
An ex-ante economic evaluation of the Maternal and Child Health Voucher Scheme as a decision-making tool in Myanmar

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Abstract

Reducing child and maternal mortality in order to meet the health-related Millennium Development Goals (MDGs) 4 and 5 remains a major challenge in Myanmar. Inadequate care during pregnancy and labour plays an important role in the maternal mortality rate in Myanmar. A Maternal and Child Health (MCH) Voucher Scheme comprising a subsidization for pregnant women to receive four antenatal care (ANC), delivery and postnatal care (PNC) free-of-charge was planned to help women overcome financial barriers in addition to raising awareness of ANC and delivery with skilled birth attendants (SBA), which can reduce the rate of maternal and neonatal death. This study is part of an ex-ante evaluation of a feasibility study of the MCH Voucher Scheme. A cost-utility analysis was conducted using a decision tree model to assess the cost per disability-adjusted life years (DALYs) averted from the MCH Voucher Scheme compared with the current situation. Most input parameters were obtained from Myanmar context. From the base-case analysis, where the financial burden on households was fully subsidized, the MCH Voucher Scheme increased utilization for ANC from 73% up to 93% and for delivery from SBAs from 51% up to and 71%, respectively; hence, it is considered to be very cost-effective with an incremental cost-effectiveness ratio of 381 027 kyats per DALY averted (2010, price year). From the probabilistic sensitivity analysis, the MCH Voucher Scheme had a 52% chance of being a cost-effective option at 1 GDP per capita threshold compared to the current situation. Given that the Voucher Scheme is currently being implemented in one township in Myanmar as a result of this study, ongoing evaluation of the effectiveness and cost-effectiveness of this scheme is warranted.

Key words: Cost-utility analysis; decision analysis model; demand side financing; maternal and child health; obstetric labor; pre-natal care; skilled birth attendant; traditional birth attendant

Key Messages

- Inadequate care during pregnancy and labour due to financial barriers plays an important role in maternal mortality rate in Myanmar.
- This study evaluated the cost-effectiveness of the maternal and child health voucher scheme.
- The results suggest that the Voucher Scheme may be cost-effective under the Myanmar context.

Background

Reducing child and maternal mortality in order to meet the health-related millennium development goals (MDGs) 4 and 5 remains a major challenge for Myanmar. Currently, it is estimated that the country meets only 55% of its target for the infant mortality rate (26 per 1000 live births) and 82% of its target for the maternal mortality ratio (130 per 100 000 live births) (Saw *et al.* 2013). Though the statistics from the Myanmar Central Statistical Organization reported that its maternal mortality ratio for the whole nation to date was 142 per 1000 live births, this number is likely to be underestimated around three times as is shown from the Nationwide Cause Specific Maternal Mortality Survey in 2004–2005 (Ministry of Health 2005). Figure 1 compares the trend of maternal mortality ratio from different sources (World Health Organization 2004; Ministry of Health 2005; Ministry of Health 2009, 2010a, b, 2012, 2013).

In low-income countries, maternal deaths are mainly due to inadequate care during pregnancy and labour. Results from the Nationwide Cause Specific Maternal Mortality Survey suggest that 31% of maternal death was due to postpartum haemorrhage while eclampsia and hypertensive disease of pregnancy ranked second (17%) (Ministry of Health 2005). The major factor causing those complications is due to the low coverage of antenatal care (ANC) and delivery attended by skilled health professionals. From the survey in 2004–2005, it is reported that about half of the pregnant women (50.80%) had an attended delivery and 56.34% had antenatal care from skilled birth attendants (SBA) (Ministry of Health 2005). Around one-third of maternal deaths did not have prior ANC and about half of maternal deaths (52.17%) had care from traditional birth attendants or trained traditional birth attendants (TBA/TTBA) at the time of delivery (Ministry of Health 2005).

In order to reduce maternal and neonatal mortality, reproductive health services need to be improved. Although the World Health Organization has recommended ANC as a basic health service provided to pregnant women, numerous factors contribute to unattended ANC with skilled attendants, such as the availability of health providers, quality of service provided, distance to health facility, economic associated to the service utilization and cultural and social factors. From a community survey conducted in two townships in Myanmar, Yedash and Tatkone, the three main reasons for pregnant women to not have ANC is that (1) receiving ANC by SBAs was not needed or important, (2) the perception that the pregnancy was still at an early stage and (3) unaffordable costs (Republic of Myanmar Ministry of Health *et al.* 2010). From the same survey, 67% of pregnant women and new mothers found difficulties in raising the funds necessary to cover ANC and delivery services. The majority of them needed to borrow money from others (39%), sacrifice essential food consumption (17%) or sell crops or pledge gold (13%). Moreover, pregnant women in Myanmar preferred to deliver with TBAs because they usually provide other services, including washing, cleaning and baby-sitting children in the family during the first week after delivery.

The GAVI-HSS initiative in Myanmar comprises three major elements, including the reforms of financing, human resources and infrastructure to tackle the supply side of the services. However, there is a need to develop a model to tackle the demand side as well. Therefore, the Maternal and Child Health (MCH) Voucher Scheme comprising the subsidization for pregnant women to received four ANC, delivery and postnatal care (PNC) free-of-charge by paying to both providers and pregnant women was planned to help women overcome financial barriers in addition to raising awareness of ANC and delivery with SBAs; this can also result in the reduction of maternal and neonatal death. Since evidence-supported decision-making in low-income countries is becoming high in demand, the economic evaluation of the MCH Voucher Scheme was conducted as a part of an ex-ante evaluation to determine whether the program should be implemented in Myanmar.

Methods

Model and design

A decision tree model was developed in Microsoft Excel 2007 to estimate the costs and outcomes of the pregnant women and child from the MCH Voucher Scheme compared to the current situation. Figure 2 illustrates the decision tree for predicting the costs and consequences of the Voucher Scheme compared to the current practice in Myanmar. The square node represents the point where a decision should be made about whether to implement the Voucher Scheme, while the circular nodes represent possible events that can occur following each decision. Pregnant women were defined by specific health conditions, which are categorized as either a high-risk pregnancy or not. These women have a chance of receiving ANC and delivery either from skilled attendants or traditional birth attendants. The outcomes for mothers include healthy, maternal morbidity and death. Meanwhile, the outcomes for the child include alive without co-morbidity, low birth weight/preterm baby and death. The study was conducted in regards to the Myanmar context using the societal viewpoint, with a hypothetical cohort of pregnant women aged 25–29 years old and their newborn child.

