoma Region, a component to improve “Health Technology Management” (HTM) has been included in the project.

Since June 2011, the project supports the government of Tanzania to put in place an innovative approach for a systematic management of health technologies including

- recruitment and training of adequate technical personnel for maintenance and repair,
- introduction of a technical inventory of medical equipment,
- establishing a systematic approach to maintenance and repair of medical equipment including planned preventive maintenance
- regular systematic inspection of buildings and infrastructure and adequate and ensuring adequate repair
- and systematic planning and provision of adequate budgets within region and Local Government frameworks.

During the first phase of the project (2011 – 2014) the activities focussed on all Districts of Dodoma Region and the Regional Hospital in Dodoma. During the second phase of the project (2014 – 2018) the HTM-component has not been considered for the extension to Morogoro and Shinyanga Region and continued to extend and improve the system in Dodoma Region. However, on request, the project supported efforts of other Regions to improve maintenance activities. In particular, the project assisted Ruvuma and Njombe Regions with some training sessions and advice to start the implementation of a similar system than Dodoma.

2 Rationale

After 7 years of implementation of a basic HTM system in Dodoma Region and in preparation of the next phase of the project it seemed necessary to review success and failure of introducing HTM in Dodoma Region.

This need was reinforced by the recommendation of the project Mid-Term Review and the management response of the Swiss Development Cooperation that the project should prepare an analysis of the results of each component for capitalization and to improve the visibility of the project.

This analysis will document the outcome and the impact of the introduction of the HTM system in Dodoma Region and will establish where possible and reasonable the economics benefits.

To compare the HTM situation in Dodoma with other Regions, the situation of HTM in Njombe and Morogoro Region was briefly analysed. Njombe Region had been supported by the project with some training sessions and advice, Morogoro Region - though part of the project region for the implementation of Health Financing and Medicine Management components – did not receive any support on HTM from the project.

3 Approach of the analysis

The analysis used various methods to study results and impact of HTM improvement.

Beside visiting various health facilities and institutions in Dodoma Region, the team travelled to Njombe and to Morogoro to collect relevant information to compare the situation.

The analysis included in particular:

- Study of various documents, i.e. projects reports, mid-term review, financial documents
- Interview with project members
- Interview with Regional and District Medical Officers and/or their representatives
- Interview with Regional, District and Hospital Health Secretaries
- Interview with Hospital/Health Center Medical Officers In-charges
- Structured interview with selected technicians of different districts in Dodoma, and Njombe and Morogoro
- Interview with key persons in MOHCDGEC and PORALG
- Interview with technical staff of collaborating institutions
- Evaluation of documents available in workshops like job cards
- Evaluation of openMedis data

4 Approach and Activities of the Project

Based on the results of the situation analysis in 2011, the project developed and introduced a simple but effective management system for maintenance of medical equipment and infrastructure.

During planning and implementation, the project obeyed the following guiding principles for the strengthening of maintenance in Dodoma Region:

1. all activities should be in line or complement the technology management policy and regulations of Tanzania
2. all available resources for maintenance will be used, private market, private health facilities, faith based organisations, available support of central level
3. maintenance of infrastructure and medical equipment must fully be integrated into the management of the health system and the individual health facilities
4. all suggested improvements must be adapted to the situation, flexible for further extension and sustainable.

Maintenance of Medical Equipment:

The development of the management system was based on the technology management cycle providing in particular all necessary tools for documentation and reporting

Technology Management Cycle

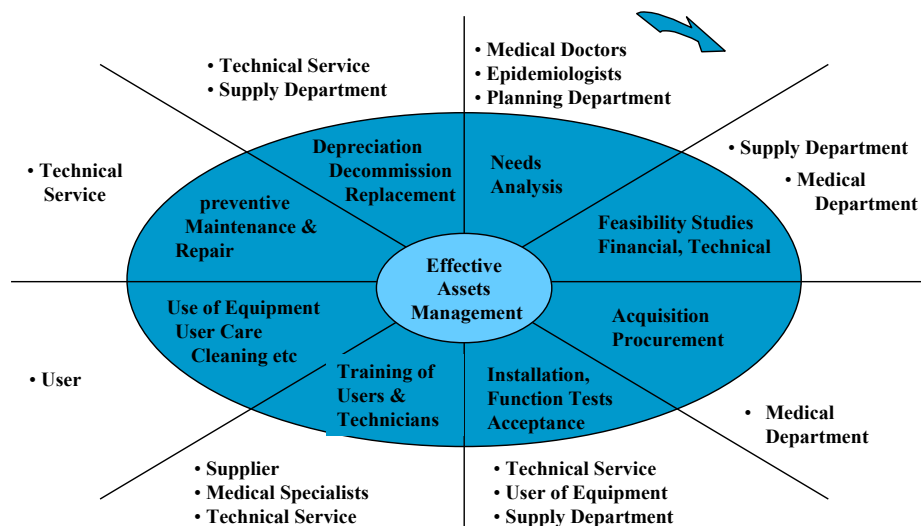


Figure 1 Technology Management Cycle

Within the maintenance pyramid, the main focus were primarily the lower levels, the basic maintenance at District and Facility level and the user maintenance to avoid unnecessary failure due to incorrect operation and misuse.

As qualified technical staff for the maintenance and repair of medical equipment did not exist in Dodoma Region, the project planned comprehensive practical trainings for identified staff in the different Districts

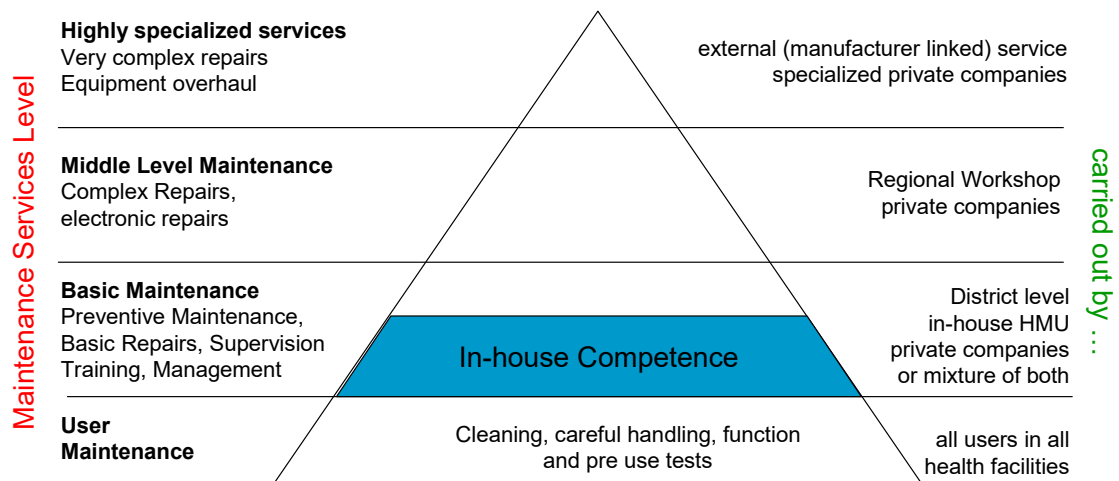


Figure 2 Maintenance Pyramid

Maintenance of Infrastructure:

Following the principal to use all available resources and as technical competence for the maintenance and repair of buildings (artisans of various professions) can be found within the Districts, the project planned to introduce community based approach for the maintenance of the infrastructure. The project focussed mainly on the development of a systematic approach and trained the technicians in supporting the Health Facility Governing Committees (HFGCs) and Health Care Workers in planning and monitoring of maintenance but did not transfer technical skills for building maintenance.

