

Research Article

Unit cost analysis of medical services at different levels of health facilities of a township in Myanmar

AThi Win Shwe^{1,2},
Arthorn Riewpaiboon ^{1*}

¹Division of Social and Administrative Pharmacy, Department of Pharmacy, Faculty of Pharmacy, Mahidol University, Bangkok 10400, Thailand.

²Yangon General Hospital, Department of Medical Services, Ministry of Health and Sports, Myanmar.

***Corresponding author:**
Arthorn Riewpaiboon
Arthorn.rie@mahidol.ac.th

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ABSTRACT

In Myanmar, township health system, is the backbone of primary health care and provide comprehensive health service especially at rural area. Therefore healthcare services provided from health facilities in township healthcare system need an acceptable level of quality and at least possible cost. However, there is no comprehensive study in healthcare facilities to calculate the operating costs and the unit costs of the medical services they provide. The present study intended to calculate unit cost of basic medical services in different levels of health facilities (township hospital, station hospital and rural health center) under township healthcare system from hospital perspective by using standard costing method. The study results included unit cost of 28 basic medical services including OPD visit cost [1.6 USD (TH), 1.99 USD (SH), 0.54 USD (RHC)]; IPD admission cost [9.48 USD (TH) and 6.11 USD (SH)]; IPD hotel stay cost [2.02 USD (TH) and 1.20 USD (SH)]; surgery cost [10.37 USD (TH) and 10.97 USD (SH)]; delivery cost [200.32 USD at RHC] and home delivery cost [22.01 USD at RHC level]. The present study can identify areas where improvements in efficiency might get significant cost savings and can compare in different level of health facilities within township level. It also give evidence that detailed costing of hospital in Myanmar is feasible and it can provide information on the actual cost of basic medical services in different level of township health system in Myanmar which can be used in monitoring efficiency, resource allocation, hospital planning and management decision.

1. INTRODUCTION

Healthcare sector is one of the most important services for every country because of its impact on the protection and promotion of human life¹. Hospitals and health care centers stand key player to provide health care services both for curative and preventive care. A major World Bank study found that hospitals consumed 50 to 80 percent of health care resources in developing countries^{1,2}. In Myanmar, hospital expenditure is 69.80 percent of total health expenditure in 2011-12 fiscal year³. Also in developed countries, hospitals play a vital role for benefit of the community. So giving healthcare services from hospitals have to be an acceptable level of quality and at least possible cost, therefore need information on the actual cost of the service they provide^{1,2}.

Cost refers to the monetary value of resources that are used for production of products or services. Information about hospital cost is

also needed to inform policy makers for evidence based decision. However, very few detailed studies have been carried out on the economics of hospitals in low and middle income countries^{2,4}.

Myanmar health care system is the mixture of public and private sector and Ministry of Health and Sports (MOHS) remains the major providers of healthcare services. There are major six departments under MOHS. Among these, Department of Public Health and Department of Medical Services are mainly responsible for health care, basic medical services and all hospital services⁵. The network of hospitals and health centers, expanding down to village level, provide curative services ranging from primary to tertiary health care⁶.

Public hospitals are categorized into general hospitals (up to 2,000 beds), specialist hospitals and teaching hospitals (100-1200 beds), regional/ state hospitals and district hospitals (200-500 beds), and township hospitals (25-100 beds). In rural area, station hospitals (16-25 beds), rural health centers (no beds), sub-rural health centers (no beds) provide healthcare services, including public health services⁵. According to 2014 health in Myanmar data, there are 1056 public hospitals which provide curative and rehabilitate services and 87 primary and secondary health center, 348 MCH center, 1684 RHC and 80 School Health team which provide basic medical services, preventive services and public health activities^{3,5}.

Township health system, is the backbone of primary health care and provide comprehensive health service especially at rural area because 70% of total population is in that region⁶. Therefore healthcare services provided from health facilities in township healthcare system need an acceptable level of quality and at the least possible cost and therefore they need information on actual cost of the services they provide².

