

FY2017 Ex-Post Evaluation of Japanese Grant Aid Project

“The Project for Improvement of Medical Equipment in Hospitals in Yangon and Mandalay”

External Evaluator: Ryoto Uchida, Kaihatsu Management Consulting, Inc.

0. Summary

This project was implemented for the objective to achieve expansion and quality enhancement in the medical services at the five top-referral (tertiary) medical facilities in the Mandalay and Yangon by improving the medical equipment at the facilities, thereby contributing to improvement of the referral function.

The relevance is high. The implementation of this project is consistent with the development policy in the health sector of Myanmar focusing on the quality enhancement of hospital medical services, the development needs to enhance the medical services and efficiency by improving the medical equipment, and Japan’s ODA policy prioritizing the aid to improve the people’s life swiftly by improvement in the health and medical services, in the condition where risky operations were performed with the decrepit medical equipment while the nurses were insufficient.

The efficiency is high. Both the project cost and the project period are within the plan. The procurement and the installation of the medical equipment were all completed as planned.

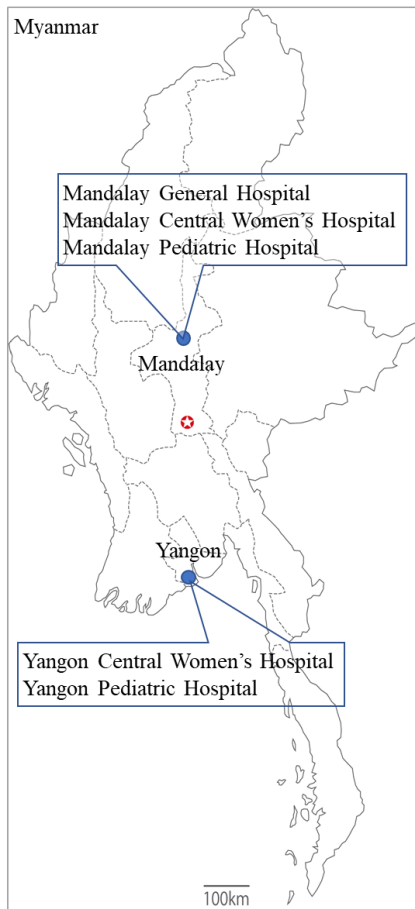
The actual values and the increase ratios exceeded the targets for all the target hospitals on all the operation indicators, such as the number of operations, the number of diagnostic examinations and the number of treated patients (except for the indicators on which the target and actual values cannot be compared). In particular, a variety of the diagnostic instruments and endoscopic surgical instruments contributed to accurate diagnosis and reduction of surgical risk, while the automatic monitoring / nursing equipment enabled acceptance of more patients in ICU and SBCU. The avoidance of patient transfer between the tertiary hospitals and the life-saving of super-premature babies are recognized as the examples at the individual target hospitals to demonstrate “improvement in the referral system” that were not available before but are available now. The emergence of these effects was brought as planned by implementation of the project. Therefore, effectiveness and impacts of the project are high.

Even though there is no major problem with the operation, there exist serious problems with the maintenance of equipment procured by the project. This is due to inadequate organization, the shortage of biomedical engineers¹ (hereinafter referred to as “BMEs”) and the insufficient development capacity to improve the organization. In the current maintenance status, it is worrying that the procured equipment may become unusable earlier than the expected life for use, if the status is not improved. Major problems have been observed in terms of the organizational aspect and current status regarding maintenance for this project. Therefore, sustainability of the project effects is low.

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

¹ A scientific field combining medicine and engineering to apply engineering to medicine, or an engineer specialized in this field

1. Project Description



Project Location Map



Mandalay General Hospital



Procured CT Scanner in the above hospital

1.1. Background

At the planning time of this project, the health and medical sector in Myanmar was in the tight budgetary condition that sufficient budgetary actions were not taken, although the government was working on quality enhancement of the hospital care services and increase of the hospital beds among others. In this country, the top-referral hospitals in Mandalay and Yangon played an important medical-service role in taking care of the serious patients who could not be treated in other hospitals. However, medical equipment at these hospitals was insufficient or decrepit causing frequent failures those days, so that enhancement of the medical services by improving equipment was an urgent issue. In addition, it was also necessary to strengthen the maintenance system in order to use the medical equipment safely for a long time.

Considering this situation, this project was implemented from 2013 in response to a request from the government, so as to improve the medical equipment and provide technical guidance for the maintenance capacity development. Five target hospitals were selected by priority from among the top-referral hospitals in Mandalay and Yangon. These are Mandalay General Hospital (hereinafter referred to as "MGH"), Mandalay Central Women's Hospital (hereinafter referred to as "MWH"), Mandalay Pediatric Hospital (hereinafter referred to as "MPH"), Yangon Central Women's Hospital (hereinafter referred to as "YWH"), and Yangon Pediatric Hospital (hereinafter referred to as "YPH").

1.2. Project Outline

The objective of this project is to achieve expansion and quality enhancement in medical services at the five top-referral (tertiary) medical facilities in Mandalay and Yangon by improving medical equipment at the facilities, thereby contributing to improvement of the referral function.

G/A Grant Limit / Actual Grant Amount	1,140 million yen / 1,061 million yen
Exchange of Notes Date / Grant Agreement Date	March 2013 / March 2013
Executing Agency	Ministry of Health and Sports
Project Completion	November 2014
Main Contractor	Mitsubishi Corporation
Main Consultant	International Total Engineering Corporation (ITEC)
Basic Design	June 2012 - March 2013
Related Projects	Technical Cooperation: The Project for Human Resource Development of Medical Engineering (2018 - 2023) Senior Overseas Volunteers: Medical Equipment (2016) Japan Overseas Cooperation Volunteers: Medical Equipment (2017-2018)

2. Outline of the Evaluation Study

2.1. External Evaluator

Ryoto Uchida (Kaihatsu Management Consulting, Inc.)

2.2. Duration of Evaluation Study

This ex-post evaluation study was conducted in the following schedule.

Duration of the Study: August 2017 – November 2018

Duration of the Field Study: December 2 – 14, 2017 and March 12 – 16, 2018

3. Results of the Evaluation (Overall Rating: B²)

3.1. Relevance (Rating: ③³)

3.1.1. Consistency with the Development Plan of Myanmar

The objective of this project is consistent with the country's long-term development policy at both time of the planning and the ex-post evaluation, since the quality enhancement of health and medical services is determined to be a goal by both Myanmar's long-term health development plans known as *Myanmar Health Vision 2030* at the planning and *National Comprehensive Development Plan 2011-2031 (Health Sector)* at the ex-post evaluation. Furthermore, both of the *National Health Plan 2006-2011* and the *National Health Plan 2017-2021*, which are the five-

² A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

³ ③: High, ②: Fair, ①: Low

year health development plans at the respective time points, determine the quality enhancement of hospital medical services to be a priority. Therefore, the objective of this project to achieve expansion and quality enhancement of medical services at the top-referral hospitals by improving the medical equipment is consistent with the development policy in this country at the time of the planning and the ex-post evaluation.