Approach

Three major areas of activities were identified to improve HTM

- development of a systematic management system including all necessary procedures for HTM
- To identify and train technicians to provide qualified personal for HTM
- To establish the necessary Infrastructure (workshops, tools) for HTM

It has been the intention to provide HTM services for all public Health facilities in Dodoma Region

| District | RH | DH | HC | Disp | Total |
|----------|----|----|----|------|-------|
| Bahi | 00 | 00 | 04 | 33 | 37 |
| Chamwino | 00 | 01 | 05 | 56 | 62 |
| Dodoma | 01 | 01 | 03 | 29 | 34 |
| Kondoa | 00 | 01 | 05 | 54 | 60 |
| Kongwa | 00 | 01 | 03 | 33 | 37 |
| Mpwapwa | 00 | 01 | 2 | 41 | 44 |

Table 1 Health Facilities in Dodoma Region in 2011

| District | RH | DH | HC | Disp | |
|-----------|-----|----|----|------|----|
| Bahi | 00 | 00 | 06 | 35 | 41 |
| Chemba | N/A | 00 | 04 | 33 | 37 |
| Chamwino | N/A | 01 | 05 | 61 | 67 |
| Dodoma | 01 | 01 | 04 | 32 | 38 |
| Kondoa TC | N/A | 01 | 00 | 05 | 06 |
| Kondoa DC | N/A | 00 | 04 | 31 | 35 |
| Kongwa | N/A | 01 | 04 | 48 | 53 |
| Mpwapwa | N/A | 01 | 4 | 51 | 56 |

Table 2 Health Facilities in Dodoma Region in 2018

4.1 Management System

A large and important part of the activities focussed in particular on introducing and convincing health management staff on the need and usefulness of HTM, to create a “maintenance culture” and to include the maintenance system into the health management structures available.

Inventory

Basis for all management systems is the availability of key data of the items to manage. Though the HF kept a basic administrative inventory for medical equipment, the information was incomplete and not sufficient for technical purposes. The project developed data collection sheets, trained the available technicians and with the support of a private company (TAMEQ) embarked on the inventory exercise in all Public Health Facilities in the Dodoma Region.

Beside administrative data (location, responsible, contact etc) information on the physical infrastructure (condition of building, water supply, electricity etc) and technical data on all medical equipment was collected.

Beside establishing an inventory, the exercise was used to - wherever possible – carry out basic repairs and thus further train the district technician.

The existing open source software for medical equipment management of the SCIH “openmedis” was adapted to the Tanzanian situation and needs and all collected data were entered.

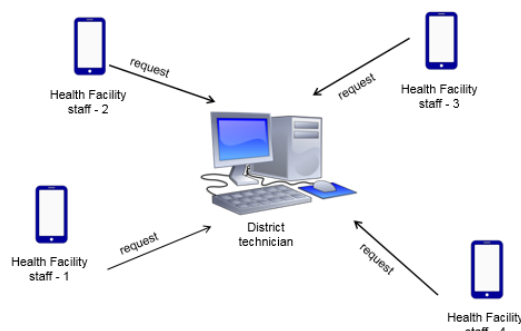
| Date | Activity | Total cost |
|---------------------|----------------------------|---------------|
| 30.1.2012-23.4.2012 | Taking inventory | 6,000,000.00 |
| 2013 | Customisation of openMEDIS | 13,230,000.00 |
| 9.6.2014 | Update data in open Medis | 10,447,000.00 |

Table 3 Activities and cost related to inventory

In the first inventory exercise **276** health facilities with a total of **5386** equipment were registered.

In the second phase of the project, an application for mobile phones (openmedis mobile) to allow data requesting and entering data into openmedis was developed and deployed in the Health Facilities in Dodoma region. This facilitates in particular through the application can request for maintenance, repair, installation and calibration services from Technicians which can be placed directly from the health facility into openMedis and prompt message sent to the technician email address, this allows appropriate actions to be planned by the technical team.

openMEDIS mobile - organisation



In addition, the mobile version allows to enter and trace data during maintenance activities in the field. This will facilitate all maintenance activities.

Management, Planning and Budgeting Approach

Situational analysis of 2011 revealed weakness and non-existences of systematic managerial skills for HTM and therefore documentation, planning and budgeting for equipment` corrective and planned preventive maintenance at Regional, District and facility level were challenging. At most where budgets were prepared a figure was put based on “smart guess” to support repair and maintenance of equipment which were done through either support from National and Zonal Technicians, outsourced services from Private companies and unqualified local fundis.

In order to address the challenge HPSS introduced capacity development activities for improving management skills for planning, budgeting and overall management of HTM processes. Through these interventions project conducted **4 training sessions** and **12 follow up sessions** with health system managers and administrators namely; Regional and District Medical Officers, Regional, District and Hospital Secretaries and Hospital Medical Officer In-charges of all Public and designated hospitals in the regions. In addition, non-health managers and leaders participated in the sessions, these includes; Regional and District Planning Officers, Civil Engineers, Water Engineers and Procurement Officers and District Treasurers. Inclusion of the non-health sector managers and leaders is crucial for extending the knowledge and understanding key elements of HTM aspects since they both at some point make decision on approving or disapproving financial and non-financial resources allocation during planning and budgeting for HTM and execution of the same in their respective areas.

Planning and documentation

To introduce an effective HTM system all necessary forms and procedures (SOPs) were developed for both maintenances of medical equipment and infrastructure maintenance including:

- Reporting of technical problems
- “Jobcards” to document repair interventions
- “Equipment history cards” to document the performance of equipment
- Regular reports to the health facility management
- Handing back repaired equipment and user instructions

Use and usefulness of the documentation system were trained during various training sessions, not only to the technician but also to medical and managerial staff.

Management of HTM

All steps of the development and introduction of the system were agreed in regular management and Regional Technical Working Group meetings.

| Date | Topic | No of participants | Total Cost |
|------------|--|--------------------|--------------|
| 24.2.2014 | HTM TWG: Progress Reporting and Technical Analysis on Emerging Issues | 25 | 3,438,500.00 |
| 23.06.2014 | HTM TWG: Progress Reporting and Technical Analysis on Emerging Issues | 25 | 3,438,500.00 |
| 8.10.2014 | HTM TWG: Progress Reporting and Technical Analysis on Emerging Issues | 25 | 3,438,500.00 |
| 25.5.2015 | HTM TWG and Peer Learning: Progress Reporting and Technical Analysis on Emerging Issues | 30 | 5,105,000.00 |
| 29.2.2016 | HTM Policy Meeting Between MoHCDGEC, PORALG and Regional, District Management Team and Technicians | 40 | 8,120,600.00 |

Table 4 Management meetings

The results and necessary actions e.g. planning and budgeting for maintenance were presented, discussed and agreed upon in various training and motivation sessions for managers in the health system.

| Date | Topic | No of participants | Total Cost |
|-----------|---|--------------------|---------------|
| 26.2.2016 | Orient members of RHMT, DRRH management team, CHMTs and DPLOs on PPM planning, budgeting and implementation | 50 ¹ | 11,388,000.00 |
| 4.4.2017 | Consolidate a system for procurement of electronic, electrical, and biomedical spares and consumable | 48 ² | 9,898,000.00 |
| 7.2.2018 | Working Session with Medical Officers, Health Secretaries and Technicians | 45 | 10,000,000.00 |

Table 5 Training for managers

4.2 Technical Personnel, Training

Technical competence to manage and maintain medical equipment did hardly exist in Dodoma Region. The three years Diploma course for Biomedical technician had not even started by 2011.