However, till date, there is no comprehensive study in healthcare facilities to calculate the operating costs and the unit costs of the medical services they provide. So, the present study intended to calculate unit cost of basic medical services in different levels of study health facilities under township healthcare system.

2. MATERIALS AND METHODS

2.1. Study design

We estimated unit costs of basic medical services of the study health facilities from

hospital perspective by using standard costing method^{7,8}. We calculated both service levels_ at the intermediate service level (e.g., cost per laboratory test) and at the final cost center level (e.g., cost per out-patient visit).

2.2. Study area

Three level of health facilities under township healthcare system were chosen based on accessibility of data: a 25-bedded township hospital, a 16-bedded station hospital and one rural health center (no bed). As a further consideration of selecting study area, this study is one of the supporting study for economic evaluation of maternal and child health voucher scheme (MCHVS) program which is implemented as a pilot program in that township^{9,10}.

2.3. Data collection

Annual data were collected retrospectively from each of the study health facilities which was from April 2015 to March 2016 (2015 fiscal year) to avoid seasonal variation. The main source of data for health facility's activities, capital items and accounting reports was administration department of each health facility. Information about human resources was taken from health facility payroll and confirmed by health facility administrators. Since there is no medical record section to record statistics of outpatient visits, inpatient admission, patients operated, available category and number of laboratory test and number and types of imaging, we took those data from the individual departments' registers. We used standard hospital stay for each level of health facilities from Annual Hospital Statistics Report, 2013 from Ministry of Health and Sports, Myanmar¹¹. Annual recurrent expenditures, which included salaries, electricity, telephone bill, fuel, office supplies and maintenance cost, were collected from annual expenditure report of health facility from administration department. For cost of drugs and medical supplies, we collected from invoice which include quantities and cost from pharmacy department.

2.4. Costing method

The unit costs of medical services have been calculated using the standard costing method which involve six steps⁴:

- (i) Designing and planning,

- (ii) Organization analysis and cost center classification,
- (iii) Direct cost determination,
- (iv) Indirect cost determination,
- (v) Full cost determination and
- (vi) Calculation of unit cost of medical services

The first step is already described in study design, study area and data collection. In second step of organizational analysis and cost center classification, based on the function of department, the study health facilities were divided into patient care cost centers (PCCs) and supporting cost centers (SCCs). PCCs, such as laboratory department, X-ray department, surgery department, outpatient department and inpatient department, are service producing cost centers which are also called absorbing cost center (ACCs) which refers to the cost of services provided directly to patients¹². So, we gave name to those ACCs as A1, A2, A3, A4 and A5 respectively for township hospital and station hospital. In case of rural health center, they cannot give X-ray service and operation service and they didn't have inpatient department. So, we excluded those three PCCs (A2, A3 and A5) and added delivery and home delivery department. Therefore, we gave rename for rural health center as laboratory department (A1), outpatient department (A2), delivery department (A3) and home delivery department (A4).

SCCs provide supporting to PCCs through Administration department and Pharmacy department which is also called transient cost centers (TCCs) which refers to costs incurred by departments or activities that provide services only to other departments of the health care center, not directly to patients¹². Cost center classification of three level of study health facilities are shown in Table 1.

Next step of the direct cost of each cost center was calculated by summing capital cost,

labor cost and material cost. Capital cost, in economic approach, includes annualized discounted cost of using building, equipment and furniture cost. Opportunity cost of land was excluded in this study because of a government property. In direct cost calculation for capital items, we used current cost by adjusting the original cost with an inflation adjustment factor, which was calculated using the consumer price index (CPI)¹³. The following equations were used for direct cost calculation of capital cost^{7, 14}.