Model inputs

The model input for this ex-ante evaluation primarily aimed at using domestic and locally relevant local information since its objective was to inform policy makers in Myanmar. However, the scarcity of some information in Myanmar where local data is not available, then regional or international information with comparable socio-economic context was selected. The international information from other settings including high-income country will be used as the last resources. Lastly, when there was no information available, opinion from local experts or local relevant authority were used by conducting an expert consultation meeting and the same meeting was organized to validate the model parameters as well. Details of the participant list can be found from <http://www.hitap.net/en/research/>

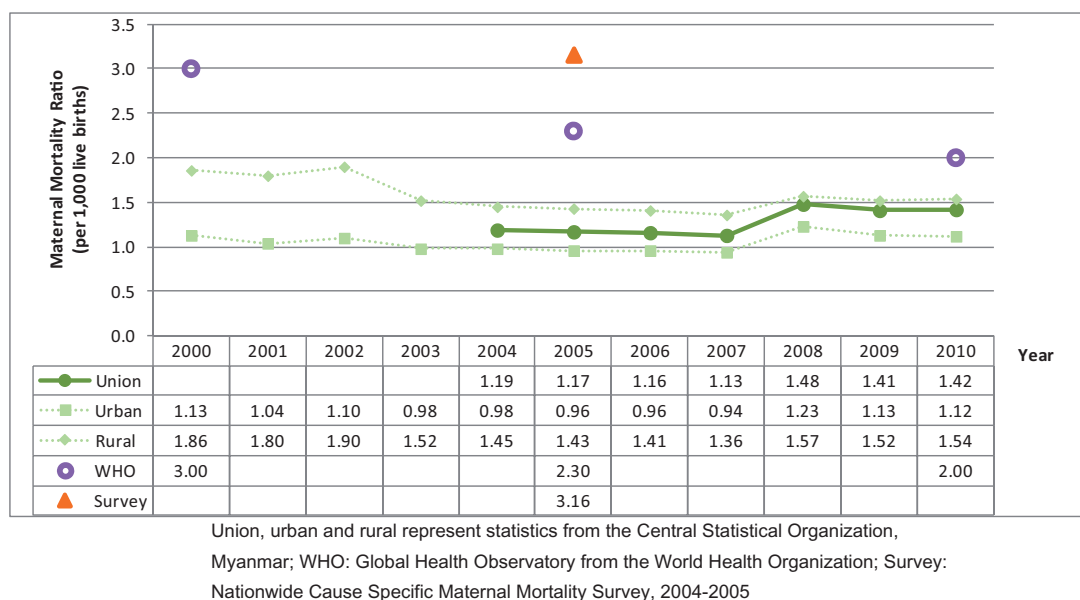


Figure 1. Comparing the maternal mortality ratio (per 1000 live births) among different sources of data

17680 (Republic of Union of Myanmar Ministry of Health *et al.* 2010).

The preliminary result of this study, including all parameters used, were presented to stakeholders in total of 28 people comprised with the WHO expert; directors, senior officers and officers from Department of Health and the Department of Health Planning, Ministry of Health; and medical officers and midwives from Yedashe and Tatkone townships on March 15th, 2011 in Ministry of Health, Nay Pyi Taw (Republic of Union of Myanmar Ministry of Health *et al.* 2010). Key input parameters used in the decision models are summarized in Table 1.

Epidemiological data

Baseline information of the current situation regarding the service utilization of ANC and delivery in Myanmar was retrieved from a community survey conducted by authors in two townships, Yedashe and Tatkone, during September and November 2010. The two townships were purposely selected as they were originally planned pilot sites if the MCH Voucher Scheme found feasible and good value-for-money. These two townships are located in Bago (East) and Mandalay region (delta area and plain terrain, respectively), with mixed urban and rural, with more than 70% of the population residing in rural. The antenatal care coverage in these two regions are higher than the national average (70.6 and 69.2%, respectively, compared to the 68.2% of the national average) (Ministry of Health 2010b).

Detail methods and study sampling of the community survey are available at <http://www.hitap.net/en/research/17680>. The community survey identified 73% and 51% of the samples as having ANC and delivery by SBAs, respectively. Moreover, around 21% of pregnant women received ANC at home while only 19% delivered their child at health facilities.

Baseline mortality and morbidity of pregnant women and newborns were retrieved from the national statistics. Myanmar's Annual Public Health Statistics in 2008² reported a maternal mortality rate of 3.16, a neonatal mortality rate of 16.13, and a low birth weight rate of 150 per 1000 live births (Ministry of Health 2010). However, statistics for the maternal morbidity rate were not

