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Costing and Economic Analysis of Strengthening Union Level Facility for Providing Normal Delivery and Newborn Care Services in Bangladesh

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ABBREVIATIONS

CC	Community Clinic
CEA	Cost-effective Analysis
DNCS	Delivery and Newborn Care Services
ESP	Essential Services Package
FWV	Family Welfare Visitor
HFWC	Health and Family Welfare Center
MDG	Millennium Development Goal
MMR	Maternal Mortality Ratio
MOHFW	Ministry of Health and Family Welfare
NMR	Neonatal Mortality Rate
U5 MR	Under-five Mortality Rate
UHC	Upazila Health Complex

CONTENTS

Background

For a long time, the reduction of maternal mortality ratio (MMR) has constituted a major challenge for the health, nutrition and population (HNP) sector of Bangladesh. Although the sector has achieved significant progress in many areas of service provision, MMR still remains unacceptably high. The recently published results of the 2010 Bangladesh Maternal Mortality and Health Care Survey (BMSS 2010) has shown that MMR has declined from 322 in 2001 to 194 in 2010, which appears to be a remarkable achievement, placing the country on the needed track to reach MDG 5 (NIPORT, 2011).[1]The momentum is to be maintained in the next five years so as to reach the MDG target by 2015. The task may not be as easy as it seems if the high inequity in the MMR decline that exists between areas is taken into account. MMR in the disadvantaged regions has to be drastically reduced to increase equity in maternal health and to ensure the trend of improvement in MMR reduction to continue.

Several studies have shown that the risk of mortality for mothers and newborns is highest between the third trimester and the first few days of birth, peaking the day of and in the 24 hours immediately after delivery (Hurt et al., 2008; Rousmans, et al., 2010). Skilled attendance at birth and access to emergency obstetric care are generally regarded as key interventions for improving maternal and newborn health, since most of the problems leading to mortality can be medically treated, although not predicted (Campbell and Graham, 2006). The findings of several surveys, including the 2010 BMSS maintain that eclampsia and hemorrhage are the two main causes of maternal death in Bangladesh (NIPORT, 2011; Koblinsky, et al., 2008), both of which have medical solutions. But the number of deliveries assisted by skilled attendants is very low in Bangladesh, only 26.5 percent. The rate is much lower in the northern regions (NIPORT, 2011). Around 85 percent of births are delivered at home, mostly in unsafe and unhygienic conditions. Trained traditional birth attendants assist 14 percent of births and untrained attendants assist the remaining 63 percent (HEU, 2010). Moreover, access to emergency obstetric care still remains dismally low in most areas of the country.

Over the last few decades, the under-five mortality rate (U5 MR) has significantly declined in Bangladesh. It has declined from 133/1000 in 1991 to 65/1000. The rate of annual decline (5.3%) is higher than the rate needed (4.5%) to achieve the MDG 4. But surprisingly, the neonatal mortality rate (NMR) has not declined at that rate. The NMR has decreased from 52 to 37 per 1000 during the same period, the rate being lowest as compared with the same of the under 5 group, 1-4 years group, and post neonates. As a result, neonatal mortality now accounts for 57 percent of the U5MR (Arifeen, 2008). It is unlikely that the rate of mortality decline in the other groups will remain so high (GOB, 2005) and hence, further decline in the NMR is urgently needed for achieving MDG 4.

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[1] It can be noted, the most recent survey of global maternal deaths has found maternal mortality has declined from 500000 to 358000 per year between 1990 and 2008 in the world, but 99 percent of deaths occur in the developing countries. See WHO, UNICEF, UNFPA and WB (2008). Furthermore, the Global Health Observatory has found the number of annual neonatal deaths worldwide at 3.1 million and 40 percent of child mortality is attributable to neonatal deaths (WHO, 2010).

Rapid decline in the MMR and NMR are needed not only for achieving the MDGs 4 and 5, but also for improving the overall reproductive and child health status of the population, increasing spatial and income equity of health status, accelerating poverty reduction, and raising the women empowerment and human rights indices. Improved maternal health and reduction of MMR require significant improvement of maternal health care services. Maternal health care has three levels or components: antenatal care, delivery care, and post natal care. Utilization of antenatal care services has been increasing over the years but the use of delivery and postnatal care services remains relatively low. Similarly, while use of the various types of child health care including immunization and post neonatal services have increased over the years; the rate of new born care services remains low. Only 19 percent of infants received a check-up from appropriate provider within second day of birth (NIPORT, 2008).