3.1.2. Consistency with the Development Needs of Myanmar

The 5 target hospitals, selected at the planning time as described in "1.1 Background", still continue playing an important role in medical services of Myanmar as the top-referral hospital in the two largest cities at the ex-post evaluation time.

At the planning time, the target hospitals needed the immediate measures due to their insufficient or decrepit medical equipment, as they had serious problems to be described hereinafter. First, the surgery was being performed with high risk because the diagnostic instruments using X rays and ultrasound and the endoscopic instruments were insufficient or decrepit. Therefore, it was necessary to update these instruments to enhance the safety of surgery. Next, due to the shortage of nurses, patients could not be accepted adequately, especially in ICU and SBCU. Therefore, it was necessary to improve efficiency with the introduction or increase of automatic monitoring / nursing instruments. Thus, the demand and urgency for improvement of equipment to enhance the medical services and efficiency were high at the target hospitals.

The automatic monitoring / nursing instruments, procured to meet the aforementioned demand, are utilized 365 days a year with no spare instruments at ICU and SBCU. In order to cope with the increase in hospital beds since the planning time and conduct their timely inspection, more instruments are still needed at the ex-post evaluation time. In addition, the automatic ventilators for infants and protectors for a mobile X-ray machine are also needed among others because of their frequent use. Therefore, the improvement of medical equipment is a continuous need even at the ex-post evaluation time.

As mentioned above, the objective of this project is consistent with the development needs of the country at both time of the planning and the ex-post evaluation.

3.1.3. Consistency with Japan's ODA Policy

At the planning time, Japan's ODA policy *Economic Cooperation Policy with Myanmar (April 2012)* identified the improvement in health and medical services to be a specific measure in a priority sector of the aid to improve people's lives. This was to achieve the objective of promoting reform efforts towards democratization, national reconciliation, and sustainable development. This project is consistent with this ODA policy of Japan.

This project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2. Efficiency (Rating: ③)

3.2.1. Project Outputs

The outputs in terms of the equipment procurement and the soft component were as planned on the whole, as shown below. The changes in the outputs were inevitable, but their influences were minor.

<Target top-referral hospitals>

3 hospitals in Mandalay: MGH, MWH, MPH

2 hospitals in Yangon: YWH, YPH

<Equipment Procurement>

The procured equipment consists of 120 items in total, mainly including X-ray diagnostic machines, ultrasound diagnostic machines, CT scanners, patient monitoring instruments, ventilators, autoclaves, operation tables, and centrifuges. Its summary is shown in the table below, although the units of equipment installed vary according to the functions of the hospitals.

Unit of equipment installation	Main equipment
Radiology / Emergency & Outpatients	X-ray diagnostic machines, ultrasound diagnostic machines, CT scanners
ICU / SBCU	patient monitoring instruments, ventilators, autoclaves
Operation Room	operation tables, mobile X-ray machines, autoclaves
Blood Bank / Laboratory	centrifuges

< Reduction in the equipment>

2 pH meters were unavoidably cut down due to weakened JPY.

<Change in the equipment item>









A spectrophotometer was replaced with an automatic chemical analyzer. It was due to the model no longer manufactured and for better operation.

The impact of these changes was minor because MWH, where these instruments were to be installed, accepted the changes for the unavoidable reasons.

<Soft Component>

In the soft component of this project, the Central Medical Store Depot (hereinafter referred to as "CMSD") was instructed to properly supervise and guide the target hospitals on the maintenance of medical equipment. In addition, it was instructed to produce various standard forms and give notice and notification to the hospitals with them.

The target hospitals were instructed to appoint the responsible person for maintenance and share the common forms, and properly conduct daily maintenance work. In addition, they were instructed to share common inventory forms and develop the annual plan to procure consumables and replacement parts on their own.

Planning time	Ex-post evaluation time
 <p>Ultrasound diagnostic machine at MWH</p>	 <p>Ultrasound diagnostic machine in MPH Radiology Unit</p>
 <p>Fixed type of X-ray diagnostic machine at YPH</p>	 <p>Mobile X-ray diagnostic machine installed in MGH Operation Room</p>
 <p>SBCU at MPH</p>	 <p>SBCU at MWH (with automatic monitoring / nursing instruments)</p>
 <p>Endoscopes in the storage shelf at MGH (all decrepit and unusable)</p>	 <p>A set of Endoscopic components installed in MGH Uro Surgery Unit</p>

Source: Preparation Survey Report of this project (February 2013) for the photos at the planning time
The photos at the ex-post evaluation time were taken by the external evaluator in December 2017.

3.2.2. Project Inputs

3.2.2.1. Project Cost

The planned project cost was 1,140 million yen on the Japanese side and 161 million kyats (about 15 million yen) on the Myanmar side, totaling 1,155 million yen. The actual cost on the Japanese side was 1,061 million yen. All that could be confirmed about the resulted cost on the Myanmar side was only 10.2 million kyats (about 1.1 million yen) which was banking fees disbursed by the Department of Medical Services (hereinafter referred to as "DoMS"). The renovation and construction costs spent by the hospitals to install the procured equipment were disbursed out of the general budget allocated to each hospital, so that the amount could not be identified. The planned and actual costs were only compared for project costs on the Japan side, because the project cost on the Myanmar side is less than 2% of the total cost even in the plan. As a result, the actual project cost was 1,061 million yen and maintained within the plan (92% of the plan).

The actual cost on the Japanese side was less than planned due to the tendering result. No efficiency problem occurred as necessary construction by the hospitals to install and operate the procurement equipment was completed in a timely manner.

3.2.2.2. Project Period

The actual project period was the same as the planned period of 21 months, from March 2013 to November 2014 (100% of the plan). The actual period to implement the soft component was 12 months which was also the same as planned.

Both the project cost and project period were within the plan. Therefore, efficiency of the project is high.

3.3. Effectiveness and Impacts⁴ (Rating: ③)

3.3.1. Effectiveness

3.3.1.1. Quantitative Effects

[Operation Indicators]

As shown in the following tables, the actual values and increase ratios exceeded the targets on all the operation indicators for all the target hospitals (except for the indicators with + or * on which the target and actual values cannot be compared).

⁴ Sub-rating for Effectiveness is to be put with consideration of Impacts.