To still improve the situation, the Districts agreed to employ a qualified technician with qualifications in either electrical, mechanical or electronic field. However, finally, the Districts nominated technicians already available in the District in other functions, mainly from civil, water or works departments.

To introduce the technical staff to systematic HTM and familiarize the staff with health facilities and medical equipment, the technicians were – wherever possible – involved in the inventory exercise.

The project in 2012 developed a series of training courses including management but mainly focussing on practical maintenance and repair of the most common equipment, starting with equipment available in Dispensaries and continuing with common equipment in Health Centres and Hospitals.

In 2014 the first “Biomedical technician” graduated from Arusha Technical College and Dar es Salaam Institute of Technology. With the support of the MOHCDGEC (then MoHSW) six of them were posted to Dodoma Region as a priority of the ministry to enhance the pilot approaches being implemented by the project in the region by addressing the skills gap. These newly graduates had to undergo induction training to familiarize them with the system and to strengthen technical capacity. As some of the graduates lacked practical experience additional training course were designed and held.

In general, the approach of the project to train in specifically designed training courses proved adequate, most of the technicians afterwards successfully maintained equipment.

¹ Includes RMO, RHS, DRRHS, Medical Officer In charge of regional and district hospitals, DMOs, DHSs, DPLOs and Technicians

² MoHCDGEC, PORALG and MSD representatives, DMOs, DHSs, District Procurement Officers and Biomedical Engineering Technicians

| Date | No of days | Topic | No of participants | Total Cost |
|---|------------|---|--------------------|---------------|
| 24 th -26 th February 2014 | 3 | OpenMedis Training | 23 | 5,600,000.00 |
| 8-15.9.2014 | 8 | Induction/Refresher Training to New and Existing Technicians | 11 | 12,954,000.00 |
| 29.1.2015- 1.2.2015 | 4 | Cooling Refrigeration (EPI Certified Training) Training to Biomedical Technicians | 23 | 18,452,000.00 |
| | 5 | Technical training on repair, maintenance and installation of: Health Imaging (x-ray, ultrasound, foetal heart monitor) Vital Signs (Patient Monitors BP machines); Ventilators (anaesthesia machines), oxygen concentrators; sterilisers both steam and hot air; Suction pumps (electrical and manual); Chemistry analysers; microscope, centrifuge machine; | 144 | 15,164,500.00 |
| 22- 24.2.2016 | 3 | Training of Technicians on Planned Preventive Maintenance of Medical Equipment | 14 | 4,557,000.00 |

Table 6 Training courses for technician

In addition to the training of technicians, the project provided intensive training for users in correct handling of medical equipment to avoid user faults and possible breakdowns. This training also proved highly effective.

| Date | No of days | Topic | No of participants | Total Cost |
|--------------------------|------------|--|--------------------|---------------|
| 29.9.2014- 01.10.2014 | 3 | Maternal Health Equipment | 75 ⁵ | 19,727,000.00 |
| 20-24.3.2017 | 5 | Health Imaging (x-ray, ultrasound, foetal heart monitor) Vital Signs (Patient Monitors BP machines); Ventilators (anaesthesia machines), oxygen concentrators; sterilisers both steam | 120 | 57,415,000.00 |

³ Biomedical Technicians

⁴ Regional and District Biomedical Engineering Technicians

⁵ Trainees included Medical Doctors, Assistant Medical Doctors, Clinic Officers, Nurse Midwifery, Nurse Officers and Biomedical Engineering Technicians

| | | | | |
|--|--|--|--|--|
| | | and hot air; Suction pumps (electrical and manual); Chemistry analysers; microscope, centrifuge machine; | | |
|--|--|--|--|--|

Table 7 Training for users

4.3 Infrastructure for maintenance

In the beginning of the project only one of the hospitals had a workshop for maintenance and repair activities. This workshop was in a rather poor condition, not apt for management and maintenance of medical equipment.

The project agreed with the management of the District and Regional Hospital to support the renovation and provide tools and equipment under condition that the health facility identifies and avails adequate rooms for a workshop and participates in renovation.

Support workshop construction

| Date | Location | Project contribution | HF contribution |
|--------------|-----------------------------------|----------------------|-----------------|
| January 2014 | Chamwino | 2,500,000.00 | 935,000.00 |
| October 2014 | Kongwa | 2,777,800.00 | 1,790,000.00 |
| October 2014 | Mpwapwa | 3,977,000.00 | 1,545,000.00 |
| April 2015 | Kondoa | 5,422,900.00 | 4,160,000.00 |
| March 2015 | Dodoma City | 7,277,500.00 | 1,000,000.00 |
| April 2015 | Dodoma Regional Referral Hospital | 20,000,000.00 | nil |

Table 8 Renovation of workshops

As the hospitals did not even have the basic tools required for maintenance, the project developed a list of required tools and provided a basic tool set for each district. For Districts having identified and supported a workshop, an additional set of workshop tools was provided.

| Date | Location | toolset | Total cost |
|------------|------------------------------------|----------------------|---------------|
| 23.10.2014 | Chamwino District Council | Set of working tools | 21,406,398.00 |
| 23.10.2014 | Kongwa District Council | Set of working tools | 21,406,398.00 |
| 23.10.2014 | Mpwapwa District Council | Set of working tools | 21,406,398.00 |
| 23.10.2014 | Kondoa District Council | Set of working tools | 21,406,398.00 |
| 30.7.2017 | Dodoma City | Set of working tools | 21,406,398.00 |
| 23.10.2014 | Dodoma Regional Referral Hospital | Set of working tools | 28,215,044.00 |
| 30.7.2017 | Mvumi Institute of Health Sciences | Set of working tools | 21,406,398.00 |

Table 9 Tools provided to technician and workshops

With the introduction of openMedis as an electronic means for health technology management it was necessary to provide a basic computer to each of the Districts.

| Date | Location | computer | Total cost |
|-----------|-----------------------------------|-----------------------|--------------|
| 27.1.2015 | Bahi District Council | Dell OptiPlex 7010 MT | 1,447,250.00 |
| 27.1.2015 | Chamwino District Council | Dell OptiPlex 7010 MT | 1,447,250.00 |
| 27.1.2015 | Kongwa District Council | Dell OptiPlex 7010 MT | 1,447,250.00 |
| 27.1.2015 | Mpwapwa District Council | Dell OptiPlex 7010 MT | 1,447,250.00 |
| 27.1.2015 | Kondoa District Council | Dell OptiPlex 7010 MT | 1,447,250.00 |
| 27.1.2015 | Dodoma City Council | Dell OptiPlex 7010 MT | 1,447,250.00 |
| 27.1.2015 | Dodoma Regional Referral Hospital | Dell OptiPlex 7010 MT | 1,447,250.00 |

Table 10 Computers for openMedis

4.4 Additional activities

Right from the beginning, the project worked in close cooperation with relevant Tanzanian authorities, in particular the Health Care Technical Services (HCTS) of the MoHCDGEC, to assure that all activities planned and done are in line with the Tanzanian policies. All new innovations were designed, discussed in the regional HTM Technical working groups and endorsed for implementation, results from implementation were then shared in the Technical Working Group for technical review and Regional Advisory Board for endorsement.

