

Country Name	Project for the Improvement of the Medical Equipment of the University Teaching Hospital
Republic of Zambia	

I. Project Outline

Background	<p>The University Teaching Hospital (UTH), which was the target institution of this Project, was the top referral hospital in Zambia, engaged in tertiary medical care and clinical education of medical service providers and medical students studying to be doctors and nurses. Moreover, it was the only hospital providing advanced medical services to the citizens of Lusaka, where about fifteen (15) % of the total population (approximately 12 million, 2009) was concentrated. However, due to budgetary constraints, replacement of degraded medical equipment as well as maintenance and management of the huge medical facilities could not be sufficiently implemented by the Government of Zambia. It seemed to affect medical treatment activities as indicated in the decrease of number of operations and deliveries.</p> <p>Confronted with this situation, UTH was making efforts to repair the facilities and equipment with a grant from the Ministry of Health and with self-earned funds (revenues from clinical services). However, as it was difficult to appropriately budget for all the different kinds of repair and construction works at once, construction works was carried out on a small scale in accordance with the priority, and it was difficult to allocate the budget for replacement of degraded medical equipment.</p>				
Objectives of the Project	<p>To improve the quality of health services delivered by the University Teaching Hospital (UTH), and also to enhance the capacity of UTH in providing pre-service and in-service training of health care professionals by the procurement of medical equipment and strengthen the maintenance and management of medical equipment, thereby contributing to reduction of the number of death cases of new born baby, pregnant and parturient women as well as children at UTH.</p>				
Contents of the Project	<p>1. Project Site: University Teaching Hospital (UTH), Lusaka</p> <p>2. Japanese side</p> <p>(1) Procurement of medical equipment for main operation theatre, emergency operation theatre, obstetric & gynaecology operation theatre, and Paediatric Intensive Care Unit (PICU)</p> <p>➢ X-ray, mobile (2), Ultrasound Machine, Colour Doppler (2), Ultrasound Machine (1), Anaesthesia machine (10), Ventilator, Infant (7), Ventilator, Podiatric & Adult (10), Operating Light (9), Laparoscope (1), Intensive Care Unit (ICU) Bed (10), Delivery Bed (17), Infant Incubator (18) and Others</p> <p>(2) Soft component (Consulting service)</p> <p>➢ Strengthen the maintenance and management of medical equipment through establishment of manuals and structure and organization</p> <p>(Established documents)</p> <p>➢ (i) Medical Equipment Management Log, (ii) Planned Preventive Maintenance (PPM) Manual, (iii) 5S Rule, (iv) User Maintenance Check Sheet, (v) Handover Checklist/Sheet</p> <p>3. Zambian side:</p> <p>(1) Allocation of operation and maintenance budget for medical equipment of the project</p>				
Ex-Ante Evaluation	2009	E/N Date	December 11, 2009	Completion Date	April 21, 2011
Project Cost	E/N Grant Limit: 324 million yen, Actual Grant Amount: 286.8 million yen				
Implementing Agency	Ministry of Health, Department of Policy and Planning				
Contracted Agencies	Fujita Planning Co., Ltd. , OGAWA SEIKI CO., LTD				

II. Result of the Evaluation

1 Relevance
<p><Consistency with Development Policy of Zambian Government at the time of ex-ante evaluation and ex-post evaluation></p> <p>This project was consistent with Zambia's development policy of "improvement of medical equipment and facilities and enhancement of training capacity for health care workers in Zambia" as set forth in the policy documents including the National Health Strategic Plan (NHSP) (2006-2010) and NHSP (2011-2015).</p> <p><Consistency with Development Needs of at the time of ex-ante evaluation and ex-post evaluation></p> <p>This project met the development needs of Zambia to improvement of medical equipment as well as strengthening O&M capacity for medical equipment in UTH in order to secure the provision of quality health and medical services.</p> <p><Consistency with Japan's ODA Policy for Zambia at the time of ex-ante evaluation></p> <p>The project was consistent with Japan's Country Assistance Plan for Zambia (established in 2002) to prioritize the improvement of cost-effective health and medical services as one of the priority areas.</p> <p><Evaluation Results></p> <p>In the light of above, the relevance of this project is high.</p>
2 Effectiveness/Impact
<p><Effectiveness></p> <p>The project has partially achieved its objectives, "to improve the quality of health services delivered by UTH, and also to enhance the capacity of UTH in providing pre-service and in-service training of health care professional". The number of operations increased from</p>

15,445/year in 2007 to 19,984/year in 2014, which indicates 29% of increase in pre and post project implementation. The major types of operation are general surgery¹ (approximately 63%) and caesarian section (approx.18%). The number of delivery also increased from 13,414/year in 2007 to 21,995/year in 2014, which shows 64% of increase in pre and post project implementation. Regarding the average length of stay in the Intensive Care Unit (ICU), its actual data after project completion was not available at UTH, therefore, the degree of achievement of this indicator could not be verified.