The Government of Bangladesh has been attaching high importance on rapid improvement of maternal and child health services for a long time. Despite this, utilization of delivery and newborn care services remains low due to a number of factors that include both the supply and the demand sides. On the supply side, the major problem is that the appropriate delivery and newborn care services do not exist in the nearby health facility. At present Upazila Health Complexes (UHCs) are the nearest possible facilities for the households where these services are available. But for most of these households, UHC which located in the upazila headquarters, is far away, given local road conditions and mode of transportation. Travelling to UHC involves a large cost in term of time and money. The rural women usually consider the upazila town as an urban area, situated outside their community and feel shy and uneasy in going to that facility since it is less familiar to them. In addition, unfriendly behavior of service providers and shortage of trained personnel exacerbate the problem by discouraging the women to go there. As a result, many women do not visit UHC even when they are willing to avail of the appropriate services.

It can be argued based on a priori reasoning and evidence that easy accessibility of households to affordable and acceptable health care services will greatly overcome the constraints and will increase utilization of delivery and newborn care services. In the rural areas, the first level service providing facility is the union level Health and Family Welfare (HFWC). The community clinics (CCs) are the lowest tier/type of the health facilities and these are located more close to the households than are the HFWCs. But the CCs are basically meant for organizing BCC campaign and community mobilization for increasing use of health and family planning (FP0 services; direct provision of health/FP services from there is limited. In fact, the CCs should be considered the auxiliary facilities of the HFWCs, conducting some activities that are complementary to the activities of the latter and doing so under the supervision of HFWC personnel. The delivery and newborn services need a moderately high level of medical services, given the level of risk and sensitivity involved in it, hence, the CCs will not be able to provide these services efficiently.

A priori reasoning suggests that availability of the delivery and newborn care services in HFWC will significantly increase accessibility of the households to these services and rapidly increase the

utilization of these services. HFWC is located in the neighborhood, close to all most all household residing in a union. Hence, the problems caused by the distance – travel time, travel cost and income loss, and cost of companion – will be reduced to the minimum level. Since HFWC is a permanent facility the households might be more familiar with the service providers and service provision mechanism of the facility. In addition, service providers of HFWC regularly organized satellite clinics in the locality increasing rapport with the people, specially the women. If the capacity of the HFWC is enhanced so that it can provide normal delivery and less complicated newborn care services and refer the complicated cases, including emergency obstetrics care, to the UHC, the target of reaching MDGs will be reached within the time frame.

Objectives and Hypothesis

The objectives of this study is to estimate the costs of the additional inputs required for strengthening HFWC for providing normal delivery and newborn care services, to assess the cost-effectiveness and, the financial implications of the addition of capacity in HFWC. The implicit hypothesis is that the investment for strengthening HFWC will generate high return in terms of quality-adjusted outputs and rapidly raise the use rates of the services, enabling the health sector to fully achieve MDGs 4 and 5 within the set timeframe.

Theoretical Background of the Intervention

The implicit issues in the study are:
- Will additional inputs increase use of two services?
- What will be the cost of increasing capacity of HFWC?
- Will the amount of costs be justified in terms of the cost-output ratio?
- Will the nature and trend of the cost function be reasonable and acceptable to the sector?
- Will the required finance as implied by the estimated costs feasible for the sector?

The simple microeconomic theories can be used to find the possible effects of additional investment (of the required type) on the use of the particular component of the essential services package (ESP) – delivery (referral for complicated cases included) and newborn care services. We assume that the interplay of the supply and demand functions as in a competitive market exists for ESP in the rural areas. [2]

We define supply of delivery and newborn care services (DNCS), which are the integral items of ESP, as the availability of the services with minimum necessary quality in the facilities located in the proximity of the households. True, some households, a very low proportion though, can and do receive these cares from the UHCs and even more distance sources. These few households are not considered here. Demand for the services refer to the willingness of the households (not just of only women) to use the appropriate cares from the nearby facilities even at monetary or real costs. Unmet need or the latent demand refers to the amount of services which is needed by the women and children but not sought by the households from the proper sources.