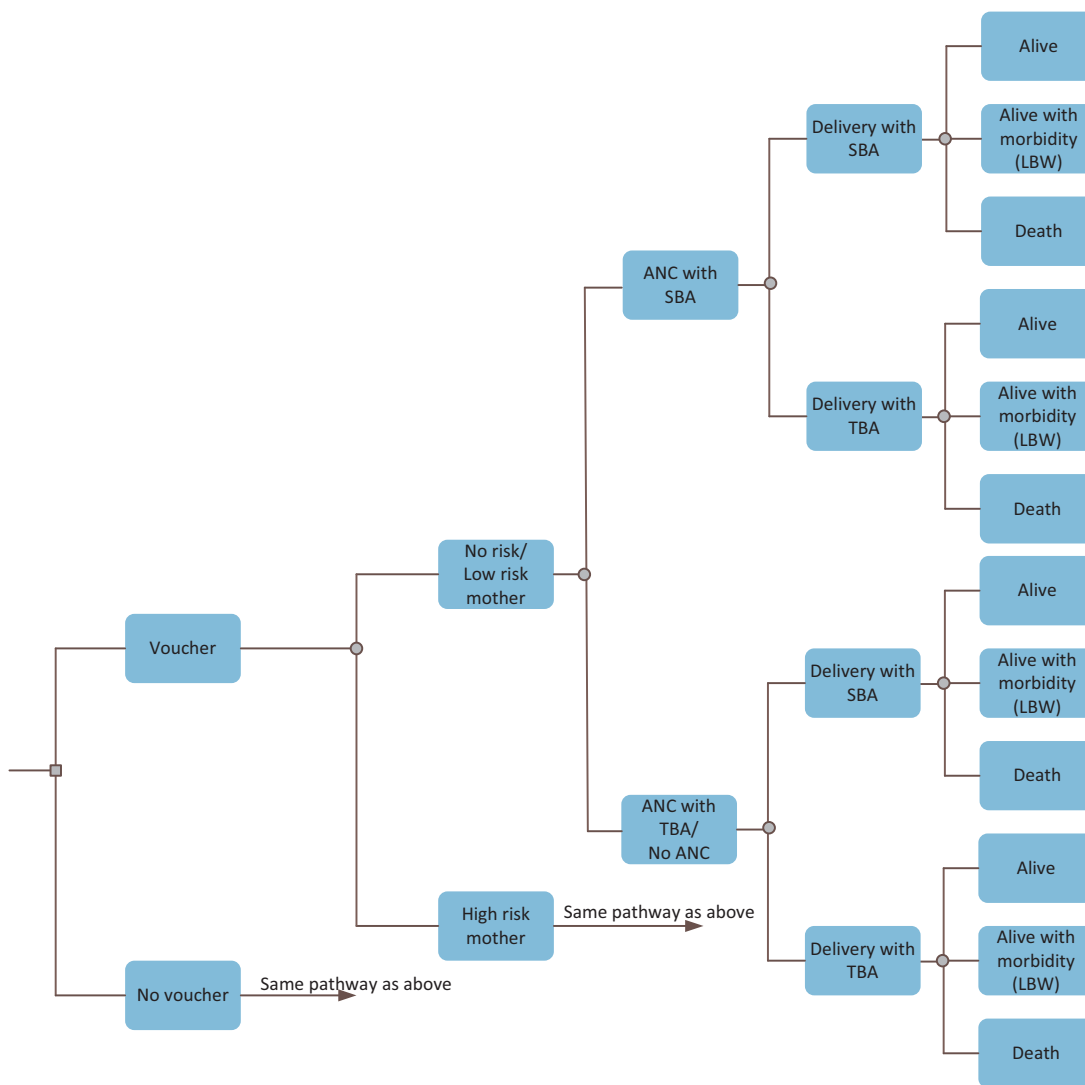
available in the report and Ministry of Health experts agreed to assume that the rate is approximately 10 times higher than the maternal mortality rate (Republic of Union of Myanmar Ministry of Health *et al.* 2010).

Costs of the MCH Voucher Scheme

Since the MCH Voucher Scheme will be designed to reduce the financial burden of pregnant women, information on the unit cost of providing services at different levels of healthcare providers (provider side) and household expenses on receiving the services (societal side) are vital. The unit costs of ANC and delivery services at different level of facilities were also collected in 17 from different level of health facilities in Yedashe and Tatkone using self-administrative costing questionnaires (for ANC and delivery services). For township hospitals, maternal and child health centres, station hospitals, all health facilities were selected as a sample in this study whereas 10 sub-centres were randomly selected to represent 48 subcentres in these two townships. Details of survey including data collection form are available in the full report at <http://www.hitap.net/en/research/17680>. The unit cost of providing health services was calculated only from materials used and labour cost; capital cost was not included as most of the buildings were used for more than 20 years and machines were used for longer than 5 years.

For household expenses related to pregnancy and child delivery, a face-to-face interview using structured questionnaire was carried out by trained staff from the Myanmar Ministry of Health in 25 villages from Yedashe and Tatkone between September and November 2010 in order to interview 215 pregnant women and 97 new mothers who had given birth not more than 30 days previously. Productivity loss was obtained from the average loss of income of relatives who accompanied the pregnant women and new mothers for each service (details of survey method and its questionnaire are available at <http://www.hitap.net/en/research/17680>).

For the cost of treating maternal complications, which was identified from the emergency obstetric report conducted in 2008 (Department of Health *et al.* 2010). The cost of hospitalization for low birth weight infants were retrieved via standard costing from the Thai health system (Riewpaiboon 2011). The cost was converted



ANC: antenatal care; SBA: skilled birth attendants; TBA: traditional birth attendants; LBW: low birth-weight, the outcomes for children are different from those for pregnant women

Figure 2. Decision tree illustrating the pathway of the MCH Voucher Scheme

to kyats using a purchasing power parity (PPP) conversion rate and all costs obtained from literature review were converted into the analysis year of 2010 using the average consumer price index (International Monetary Fund 2010).

Effectiveness

Effectiveness of the Voucher Scheme

The effectiveness of the Voucher Scheme as a demand-side financing tool to reduce financial burden and improve access to and utilization of SBA services is not available in the Myanmar context. As this is an ex-ante evaluation of the Voucher Scheme, the effectiveness of the program was derived from the price elasticity of demand for public health services. The price elasticity of demand is a measurement used to show the responsiveness of the quantity demanded of goods or services with respect to changes in price.

There is currently no direct price elasticity of demand toward maternal and child health in Myanmar. As such, we obtained data from another country with a similar economic status where the price

elasticity of demand ranged from 0.2 to 1.5, as suggested by Ensor (2005). Therefore, the data from Nepal were used as the two countries had similar levels of per capita income: 1246 PPP\$ in Myanmar 1250 PPP\$ in Nepal in 2010. In Nepal, the introduction of demand-side financing tools for child health services resulted in a price elasticity of demand of 0.2–0.4.