Networking to foster HTM in Tanzania has been an initiative from the beginning of the project. Contacts were made to the training institutions namely Dar es Salaam Institute of Technology (DIT), Arusha Technical College (ATC), Vocational Education Training Authority (VETA) Central Zone for establishing collaboration on training and capacity building. Apart from this the project has linked with Medical Stores Department (MSD) through its Central Zone and Headquarter as well as to various medical equipment Suppliers and Distributors. The network aimed at lobbying and persuading the organisations to stock and distribute spare parts and consumables for preventive and corrective maintenance of medical equipment since there has been no reliable supply of spare parts and consumables for most equipment in the facilities. As a results private companies have started to stock parts and consumables which allows region and councils to procure them. MSD is reviewing its procurements practices to ensure that suppliers of approved equipment also provide solutions for spare parts and consumables. Through coordination with MoHCDGEC the project has established links with the American International Health Alliance (AIHA) and Korea Foundation for International Health (KOFIH), the two organisations support different health interventions including capacity building for Biomedical Technicians in Tanzania.

As part of its project policy for dissemination of results, peer assessment and experience sharing, the project has successfully participated in various local and international meetings to present approach, success and lesson learnt of the approach to establish the HTM system in Dodoma Region through which feedback is received from participants regarding best practices, lesson learnt and areas which require improvement. Papers where presented in the following conferences;

2012 Participation and Presentation of HPSS during 3rd East African Regional Healthcare Engineering Conference in Dar es Salaam

2013 Tanzania Public Health Association Annual Scientific Conference in Mwanza,

2014 Tanzania Public Health Association Annual Scientific Conference in Dodoma,

2014 4th East African Regional Healthcare Engineering Conference in Kigali, Rwanda

2015 Tanzania Health Summit in Dar Es Salaam

2018 Tanzania Health Summit in Dar es Salaam

In the second phase, the project continued the intensive cooperation with the HCTS and supported and participated in the review of 2012 HCTS Policy Guidelines and later on support the on-going processes of development of new HCTS Policy Guidelines.

Based on the experience in Dodoma, the need for a more practical shorter training for Biomedical engineering artisans was identified. Mvumi Institute of Health Sciences – which had offered Certificate Training in Medical Equipment Maintenance before but had stopped the training – showed interest to revive the training. In cooperation with the Training Institute in Mvumi, MOHCDGEC, DIT, ATC, VETA and Mirembe School of Nursing the project started the development of the curriculum.

On request of MoHCDGEC and PORALG to further extend support to Njombe and Ruvuma regions, the project supported introduction of HTM interventions in the two regions with advice and some training to begin to establish a similar maintenance system. Health sector leaders from region and local government authorities and health facilities have been oriented on the HTM management approaches such as inventory taking, planning and budgeting for corrective maintenance and planned preventive maintenance, and establishment of maintenance workshops at hospital level. Further to this, Electrical technicians from regional hospital and District Hospital were trained on performing maintenance and repair of medical equipment.

5 Results, Achievements

The evaluation team tried to capture the actual situation relative to HTM mainly in Dodoma Region and in comparison in Njombe and Morogoro Region.

5.1 Management

All interviewed managers in Dodoma Region stressed the need for maintenance of medical equipment.

In Dodoma Region all Districts included the technicians in the District Management Team mostly as permanent but at least as co-opted members. Technical staff is included in the regular supportive supervision of the DHMT to the health centres and Dispensaries.

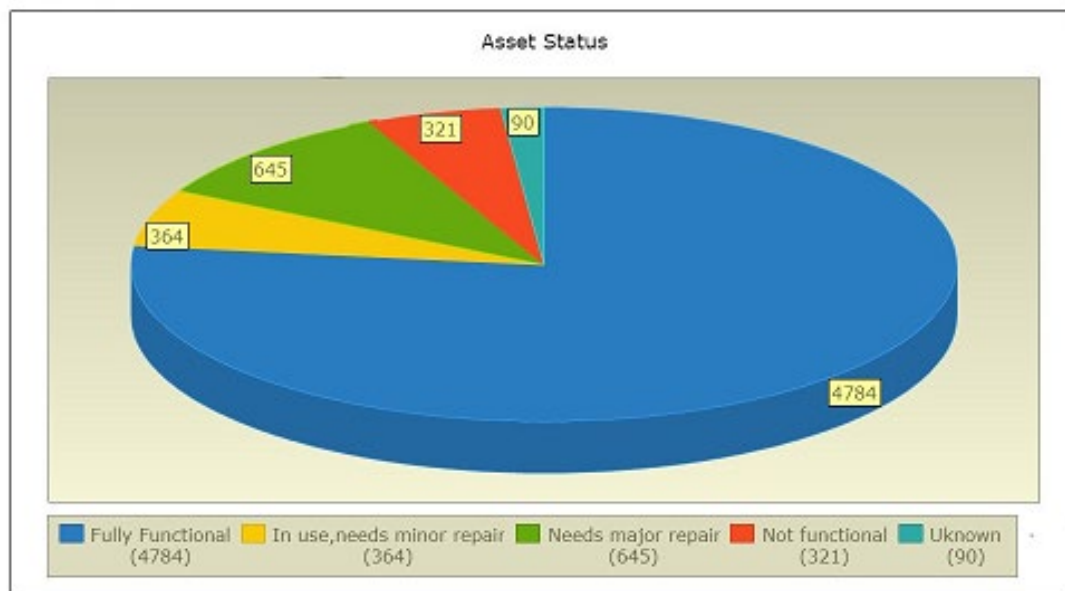
Standard Operation Procedures are available for main activities for equipment and building maintenance.

Operational procedures for maintenance of medical equipment seem to be mostly applied. Requests for maintenance are made and the maintenance activities are documented. Unfortunately, not all data is entered into openMedis.

A review of application of Operational Procedures for building maintenance in July 2018 showed some difficulties in application. However, a total of 80 facilities has been supported to carry out building maintenance.

5.2 Technical Inventory

Technical inventory of equipment were established to support management of the asset through the digital solutions (openMedis) different level of management and technical personnel are able to view the status of equipment and request coming from the user department. The openMedis provides a snap shot on the status of equipment through the dashboard.



Extract from openMedis, 2018

| Item | Dodoma 2015 | Dodoma 2016 | Dodoma 2017 | Dodoma 2018 | Njombe 2017 | Morogoro 2018 |
|-----------------------------|-------------|-------------|-------------|------------------|------------------------------|-----------------|
| # of equipment in Inventory | 5360 | No update | No update | 6,204 | Not ⁶ established | Not established |
| # of requests | 1,634 | 2,078 | 1,064 | 560 | No records | No records |
| #of repairs done | 1,157 | 1,626 | 947 | 481 ⁷ | No records | No records |

Note: requests for maintenance declined in year 2017 and 2018 due to improve management of medical equipment by user and initiation of Planned Preventive Maintenance practices by users and biomedical technicians.