At present HFWC provides a large ESP, but it does not have the capacity to provide delivery and newborn care services. It is assumed that supply function of a HFWC is of the Keynesian type; it is perfectly elastic up to a point at which it becomes perfectly inelastic. It is perfectly inelastic within a range because provider cost (per client) does not increase as provision of ESP increases within that range. Thereafter, it becomes perfectly inelastic because the facility cannot increase supply at all even if there is demand for hitherto not provided components of ESP------delivery and newborn care services.

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[2] The assumption may appear restricted in several senses. The public sector facility rarely operates in a competitive market situation and the providers of the facilities rarely charge the full amount of cost upon the users. Hence, for the public sector activities there is no supply function and demand function as such and, hence, no equilibrium price. However, considered from a different viewpoint, it will appear that some forces like supply and demand exist since the cost of production, the root of the supply function, and willingness to pay and ability to pay, which form the basis of the demand function exist even for the public goods/services. The forces are usually called in literature pseudo-supply and pseudo-demand functions. Second, a public facility faces competition even in the rural areas. The competitors may be formal or informal providers. It may further be noted that operations of the market forces becoming more and more pronounced day by day everywhere with the increased marketisation of health care.

In Figure 1, S_0 is the initial supply function of the HFWC when the facility cannot provide DNCS. The initial demand function for ESP (without DNCS) is D_0. OU_0 amount of ESP is then used by the people in the union. If demand for ESP increases and the curve shifts to D_1, use of ESP (still without DNCS) increase to OU_1. But if the demand functions for ESP shifts further, to D_2, due to increased demand for DNCS, amount of use still remains at the earlier level (OU_1) since the supply function is unchanged.

Figure 1 Effect of increased supply on use of normal delivery and newborn care services
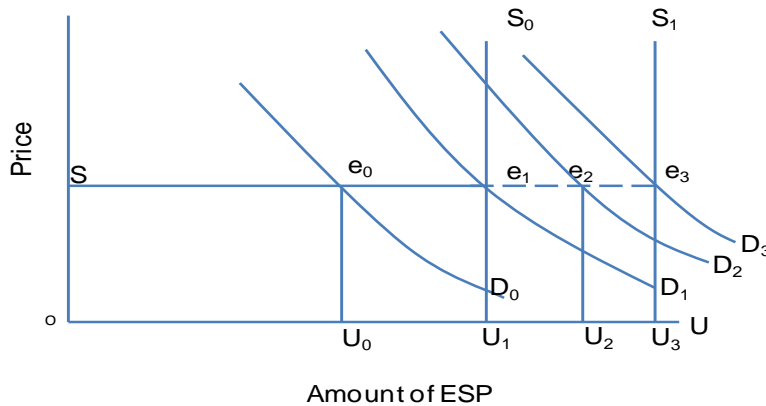
However, if the supply function shifts to S_1, then increased demand for DNCS will increase use of those services and thereby, of ESP too, to OU_2 amount. If demand for DNCS increases further and the curve shifts to D, use of DNCS will increase to OU_3 amount. It is expected that at equilibrium point e_3, all demand for DNCS and also that for ESP will be exhausted, and the supply capacity will fully match the demand. At e_3, total amount of use of ESP from the HFWC will be OU_3, of which U_1U_3 will be the amount of DNCS.

The shift in supply function from S_0 to S_1, resulting from the strengthening of HFWC, has increased use of normal delivery and newborn care services from zero amount to U_1U_3 amount. The shift in the supply function has been caused by the shift in the production function which, in turn, has been affected by the increased amount of expenditure. Figure 2 exhibits the relationship between change in expenditure and change in output (U) using the theory of production. A production function is defined as:

$$U = f(x_1, x_2, \ldots \ldots x_n)$$

where, U is output (use of care) and x_i is an input of production. The iso-cost line can be defined as:

$$C = r_1x_1 + r_2x_2 + \ldots \ldots + r_nx_n$$

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Where C is cost/expenditure for production and r_i is the price of x_i. In Figure 2, the initial production function is U_1 and iso-cost line is C_1. The equilibrium is determined at K. The increase in expenditure from C_1 to C_3 increased output from U_1 to U_3.