For the base-case analysis, the most conservative assumption was used by indicating that the price elasticity of demand for ANC and delivery from SBA equal to 0.2. This means that if the price changes by 1%, then the demand for ANC with SBAs will increase by 0.2%. It can be calculated using the following formula:

$$Ed = \frac{\% \text{ change in ANC (or delivery) received from SBA}}{\% \text{ change in price}}$$

Effectiveness of services delivered by skilled birth attendants

ANC and care during delivery by SBAs can minimize the risk of mortality and morbidity for both mother and child. The

Table 1. Model parameters, values, parameter distributions and data sources used in the decision tree model

| Parameters | Mean (SE) | Parameter distribution | Data source |
|---|----------------------|------------------------|---|
| <i>Health service utilization</i> | | | |
| Baseline probability of seeking ANC with SBAs | 0.73 (0.03) | Beta | Survey |
| Baseline probability of delivery with SBAs | 0.51 (0.04) | Beta | Survey |
| Probability of receiving ANC at home | 0.21 (0.03) | Beta | Survey |
| Probability of delivery in health facility | 0.19 (0.04) | Beta | Survey |
| <i>Epidemiological data</i> | | | |
| Proportion of high-risk pregnancy | 15% (0.42%) | Beta | (Majoko <i>et al.</i> 2005) |
| Maternal mortality rate (per 1000 live births) | 3.16 (0.7) | Beta | (Ministry of Health 2005) |
| Maternal morbidity rate (per 1000 live births) | 31.6 ^b | Beta | Expert opinion |
| Neonatal mortality rate (per 1000 live births) | 16.13 ^b | Beta | (Ministry of Health 2010) |
| Low birth weight infant (per 1000 live births) | 150 ^b | Beta | (Ministry of Health 2010) |
| <i>Relative risk</i> | | | |
| Odd ratio of maternal mortality, high-risk | 9.3 (0.87) | Gamma | (Gupta <i>et al.</i> 2010) |
| Relative risk of maternal morbidity, any complications | 1.82 ^b | Gamma | (Majoko <i>et al.</i> 2005) |
| Relative risk of perinatal death, high risk | 1.56 (0.39) | Gamma | (Majoko <i>et al.</i> 2005) |
| Relative risk of low birth weight, high risk | 1.97 (0.28) | Gamma | (Majoko <i>et al.</i> 2005) |
| Relative risk of maternal mortality, ANC with non-SBA | 1.18 (0.30) | Gamma | ^a |
| Relative risk of maternal morbidity, ANC with non-SBA | 1.18 (0.30) | Gamma | Expert opinion |
| Relative risk of neonatal mortality, inadequate ANC | 1.42 (0.04) | Log normal | (Chen <i>et al.</i> 2007) |
| Relative risk of low-birth weight infants, ANC with non-SBA | 2.0 ^b | Gamma | Expert opinion |
| Relative risk of maternal mortality, deliver with non-SBA | 1.94 (0.62) | Gamma | ^a |
| Relative risk of maternal morbidity, deliver with non-SBA | 1.94 (0.62) | Gamma | Expert opinion |
| Relative risk of neonatal mortality, deliver with non-SBAs | 2.7 (1.35) | Gamma | (Lawoyin <i>et al.</i> 2010) |
| <i>Unit cost of health services (kyats 2010 price year)</i> | | | |
| Cost of treating mother who has complications | 127 964 (9950) | Gamma | (Department of Health <i>et al.</i> 2010) |
| Cost of treating LBW new born | 150 010 ^b | Gamma | (Riewpaiboon 2011) |
| Antenatal care at township hospital level | | Gamma | Survey |
| - 1 st visit | 16,355 (454) | | |
| - Subsequent visit | 3,915 (234) | | |
| Antenatal care at MCH hospital level | | Gamma | Survey |
| - 1 st visit | 16 895 (1521) | | |
| - Subsequent visit | 3983 (948) | | |
| Antenatal care at station hospital level | | Gamma | Survey |
| - 1st visit | 22 988 (6528) | | |
| - Subsequent visit | 6965 (3225) | | |
| Antenatal care at sub-centre level | | Gamma | Survey |
| - 1st visit | 16 441 (371) | | |
| - Subsequent visit | 3935 (367) | | |
| Delivery at township hospital | 38 953 (15 291) | Gamma | Survey |
| Delivery at MCH hospital | 10 631 (5571) | Gamma | Survey |
| Delivery at station hospital | 19 460 (5101) | Gamma | Survey |
| Delivery at sub-centre | 15 039 (1335) | Gamma | Survey |
| <i>Patient cost (kyats 2010 price year)</i> | | | |
| Antenatal care received from traditional birth attendants | | Gamma | Survey |
| - Cost of antenatal care | 500 (387) | | |
| - Transportation cost | 667 (494) | | |
| Antenatal care received from SBAs at home | | Gamma | Survey |
| - Cost of antenatal care | 436 (160) | | |
| - Transportation cost | 427 (67) | | |
| Antenatal care received from SBAs at health facility | | Gamma | Survey |
| - Cost of antenatal care | 1140 (197) | | |
| - Transportation cost | 427 (67) | | |
| - Productivity loss | 535 (137) | | |
| Delivery received from traditional birth attendants | | Gamma | Survey |
| - Direct medical cost | 12 239 | | |
| ✓ Fee to traditional birth attendants | 9097 (1022) | | |
| ✓ Fee to anyone else | 1435 (608) | | |
| ✓ Gifts for traditional birth attendants | 335 (152) | | |
| ✓ Cost of drugs/supplies purchased from government health facilities | 581 (490) | | |
| ✓ Cost of drugs/supplies purchased outside government health facilities | 661 (240) | | |
| ✓ Clean delivery kits | 129 (129) | | |

(continued)