(1) MGH

Table 1 Operation Indicators for MGH

	Baseline	Target	Increase	Actual			Increase
	2011	2017		2014	2015	2016	
		3 Years After Completion		Completion Year	1 Year After Completion	2 Years After Completion	
# of Operations	11,631	12,266	5%	19,682	19,263	21,392	84%
# of Ultrasound exams	11,751	12,565	7%	21,269	23,038	28,295	141%
# of X-ray exams	41,422	45,742	10%	59,567	73,522	78,199	89%
# of Clinical exams	123,430	140,869	14%	196,766	231,530	280,184	127%
# of ICU patients ⁺	434	N.A.	N.A.	560	880	931	115%
# of CT exams	3,081	7,200	134%	2,259	4,935	9,128	196%

Source: JICA Preparation Survey Report for Baseline and Target values, the response of each target hospital for Actual values (However, when a difference was found in the ex-post evaluation survey, the values obtained at the planned time and at the time of evaluation are put in the upper row and in the lower row respectively). Exceptions are added to each table if any. (Common between Table 1 - Table 5)

Notes: Comparison is made between 2016 Actual and 2017 Target values because the 2017 Actual values have not been counted at the hearing time.

+: The indicator which was not listed at the planning time but added and heard at the ex-post evaluation time. Therefore, the Target and Increase values at the planning time are not available.

*: The Actual values only for the procured instrument in this project were available at the ex-post evaluation time. Therefore, they cannot be compared with the Target value which was for the total instruments.

N.A.: Not Available at the ex-post evaluation time for the reasons described in the above notes

#: abbreviation for “number”, exams: abbreviation for “examinations”

(Common between Table 1 - Table 5)

(2) MWH

Table 2 Operation Indicators for MWH

	Baseline	Target	Increase	Actual			Increase
	2011	2017		2014	2015	2016	
		3 Years After Completion		Completion Year	1 Year After Completion	2 Years After Completion	
# of Operations	4,298	4,552	6%	4,579	5,271	6,189	44%
# of Ultrasound exams	4,836 7,099	9,316	93%	9,937	13,490	18,361	159%
# of X-ray exams* ⁵	1,307 0	1,767	35%	9	43	56	N.A.
# of Clinical exams	9,988 15,374	12,283	23%	21,350	31,097	37,515	144%
# of SBCU patients	1,678 1,714	2,185	30%	1,917	2,397	2,412	41%
# of Deliveries	5,750	5,840	2%	6,917	7,853	9,278	61%

Note: The baseline values in the Preparation Survey Report differed a lot from the 2011 values given by the hospital at the ex-post evaluation time. As the hospital confirmed that the latter was correct, it was used for the Actual Increase.

⁵ The Baseline and Target values are # of the exams with regular fixed-type x-ray diagnostic machines, while the Actual values are only with the mobile machine (the arm style used during an operation) introduced by this project for the first time. It is also true for MPH. The indicator selected at the planning time was not appropriate since the uses differ.

(3) MPH

Table 3 Operation Indicators for MPH

	Baseline	Target	Increase	Actual			Increase
	2012	2017		2014	2015	2016	
		3 Years After Completion		Completion Year	1 Year After Completion	2 Years After Completion	
# of Operations	2,171	2,153	-1%	3,830	3,850	4,024	85%
# of Ultrasound exams*	N.A.	1,537	N.A.	635	4,746	4,584	N.A.
# of X-ray exams* ⁵	1,841 0	4,262	132%	14	232	285	N.A.
# of Clinical exams	17,810	24,081	35%	33,515	58,172	56,343	216%
# of SBCU patients+ ⁶	933	N.A.	132% ⁶	1,792	2,061	2,213	137%

Note: As MPH opened in August 2011, the Baseline values are set to be the 2012 values given by the hospital at the ex-post evaluation time.

(4) YWH

Table 4 Operation Indicators for YWH

	Baseline	Target	Increase	Actual			Increase
	2011	2017		2014	2015	2016	
		3 Years After Completion		Completion Year	1 Year After Completion	2 Years After Completion	
# of Operations	9,559 11,631	9,787	2%	14,535	18,185	20,548	77%
# of Ultrasound exams	7,495 11,751	7,733	3%	19,971	20,916	19,026	62%
# of Clinical exams ⁷	165,124 123,430	169,017	2%	105,233	143,527	150,626	22%
# of SBCU patients+	N.A. 1,103	N.A.	N.A.	1,746	2,381	3,077	179%

Note: The baseline values in the Preparation Survey Report differed much from the 2011 values given by the hospital at the ex-post evaluation time. As the hospital confirmed that the latter was correct due to the information system introduced, it was used for the Actual Increase.

(5) YPH

Table 5 Operation Indicators for YPH

	Baseline	Target	Increase	Actual			Increase
	2011	2017		2014	2015	2016	
		3 Years After Completion		Completion Year	1 Year After Completion	2 Years After Completion	
# of Operations	4,089	4,734	16%	3,678	5,844	7,936	94%
# of Ultrasound exams	5,177	5,993	16%	4,818	6,751	8,207	59%
# of X-ray exams	11,312	13,095	16%	10,519	14,876	19,130	69%

The transition data of the total number owned by the hospital, and the annual number / days of the operations, and the number procured by this project were also collected from each hospital for each of main procured instruments at the time of ex-post evaluation. As a result of the analysis,

⁶ The amount of equipment procured by JICA and number of patients are much more in SBCU than in ICU, so the indicator was switched to the number of SBCU patients. However, the target increase ratio is the value for the number of ICU patients at the planning time.

⁷ Although the actual value has not reached the target value due to the note below the table, the increase ratio is much higher than the target (about 11 times).

the number of operations increased after the completion of this project on the whole. The automatic nursing instruments were used 365 days a year without a break. This result also confirmed that the operation effect was high.

3.3.1.2. Qualitative Effects (Other Effects)

It was found in the interviews of the medical staff in the target hospitals at the time of ex-post evaluation that more accurate diagnosis and reduction of surgical risks (avoidance of unnecessary operations and laparotomy) have been achieved due to utilization of the various types of the diagnostic machines and the endoscopic operation instruments. This shows the emergence of the qualitative effect "More accurate diagnosis and more appropriate treatment will be performed." expected at the planning time.

In addition, the introduction or increase in the automatic monitoring and nursing equipment brought by this project, such as monitoring instruments, ventilators, incubators, injection / infusion pumps among others, enabled acceptance of more patients in ICU and SBCU above all, although the number of nurses is still much lower than the approved cadre at each hospital. For example, the ICU patients at MGH and the SBCU patients at MWH, MPH, YWH increased by 115%, 41%, 137%, 101% respectively as ratios to the baseline values for 4 years from the baseline year to 2016. Furthermore, avoidance of laparotomy by the above-mentioned endoscopic operations brought about a reduction in the hospitalization period, allowing more patients to be accepted. These show the qualitative effect of "Expansion and quality enhancement of the medical services by improving the operational efficiency" expected at the planning time.