Figure 2 Change in expenditure causing change in output

Input 1

m

U_3

U_1

K

O

C_1

C_3

Input 2
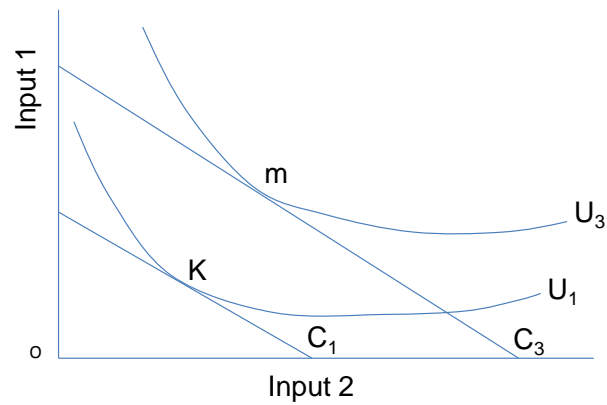
The main issue under study here is to estimate the average cost of the additional output, or to estimate the ratio:

$C_3\text{-}C_1/U_3\text{-}U_1=\Delta C/\Delta U$

Where, $U_3\text{-}U_1$ (or ΔU) is the amount of DNCS created by the additional investment $C_3\text{-}C_1$ (or ΔC).

Methodology

Sources of data

- An ingredient approach was followed. The additional inputs required for strengthening HFWC were selected based on the outcomes of a workshop and discussions with the service providers and public health experts.

- At present three types of HFWCs exist depending on the size of space (one-storied, two-storied and three-storied). Since the additional inputs depend on the existing space, additional space was identified for each type separately.

- Field visits were conducted to observe the functioning of HFWC, existing constraints to provide delivery and newborn care, and to assess the possible effects of strengthening on the supply and demand sides of DNCS.

- Data on costs of inputs were collected from different sources using the current market prices of inputs. The prices of inputs in the context of an average rural area were used as the parameters so as to obtain the minimum costs and ensure highest possible efficiency of input use.

- Information on additional outputs (use of DNCS) to be generated from strengthening of a HFWC were projected based on available data on pregnancies, discussion with the HFWC providers, and community stakeholders.

Method of computation of costs

- The costs of all inputs (line items) were added to obtain the total additional cost. Only the direct costs have been considered.

- The total additional costs have been calculated for two consecutive years. Since the costs have been calculated at the constant market prices of year 2011, the escalating factor (embodying the rate of inflation and the rate of interest) has not been used.

- The total annual cost for strengthening of all HFWCs of the country has also been computed.

Method of analyzing efficaciousness of the estimated costs

- The ratio of total additional cost to the current total cost of a HFWC was calculated to assess the proportion of increased cost.

- The total additional cost of a HFWC was divided into the relevant categories: capital and recurrent.

- Optimality of the estimated costs was examined using the standard criteria.

- The output/cost ratio (and B/C ratio) was estimated to assess, at least tentatively or crudely, the level of cost-effectiveness of strengthening project.

- Attempts were made to assess the possible resource envelope (including cost-recovery) and financial feasibility of the project in terms of estimated costs.

Results

As mentioned earlier, strengthening of HFWC will be brought about by adding some inputs to the existing volume of inputs of HFWC. Table 1 in the annexure shows the additional inputs required for strengthening a one-storied HFWC. The inputs have been categorized into broad six groups (cost centers):

- human resources
- infrastructure
- equipments and furniture
- delivery room materials
- labor ward logistics; and
- drugs.

It may be noted that a number of drugs will be needed for the delivery clients. The drugs will be supplied by the Ministry of Health and Family Welfare (MOHFW) free of charges, hence, these have not been considered as direct cost items. The costly line items are salary of one additional Family Welfare Visitor (FWV) and one additional aya in the human resource component, building additional rooms in the infrastructure category, one generator in the equipment and furniture category, and one equipped labor table, one oxygen cylinder and one sucker machine in the labor room.