Table 1. Continued

| Parameters | Mean (SE) | Parameter distribution | Data source |
|---|------------------------|------------------------|----------------------------------|
| - Direct non-medical cost | | | |
| ✓ Food | 903 (644) | | |
| - Productivity loss of accompanying person | 15 081 (3074) | | |
| Delivery received from SBAs at home | | Gamma | Survey |
| - Direct medical cost | 18 115 | | |
| ✓ Fee to health professional | 13 344 (1227) | | |
| ✓ Fee to anyone else | 1148 (345) | | |
| ✓ Gifts for staff | 577 (226) | | |
| ✓ Cost of drugs/supplies purchased from government health facilities | 833 (560) | | |
| ✓ Cost of drugs/supplies purchased outside government health facilities | 2021 (616) | | |
| ✓ Clean delivery kits | 192 (139) | | |
| - Direct non-medical cost | | | |
| ✓ Food | 565 (226) | | |
| - Productivity loss of accompanying person | 13 579 (2815) | | |
| Delivery received from SBAs at health facility | | Gamma | Survey |
| - Direct medical cost | 25 111 | | |
| ✓ Registration fee | 56 (25) | | |
| ✓ Fee to health professionals | 15 167 (4647) | | |
| ✓ Gifts for staff | 944 (659) | | |
| ✓ Cost of drugs/supplies purchased from government health facilities | 7778 (2049) | | |
| ✓ Cost of drugs/supplies purchased outside government health facilities | 1167 (860) | | |
| - Direct non-medical cost | 26 578 | | |
| ✓ Accommodation for pregnant women | 1694 (668) | | |
| ✓ Accommodation for accompanying person | 1389 (1389) | | |
| ✓ Food | 11 278 (3647) | | |
| ✓ Washing clothes or cleansing | 828 (364) | | |
| ✓ Transportation cost to health facilities | 11 389 (2926) | | |
| - Productivity loss of accompanying person | 15 689 (4624) | | |
| Cost of voucher production (kyats) | 1340 ^b | Gamma | ^c |
| Outcome measure | | | |
| Life expectancy at birth | 54.40 | | (World Health Organization 2011) |
| Life expectancy at 28 years old | 42.80 | | (World Health Organization 2011) |
| Disability weight | | | |
| Vary from low birth weight to birth asphyxia and birth trauma | 0.106 (0.372–0.106) | Beta | (World Health Organization 2004) |
| Vary from stress incontinence to obstructed labour | 0.093 0.43–0.025 | Beta | (World Health Organization 2004) |

MCH = Maternal and Child Health Centre; SE = standard error.

^aCalculation based on data from the Nationwide Cause Specific Maternal Mortality Survey.

^bAssume standard error equals to mean values.

^cBased on the actual voucher production.

effectiveness of services provided by SBAs was measured in terms of the reduction of the mother and child's mortality and morbidity. Its effectiveness is context-specific and should therefore be derived from the Myanmar context. However, the amount of available information in Myanmar is limited. The Nationwide Cause Specific Maternal Mortality Survey conducted in 2004–2005 reported the care-seeking behaviour of deceased pregnant women (Ministry of Health 2005). Maternal mortality was higher for those who had unattended antenatal care or non-skilled attendants compared to skilled attendants, but this relationship was not significant (RR = 1.18; 95% CI: 0.72–1.91). Also, for delivery with non-skilled practice, the maternal mortality was significantly higher compared with skilled attendants (RR = 1.94; 95% CI: 1.07–3.51). There was no report available in Myanmar regarding maternal morbidity; hence, the relative risk of maternal morbidity was assumed to be equal to maternal mortality, based on expert opinions from the

expert consultation meeting in the Ministry of Health, Myanmar (Republic of Union of Myanmar Ministry of Health *et al.* 2010).

Prematurity, birth asphyxia and sepsis are the three main causes for neonatal deaths in Myanmar (Women and Child Health Development Project 2003). However, there were no data available regarding whether the mother received ANC or delivery care from SBAs. From a USA national survey, low-risk pregnant women who received inadequate ANC had a higher neonatal mortality rate than those that received adequate ANC (RR = 1.42; 95% CI 1.39–1.46) (Chen *et al.* 2007). Lawoyin *et al.* (2011) found that the levels of neonatal mortality among pregnant women who delivered by non-SBAs were higher than among those who delivered by SBAs (RR = 2.7; 95% CI 1.1–6.4) (Lawoyin *et al.* 2010). The risk of having low birth weight infants was assumed to be two times higher than for pregnant women who had ANC by SBAs (Republic of Union of Myanmar Ministry of Health *et al.* 2010).

Majoko *et al.* (2005) reported the proportion of high-risk pregnancies to be 15% of the total number of pregnancies (Majoko *et al.* 2005). Complications during the antenatal period were found to be a significant factor which increased the risk of maternal death (OR = 9.30; 95% CI 7.70–11.16) and the risk of maternal morbidity (RR = 1.82) (Gupta *et al.* 2010). In addition, high-risk pregnancy increases the risk of perinatal death (RR = 1.56; 95% CI 0.98–2.49) and low birth weight (RR = 1.97; 95% CI 1.50–2.58) compared to low-risk pregnancies (Gupta *et al.* 2010).

The figures for life expectancy at birth and life expectancy for pregnant women were obtained from the Myanmar Life Table (World Health Organization 2004). The life expectancy at birth was reported to be 54.40 years in 2008. From the community surveys, the average age of pregnant women was 28 years; therefore the life expectancy of pregnant women was 42.80 years. Regarding the limited data, the Thai burden of diseases project indicates that the life expectancy of low birth weight infants was shorter than that of normal birth weight infants by ~0.05 years, and the life expectancy of women with maternal morbidity was 0.01 years shorter than that of mothers without maternal morbidity (Thai Working Group on Burden of Disease and Injuries 2007). The disability weights of maternal and neonatal morbidity were from the global burden of disease 2004 update, the World Health Organization (World Health Organization 2004).

Data analysis

The probability of death and morbidity given (1) pregnancy risk, (2) receiving ANC by SBAs and (3) receiving delivery by SBAs can be calculated using the probability theory. From this, conditional

probabilities can be calculated using the formula below (Drummond and McGuire 2001):

$$P(C) = P(C|S) \times P(S) + P(C|N) \times P(N)$$

$$RR = \frac{P(C|S)}{P(C|N)}$$

$$P(C|N) = \frac{P(C)}{1 - P(S) + RR \times P(S)}$$

$$P(C|S) = \frac{RR \times P(C)}{1 - P(S) + RR \times P(S)}$$

The conditional probabilities of all conditions were calculated and presented in Tables 2 and 3.

The incremental cost-effectiveness ratio was then calculated by dividing the incremental cost of the MCH Voucher Scheme compared with the current situation by the incremental effectiveness, in terms of life-year saved or disability-adjusted life year (DALY) averted.