3.3.2. Impacts

3.3.2.1. Intended Impacts

The impact expected from this project was "Improvement of the referral function". However, the referral system in Myanmar is not to divide patients between different levels of medical facilities, because a patient does not need the reference letter issued at a lower-level medical facility in order to receive medical treatment at a top-referral hospital⁸. Rather, it is to identify the upper-level hospital with which a lower-level medical facility can entrust patients when the treatment beyond its capacity is necessary. Therefore, information such as the number of the referred patients accepted was not available at the target hospitals.

Taking into account the referral system in this country, the expected impact from this project is regarded as reinforcement of the capacity of the upper-level hospitals who should accept the patients when a lower-level medical facility needs the treatment beyond its capacity. This impact has been achieved as described in 3.3.1.2 Qualitative Effects.

In addition, the ex-post evaluation found that some medical functions that had previously been unavailable were made possible at the target hospitals by the implementation of this project, as described below. These examples demonstrate how the capacity of the target hospitals has been

⁸ This point is an issue about what the referral system in this country should be.

reinforced to accept patients.

[Avoidance of transfer between tertiary hospitals]

- In MGH, some transplant surgery has become available in its own hospital. Previously, these patients were transferred the far away to a tertiary hospital in Yangon.
- In MWH, blood component transfusion has become available in its own hospital, because the introduction of a centrifuge made it possible to separate each component of transfused blood. Previously, the patients were transferred to MGH.

[Medical functions newly available]

- Saving lives of super-premature babies: Ventilators for neonates made it possible to save some super-premature babies (0.75 kg or less) that was not possible before. In MWH, the survival rate of neonates weighing less than 1 kg was 0% in 2011 but increased to 44.6% in 2016.
- Swift response to emergency patients: With the CT scanner installed at the emergency room center in MGH, it has become possible to swiftly diagnose the emergency patients who require quick treatment. Previously, the emergency diagnosis with a CT scanner was not available, because Radiology Unit had the only one which was fully booked.
- Prevention of cervical cancer: With the laparoscopic operation now available, YWH has become also able to prevent cervical cancer for female patients, in addition to reducing the risk for the patients by avoiding laparotomy surgery.

3.3.2.2. Other Positive and Negative Impacts

- (1) Impact on the natural environment: IEE / EIA was unnecessary.
- (2) Resident relocation or land acquisition: did not occur.
- (3) Other impacts:

Medical treatment is basically free of charge in Myanmar. Therefore, the poor can also visit a top-referral hospital. Although medical treatment with high-cost medical equipment such as CT scanner is charged, the hospitals reduce the payment burden for those who find it difficult to pay by introducing donors to them. Thus this country has the system in which all the people can take examinations and/or operations with the procured equipment in this project. Therefore, the procured equipment is useful in improving the medical care for the poor as well.

In addition, this project improved the medical services for pregnant women and premature babies because the equipment was mainly procured for the hospitals for women and/or children. One of the remarkable examples is saving lives of super-premature babies in MWH with introduction of ventilators for neonates, as described above. In the same hospital, the beneficiaries are also increasing as the number of hospitalized neonates increased from 1,669 in 2013 to 2,789 in 2016. The humanitarian contributions are also confirmed because the neonatal mortality rate decreased from 10.5% to 6.6% for the same period.

Thus, the impacts brought by the implementation of this project include the benefits for the poor and the humanitarian contributions, in addition to the quality enhancement in the medical services, increasing capacity to accept more patients, and medical functions made newly available.

This project has achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4. Sustainability (Rating: ①)

3.4.1. Institutional / Organizational Aspects of Operation and Maintenance

3.4.1.1. DoMS

The executing agency of this project is DoMS, which is managed by 4 Deputy Directors General (hereinafter referred to as "DDG") under supervision of the Director General (hereinafter referred to as "DG"). The DDG in charge of Procurement, Supply & Distribution (hereinafter referred to as "PSD") is responsible for procurement and maintenance of medical equipment. The Procurement Division and the Distribution Division (one director supervising both divisions at present) come under this position of PSD DDG newly established in 2015.

The Organization Diagram is shown by Figure 1 as of March 2018. But DoMS plans the reorganization shown in Figure 2.

The Procurement Division is in charge of the equipment procurement, which is done mainly in Yangon. This division is in charge of the equipment maintenance as well. This division also has the important responsibility for capacity development and allocation of BME. So far there has been no educational course to develop the BME capacity in Myanmar (medical engineer development course started in June 2018, as described in 3.4.4.2). Therefore, BMEs are very short. In the new organization, the BME Division will be newly established to take the responsibility to develop BMEs and allocate them to the local offices and the tertiary hospitals which will be transferred from the Procurement Division.

The Distribution Division is in charge of distributing consumables and medicines. Under its supervision, CMSD in each location carries out the distribution and the inventory management.

CMSD is located in Yangon and has its local offices in Mandalay and Taunggyi. Supervised by the Procurement Division in addition to the Distribution Division, they play the role as a local office to supervise and advise the equipment maintenance in each region. However, they are not playing the role for the maintenance, having few such experts. In the new organization, the local offices of the BME Division, which will be newly established, are to perform this role expected of CMSD.

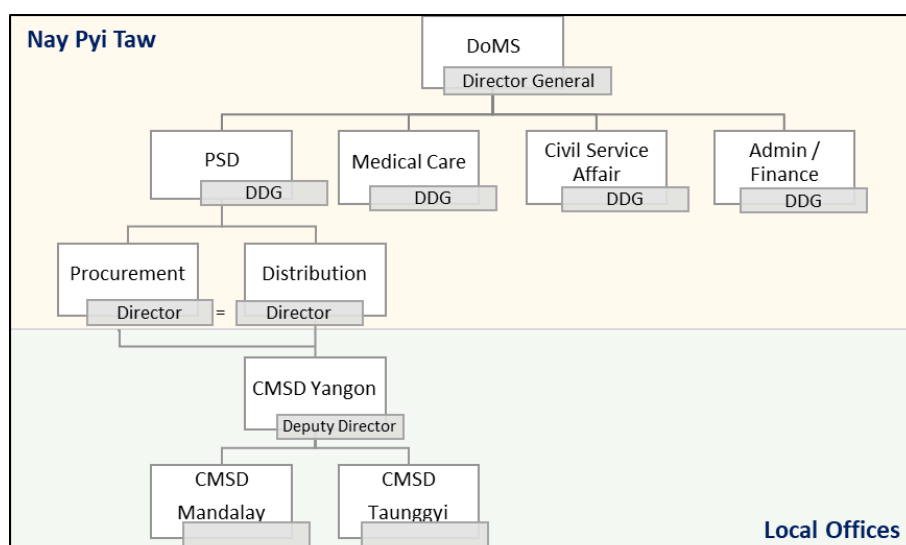


Figure 1 DoMS Organization Diagram (Present)