Currently each HFWC has one FWV and most of the facilities are not providing delivery care. If the HFWC is to provide delivery care and ensure the availability of delivery care for 24 hours, one FWV will not be able to perform the additional task. Hence, one more FWV has to be recruited. The amount of physical space that exists in a one-storied HFWC will not be sufficient for conducting the additional activity. Two additional rooms should be constructed as an extension of the existing building; one to be used as reception and counseling room and the other as the office room of the new FWV. Then it will be possible to create one labor room within the existing building after making some adjustment and reorganization of the space therein. One generator is to be installed so that electricity is made available at the delivery time by way of overcoming the load shedding problem in the facility which still remains outside power connection. Equipped labor table, oxygen cylinder and sucker machine are the necessary equipments for a labor room. The inputs will differ only marginally by the type of structure of the HFWC. The only difference is that for a two-storied HFWC, one additional room has to be built and for a three-storied HFWC no additional space will be required.

Table 1 in the annexure also shows the estimated cost of each line item for each year for a one-storied HWFC calculated at the current market prices. The two types of inputs, capital and recurrent, were identified. The purchase price of each capital input was divided by its expected life years to obtain the average annual cost of the input. The total of recurrent costs and annualized

values of capital costs in each year yield the total cost in the year. The total costs for a two-storied and a three-storied HFWC are marginally lower than that for a one-storied HFWC.

Table 1 presents the estimated total cost in two years by major input groups and type of structure of the HFWC. The salary and allowances of the additional manpower is the largest cost item, constituting 64 percent of total cost. Total cost in two years will be highest (Tk. 678,020) for one-storied HFWC; the total cost for other two types of HFWC will be marginally lower.

Table 1 Estimated cost of strengthening one HFWC by structure and broad line items in two years (in thousand Tk.)

Category	1- storied	2-storied	3-storied
Human resource	432.0	432.0	432.0
Physical infrastructure	54.0	44.0	34.0
Equipments and furniture	65.0	65.0	65.0
Delivery room equipments and supplies	109.1	109.1	109.1
Labor ward logistics	15.0	15.0	15.0
Drugs	2.9	2.9	2.9
Total	**678.0**	**668.0**	**658.0**

Table 2 shows the amount of capital cost and recurrent cost to be incurred for a one-storied HFWC in Year 1. In the first year, a number of capital inputs will be purchased and, hence, capital cost will be higher (Tk. 447,700) than the recurrent cost (Tk. 307,500). In the second year, there will be no capital cost (except the small amount for repairing of equipments).

Table 2 Amount of capital and recurrent cost for a one-storied HFWC in year 1 (in thousand Tk.)

Category	Capital cost	Recurrent cost	Total cost
Human resources	-	216.0	216.0
Physical infrastructure	220.0	26.0	246.0
Equipments and furniture	85.0	24.0	109.0
Delivery room equipments and supplies	120.1	37.3	157.4
Labor ward logistics	22.6	2.8	25.4
Drugs	-	1.4	1.4
Total	**447.7**	**307.5**	**755.2**

The estimated amounts of capital and recurrent costs for one upazila in Year 1 have been shown in Table 3.

Table 3 Amount of capital and recurrent cost in one upazila in year 1
(in thousand Tk.)

Category	Recurrent cost	Capital cost	Total cost
Human resources	1512.0	-	1512.0
Physical infrastructure	112.0	1540.0	1652.0
Equipments and furniture	168.0	350.0	518.0
Delivery room equipments and supplies	261.0	845.6	1106.6
Labor ward logistics	19.6	158.2	177.8
Drugs	9.8	-	9.8
Total	**2,082.4**	**2,893.8**	**4,976.2**