Equation 1:

Annualized discounted capital cost = Current price/ Annuity factor

Equation 2:

Current Price = Original purchasing price x Inflation adjustment factor

Equation 3:

Inflation adjustment factor = CPI in year of analysis/ CPI in year of purchasing

Equation 4: Annuity factor = $[1-(1+r)^{-n}] / r$

Whereas, r = discount rate
 n =useful life (years)

Items which we didn't access actual data from the health facilities, we assumed as a current price from reference price list. For building, we used reference price which is identified as the fixed rate with level of health facilities from Myanmar Ministry of Health and Sports. We got fixed assets lists from health facilities only with year of first use and quantity especially those assets are before the year of 2000. In that cases also, we used reference price from supplier price list of those assets. For furniture, we made price surveying from suppliers and taking average. For equipment, we took from online selling website named Alibaba.com¹³.

Table 1. Cost center classification for three health facilities under Yedashae Township

Cost Center	Type	TH	SH	RHC
Administration department	TCC	T1	T1	T1
Pharmacy department	TCC	T2	T2	T2
Laboratory department	ACC	A1	A1	A1
X ray department	ACC	A2	A2	×
Surgery department	ACC	A3	A3	×
Outpatient department	ACC	A4	A4	×
Inpatient department	ACC	×	×	A2
Delivery department	ACC	A5	A5	×
Home delivery department	ACC	×	×	A3
		×	×	A4

TH = township hospital, SH = station hospital, RHC = rural health center

Items on the furniture list include cupboard, office table, computer table, file shelf, chair, bench, patient bed, dental chair, patient trolley, wheel chair and on the equipment list include phone handset, computer, printer, copier, generator, power meter, operating theatre table, minor surgical instrument set, X-ray machine, ECG machine, patient monitor, BP cuff, stethoscope, weighing scale, oxygen cylinder and laboratory equipment such as monocular microscope, ESR stand, hematocrit centrifuge, spirit lamp, glucometer, timer and counting chamber. The useful life of buildings was considered 50 years; furniture such as cupboard, table and file shelf was assumed to be 15 years; for chairs 8 years and for hospital equipment 10 years according to Myanmar Ministry of Finance which was announced in 1964¹⁵. Since then, there was no updated announcement for useful life of items. A 3% discount rate was used to calculate the cost of depreciable assets^{16, 17}.

Material costs cover drugs and medical materials (drugs, laboratory reagents, radiology materials), office supplies, maintenance and overhead utilities (telephone bill, electricity and fuel cost).

We account only salaries for calculating labor cost as we cannot get data for other fringe benefits. For staff, who work in more than one cost center, labor costs were apportioned based on the working time in each cost center. To calculate full time equivalent (FTE) of each staff, we used duty roster to allocate their working time and associated salaries because we cannot access actual working time for each staff.

After calculating the direct cost of each cost center, we allocated the direct cost of SCCs to PCCs via the simultaneous equation method⁷. To make allocation, we need to find allocation criteria because detail usage of indirect cost of each PCCs from SCCs is unknown. We chose the allocation criteria for SCCs which would be appropriate for our study health facilities by reviewing other similar studies and also discussing with experts in that area^{1, 2, 18}. Our allocation criteria for administration department was personal management (output unit: FTE) and for pharmacy department was drug supply (output unit: value of supply). Then by using these criteria, we made full adjustment of cost centers and solved with a set of simultaneous linear equation to determine the allocations. After being allocated to PCCs, the direct costs of SCCs become the indirect cost of PCCs.

The direct and indirect costs of each PCCs were then added to get the full cost of each PCCs. To calculate the unit cost of medical services, we used the average cost method and micro-costing method based on the availability of the data⁴. Unit cost of surgery, OPD visit, IPD admission and IPD hotel stay were calculated by using average method. For example, to find the unit cost of outpatient visit, we calculated by using the full cost of outpatient department which was divided by the total number of outpatient visits at the hospital during the whole year of study period.