It was confirmed that the quality of health services delivered by UTH has been improved. The equipment provided by the project has made it possible for certain complex operations to be done, e.g. open heart surgery for both adult and children. It has also allowed for better patient monitoring particularly in the labour ward by utilizing cardiac monitor. The waiting list in the main operating theatre has also been reduced. According to the interview with the patients, they appreciated the quality of the services. The patients after the operation at the emergency theatre commented that waiting time might be improved because the availability of the equipment made them possible to attend more patients promptly.

The training capacity in UTH is also strengthened. The new training programs have been introduced such as postgraduate degree in anaesthesiology and radiology due to the availability of the equipment. The practical training of the postgraduate in surgery has also been improved. In the ICU, the equipment is enhancing the training for the nursing specialties such as critical care nurses, theatre nurses and paediatric nurses. The clinical officer anaesthetist program also conducts practicals at UTH, though the theory is at Chainama Hills College. The Neonatal Intensive Care Unit (NICU) nursing is planned to start in 2016.

The above achievement were supported by other factors such as (i) increase of population in Lusaka and in Zambia have, (ii) rehabilitation of UTH such as a complete overhaul of main and the emergency operation theatres by the Government of Zambia, (iii) capacity development of medical staff in the operation theatres by specialists dispatched by the international organization. These external factors are supposed to have led to a better medical service and working environment and to raise working motivations of staff at UTH.

On the other hand, it was confirmed that approximately 73% of equipment provided by the project were utilized at the time of ex-post evaluation. The rest of 27% of equipment such as ventilators, anaesthetic machines, delivery beds, patient monitors and infant incubators were not utilized due to lack of spare parts, accessories and consumables, and some of the equipment were not meeting to specification of UTH and in some cases, the users did not know how to use the equipment. The health staff reported that they stopped using infant incubators due to the shortage of the human resources to properly use them according to the infection prevention procedure.

<Impacts>

The project has limited positive impact on decrease in death case of new born babies at UTH. As shown in the table right, the number of death case for new born babies as well as the fatality rate of new born babies (death per delivery) in UTH has been moderately increasing after the project completion in 2011. According to UTH, the above result may be due to increased resistance of infection to most available antibiotics. However, it is evident the project was not able to contribute to decrease of number of new born babies in UTH directly. It was found that all infant incubators provided by the project have not been utilized.

While, the number of death case for pregnant and parturient women as well as the fatality rate of pregnant and parturient women (death per delivery) in UTH has slightly decreased. This reduction can be partially attributed to medical equipment procured by the project, but there are other factors such as technical capacity of medical staff, health management during pregnancy by women, etc. contributing to this. It was difficult to verify the project impact on death case of children in UTH due to non-availability of data.

No negative impact was observed and no land acquisition and resettlement of people was associated with the project.

<Evaluation Result>

As the project objective was partially achieved since the achievement of one out of three quantitative indicators could not be verified and the 27% of equipment provided in this project were not in use, and the project has a limited positive impact, the effectiveness/impact of this project is fair.

Quantitative Effects

Indicator	(before the project) Year 2007 Actual	(target year) Year 2014 Planned	Year 2011 Actual	Year 2012 Actual	Year 2013 Actual	Year 2014 Actual	(ex-post evaluation) Year 2015 Actual
Indicator 1 Average length of stay in ICU (days)	50	Reduce	N.A.	N.A.	N.A.	N.A.	N.A.
Indicator 2 Number of operations (number/year)	15,445	Increase	18,710	18,242	19,067	19,984	9,714 (up to June)
Indicator 3 Number of deliveries (number/year)	13,414	Increase	18,682	17,768	20,992	21,995	10,860 (up to June)

Sources: The Preparatory Survey Report and response to the questioner by Ministry of Health.

¹ General surgery consists of all non-specialty cases, of which the most common are appendectomy, hernia repair, debridement and suturing of lacerations, incision and drainage and simple excision of lumps and tumors.