Table 11 Equipment registered and number of interventions

5.3 Personnel and training

| Item | Dodoma | Njombe | Morogoro |
|--------------------------------------|--------|--------|----------|
| # of biomedical technician (Diploma) | 07 | 00 | 02 |
| No of trained artisan | 15 | 08 | 00 |

Table 12 Existing technicians/artisans in the Regions

⁶ At the time of assessment, Morogoro and Njombe have not establish medical equipment inventory

⁷ From 560 request for maintenance, 481 were repaired successfully, the remaining were still open waiting for spare parts

5.4 Workshops

| Item | Dodoma | Njombe | Morogoro |
|-----------------------------|--------|-----------------|----------|
| # of workshops | 06 | 04 ⁸ | 00 |
| Availability of basic tools | yes | no | no |

Table 13 Workshops in the Regions

6 Impact

Maintenance culture

The main impact concerning HTM is the noticeable acceptance of maintenance as part and parcel of the health system in Dodoma Region. In particular, for small repairs and basic equipment managers generally know how to arrange for maintenance and are willing to support. The former mantra “maintenance is too difficult, don’t know how to manage, it takes too long, it is better to buy new” seems to have mostly disappeared. This change of mind set is attributed to the work of HPSS on introducing the concept of health technology management and building capacities of different actors within the health system in the region. It was noted during this assessment that all health managers underlined the need for maintenance and that they are committed to support the needs. Wherever technicians were in place, the managers stressed the rapid intervention for installation, maintenance and repair and the benefits for the health system. They also mentioned the improved handling of the medical equipment by medical staff due to continued user training and instruction by the technicians.

Results of the HPSS 2018 follow up survey indicates a different greater improvement on maintenance culture in the regions. The study shows that the rate of regular inspection of building and equipment by technicians has improved very highly as over two-thirds (69.3percent) of the health facilities confirm to do regular inspection and maintenance of the infrastructure (walls, roof, windows & doors, furniture, electricity, water, etc.). This is an increase of about 35.7 percent as compared with the situation in 2011. On medical equipment (fridges, suction pump, blood pressure equipment, etc.) in health facilities, 82.5 percent of the health facilities confirm to have regularly inspected by technicians to verify their functioning and/or identify and carry out small repairs. This is an increase of about 47.5 percent from the baseline results of 2011. Table 5.1 summarise findings of the follow up health facility survey.

⁸ After sensitisation training by the project in Njombe councils have allocated rooms of which Artisans are using to repair and maintain medical equipment. These are not proper workshop as the ones set up in Dodoma

| District | Facility regularly inspected by technicians to verify functioning and /or identify and carry out small repairs for infrastructure | | Facility regularly inspected by technicians to verify functioning and /or identify and carry out small repairs for medical equipment | |
|---------------------|---|------------------|--|------------------|
| | YES | NO | Yes | NO |
| Bahi | 8(53.3%) | 7(46.7%) | 11(73.3%) | 4(26.7%) |
| Chamwino | 12(57.1%) | 9(42.9%) | 16(76.2%) | 5(23.8%) |
| Chemba | 14(87.5%) | 2(12.5%) | 14(87.5%) | 2(12.5%) |
| Dodoma Urban | 7(46.7%) | 8(53.3%) | 9(60.0%) | 6(40.0%) |
| Kondoa | 7 (77.8%) | 2(22.2%) | 9(100.0%) | 0(0.0%) |
| Kongwa | 16 (88.9%) | 2(11.1%) | 17(94.4%) | 1(5.6%) |
| Mpwapwa | 15(75.0%) | 5(25.0%) | 18(90.0%) | 2(10.0%) |
| Total(N=114) | 79 (69.3%) | 35(30.7%) | 94(82.5%) | 20(17.5%) |

Table 14 Regular inspection of building and equipment by a technician (HPSS Follow Up Health Facility Survey 2018)

The situation in 2011 was very different as maintenance was regarded as non-health sector business. Result of the HPSS Health Facility Survey of 2012 shows that Only 33.6% of the facilities confirm regular inspection of the infrastructure, while regular inspection of medical equipment is done in 35% of the facilities.

| District | Facility regularly inspected by technicians to verify functioning and /or identify and carry out small repairs for infrastructure | | Facility regularly inspected by technicians to verify functioning and /or identify and carry out small repairs for medical equipment | |
|-----------------------|---|--------------------|--|--------------------|
| | Yes | No | Yes | No |
| Mpwapwa (N = 43) | 31 (72.1%) | 12 (27.9%) | 33 (76.7%) | 10 (23.3%) |
| Kongwa (N = 36) | 18 (50.0%) | 18 (50.0%) | 18 (50.0%) | 18 (50.0%) |
| Bahi (N = 30) | 6 (20.0%) | 24 (80.0%) | 8 (26.7%) | 22 (73.3%) |
| Dodoma Urban (N = 24) | 10 (41.7%) | 14 (58.3%) | 13 (54.2%) | 11 (45.8%) |
| Kondoa (N = 53) | 10 (18.9%) | 43 (81.1%) | 6 (11.3%) | 47 (88.7%) |
| Chamwino (N = 55) | 6 (10.9%) | 49 (89.1%) | 7 (12.7%) | 48 (87.3%) |
| | | | | |
| All (N = 241) | 81 (33.6%) | 160 (66.4%) | 85 (35.3%) | 156 (64.7%) |

Table 15 Regular inspection of building and equipment by a technician (HPSS Health Facility Survey 2012)

Further to the mentioned achievement explained above, in Dodoma region a culture of maintenance is seems to be well internalised within the health systems, facilities are preparing annual plans and budget for planned preventive maintenance of medical equipment and infrastructures. During the assessment it was reported by District Biomedical Technicians, medical officers in charges and District Health Officers as well as District Health Secretaries that facilities are supported to develop yearly planned preventive plan for maintenance of medical equipment. These testimonies are supported by the results of Health Facility Follow up Survey which revealed that 71.9 percent of the health facilities in Dodoma region have yearly preventive plan on what should be improved/repaired/maintained within the facility. See table 5.3 presents the situation in the regions with regard to preventive plan. Preventive maintenance is crucial for ensuring that equipment last for many years, reduction of breakdown

and downtime, maintaining effective functionalities of equipment and thus investment cost.

| District | N | Availability of yearly preventive plan on what should be improved/repaired/maintained within the facility | | |
|--------------|------------|---|--------------|-------------|
| | | No | Yes | Partly |
| Bahi | 15 | 60.0% | 20.0% | 20.0% |
| Chamwino | 21 | 52.4% | 47.6% | 0.0% |
| Chemba | 16 | 31.3% | 68.8% | 0.0% |
| Dodoma Urban | 15 | 13.3% | 80.0% | 6.7% |
| Konooa | 9 | 0.0% | 100.0% | 0.0% |
| Kongwa | 18 | 5.6% | 94.4% | 0.0% |
| Mpwapwa | 20 | 0.0% | 100.0% | 0.0% |
| Total | 114 | 24.6% | 71.9% | 3.5% |

Table 16 Availability of yearly preventive plan at health facilities

This change of mind can certainly be attributed to a large extent to the HTM component of the HPSS Project supported which have played crucial part in training and coaching decision makers and implementers within the region and LGAs on how to approach maintenance and repair interventions for medical equipment and infrastructures. Addition factors like Policy changes of the MOHCDGEC and the creation of a resource centre at the PORALG which facilitate discussions and exchange of experience and provide supportive supervision on implementation have also contributed on achieving this results.

- “instruction to plan for 16% to 20% of the whole budget of a health facility for maintenance
- Development of HCT Guidelines

HTM technician integrated in hospital management/administration

Hospital maintenance technician are (mostly) well integrated into the hospital administration and hospital management. This assures that maintenance issues are quickly brought to the attention of the management and can be tackled. In addition, the technician provides technical input as required to the management team.