Unit cost of each laboratory test and imaging were calculated by using micro-costing method. For example, to find the unit cost of laboratory test, we calculated direct cost of each test (summed capital cost, labor cost and material cost) and indirect cost of each test (calculated from the result of the full cost of laboratory department subtracted by sum of total direct cost of each test). Then indirect cost is allocated to each test based on proportion of direct cost of each test and finally direct and indirect costs of each test was then added to get the unit cost of each test.

All costs were converted to 2015 prices by using consumer price index (CPI) and then converted from local currency, Myanmar kyats (MMK) to US dollars (USD) by using average exchange rate of 2015 (1 USD = 1199.07MMK)¹³

3. RESULTS

3.1. Output of study health facilities

Firstly, we summarized the output of the three health facilities during the study period which is presented in Table 2.

From the number of visits in the outpatient department, we estimated the average case load per day for the study health facilities by dividing total output of OPD patients with 365 days. One of the efficiency indicators of hospitals is the bed occupancy rate: hospitals with 80 percent occupancy rate are assumed to be efficient per WHO recommendation². We found that both study health facilities didn't get the target of 80 percent occupancy rate during our study period.

Regarding staffing of the study health facilities in our study year, total staff in township hospital was 26 including 6 doctors, 9 nurses and 11 support staffs; station hospital was 10 including 2 doctors, 3 nurses and 5 support staffs; and rural health center was 10 including 1 HA, 7 nurses and 2 support staffs.

Table 2. Output of three study health facilities, 2015 fiscal year

Output	TH	SH	RHC	Source
Bed (number)	25	16	NA	Admin department
Bed occupancy rate (%)	41.23	44.62	NA	From calculation
OPD visit (number)	9987	7954	4426	OPD department
Average case load per day	27	22	12	From calculation
Inpatient treated (admission)	3762	2606	NA	IPD department
Patient operated (number)	575	287	NA	Surgery department
Delivery at RHC (number)	NA	NA	19	Admin department
Delivery at Home (number)	NA	NA	251	Admin department
Average length of hospital stay (day)	4.7	5.1	NA	Annual Hospital Statistic Report,2013
Adult Chest X ray	416	312	NA	X-ray department
Arms, Legs and Knee X ray	348	288	NA	X-ray department
Child X ray	230	100	NA	X-ray department
HIV test	4967	501	487	Lab department
Hbs-Ag test	976	377	998	Lab department
HCV test	979	377	467	Lab department
VDRL test	945	192	876	Lab department
Hemoglobin test (Hb)	112	0	NA	Lab department
CP test	10	0	NA	Lab department
RBS test	2243	1352	NA	Lab department
ESR test	25	0	NA	Lab department
PCV test	0	0	NA	Lab department
BT, CT test	1	0	NA	Lab department
Grouping & Matching test	980	179	NA	Lab department
Rh test	980	179	NA	Lab department
MP (Film) test	43	0	NA	Lab department
MP (ICT) test	129	199	331	Lab department
Z-N test	1535	0	NA	Lab department
Urine Re test	6	0	NA	Lab department
Urine Re (test strip)	5542	3786	1159	Lab department
Urine UCG test	NA	NA	NA	Lab department
Stool Re test	NA	NA	NA	Lab department

TH = township hospital, SH = station hospital, RHC = rural health center, NA = Not Applicable

3.2. Direct cost of all cost centers (ACCs and TCCs)

We calculated direct cost by summing up of capital cost, labor cost and material cost for all TCCs and ACCs. We calculated the percentage of cost components which were occupied in the total direct cost of each health facilities.

From those result, we can see that the major cost component for the township hospital and rural health center was labor cost which occupied more than 50 percent of total direct cost: 51.25% and 58.09% respectively. For the station hospital, capital cost stood major cost component which is 37.44% even though it was not too much difference with labor cost which is 37%. To be understandable, we also described those comparison with Figure 1.