Death case at UTH

	2010	2011	2012	2013	2014	2015 Up to Jun
1. New born babies						
a) No. of death	1,102	1,045	1,194	1,423	1,360	710
b) Fatality rate (death per delivery)	6.3%	5.6%	6.7%	6.8%	6.2%	6.5%
2. Pregnant and parturient women						
a) No. of death	203	165	148	149	138	56
b) Fatality rate (death per delivery)	1.16%	0.88%	0.83%	0.71%	0.62%	0.52%

Note: The number of death case of children in UTH was not available.

3 Efficiency
Both the project cost and project implementation period were within the plan (84% and 92% respectively), the efficiency of this project is high.
4 Sustainability
<p data-bbox="33 215 1559 248"><Institutional Aspect></p> <p data-bbox="33 248 1559 573">The Biomedical Engineering Department (BME) of UTH is in charge of the maintenance and management of the medical equipment of the project. There is a shortage of staff in the BME department as only three engineers out of required 12 engineers are available at BME at ex-post evaluation due to limited budget. This caused some difficulties such as long waiting time for the equipment to be repaired, lack of quality of daily maintenance services for the user departments and non-implementation of 5S². In order to mitigate the shortage of manpower in the BME department, the human resources department proposed to recruit new staff the BME department as a part of the on-going restructuring of UTH. Currently, the part time staff of electricians and students help BME department for the simple maintenance works. Similarly, there is a shortage of manpower of medical staff at UTH including medical doctors, clinical officers, nurse, midwife, and paramedical staff and there is an average of 20% of vacant position against required number of positions. UTH reported that this has created some issues such as long waiting lists in the operating theatres, lack of proper utilization of project documents like hand over checklist, non-functional committee like 5S committee and decreased quality of services.</p> <p data-bbox="33 595 1559 629"><Technical Aspect></p> <p data-bbox="33 629 1559 920">The staff of BME department are graduates of technical institutions specialized in electro and electric techniques. Since BME staff received the maintenance training of the project equipment by the manufacturers during the installation of the equipment, they are able to conduct daily check and maintenance. While, part time staff in the BME department are not formally trained for the medical equipment and sometimes they do not know how to deal with the technical aspects of the equipment. Once the serious failure found, BME have to contact to the manufactures for instruction or to replace the parts. When the BME staff cannot fix the equipment, they have to call outside engineers to repair the equipment with no service contracts in most cases. It requires extra cost since only imaging equipment have the service contract. There are some equipment such as the patient ventilators which are difficult to be repaired by local service providers due to lack of expertise. In addition, as mentioned earlier, the shortage of BME manpower has affected the implementation of daily check, utilization of some operation and maintenance (O&M) documents and 5S rules.</p> <p data-bbox="33 920 1559 1111">On the other hand, although the soft component of the project included the training for the users such as medical staff of UTH to conduct daily checks of the equipment, the users such as medical doctors, nurse and paramedical staff do not conduct daily checks and maintenance. The medial staff in most cases just reported the malfunctioning equipment to the BME without attempting to troubleshoot the equipment for problems. BME rounds the departments to check the equipment only weekly according with the schedule due to the shortage of manpower. The BME department was utilizing the documents for their daily activities. However, most of user departments only kept inventory lists of the equipment. Some of the constraints in utilization include lack of time and lack of understanding of the documents.</p> <p data-bbox="33 1133 1559 1167"><Financial Aspect></p> <p data-bbox="33 1167 1559 1368">Although some funds have been secured and there is a steady increase in the O&M budget, the current O&M budgets were still insufficient due to limitation in resources from the National Treasury. For example, UTH received about Zambian Kwacha (ZMW) 430,000 for O&M budget in 2014 but it was still below the required budget of ZMW 728,300. The shortage of the budget delays the purchase of necessary parts and consumables. As a result, the several broken equipment such as patient monitors, ventilators, anaesthetic machines and delivery beds, were left at BME department waiting for maintenance and spare parts. Although they manage to handle the patients using the available resources, it affects the service delivery and quality in UTH.</p> <p data-bbox="33 1391 1559 1424"><Current Status of Operation and Maintenance></p> <p data-bbox="33 1424 1559 1626">The BME rounds for the inspections at least twice a week in all the departments, and daily in labour ward and delivery room. Repair works include servicing of suction machine, repairing the ventilators, and any other work requested by the user departments. As the new government procedures require long process and purchases of spares and consumables cannot be made directly to the manufacturer, but through a local agent. This has led to delayed deliveries and high cost of spares and consumables. In addition, it was found that some equipment such as patient monitors, anaesthetic machines, ventilators and delivery beds are not meeting Zambian context and not meeting the specification submitted by UTH.</p> <p data-bbox="33 1648 1559 1682"><Evaluation Results></p> <p data-bbox="33 1682 1559 1749">Therefore, there are some problems in the institutional, technical, financial aspects as well as current status of operation and maintenance, the sustainability of this project effect is low.</p>
5 Summary of the Evaluation
<p data-bbox="33 1783 1559 2040">The project has partially achieved its objectives, “to improve the quality of health services delivered by UTH, and also to enhance the capacity of UTH in providing pre-service and in-service training of health care professional”. The number of operations increased by 29% and the number of delivery also increased by 64% in pre and post project implementation. However, the reduction in average length of stay in the ICU could not be verified due to non-availability of data. The training capacity in UTH is strengthened. These above achievement were supported by the other factors. On the other hand, it was confirmed that 27% of equipment were not utilized due to lack of spare parts, accessories and consumables because some of the equipment were not meeting to specification of UTH and in some cases, the users did not know how to use the equipment. The project has limited positive impact on decrease in death case of pregnant and parturient women at UTH. Therefore, effectiveness/impact of this project is fair.</p> <p data-bbox="33 2040 1559 2065">As for sustainability, there are problems in terms of institutional, technical, financial aspects as well as current status of operation and</p>