Regular reports on HTM activities

The District technicians prepare a monthly report to the District Management Board on repair activities and existing maintenance issues. The report is normally presented during the District Management Board and enables the management to take corrective actions to avoid longer unavailability of the equipment.

Availability of budgets

All Districts and health facilities provide budgets for maintenance. Though the budgets are sometimes not sufficient and not adequately used, this allows often rapid actions in case of maintenance need and avoids long waiting times to identify the necessary financial resources to perform maintenance. District Councils and since 2016/2017 health facilities are planning and allocating financial resources for repair and maintenance of medical equipment, it has been also found out by the project follow up health facility survey that 72.8 of surveyed facilities have budget for maintenance and repair of medical equipment as presented in the figure 5.1 below. This is opposite of the situation in 2011 were nearly 50% of Health Facilities plan and budget for maintenance and repair.

| District | N | Availability of planned yearly budget for maintenance and repair | | |
|--------------|------------|--|--------------------|-------------------|
| | | No budget planned | 100,000 to 250,000 | More than 250,000 |
| Bahi | 15 | 33.3% | 0.0% | 66.7% |
| Chamwino | 21 | 23.8% | 4.8% | 71.4% |
| Chemba | 16 | 31.3% | 6.3% | 62.5% |
| Dodoma Urban | 15 | 20.0% | 6.7% | 73.3% |
| Kondoa | 9 | 0.0% | 0.0% | 100.0% |
| Kongwa | 18 | 5.6% | 0.0% | 94.4% |
| Mpwapwa | 20 | 60.0% | 0.0% | 40.0% |
| Total | 114 | 27.2% | 2.6% | 70.2% |

Table 17 Availability of yearly budget for maintenance and repair

Rapid repairs of medical equipment

Though there are still some deficits in documenting all necessary repair data (repair time, down time, cost for spares, etc) a review of the jobcards in the workshops showed, that for a large number of repairs/maintenance the time actually spent on repair was less than 30 minutes. This is a typical distribution of repair time, many repairs are minor, often even rather an incorrect use of equipment and can be immediately rectified. However, without technical staff, the equipment would be out of use until technical service from outside arrives. (often only after a period of up to 6 month). If technical staff would be called sooner, the cost for repair will show a very ineffective cost ratio – possibly more than 8 hrs travel for a repair activity of less than 30 minutes.

Timely Installation of new arriving equipment

With technician in place, newly arrived equipment – if not waiting for the supplier for installation – is normally quickly installed by the technician and function is explained to users. Often the technical staff is also preparing a simple user instruction leaflet to facilitate use of the equipment. With technical staff in place, it is rare, that equipment is kept uninstalled in boxes for long periods.

Reduction of new purchases

Before the establishment of the technical services equipment – in particular small equipment – was often replaced instead of repaired. (see example below). The presence of technical staff often allows fast correction of small problems, often even without costly spares-.

Training of users, reducing user faults

It has been underlined, that the handling of equipment by users has improved. Technicians have often prepared simplified user instructions of equipment and normally advise users on correct use after maintenance of repair.

Regular inspection of infrastructure by technician and HFGC

Even though regular inspection and maintenance is not yet performed for all health facilities, the SOPs are available and the technicians are supporting HFGC and staff of the health facilities to detect infrastructure problems and to arrange for adequate maintenance.

A review of infrastructure maintenance in July 2018 has shown that mainly small infrastructure problems are tackled, periodic or emergency maintenance had not been carried out. But users expressed satisfaction with the maintenance carried out and underlined positive effects on the users as well as facility staff. These include improved

hygiene and sanitation; improved quality of working spaces such as labour rooms; attractive and user-friendly environments; and increased staff motivation

Information available for planning purpose

The established inventory provides vital information for planning purposes. Equipment history documents performance of medical equipment and can be used to select durable and easy to use equipment for new procurements. Unfortunately, most equipment is still provided through central procurement and specific projects so that this information is not yet adequately used.

Induction training through MOH for new biomedical technicians

Experience with the graduates from the biomedical engineering training in Dodoma has shown, that the practical knowledge on preventive maintenance and basic repairs are not sufficient. Additional training courses have been arranged.

This had led the MOH to establish general introduction training for graduates. All technicians graduating are undergoing a four weeks special training to familiarize them with the situation in the Districts and to improve practical know how and skills. This greatly improves the effectiveness of the technicians in the field.

Training of artisans in basic maintenance of biomed equipment

The project work showed the need and possibilities of “biomedical” artisans in the health facilities. Many maintenance activities can be carried out by such cadres.

This contributed to the decision of Mvumi Technical College to establish an artisan training in the field of biomedical engineering maintenance. With the support of the project an adequate curriculum for a Basic Technician Certificate in Biomedical Equipment Engineering (NTA Level 4 and 5) had been developed. The course is in line with the technical education in Tanzania and with the HCT Guidelines of the MOH. This training will complement the technician and engineering training in the field of hospital maintenance.

7 Economic considerations

7.1 Cost of establishing maintenance systems

Methodology

The analysis covers a **period** from 2011 to 2018. The analysis adopted the top down approach using expenditure reports to track down the resource used to support the Dodoma region in the implementation of HTM interventions. The project staff provided the cost for workshop renovation, equipping the workshops, purchasing of computers, training, meetings, backstopping, monitoring and evaluation and meetings. We also acquired salaries for technicians. The resources used were categorized as capital or recurrent cost. The capital cost included; workshop renovation, equipment for workshop, computers and training. Recurrent costs included meetings.

We employed the average Bank of Tanzania interbank discount rates of about 16 per cent (BOT 2016) We assumed useful life years of thirty years for buildings , five years for equipment and training, based on previous estimates by the World Health Organisation (WHO) for low income countries, (WHO-CHOICE 2012).

Results

Total Cost

The total financial cost for the HTM component of the HPSS was Tsh. 731,655,495 /- (Table 18 Total Cost of the HTM interventions in Dodoma Regions up to 2018below). About 63.7 per cent of the resources were used on capital expenditures and 36.3 per cent of the costs were recurrent expenditures. On average about 31.2 per cent of all the expenditures were utilised for training, the expenditure on furnishing the workshops with equipment was 25.8 per cent. About Tsh 654,359,608/- (89%) millions of these resources were directly paid by HPSS project and 77,178,664/- (11%) of the resources were contributed by the District councils and Dodoma region hospital.

Annual Cost

The annual average cost of delivering HTM intervention in Dodoma region is TSh. 369,943,582/- (table 2 below). Dodoma regional hospital had the highest annual average resource use of Tsh. 72,332,717/- (19.6%). Mvumi Hospital had the least annual average resource use of Tsh. 3,818,109/- (1.0%).

Discussion

The results of this costing study of the HTM intervention in the HPSS project indicates that at an average annual cost of Tsh. 50 Million a full functioning health technology management component can be initiated within a District. The workshop can serve all health facilities within the district through the District technicians visiting the lower level facilities to preventive maintenance and providing hands on training of health workers to detect any problems earlier and bring the equipment to the district workshops for maintenance.

In a scenario were we assume that the HTM intervention has already been sensitised both at the Dodoma regional level and the National level through Ministry of introduced at Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDCGEC) and President Office Regional Authority and Local Government (PORALG). Therefore, we can omit meetings and other cost reduces the average annual budget of establishing the full functioning HTM intervention in district to Tsh. 34 Million from 50 Million.