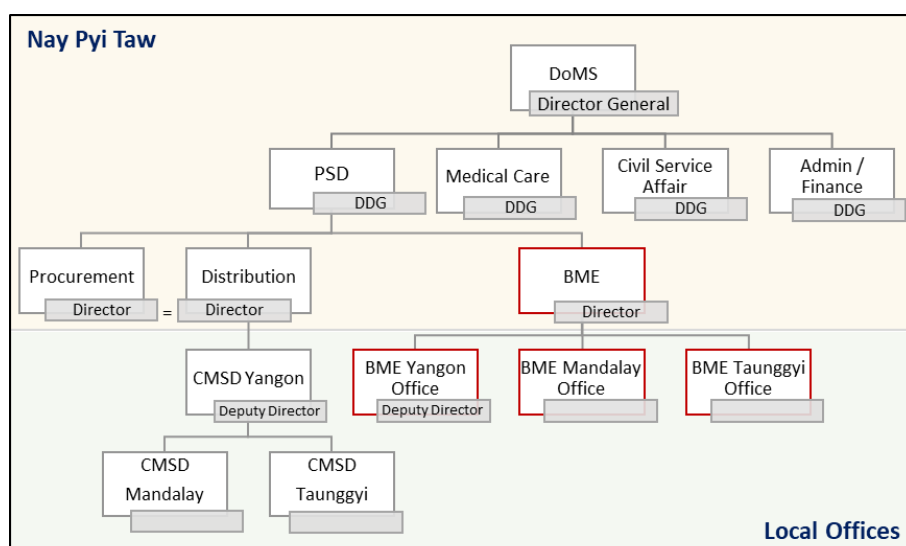


Figure 2 DoMS Organization Diagram (New)

3.4.1.2. Target Hospitals

The responsibility for equipment operation falls on the head of each medical unit under the hospital head. The healthcare workers in each medical unit know well how to use the equipment. There are no particular problems with operation of the procured equipment.

In respect to equipment maintenance, each hospital, except for YWH, has no specific person assigned to control it. Each medical unit individually liaises with the hospital head (Senior Medical Superintendent) for the procedure to apply for the approval of repairs among others. Exceptionally, only YWH has a maintenance supervisor who is the contact point for such approval requests. However, this maintenance supervisor, who has made a practical contribution, has recently moved to the Procurement Division in Nay Pyi Taw (planned to be shifted to the BME Division in the new organization).

As described above, at the time of the ex-post evaluation, no organizational problem was found particularly concerning operation of the procured equipment. However, a number of the problems were found in the organizational aspect of maintenance, such as shortage of BMEs and absence of maintenance supervisors, which are causing the major problems described in 3.4.4.2 Status of Maintenance. DoMS recognizes these problems and is trying to improve them through the organizational changes.

3.4.2. Technical Aspects of Operation and Maintenance

3.4.2.1. Technical Aspects of Operation

For most of the procured equipment, there are no technical problems concerning operation. As an exception case, however, the CO₂ incubator (MPH) and the electrophoresis (hemoglobin) device (YPH) introduced in Laboratory Units have not been used after the transfer of the doctors who worked there at the time of the request for equipment. Although the doctors at the time had the expertise to use these instruments, their successors did not use it because they do not understand the usage.

3.4.2.2. Technical Aspects of Maintenance

The technical problems are as follows, but the fundamental causes lie in the organizational problem and shortage of human resources, as described above (the details described in 3.4.4.2 Status of Maintenance).

- CMSD does not have expertise to give useful advice on repair and procurement of parts and consumables.
- There is no maintenance supervisor in each hospital, while the doctors and the nurses in each medical unit cannot make appropriate judgments or negotiate price of repairs among others. Particularly, 3 hospitals in Mandalay cannot handle even a simple breakdown with the electric system inside the hospital (detailed in 3.4.4.2) despite the far away location from the medical equipment agencies.

For the above-mentioned organizational reasons, the technical aspects of operation and maintenance are not taken into consideration in determining the sustainability evaluation.

3.4.3. Financial Aspects of Operation and Maintenance

3.4.3.1. DoMS

As described in 3.4.3.2, the interviews with the target hospitals confirmed that they are provided with the necessary expenses for operation and maintenance in response to the budget applications to DoMS. Therefore, there seem to be few financial problems with DoMS at the ex-post evaluation time.

In addition, Table 6 shows transition of the expenditure for operation and maintenance in

DoMS. The source is the Preparation Survey Report produced for the actual value in fiscal year⁹ (FY) 2012 and forecast values for FY2014 and FY2015 as of the planning time, which is the expenditure of the whole Ministry of Health at that time. Responded by DoMS at the ex-post evaluation time (March 2018), the actual values between FY2014 and FY2016 are the expenditure amounts in DoMS (Department of Health until FY2015). In addition, since Department of Health was separated into DoMS and Department of Public Health (DoPH) in terms of the expenditure account in FY2016, the DoPH expenditure was excluded (organizationally separated in April 2015).

Table 6 Expenditure for Operation and Maintenance in DoMS

Fiscal Year	Actual	Account coverage	Forecast at planning	Account coverage	Note
2012	90,057	whole Ministry			
2014	229,907	DoMS + DoPH	132,917	whole Ministry	Project Completion in Nov. 2014
2015	193,292	DoMS + DoPH	161,478	whole Ministry	
2016	146,970	DoMS			Separation of DoPH

Unit: million kyats, Source: Preparation Survey Report, Response of DoMS

The actual amounts exceeded the forecast amounts as of the planning time with regard to the operation and maintenance expenses in FY2014 and FY2015¹⁰. This fact also confirms that the necessary budget has been secured. The decrease in the actual amount from FY2015 to FY2016 is due to the fact that DoPH was separated from DoMS, so that the amount did not decrease in real terms¹¹. With regard to the expenditure of operation and maintenance, no concern is therefore seen about securing the future budget currently.

3.4.3.2. Target Hospitals

With regard to finances of the target hospitals, they do not actually generate their own income, since their revenues are all transferred to the Ministry of Health and Sports, even though charges for the CT examinations and the private room hospitalization are collected from patients. However, from the maintenance budget allocated from DoMS, they can disburse up to about 1 million kyats (about 80,000 yen) per case at their own discretion. For maintenance costs exceeding the discretion amount, they need to apply to DoMS. In most cases this has been approved. However, it was pointed out that the process takes a long time. As no hospitals pointed out shortage of budget allocation, the necessary maintenance costs are paid by DoMS.