If we break down capital cost into building, equipment and furniture and material

cost into drug and medical materials, office supplies, maintenance and overhead cost (which include water, electricity and phone bill), around 90% of material cost came from drug and medical supplies for all health facilities we can see that the building cost was the biggest portion occupied in the capital cost for all health facilities and around 90% of material cost came from drug and medical supplies for all health facilities. Percentage of detail cost component which was occupied in total direct cost is also described in Figure 2.

3.3 Indirect cost of ACCs in study health facilities

Indirect cost of ACCs got from allocation of total direct cost of TCCs by using allocation criteria. Simultaneous equation method was used for indirect cost allocation.

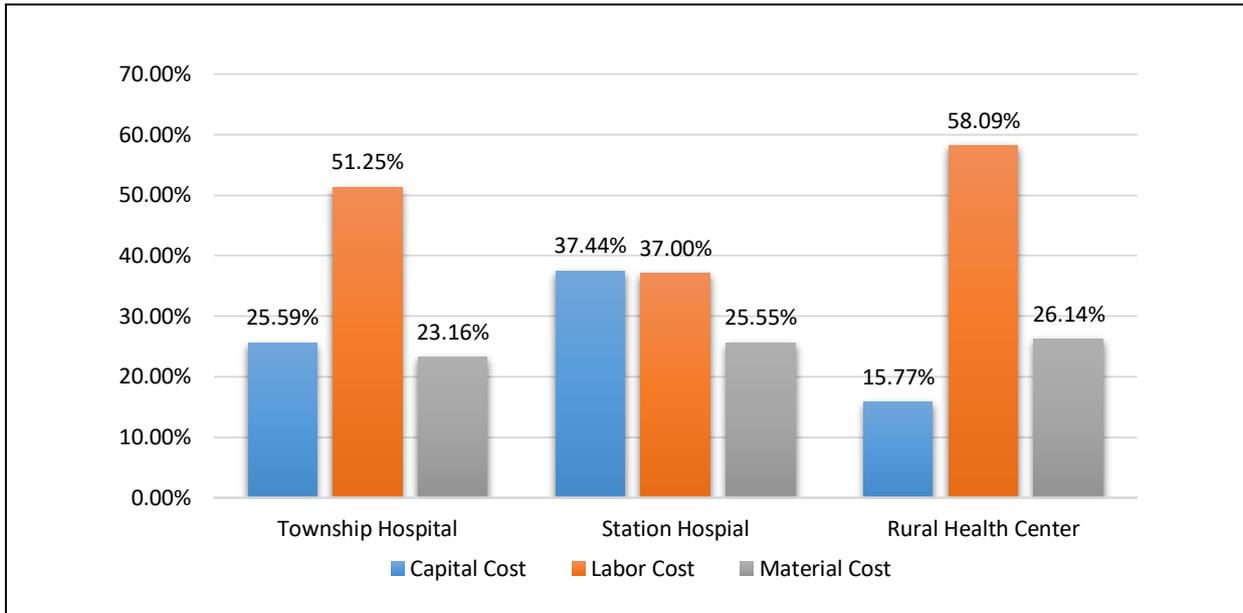


Figure 1. Comparison of different cost component in total cost of study health facilities