Assuming that due to the established training of health technology technician, the technicians will not be employed with adequate skills, hence no need of intermediate short-term training. By reducing this expenditure, the cost of establishing HTM intervention in district is further reduced to an average of about Tsh. 26 Million.

The average overhead cost of running the HTM within the district is 19 Million, that is the cost for personnel salaries and backstopping and monitoring and evaluation. However, commitment of District council in absorbing this project is still questionable as they only contributed about 11% of the total cost. This needs to be addressed and ensure the councils are responsible for implementing the scale up of the project with very minimal project assistance to ensure sustainability.

Conclusion

Following the success of the HTM intervention in districts within Dodoma region whereby equipment's worth millions of Tanzania Shillings has been repaired, rolling out this intervention country wide with councils required to budget about 26 Million to 35 Million for this activity which is within the fiscal capacity of the district councils.

Table 18 Total Cost of the HTM interventions in Dodoma Regions up to 2018

| | Dodoma RH | Dodoma City | Chamwino | Kongwa | Kondoa | Mpwapwa | Bahi | Mvumi | Total cost (%) |
|------------------------------|--------------------|--------------------|-------------------|-------------------|--------------------|--------------------|-------------------|-------------------|--------------------|
| Cost category | | | | | | | | | |
| Capital | | | | | | | | | |
| Buildings | 20,000,000 | 8,277,500 | 3,136,303 | 3,034,970 | 9,582,900 | 5,522,000 | - | - | 6.8% |
| Equipment | 32,162,294 | 25,353,648 | 25,353,648 | 25,353,648 | 25,353,648 | 32,162,294 | 1,447,250 | 21,406,398 | 25.8% |
| Training (non-recurrent) | 41,092,995 | 31,176,737 | 31,176,737 | 31,176,737 | 31,176,737 | 31,176,737 | 31,176,737 | - | 31.2% |
| Total capital costs | 93,255,289 | 64,807,885 | 59,666,688 | 59,565,355 | 66,113,285 | 68,861,031 | 32,623,987 | 21,406,398 | 63.7% |
| Recurrent | | | | | | | | | |
| Personnel | 19,480,000 | 9,740,000 | 9,740,000 | 9,740,000 | 9,740,000 | 9,740,000 | 9,740,000 | - | 10.6% |
| Backstopping M&E | 11,000,132 | 8,345,662 | 8,436,551 | 8,345,662 | 8,436,551 | 8,345,662 | 8,345,662 | - | 8.4% |
| Meetings | 14,187,256 | 10,763,692 | 10,880,915 | 10,880,915 | 10,880,915 | 10,763,692 | 10,763,692 | - | 10.8% |
| Other | 8,413,185 | 6,452,492 | 6,452,492 | 6,452,492 | 6,452,492 | 6,452,492 | 6,382,977 | - | 6.4% |
| Total recurrent costs | 53,080,573 | 35,301,845 | 35,509,957 | 35,419,068 | 35,509,957 | 35,301,845 | 35,232,331 | - | 36.3% |
| TOTAL COSTS | 146,335,862 | 100,109,730 | 95,176,645 | 94,984,423 | 101,623,242 | 104,162,876 | 67,856,318 | 21,406,398 | 731,655,495 |
| | 21.8% | 15.0% | 13.3% | 13.7% | 14.4% | 16.1% | 0.36% | 5.4% | 100.0% |

Table 19 The average annual cost of implementing the HTM interventions in Dodoma Region

| | Dodoma RH | Dodoma City | Chamwino | Kongwa | Kondoa | Mpwapwa | Bahi | Mvumi | Total cost (%) |
|------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|--------------------|
| Cost category | | | | | | | | | |
| Capital | | | | | | | | | |
| Buildings | 2,361,250 | 1,155,180 | 1,277,395 | 637,467 | 1,337,357 | 2,101,015 | - | - | 2.4% |
| Equipment | 6,071,768 | 4,857,357 | 4,857,357 | 4,857,357 | 4,857,357 | 6,071,768 | 258,136 | 3,818,109 | 9.6% |
| Training (non-recurrent) | 10,819,126 | 8,208,334 | 8,208,334 | 8,208,334 | 8,208,334 | 8,208,334 | 8,208,334 | - | 16.2% |
| Total capital costs | 19,252,144 | 14,220,871 | 14,343,087 | 13,703,158 | 14,403,049 | 16,381,117 | 8,466,470 | 3,818,109 | 28.3% |
| Recurrent | | | | | | | | | |
| Personnel | 19,480,000 | 9,740,000 | 9,740,000 | 9,740,000 | 9,740,000 | 9,740,000 | 9,740,000 | - | 21.1% |
| Backstopping M&E | 11,000,132 | 8,345,662 | 8,436,551 | 8,345,662 | 8,436,551 | 8,345,662 | 8,345,662 | - | 16.6% |
| Meetings | 14,187,256 | 10,763,692 | 10,880,915 | 10,880,915 | 10,880,915 | 10,763,692 | 10,763,692 | - | 21.4% |
| Other | 8,413,185 | 6,452,492 | 6,452,492 | 6,452,492 | 6,452,492 | 6,452,492 | 6,382,977 | - | 12.7% |
| Total recurrent costs | 53,080,573 | 35,301,845 | 35,509,957 | 35,419,068 | 35,509,957 | 35,301,845 | 35,232,331 | - | 71.7% |
| TOTAL COSTS | 72,332,717 | 49,522,717 | 49,853,043 | 49,122,226 | 49,913,005 | 51,682,962 | 43,698,802 | 3,818,109 | 369,943,582 |
| | 19.6% | 13.4% | 13.5% | 13.3% | 13.5% | 14.0% | 11.8% | 1.0% | 100.0% |

7.2 Benefits of establishing maintenance system

The main benefits of the introduction of a stringent maintenance system have already been explained in Chapter 6. As more data is not available, here are only a few samples showing that a regular and systematic maintenance has also financial benefits.

- Dodoma City,
“We used to buy approx. 40 new BP Machines per year, after the technician has started work, BP machines were repaired and the new purchases dropped down to three or four per year”
Total number BP machines registered in Dodoma City: 109 (Source: openMedis)
Replacement before technician approx. 40 per year, 39%,
replacement cost approx. 10,000,000 TZS (250,000 TZS per piece)
Replacement after technician approx: 4 per year, 4%, repair cost approx. 30% of new value
Cost: replacement 1,000,000, repair cost approx. 2,700,000, total cost, 3,700,000
Saving in Dodoma City: 6,300,000TZS
Considering the total number of BP machines registered in Dodoma Region and the same scenario, the total saving would be approx. **34,500,000 TZS**
- Mpwapwa District. The autoclave in Mpwapwa did not function. To continue to offer at least minimal surgical services, instruments and materials had to be brought to Kongwa (45 km) every evening. Three persons (one driver, two nurses) were involved and had to stay overnight and to return early next morning with the sterilized equipment.
Cost per transport, including per Diem, fuel, etc expenses per each night were **450,000 TZS**. This routine was executed for 21 days and costed the hospital nearly **10,000,000 TZS**. until the repair was performed by the District Technicians with support from HPSS project.