At the time of the ex-post evaluation, the blood culture system (MGH) and the automatic chemical analyzer (MPH) introduced in the laboratory units were not used because the reagents were too expensive to come by. However, this seems to be a problem concerning the procedure

⁹ A fiscal year starts on April 1 and ends on March 31 for the government organizations in Myanmar until March 2018 (FY2017). However, from October 2018 on, it will start on October 1 and end on September 30.

¹⁰ The exceeded amount is actually more than their simple difference because the actual amount covers only DoMS + DoPH while the forecast amount covers the whole Ministry.

¹¹ Explained by Finance Director in DoMS. According to this director, the decrease from FY2014 to FY2015 is within the annual fluctuation range.

for equipment selection at the time of planning, rather than a financial problem. At the time of the equipment selection, although the hospital accepted the possibility that the reagent could be expensive, DoMS, who has the authority to approve budget, does not seem to have recognized this possibility. Therefore, when the hospital applied to DoMS for the budget to purchase the reagents, the approval was not given because it was too expensive.

Therefore, the financial problems with regard to the operation and maintenance are considered to be relatively small.

3.4.4. Status of Operation and Maintenance

3.4.4.1. Status of Operation

In this project where a wide range of equipment consisting of 276 items of 120 different types was procured, most of the equipment is being used effectively, as described in 3.3.1 Effectiveness. Under these circumstances, the total of four aforementioned instruments, two of which were not used after the transfer of the doctors who requested the instruments (3.4.2.1) and two others were not used due to the non-availability of expensive reagents (3.4.3.2), are counted as the exceptions.

3.4.4.2. Status of Maintenance

In addition to the above-mentioned problems with the organization being not well-established and shortage of human resources (BME), another problem is due to inadequate response from or closing down of medical equipment agencies. The status regarding the Procurement Division, CMSD, the target hospitals, and the agencies is described below.

Procurement Division of DoMS

Although the shortage of BME was already mentioned as an issue with maintenance even at the planning time, the development of BME is still insufficient at the ex-post evaluation time. Although the Procurement Division is planning to allocate BMEs to CMSD and the target hospitals in order to respond to their various problems and improve their situation, it has not been able to do so due to the shortage of human resources.

In addition, although the Procurement Division could approve the budget for maintenance and/or regular inspection contracts for expensive instruments (e.g., CT scanners), it cannot judge the economic efficiency of such an insurance measure due to shortage of experts. BME is thus required for this role too.

However, since there is no educational course to develop BME as described in 3.4.1.1, even the requirements of BME are not clearly defined. Actually, there are few experts even among so-called BMEs in this division. Most of them are young officials with expertise in general engineering, who are merely BME candidates to be developed from now.

While the shortage of BME is a fundamental problem as described, there is also a problem with the ability to train BME. DoMS has conducted two BME trainings (total of 20 days in 2012, 30 days in 2016) so far. It has been giving 1-2 days OJTs to the officials since 2017, dispatching

them taking an opportunity to install procured equipment. But the trainer is not an official in this division but a specific cooperative agency. Furthermore, in June 2018, a one-year ME development course will start at the University of Medical Technology (UMT) in Yangon with JICA's cooperation (Although it has not started yet as of the time of the local survey, it actually started as planned.). To the questions asked about the requirements of BME in Myanmar to be fulfilled in this regard, the reply of this division implied that such requirements were not specified by then. Not limited to this division, some medical administrators and managers actually misunderstood that BME could repair various medical equipment. Therefore, this division does not seem to have sufficient capacity to develop BME on its own in the present state.

In addition, the demand for BME human resources is not confined to the Ministry of Health and Sports (including the related hospitals). PSD DDG stated the concern "Because medical equipment manufacturers and their agencies, also seeking such human resources, hire them with higher compensation, there are already some cases where some trained officials changed their jobs. So, it is also an issue how to keep the BME after the training."

In order for the Procurement Division to have capacity to develop BME, it is necessary to start with specifying the practical requirements of BME in this country and having them acknowledged widely.

CMSD

As described in "Institutional / Organizational Aspects of Operation and Maintenance", being the local office of the Procurement Division, CMSD takes the responsibility as supervisor and adviser on equipment maintenance for the hospitals. But it hardly fulfills this responsibility.

In the maintenance training done in the soft component (described later in 3.4.4.3), CMSD Yangon was instructed to collect and centrally manage the equipment information including maintenance. Although this was essentially expected to work effectively, since the hospitals do not recognize that CMSD takes the responsibility as reception window for consultation on maintenance, they never contacted or consulted CMSD. The function to collect and share the information has not been implemented by the time of ex-post evaluation. In order for CMSD to support the maintenance for the hospitals, it is urgent that the Procurement Division develop BME and allocate the necessary human resources there.

Medical equipment agencies

Although the medical equipment agencies are not directly related to this project, a major problem with maintenance has been caused by them making insufficient responses (such as not visiting, taking a long time to visit) or having closed down unexpectedly. This impact was remarkable in Mandalay, which is far from Yangon where many agencies are located.

Since most of the medical equipment manufacturers have exclusive agency contracts, the other agencies often cannot take requests to repair the equipment or obtain the consumables. Nevertheless, in Yangon, the many cases were found where the target hospitals had such requests taken by another agency with which they keep a good relationship. By contrast, in Mandalay, the

agency problem is far more serious, so that some instruments were found not being used due to this problem.

Target hospitals

At most of the target hospitals, each medical unit individually requests the agent for repair and procurement of consumables. It is due to the background that a maintenance supervisor is not assigned in each hospital (except for YWH). Consequently, the following problems are occurring.

- The maintenance information is not shared. As a result, the hospitals cannot negotiate with the agencies effectively, cannot make a measure against the response problem of agencies, and cannot share the measure with other units even if it was made.
- Although electric engineers in the administrative department may support the procedure for repair or others when necessary, they cannot give an effective measure or advice as maintenance of medical equipment is not their expertise.
- There are cases where repair is not arranged because a unit does not know the application procedure for maintenance.

Although each hospital hopes to have a BME allocated to the maintenance supervisor, BMEs have not been allocated because they are short even in the Procurement Division. As an alternative solution, it could be considered to develop the BME capacity from engineers inside the hospitals and assign them to the maintenance supervisors. But it is not realized due to insufficient development capacity of the Procurement Division. These are the reasons why the maintenance supervisor is not allocated. In another aspect, some hospital managers including the senior superintendents misunderstood that a BME could repair various medical equipment inside the hospital. Thus, the concern that they put too high an expectation on BME was perceived.

Regarding the agency problem above, no practical suggestion for improvement was heard from the hospitals. They just hoped for improvements to be made by the agencies themselves. As a result, some instruments were found unused, either because repairs or parts were not available. Particularly at the hospitals in Mandalay, as one of the countermeasures to the agency problem, it is desirable that the electrical failures among others could be handled inside as much as possible. However, without a maintenance supervisor, it is not judged whether they could be handled inside or not.