² 5S is the principles of work environment improvement derived from the Japanese words Seiri (Sort), Seiton (Set), Seiso (Shine), Seiketsu (Standardize) and Shitsuke (Sustain) as a means to achieve the goals.

maintenance due to shortage of O&M staff, O&M budget, technical capacity of local O&M service providers, and difficulties in procurement of accessories and spare parts of the equipment.

In light of the above, this project is evaluated to be partially satisfactory.

III. Recommendations & Lessons Learned

Recommendation for Department of the Implementing Agency (UTH)

(1) Training

- For the non-utilized equipment like the defibrillators and infant incubators, UTH should conduct user training or orientation in order for them to properly utilize the equipment.
- UTH should ensure that all users of the equipment attend such trainings or orientation. Internal communication linkages within UTH should also be strengthened to ensure that all relevant departments are aware when such trainings are being offered.

(2) Procurement of equipment spare parts and consumables.

- UTH with assistance from the Ministry of Health should put in place a consistent system that expedites the procurement of equipment spares and consumables so that equipment like suction machine, infusion pumps, infant resuscitation machine, vacuum extractor, operating tables, laryngoscope, bilirubinometer, cardiotocograph, table top autoclave and ICU beds will be continuously maintained, repaired and utilized.

(3) Manpower of O&M

- UTH, with the help of the Ministry of Health should have the adequate number of engineers in the BME department in order to provide sufficient monitoring and maintenance of the equipment.

(4) Finance of O&M

- In addition, the Ministry of Health should disburse sufficient funds for operation and maintenance of medical equipment at UTH.

(5) 5S

- 5S concepts and implementation need to be reactivated. 5S rules should be put on notice boards to serve as a constant reminder of how to keep equipment in a proper manner. Various departments should also pick 1 day in a month to conduct 5S activities.

Lessons learned for JICA:

(1) Appropriate specification of equipment

- The specifications for some equipment such as the ventilators, anaesthetic machines, delivery beds and patient monitors are not suitable for Zambian context. For example, regarding ventilator, anaesthetic machine, there were no agency to be able to repair in Zambia and spare parts are not available within the affordable costs. The size of delivery bed is different between Japan and Zambia, and there was no back up battery for patient monitor although the equipment was designed to have back up battery. As the result, they have been non-functional and not being utilized. Therefore, when making the specifications for the equipment during the planning stage, JICA together with the implementing agency should consult widely with the user departments to ensure that the equipment provided in the project are useable and fit in the local context including local environmental condition and condition of electricity supply, etc.
- If there are some equipment, of which accessories and spare parts are difficult to be procured in the partner country, JICA should consider to provide the relevant quantity of accessories and spare parts of such equipment good enough to sustain their product life.

(2) Indicators for effectiveness

- Since the status of utilization and operation of medical equipment directly affect realization of project effects, it is recommended that JICA should consider to add the annual operation ratio for major medical equipment as an operational indicator of the project, whenever possible.



Phototherapy machine helping new born baby



Mobile X-ray at ICU



Infant Incubators unutilized