Results

Expected service utilization

From the current situation, the service utilization of skilled attendants was 73% for ANC and 51% for delivery, respectively. For the base-case analysis which used a conservative assumption where every 1% of household payments is subsidized, the service utilization of skilled attendants increased by 0.2% (Ed = 0.2). When the MCH voucher with full subsidization (88 513 kyats) is available for pregnant women, it is expected that the utilization of ANC and

Table 2. Conditional probabilities for maternal mortality and maternal morbidity given pregnancy risk, antenatal care and delivery by skilled attendants

| Conditions | | | Conditional probabilities | | |
|------------|---------------------------------|---------------------------------|---------------------------|-----------|--------|
| Pregnancy | Antenatal care | Delivery | Healthy | Morbidity | Death |
| Low risk | By SBAs | By SBAs | 0.9135 | 0.0799 | 0.0066 |
| Low risk | By SBAs | By traditional birth attendants | 0.8913 | 0.1001 | 0.0086 |
| Low risk | By traditional birth attendants | By SBAs | 0.9077 | 0.0852 | 0.0071 |
| Low risk | By traditional birth attendants | By traditional birth attendants | 0.8854 | 0.1054 | 0.0091 |
| High risk | By SBAs | By SBAs | 0.8787 | 0.1030 | 0.0183 |
| High risk | By SBAs | By traditional birth attendants | 0.8564 | 0.1233 | 0.0203 |
| High risk | By traditional birth attendants | By SBAs | 0.8728 | 0.1084 | 0.0188 |
| High risk | By traditional birth attendants | By traditional birth attendants | 0.8506 | 0.1286 | 0.0209 |

Table 3. Conditional probabilities for neonatal mortality and maternal morbidity given pregnancy risk, antenatal care and delivery by skilled attendants

| Conditions | | | Conditional probabilities | | |
|------------|---------------------------------|---------------------------------|---------------------------|-----------|--------|
| Pregnancy | Antenatal care | Delivery | Healthy | Morbidity | Death |
| Low risk | By SBAs | By SBAs | 0.7128 | 0.2491 | 0.0381 |
| Low risk | By SBAs | By traditional birth attendants | 0.6979 | 0.2491 | 0.0530 |
| Low risk | By traditional birth attendants | By SBAs | 0.5887 | 0.3671 | 0.0442 |
| Low risk | By traditional birth attendants | By traditional birth attendants | 0.5738 | 0.3671 | 0.0591 |
| High risk | By SBAs | By SBAs | 0.5774 | 0.3762 | 0.0465 |
| High risk | By SBAs | By traditional birth attendants | 0.5625 | 0.3762 | 0.0614 |
| High risk | By traditional birth attendants | By SBAs | 0.4533 | 0.4942 | 0.0525 |
| High risk | By traditional birth attendants | By traditional birth attendants | 0.4384 | 0.4942 | 0.0674 |

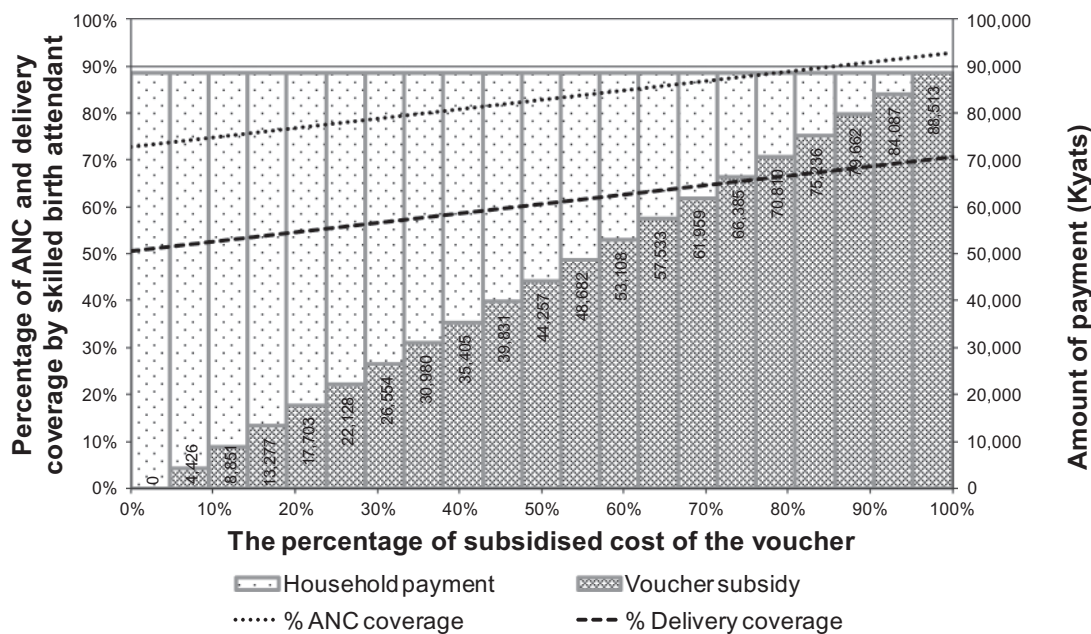


Figure 3. The percentage of service utilization where subsidies were varied for households through the Maternal and Child Health Voucher Scheme

Table 4. Costs and outcomes of the current situation of maternal and child health services and the Maternal and Child Health (MCH) Voucher Scheme

| | Mother | Child | Total |
|---|---------|--------|---------|
| Current situation | | | |
| Cost (kyats) | 73 865 | 45 003 | 118 868 |
| Life year | 42.39 | 51.75 | 94.15 |
| Disability Adjusted Life Year (DALY) | 0.41 | 2.66 | 3.08 |
| MCH Voucher Scheme | | | |
| Cost (kyats) | 173 162 | 41 462 | 214 624 |
| Life year | 42.42 | 51.98 | 94.40 |
| DALY | 0.39 | 2.43 | 2.83 |
| Incremental cost (kyats) | | | 95 756 |
| Incremental life year saved | | | 0.2513 |
| Incremental DALY averted | | | 0.2531 |
| Incremental Cost Effectiveness Ratio (kyats per DALY averted) | | | 381 027 |

delivery from SBAs will increase up to 93 and 71%, respectively. Figure 3 shows the percentage of ANC and delivery coverage by SBAs when the amount of payment from the Voucher Scheme varies at different levels of subsidization of the total expenses.