8 Recommendations for Continuation

8.1 Identified shortcomings

During the evaluation, the following issues / problems were mentioned by the interview partners hindering the HTM system to even perform better

- Frequent transfer of trained technicians / management staff
Trained staff familiar with the requirements of HTM are quite frequently transferred to other locations. As in most other Regions HTM is not yet appropriately developed, the replacing staff is not familiar with the HTM. This requires frequent retraining or may decrease efficiency of the maintenance system
- No adequate handing over --- loss of information
There is no “institutional memory” yet developed in the health facilities.
Replacement of staff is not well organized, often there is no overlapping and/or handing over. Vital information is lost.
- Insufficient and inconsistent disbursement of fund
Districts and health facilities still do not plan for sufficient funds for maintenance and/or the budget is not available if needed.

- Working environment not always satisfactory
Not all Districts / health facilities have adequate workshop rooms
- Insufficient documentation of maintenance activities
The necessary forms to document maintenance activities are not always completely filled and are often not promptly entered into openMedis. This makes it difficult to obtain adequate statistics.
- Technical documentation of medical equipment is not available.
There are still many equipment in the health facilities having neither a user manual nor a technical manual specifying the necessary preventive maintenance and supporting repair activities. This yields sometimes even for new equipment recently delivered.
- No clear distribution of technical responsibilities for specialized equipment
For many health facilities it seems not very clear whom to address in case the local technician cannot maintain/repair equipment. Equipment delivered through projects often come with warranty and/or a service contract, details of which are not always known by the facilities
- Not sufficient staff employed
Some interview partners mentioned, that the technical staff available is not sufficient to tackle all problems.
- Limited skills of technical staff
It has also been mentioned, that the competence range of the available technicians is not sufficient. In particular, technicians are not trained / instructed to carry out maintenance on more complex equipment.
- No systematic continuous training
Technicians complained, that there is no regular and systematic training available to enhance competences. They also mention, that during the installation of new and more complex equipment
- Difficult access to spares
Provision of spares still poses a big problems. Specific spares are often – if at all – available in Dar es Salaam and it is costly and difficult to find and procure, in particular as according to the procurement rules three offers are required.

To improve the identified shortcoming, the project should plan the following activities for the next phase.

8.2 Consolidation

Even though HTM is already well anchored in the health system in Dodoma, it is still necessary to consolidate and improve. In particular, it seems necessary to tackle the following

1. Review openMedis

- OpenMedis is not yet used to the full extend for the management of medical equipment. In particular data is not promptly and completely entered. It will be necessary to review the equipment management part to see if there are possibilities to make data entry easier.
- OpenMedis provides also some support for maintenance of Infrastructure. This part is not yet used and should be reviewed to see if addition service could be provided.
- The statistic features of openMedis are not sufficiently used. Monthly reports with adequate statistics of all maintenance activities could be provided to District / Facility Management

- Data already entered in openMedis is not always consistent and logic. Data cleaning will be necessary.
- OpenMedis provides basic support for consumable and spare part management. In particular provider and cost of spares can be registered. This part is not yet used but could help to obtain quick information if consumables and spares are required

Necessary activities:

- Organize a workshop with experienced technician and programmers familiar with openMedis to discuss and decide on the necessary changes
- Contract programmers to modify and update openMedis
- Arrange specific workshops with technical staff and managers to retrain data entry and use of openMedis. Use the workshop for data cleaning
- Develop a simple Handbook for the use of openMedis to facilitate staff changes

2. Improve documentation for maintenance.

- The paper forms provided for the documentation of maintenance activities (Jobcards, Equipment History) are not always correctly filled. While Jobcards are often used but not all data is entered, history cards are rarely used yet. equipment history is a major tool to monitor quality and performance of equipment and is a vital information for the decision for replacement of equipment. The existing forms should be briefly review and possible improvements made.
- Monthly report forms are not sufficiently used. Though most of technician report on monthly basis to the management board, the systematic monthly report form is rarely used. Use of the forms will contribute to a systematic and continues information sharing and will help the board to make appropriate decisions
- User and technical manuals for equipment are not always available. Each workshop should have a library of all necessary documents according to the equipment in the facilities.

Necessary activities:

- Use a meeting with technicians and management staff to discuss possible required changes in the forms.
- Motivate technicians to fill the forms correctly and inform management staff to monitor use of forms and request systematic reporting
- Lobby at MOH and CMS other organisations and HF to include the provision of adequate Manuals in the procurement of (more complex) medical equipment.
- Use openMedis to establish a library of available documents in the region and foster the exchange of documents.

3. review and adjust budgeting and disbursement procedures

4. review and adjust SOPs where necessary (Infrastructure, Equipment)

5. Retraining for technical staff

- In cooperation with the HCTS of the MOH and the training institutions try to establish a series of short training courses to enhance competence for maintenance of specific medical equipment.
- Lobby at MOH and CMS and other organisations to ensure that adequate technical and user training is included in all new purchases for more advance equipment

6. Update selected Hospitals/District to match all requirements of HTM and use them as showcases for HTM (Blueprint)

- It is recommended to prepare one / two sites (possibly the regional and one District Hospital or a District) as a showcase. This will include a nicely arranged workshop with storage and adequate office space. All necessary documents should be completely filled and perfectly arranged in folders. OpenMedis should also be up to date.

In addition, the communication and cooperation with the hospital/District administration should be as required.

This sites could be used to showcase how HTM should operate and could allow other Hospitals/Regions/Districts to learn and copy.

Necessary activities:

- Identify adequate sites with already well-functioning HTM system and competent technician in place
- Arrange a working group (hospital administration, technician, medical staff) to define aims and objectives
- Support with advice, training and some materials

8.3 Capitalisation

All the experiences, success and failures of establishing the HTM System in Dodoma Region must be collected reviewed and updated. The finally used approach needs to be systematically documented. All documents must be easily available.

1. Summarizing the HTM system
2. Review, update, finalize Policy guidelines
3. Finalize Implementation guide = Developing « how to do » manuals

8.4 Operationalisation support

1. Support MOHCDGEC and PORALG in operationalization and implementation of the policy guidelines and the operation manual
2. Transfer the responsibility of openMedis to adequate Tanzanian Structures (PORALG; MOHCDGEC)

8.5 Sustainability

1. Support to strengthen Regional Administration – regional HTM coordinator
2. Support to strengthen HTM capacity in PORALG (post of engineer, etc possibly recruitment through project to take over by government) for supporting roll out
3. Integration of retraining – HTM system, inventory, etc. in zonal training centre under MOH
4. Advice/lobby and support integration of HTM system in all training courses for HTM artisans, technicians and engineers Nurses and Clinicians
 - a. Organize exchange meetings with responsible course lecturers
5. Strengthen the community of practice within the system
6. Support health system strengthening resource centre (PORALG) on supporting HTM
7. Support restructuring of MOH to streamline and bundle HTM issues
8. Support MOH to adopt as roll out an Inventory Management system. (openMedis)
9. Strengthening HTA/procurement competences in MOH
10. Support technically MOH to establish a Centre of Excellence for Calibration and Training
11. Strengthen cooperation and exchange between MOH, MSD, TFDA etc
12. Enhance spare part availability by better cooperation between
 - Prime Vendor
 - MSD
 - Suppliers

Reference

BOT (2016). Bank of Tanzania Interest Rate Structure
<http://www.bot.go.tz/publications/EconomicIndicators/InterestRate.pdf> Dar es Salaam,
Bank Of Tanzania.

WHO-CHOICE (2012). Choosing Interventions that are Cost Effective - Capital Item -
Useful Lives Reported by Country Experts
http://www.who.int/choice/costs/prices_t4/en/index.html Accessed Sept 2012. Geneva.