Maintenance contracts including those for regular inspections are rarely made with the manufacturer agencies even for expensive equipment such as a CT scanner. As far as it could be confirmed, all the concluded maintenance contracts were for the fixed-type digital X-ray diagnostic machine installed in the YPH radiology unit.

Maintenance management was superior in YWH having a maintenance supervisor assigned, in the following aspects, to the other target hospitals having no supervisor.

- The repairs were inspected before contacting the agency, so that the electrical failures among others were repaired inside the hospital. Therefore, unnecessary communication with the agencies was reduced.
- The maintenance supervisor had a wide and strong network with the agencies which was built

up through his duties. He was therefore able to negotiate substitution for the closed agency with other agencies well. Actually, no comment was heard about a repair not being carried out due to closure of an agency.

3.4.4.3. Effectiveness of the Soft Component

In the soft component of this project, the maintenance training was implemented for the purposes to assign the supervisor and learn the management skills, based the problem recognized at the planning time that the maintenance system had not been established. After the training, the results such as "under the maintenance supervisor of the medical equipment, the organization and responsibilities have become clear at each hospital", "the following management skills have been learned", and "it was also motivated to continue the practice" were reported. However, information gathered at the ex-post evaluation time shows that the implementation of the soft component had not contributed to solving the problem identified at the planning time. Regarding the appointment of the maintenance supervisor, apart from YWH, the interviews with the hospitals showed that the mission was actually neither fulfilled nor taken over by the successor because the official position has never been established although the supervisor was appointed in accordance with the training instruction. Therefore, the management practice expected on the maintenance supervisor was not executed. However, the reasons and the background for this were not answered clearly, because most of the senior superintendents and the participants at the implementation time of the soft component had been transferred at the ex-post evaluation time.

Regarding acquisition of management technologies, the positive opinion "how to check the functions of the equipment was learned" was heard in some medical units. Although the training was also conducted on a daily check, it is not implemented since each medical unit was short of staff. There are many medical units checking their equipment only before use, while regular checks would only be done once a month at best. It seemed that the purpose was to avoid a malfunctioning instrument being used for patients rather than to prevent it from breaking down. Although training was also conducted on the maintenance budget planning, this has not been implemented in any hospital. The collection and central management of the equipment information are not implemented by CMSD, as described above.

Few problems were found with the status of operation, as the equipment procured by this project is effectively utilized except for a few instruments. There are however many problems with the status of maintenance as mentioned above. The necessary frequency for repair and parts replacement will increase as the equipment is more utilized in future. Therefore, if the status is not improved, the concern is that the procured equipment may become unusable earlier than the expected life for use. Thus, some serious problems were found with the status of maintenance.

Major problems have been observed in terms of the organizational aspect and current status. Therefore, sustainability of the project effects is low.

4. Conclusion, Lessons Learned and Recommendations

4.1. Conclusion

This project was implemented for the objective to achieve expansion and quality enhancement in the medical services at the five top-referral (tertiary) medical facilities in the Mandalay and Yangon by improving the medical equipment at the facilities, thereby contributing to improvement of the referral function.

The relevance is high. The implementation of this project is consistent with the development policy in the health sector of Myanmar focusing on the quality enhancement of hospital medical services, the development needs to enhance the medical services and efficiency by improving the medical equipment, and Japan's ODA policy prioritizing the aid to improve the people's life swiftly by improvement in the health and medical services, in the condition where risky operations were performed with the decrepit medical equipment while the nurses were insufficient.

The efficiency is high. Both the project cost and the project period are within the plan. The procurement and the installation of the medical equipment were all completed as planned.

The actual values and the increase ratios exceeded the targets for all the target hospitals on all the operation indicators, such as the number of operations, the number of diagnostic examinations and the number of treated patients (except for the indicators on which the target and actual values cannot be compared). In particular, a variety of the diagnostic instruments and endoscopic surgical instruments contributed to accurate diagnosis and reduction of surgical risk, while the automatic monitoring / nursing equipment enabled acceptance of more patients in ICU and SBCU. The avoidance of patient transfer between the tertiary hospitals and the life-saving of super-premature babies are recognized as the examples at the individual target hospitals to demonstrate "improvement in the referral system" that were not available before but are available now. The emergence of these effects was brought as planned by implementation of the project. Therefore, effectiveness and impacts of the project are high.

Even though there is no major problem with the operation, there exist serious problems with the maintenance of equipment procured by the project. This is due to inadequate organization, the shortage of BMEs and the insufficient development capacity to improve the organization. In the current maintenance status, it is worrying that the procured equipment may become unusable earlier than the expected life for use, if the status is not improved. Major problems have been observed in terms of the organizational aspect and current status regarding maintenance for this project. Therefore, sustainability of the project effects is low.

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

4.2. Recommendations

4.2.1. Recommendations to the Executing Agency

4.2.1.1. Improvement in the Organizational Aspects of Maintenance

In this project, it was recognized as a problem that some medical instruments were not being used at the target hospitals either because repairs or parts were not available. This is caused by the inadequate maintenance organization for maintenance. Ex-post evaluation recommends both

fundamental and emergency measures for the improvement here.

(1) Development and allocation of BME (fundamental measure)

a) Desired responsibilities assignment

Although it takes time to solve this problem fundamentally, it is necessary for each organization to be able to fulfill the following responsibilities in maintenance. The target hospitals were particularly troubled by the problem with the agencies' response, because they could not propose any effective countermeasures. In this situation, the following measures involving the executing agency were presented to the hospitals. The measures received a very high level of appreciation and approval from them. On the other hand, they also agreed that they must assign a maintenance supervisor and establish a close communication system with the executing agency for its realization.

Procurement Division (BME Division in the new organization)

- To identify the economically effective ones on the maintenance and/or regular inspection contracts for the expensive equipment and actively make use of such insurance measures by allocating budget for them

CMSD (the local offices of BME Division in the new organization)

- To collect information on alternative parts and alternative agencies from the hospitals and accept their consultation
- To give effective advice to the hospitals when consulted
- To implement countermeasures to the agencies problems, such as order to improve their response.

Maintenance supervisor in each hospital

- To aggregate and arrange repair among others in the hospital
- To report and consult with the local office in charge
- To judge appropriateness of repair and negotiate with an agent.

b) Necessary actions

In order to carry out the above responsibilities, each organization is recommended to take the following specific actions. In particular, the Procurement Division is required to develop BMEs with the capacity required for maintenance and allocate them to each relevant organization.