Expected costs and health outcomes

From the societal viewpoint, the total cost of current MCH services was 118 868 kyats. The MCH Voucher Scheme would require an additional 95 756 kyats per pregnant women. It is expected that the MCH Voucher Scheme will save 251 life-years for every 1000 vouchers distributed to pregnant women compared to the current situation. The incremental cost-effectiveness ratio of providing the MCH Voucher Scheme was 381 027 kyats per DALY averted. Table 4 shows the cost and outcome break-down of the current situation as well as the MCH Voucher Scheme.

Sensitivity analysis

The value of the MCH Voucher Scheme depends on the percentage of subsidized cost of the voucher and the price elasticity of maternal

and child health services. Figure 4 shows the incremental cost-effectiveness ratio of the MCH Voucher Scheme compared with the current situation when the percentage of subsidized cost of the voucher varies, and the price elasticity of maternal and child health services.

Given the uncertainty of all input parameters, a probabilistic sensitivity analysis was carried out using a second-order Monte Carlo simulation of 1000 times. Cost-effectiveness acceptability curves were provided to show the relationship between the values of the willingness-to-pay for a DALY averted and the probability of the MCH Voucher Scheme being cost-effective (Figure 5); the World Health Organization recommended the threshold range of 1–3 times gross domestic product (GDP) per capita to determine whether health intervention or programs are cost-effective. GDP per capita in 2010 was 591 742 kyats or 1246 international dollars (I\$) (International Monetary Fund 2010). At a willingness-to-pay threshold of 600 000 kyats, the MCH Voucher Scheme had a 52% chance of being a cost-effective option in the base-case scenario. However, when we varied the elasticity of demand for maternal and child health services, the probability of the MCH Voucher Scheme becoming cost-effective

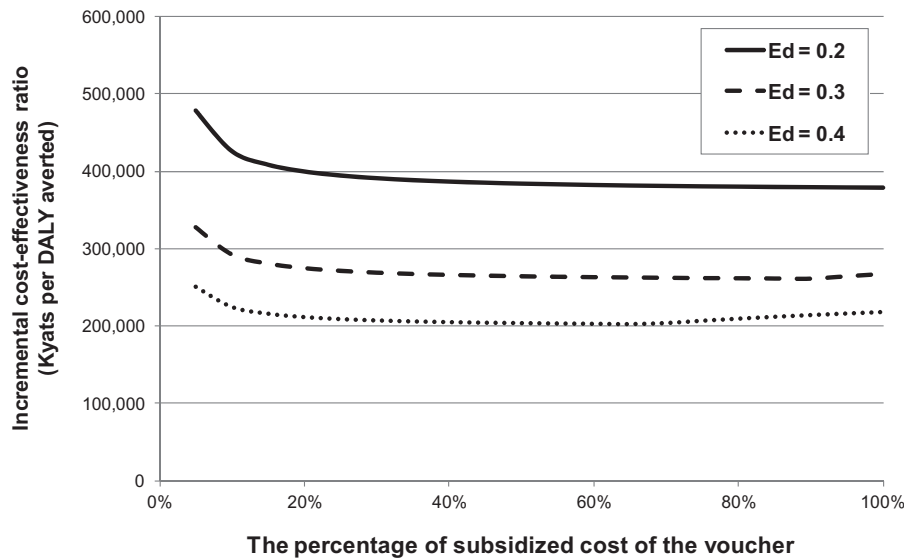


Figure 4. One-way sensitivity analysis of the incremental cost-effectiveness ratio of the Maternal and Child Health Voucher Scheme compared with current situation

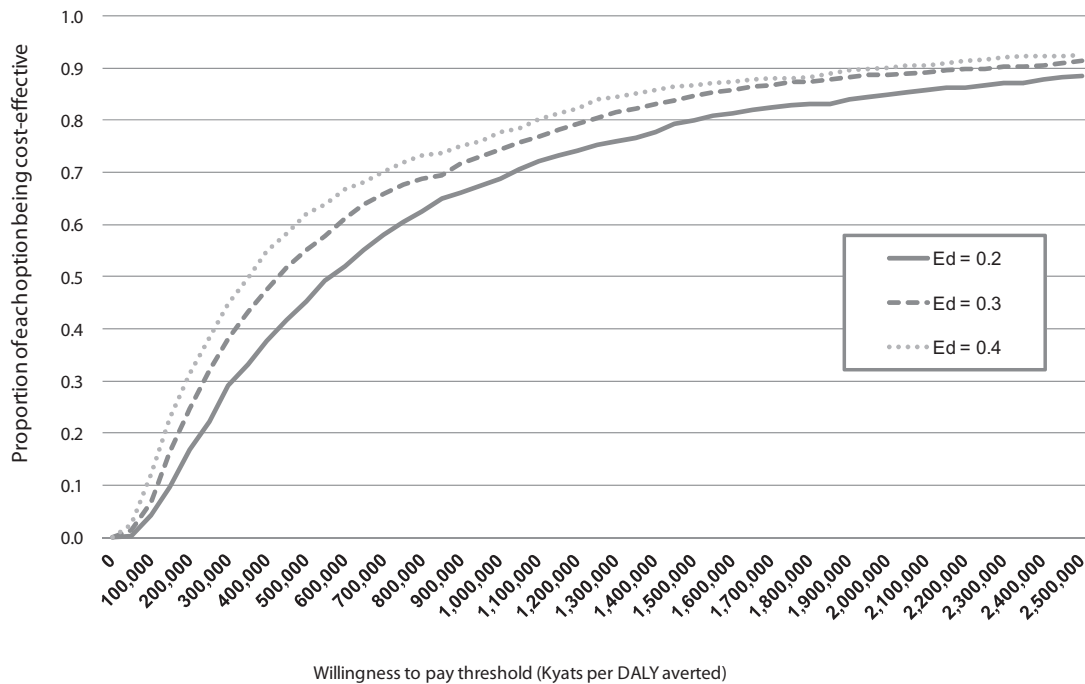


Figure 5. Cost-effectiveness acceptability curves of the Maternal and Child Health Voucher Scheme by different price elasticity of demand for maternal and child health services

increased to 61 and 67% at a price elasticity of demand of 0.3 and 0.4, respectively. For the threshold of around three times of GDP per capita (1 800 000 kyats/DALY averted), the probability of the MCH Voucher Scheme being a favourable option was 83, 87 and 88% when the price elasticity of demand was equivalent to 0.2, 0.3 and 0.4, respectively.