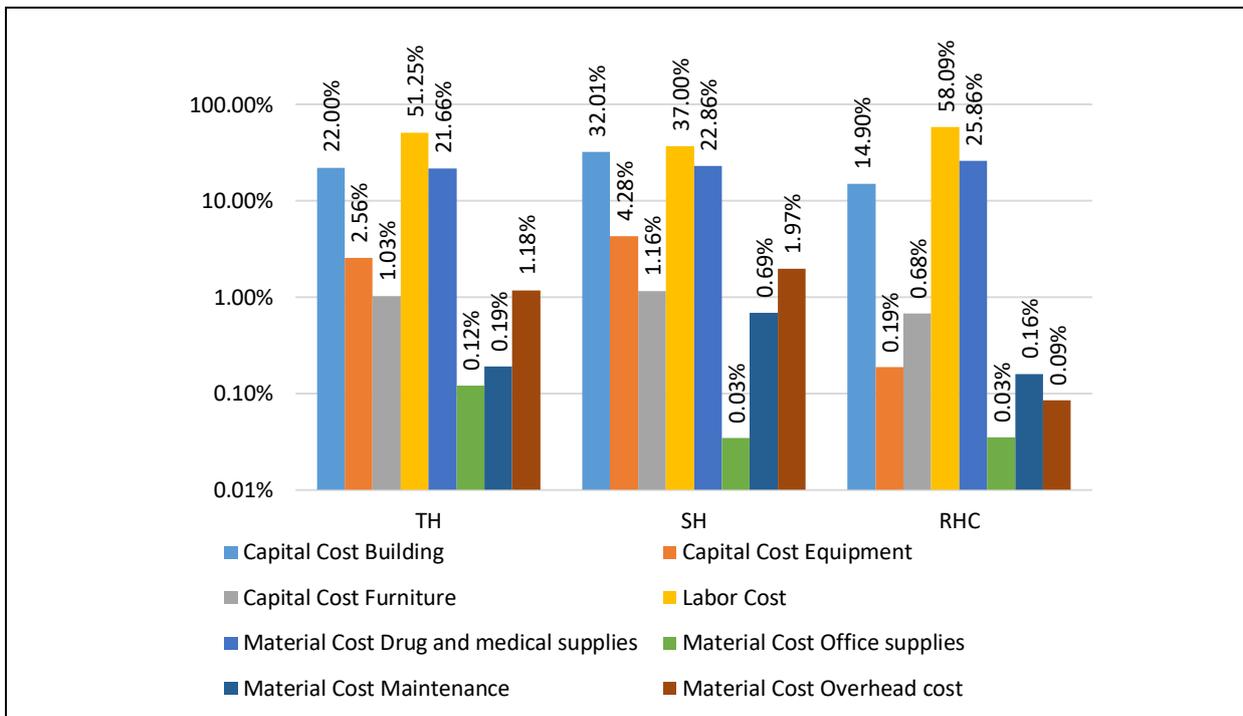


Figure 2. Comparison of detailed cost component in total cost of each health facilities

3.3. Full cost of ACCs in study health facilities

After finding direct and indirect cost for all ACCs, we calculated full cost by summing up direct cost and indirect cost of ACCs. We also calculated percentage of each cost component in individual cost center. The results are shown in Table 3 for township hospital, station hospital and rural health center.

From those results, we can see that in both township hospital and station hospital, cost of IPD department occupied the largest portion, around one third of total full cost; followed by laboratory department as a second one and OPD department as a third. For RHC, since there is not IPD department, laboratory department occupied the largest portion followed by OPD department as a second, home delivery department as a third and delivery department as the last.

Table 3. Full cost of ACCs (USD) for three study health facilities under Yedashae township