Procurement Division (BME Division in the new organization)

- To develop and allocate the required BME human resources for the local offices and the hospitals. However, because it does not have sufficient capacity to develop BME by itself in the current status, it is required to proceed with the following steps.
 - To clarify the requirements and roles of BME in Myanmar. (It is desirable to refer to the experience and the opinion of the maintenance supervisor who made a practical achievement.)
 - To seek cooperation of the donors with the development capacity and develop BME based on the clarified requirements and roles (get cooperation of agents when necessary). During the process, the division should also acquire capacity for development.
 - After that, the Procurement Division should develop BME by itself. In response to requests,

it should also accept the hospital engineers among others to develop their BME capacity.
CMSD (the local offices of BME Division in the new organization)

- To request the Procurement Division to allocate BME with knowledge about maintenance.

Each hospital

- To request the Procurement Division to allocate BME or develop the capacity for electrical engineers in the hospital, so as to appoint the maintenance supervisor.
- Utilize JICA volunteers with knowledge of maintenance who are being dispatched to several hospitals.

(2) Establishment of Regular Maintenance Conference (urgent measure)

In order for the maintenance problems currently occurring at each hospital to be led in the direction of the solutions even a little, improvement in maintenance that can be done immediately with the current staff and organization is required. It is desired to make the emergency measure that meets the objectives and reality. For this purpose, an idea is recommended hereunder. First of all, it is urgent to hold a regular conference on maintenance in order to create a bottom-up network in which information can be exchanged.

First, the hospital regular conference on maintenance should be held in each hospital. In each hospital, considering the current status where each medical unit is individually requesting agencies for repair, each medical unit appoints a unit maintenance supervisor from among those who actually request the agencies to repair. From each unit, the appointed person attends the meeting. It is desirable that the maintenance supervisor candidate should act as the chairperson. Then, information on maintenance (for example, problems with unavailable parts and the agency response, and solutions such as alternative parts and alternative agencies) is aggregated and exchanged in the hospital conference, so that the maintenance supervisor candidate can grasp the maintenance information.

Next, in each city (Yangon and Mandalay), a regional conference on maintenance should be held to exchange information between hospitals. A maintenance supervisor at the local CMSD office should be appointed to act as the chairperson. The maintenance supervisor candidate who grasps the information should participate from each hospital.

Finally, a conference should regularly be held in the regulatory organization involving the maintenance supervisors at the local CMSD offices and Procurement Director in Nay Pyi Taw to share problems and make countermeasures (especially for improvement of agency response).

The Regular Maintenance Conference system will aggregate and share the problems and make the solutions available through a bottom-up information network. The Procurement Division in DoMS should provide leadership to the hospitals and CMSD so that the regular maintenance conference will be held at each level of the hospital, the region, and the supervisor organization.

4.2.1.2. Effective utilization of unused equipment in the laboratory

Two instruments (ref. 3.4.2.1) are not being used after the doctor who worked at the time of the equipment request was transferred. In this regard, it is desirable that DoMS arranges a doctor

who can use them or move them to a hospital that needs them in order to use them effectively.

4.2.2. Recommendations to JICA

4.2.2.1. Cooperation to improve the maintenance organization

JICA already recognizes that it is indispensable to improve the maintenance organization in order to continually and effectively utilize the medical equipment procured through the cooperation projects including this project. Therefore, it has been dispatching JICA volunteers with expertise in this field and has cooperated in establishing and operating the one-year BME training course at UMT starting in May 2018.

(1) Support for BME development (fundamental countermeasure)

With regard to BME in Myanmar, the definition and/or the requirements and roles matching the country are not clarified, as described above. Considering the result of the soft component of this project which could not take effect due to insufficient discussion with the supervisor section, it is necessary that JICA discuss well and build consensus with the responsible official in DoMS, in order to effectively cooperate in the BME training course at UMT. In that case, it is desirable to pay attention to the realization of the recommendations to the executing agency described in 4.2.1.1(1), and to focus not only on engineering skills but also on administrative skills to be acquired.

Especially, formulation of the BME requirements in the country is an important issue. In order to formulate the requirements, it is possible to refer to the work and opinions of the staff member who made a practical achievement in maintenance. For example, one role model could be the staff member who has served as a maintenance supervisor in YWH for many years (transferred to the Procurement Division in March 2018) and made an achievement in implementation of effective maintenance. The opinions of such a staff member are thought to be very helpful in formulating the requirements for BME in the country.

For the training method, a specific example of success can be referred to. For example, the above staff member, being originally an electric engineer, participated in JICA training in Japan, regularly visited senior volunteers dispatched to New Yangon General Hospital, learned a lot and showed an efficient performance in the field of maintenance. Such an example will help to decide what kind of support is needed and how it should be utilized for effective BME development.

Since it is considered that JICA has much knowledge in other countries regarding human resource development for the purpose of improving maintenance, it seems remarkably useful for JICA to share this knowledge in discussion when formulating requirements and training methods for BME in Myanmar.

(2) Support for establishment of Regular Maintenance Conference (urgent measure)

Desirably, JICA should follow up the establishment and implementation of the Regular Maintenance Conference which is an urgent measure recommended above, since the maintenance status of the equipment procured under the project is worrying. It could have JICA volunteers with maintenance knowledge attend the conference and cooperate in planning the measures. The

maintenance supervisor who recognizes their capacity in the conference could be expected to visit the local JICA volunteers to receive their guidance. In addition, it is also expected that the decisions in the regular conference could be reflected in the support for the BME training course.

4.3. Lessons Learned

4.3.1. Improvement in procurement for continual and effective use of specialized equipment

In this project, a few pieces of specialized equipment in the laboratory are no longer used. Regarding the specialized equipment, it is recommended to pay attention to the following points in future.

- In selecting equipment, to make sure that there are more than one medical worker who want to use it with continual demand for it, in order to avoid a situation (ref. 3.4.2.1) where the equipment is no longer used after the transfer of the doctor who requested the procurement.
- To consider the price of the consumable well when selecting the equipment model, in order to avoid a situation where the equipment requiring an expensive consumable is no longer used (ref. 3.4.3.2). It must be checked with the government section authorizing the budget (DoMS in this project) in addition to the installation hospital whether the expensive consumables are affordable continuously or not. If the consumables are too expensive to afford, that model should be excluded from the choices.

4.3.2. Effective design of maintenance training (soft component)

Maintenance training implemented in the soft component of this project was originally extremely important, although it did not have much effect. It seems because it was not fully understood that the fundamental cause of the maintenance problem lies in inadequate organization and shortage of human resources. As a result, the training was designed only in consideration of the superficial problems that repairs were not adequately requested to the agencies. In order to have an effect, it was necessary to establish a system to aggregate and share the maintenance information first, develop the countermeasures with the agencies, and improve the repair environment. Analyzing the problem further, it was necessary to develop human resources called BME in order to establish the system. In this way, there was a rather deep-rooted problem behind the inadequate maintenance of equipment. In order to design an effective soft component, it is desirable to fully investigate the fundamental causes of the problem occurring actually and design the training.

End