Discussions

Vouchers as a demand-side financing tool has been shown to overcome financial barriers, as well as psychological and social barriers, in

order to receive health services. This research was part of a feasibility study of the MCH Voucher Scheme that showed the benefits and feasibility of the project. This ex-ante economic evaluation suggests that the MCH Voucher Scheme is very cost-effective under the Myanmar context, meaning that the effectiveness of the program would outweigh its costs. Based on this result, the MCH Voucher Scheme was implemented in one pilot township, Yedashe, in May 2013 (Ministry of Health 2012). This manuscript aims to report what research team relayed to decision makers in order to avoid conflicting information provided between the national and international community. However, more updated data for particular parameters became

available after this study was completed such as the increase in life expectancy at birth and at different age groups. Utilizing the updated information, the MCH Voucher Scheme's ICER further decreased by 17% and thus is still considered to be cost-effective.

As the first cost-utility analysis of health technologies in Myanmar using the societal perspective where all expenses from households were calculated, this study will help the allocative efficiency across different health interventions in the future. It includes the primary work for a costing study of ANC and delivery services provided by the public health facilities at different levels of health providers, including township hospitals, MCH hospitals, station hospitals and subcentres, and also the expenses shouldered by households on MCH services. This model and its parameters were validated by local stakeholders comprising public health experts and clinicians at different healthcare levels and as such, the results from the study were widely accepted by local health authorities.

While there were plans on the economic evaluation of two large-scale demand-side financing programs for maternal health in India (Sidney *et al.* 2012), to the best of our knowledge, this is the first cost-utility analysis of using vouchers as a demand-side financing tool for maternal and child health services in the world. This study can be used as a model for similar studies in other settings where economic barriers remain a major obstacle of maternal and child health services utilization. Although one strong criticism about economic evaluation is that it does not properly take the dimension of equity into account, studies on demand-side financing for maternal and child health services have shown improvements of services utilization from skilled attendants and reduced equity gaps by improving access to maternal and child health services among poor pregnant women (Ir *et al.* 2010; Powell-Jackson *et al.* 2009; Schmidt *et al.* 2010; Ahmed and Khan 2011; Nguyen *et al.* 2012). The analysis in this study did not target the poor; however, the better-off group of pregnant women will opt out from the voucher program. Therefore, there is a need to ensure that vouchers will be distributed to the target population.

There are three weaknesses in this study. The first is that although most of the costing used in the study was from the Myanmar context, the costs of management of low birth weight infants was retrieved from a costing study in Thailand due to a lack of unit cost data in low-income countries. These costs may be overestimated as there are differences between the health care systems and infrastructure. The second weakness of the study was the lack of information on the price elasticity of demand for maternal and child health services of pregnant Myanmar women. Therefore, the price elasticity of maternal and child health services in Nepal was used in this analysis. However, the work on the pilot program in Yedashe should be able to provide the true price elasticity of demand for further analyses. Result from a recent mid-term review of MCH in Yedashe indicated that the average increases in MCH services in Yedashe are similar to the previous estimate in this study, details are available in the full report at <http://www.hitap.net/en/documents/21221> (Republic of Union of Myanmar Ministry of Health *et al.* 2014). Moreover, the effectiveness of the services provided by SBA has evident the benefit. Systematic reviews are often placed at the top of the evidence hierarchy. However, this is a lack of comparative data of the effects from MCH services received by SBAs and traditional birth attendants and also the quality of methodology have been an issue of evaluating the impact of voucher schemes in low-income countries. Selective of studies matched the parameters needed in the model were selected as opposed to systematic review.

Voucher as a demand-side financing tool have become very popular in low-income settings. In countries where the provision of

universal health coverage has not been implemented, reducing financial risk by providing payments to offset costs (transportation, food, lodging and income loss) in order to receive MCH services sets a good example of a cost-effective intervention that can be included in the early development of benefit packages. In countries where the mortality rate is high and the life expectancy is low compared with Myanmar, this intervention has a greater chance of being preferable. However, it is also important that in such setting, the policy makers pay attention to the supply side as implementing the demand side financing to ensure availability of services and to ensure the capacity of services amongst health providers. The analysis in this study did not take an account of the capacity of supply-side. While the MCH Voucher Scheme primarily focuses on stimulating demand for MCH services, a payment was offered through the Voucher Scheme to providers for their services (subsidized for user fees) and travel costs. As a result, the MCH Voucher Scheme also provides a small amount of financial incentives to providers.

Conclusions

The results from this study show that the MCH Voucher Scheme seems to be feasible and has a good chance of being implemented in Myanmar with the aim of increasing the service utilization of ANC and delivery by SBAs, especially for poor households. Demand-side financing under the program is also expected to eliminate any provider fees that are currently paid by households and other household expenses related to the use of MCH services. If pregnant women have the choice of using the MCH vouchers at any health facility and there are enough incentives for providers to offer the services to voucher holders, it will promote the quality of MCH services and reduce both neonatal and maternal mortality. Readers looking to draw conclusions for policy decisions should however exercise caution insofar as the study is based on some parameters drawn from other settings and certain assumptions which may not be suitable in all contexts. Close monitoring and evaluation of these parameters and assumptions ahead of real policy implementation is recommended.

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Conflict of interest statement. None declared.

Ethical approval

The survey questionnaires were reviewed by the review panel of the Ministry of Health, Myanmar on the appropriateness of the questions and found no sensitive questions for further ethical approval.

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