Cost component/ cost center	Name of cost center	TH			SH			RHC		
		Direct cost	Indirect cost	Full Cost	Direct cost	Indirect cost	Full Cost	Direct cost	Indirect cost	Full Cost
A1	Laboratory department	21,036 (23.78%)	3,002 (3.39%)	24,038 (27.18%)	11,668 (25.60%)	2,145 (4.71%)	13,813 (30.31%)	7,645 (29.29%)	2,307 (8.84%)	9,951 (38.13%)
	X ray department	5,675 (6.42%)	1,106 (1.25%)	6,781 (7.67%)	4,121 (9.04%)	718 (1.58%)	4,839 (10.62%)	-	-	-
	OPD department	-	-	-	-	-	-	5,147 (19.72%)	1,669 (6.39%)	6,816 (26.12%)
A3	Surgery department	5,077 (5.74%)	888 (1%)	5,965 (6.74%)	2,687 (5.90%)	462 (1.01%)	3,148 (6.91%)	-	-	-
	Delivery	-	-	-	-	-	-	2,924 (11.20%)	882 (3.38%)	3,806 (14.58%)
A4	OPD department	13,032 (14.73%)	2,989 (3.38%)	16,012 (18.11%)	6,158 (13.51%)	1,680 (3.69%)	7,838 (17.20%)	-	-	-
	Home delivery department	-	-	-	-	-	-	4,116 (15.77%)	1,409 (5.40%)	5,525 (21.17%)
A5	IPD department	26,447 (29.90%)	9,205 (10.41%)	35,652 (40.30%)	11,676 (25.62%)	4,259 (9.34%)	15,934 (34.96%)	-	-	-
	Total	71,267 (80.57%)	17,189 (19.43%)	88,457 (100%)	36,309 (79.67%)	9,264 (20.33%)	45,573 (100%)	19,832 (75.99%)	6,267 (24.01%)	26,099 (100%)

OPD visit (routine service), IPD admission (routine service), IPD hotel stay, surgery, delivery and home delivery, we used average method. We compared unit cost of all medical services for three health facilities with Table 4.

When we looked and compared unit cost for three study health facilities, operation cost was highest among all other unit cost in both township hospital and station hospital. In rural health center, delivery at RHC is highest because of the low case load (19 deliveries at RHC while 251 deliveries at home delivery).

When we looked at individual laboratory test and X ray, the price is high and there is no much difference in price between township hospital and station hospital except few tests such as CP and HIV test. For those exception, price difference is very wide.

4. DISCUSSION

Although this study was conducted for full economic evaluation of maternal and child health voucher scheme (MCHVS) which was conducted as a pilot project in our study township, it can be used as a sample for further unit cost study of Myanmar hospitals^{9,10}. In this study, we have presented total operating cost and unit cost of medical service.

3.4. Unit cost of medical services in study health facilities

To calculate unit cost, we used average method and micro-costing method according to hospital data availability. For intermediate service level of laboratory test and X ray, we used micro-costing method. For final cost center level such as

4.1. Total operating cost

In total operating cost, we found that human resources are the largest component in township hospital and rural health center (>50%) which is relevant with several international studies in India, Vietnam and Netherlands which also described that human resources occupies the

Table 4. Unit Cost of Basic Medical Services (USD) of Three Study Health Facilities

Name of basic medical service	Township Hospital	Station Hospital	Rural Health Center
Operation	10.37	10.97	NA
OPD visit	1.60	0.99	1.54
IPD Admission	9.48	6.11	NA
IPD hotel stay	2.02	1.20	NA
Delivery patient at RHC	NA	NA	200.32
Delivery patient at Home	NA	NA	22.01
Adult Chest X ray	6.97	7.08	NA
Arms, Legs and Knee X ray	6.74	6.80	NA
Child X ray	6.67	6.72	NA
HIV	3.15	8.52	3.96
HBs-Ag	0.56	2.17	0.89
HCV	1.04	3.29	1.44
VDRL	0.77	2.67	1.13
Hb	0.25	0.83	NA
CP	1.67	9.91	NA
RBS	0.40	1.22	NA
ESR	4.07	6.19	NA
PCV	0.43	3.30	NA
BT, CT	0.75	1.65	NA
G & M	0.42	1.22	NA
Rh	0.40	0.96	NA
MP (Film)	1.22	7.43	NA
MP (ICT)	1.03	2.20	1.51
Z-N	1.06	6.19	NA
Urine Re	1.38	4.95	NA
Urine Re (test strip)	0.44	1.19	0.67
Urine UCG	0.11	0.83	NA
Stool Re	0.66	4.95	NA

1 USD = 1199.07 MMK in 2015 average exchange rate, NA = Not Applicable

majority of hospital total operating cost^{2,19-21}. But in station hospital, capital cost stands the largest component. This can be because of our limitation which we only use reference price for building cost as we cannot get actual original price because of old buildings. So, it might be over-estimating in real situation.

Even human resource costs are high, it still faces insufficient human resources as nurse to doctor ratio is below minimum of 2:1. According to the 1993 World Development Report, for quality care, the nurse-to-doctor ratio should be at least 2:1, a ratio of 4:1 or better is considered satisfactory². Both township hospital and station hospital is only the ratio of 1.5:1. So the shortage of nursing staff raise question on quality of care.

Moreover, non-technical support staff were performing multiple task simultaneously which can also effect on efficient functioning. Even human resource costs are high, there is another limitation for calculating of full time equivalent (FTE) by using only standard time table. In actual situation, there is insufficient human resources, especially in station hospital and RHC and so it can be under estimating.

We also found that drug and medical supplies occupies larger proportion more than 80% of total material cost in study health facilities which is also in line with other international studies^{1,2}. So, it should be considered to seek ways of how to make efficiencies in purchasing and stocking drugs and medical supplies. And also, hospital administrators should need to consider a more rational use of such materials and look for efficiencies.

4.2. Unit cost

The overall occupancy rate did not exceed 80 percent at both hospital which can affect on the unit cost, 41.23% in township hospital and 44.62% in station hospital. At 80% occupancy as recommended by WHO, the inpatient stay cost at township hospital falls by almost half, from 2.02 USD to 1.04 USD and at station hospital falls from 1.20 USD to 0.67 USD.

OPD cost is not much different in three study health facilities. For inpatient admission cost, 9.48 USD in township hospital and 6.11 USD in station hospital. In both hospital, labor

cost occupied largest proportion for IPD admission cost; in addition, capital cost is nearly the same with labor cost for station hospital. For inpatient hotel-stay cost, 2.02 USD in township hospital and 1.20 USD for station hospital. Surgery between township hospital and station hospital is nearly same even though number of operated patients in station hospital is nearly less than half compared with township hospital because of difference between surgery department operating cost as expected that station hospital is less as double than township hospital.

Unit cost of X ray at both township hospital and station hospital is nearly the same, and also both are expensive when compared with private clinic and hospital because of low case load. For our whole study year, number of X ray per township hospital is around 1000 and for station hospital is around 700. So even well-equipped and also provide enough material, case load is not satisfactory and as a consequence, it is costly. Unit costs of laboratory test in station hospital and even some in township hospital are also expensive because of low case load. Even both hospital has same equipment, case load is much more less and sometimes, not have any case in station hospital. This is because station hospital has no experienced lab technician and that station hospital is very near to township hospital and other regional hospital.

Further, delivery at RHC is too much costly because of also low case load. In our study period, we found that delivery case at RHC is only 19 cases throughout whole year when home delivery is 251 cases. So, 93 percent of delivery case is at home in rural area excluding patients who directly go to hospital. It shows that people in rural area prefer home environment.

4.3. Overall discussion

The present study can identify areas where improvements in efficiency might get significant cost savings. Our study also give evidence that detailed costing of hospital in Myanmar is feasible although it has many challenges such as difficulty in obtaining accurate activity of human resources, difficulty in obtaining price information and some statistic data need to collect manually from registry book because of no medical record department and not computerized system.

5. CONCLUSION AND RECOMMENDATIONS

The present study provides information on the actual cost of basic medical services in different level of township health system in Myanmar. We can assess efficiency and make informed hospital planning and management decision by using these data. This is a preliminary study on hospital costing in Myanmar. Because of the size and variations across health facilities, a large-scale study should be undertaken to gain a better understanding of hospital costing for different types of hospital and provide more comprehensive information for policy purposes.

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Conflict of interest

None to declare

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Ethical approval

Ethical approval was obtained from the ethical review committee of the Department of Public Health, Ministry of Health and Sports (MOHS).

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