Attempts were also made to divide the costs into two other categories: fixed and variable. It appeared that only drugs are the variable inputs here; all other inputs are fixed and costs of those inputs remain constant at all levels of output. It has been estimated that the total cost of drugs for an average delivery care will be Tk.200 approximately. It is assumed that the government will supply drugs free of cost, as is done at present. However, since the number of clients will increase in the HFWC after implementation of the intervention, the amount supplied by the government may not fulfill the entire demand. We have assumed that the supply by the government will cover 80 percent of total demand by the delivery clients (Tk.160 per client). Since no additional cost will be incurred for this by the HFWC, we have not included this amount in the estimate of direct cost. The facility will have to buy the remaining 20 percent of drugs from the market and thus spend Tk. 40 for each client. This amount has been considered as the variable cost of the intervention. The total variable cost for each HFWC will be Tk.1440 (assuming 360 clients) in a year and the same for an upazila will be Tk. 100,800. The total variable cost for the country will be Tk.463.68 lac per year.

The amount of cost per client will be low in each type of HFWC, as shown in Table 4. We assumed that each facility will be able to conduct one delivery each day on average and 360 deliveries will be conducted in a year. The per client cost then will be Tk. 940 in one-storied HFWC, Tk. 926 in two-storied HFWC, and Tk. 912 in three-storied HFWC in the first year, and less than these in the second year.

Table 4 Estimates of per client cost for strengthening HFWC by type of structure and year

Category	Cost for Year 1	Cost for Year 2
One-storied HFWC		
Total annual cost (Tk.)	338,310	339,710
Expected number of clients (No.)	360	360
Cost per client (Tk.)	**940**	**944**
Two-storied HFWC		
Total annual cost (Tk.)	333,310	334,710
Expected number of clients (No.)	360	360
Cost per client (Tk.)	**926**	**930**
Three-storied HFWC		
Total annual cost (Tk.)	328,310	329,710
Expected number of clients (No.)	360	360
Cost per client (Tk.)	**912**	**916**

However, the amount of resources (investment) required for strengthening of a HFWC will be different from the amount of estimated costs. The difference is caused by the fact that while the cost of a capital input is spread over its life time, the full expenditure is to be incurred for this input in the initial year in order to obtain the input. That is to say, the project will have to spend a higher amount in the first year than the cost; the benefit of the first year's expenditure will accrue to the facility over a number of years even after the termination of the two-year project. Table 5 through Table 7 display that the required amount of resources will be Tk. 1,026.1 thousand (USD 13.6 thousand) for strengthening a one-storied HFWC, Tk. 926.1 thousand (USD 12.3 thousand) for a two-storied HFWC, and Tk. 826.1 thousand (USD 11.0 thousand) for a three-storied HFWC in two years.

Table 5 Resource requirement for strengthening one one-storied HFWC in two years (in thousand Tk.)

Category	Amount of resources in Year 1	Amount of resources in Year 2	Total amount in two years
Human Resource	216.0	216.0	432.0
Physical Infrastructure	236.0	16.0	252.0
Equipments and Furniture	109.0	24.0	133.0
Delivery Room Equipments and Supplies	143.3	34.8	178.1
Labor Ward Logistics	25.4	2.8	28.2
Drugs	1.4	1.4	2.8
Total (in Taka)	**731.1**	**295.0**	**1,026.1**
Total (in US$)	**9.7**	**3.9**	**13.6**

USD 1 = Taka 75

Table 6 Resource requirement for strengthening one two-storied HFWC in two years (in thousand Tk.)

Category	Amount of resources in Year 1	Amount of resources in Year 2	Total amount in two years
Human Resource	216.0	216.0	432.0
Physical Infrastructure	136.0	16.0	152.0
Equipments and Furniture	109.0	24.0	133.0
Delivery Room Equipments and Supplies	143.3	34.8	178.1
Labor Ward Logistics	25.4	2.8	28.2
Drugs	1.4	1.4	2.8
Total (in Taka)	**631.1**	**295.0**	**926.1**
Total (in US$)	**8.4**	**3.9**	**12.3**

USD 1 = Taka 75

Table 7 Resource requirement for strengthening one three-storied HFWC in two years (in thousand Tk.)

Category	Amount of resources in Year 1	Amount of resources in Year 2	Total amount in two years
Human Resource	216.0	216.0	432.0
Physical Infrastructure	36.0	16.0	52.0
Equipments and Furniture	109.0	24.0	133.0
Delivery Room Equipments and Supplies	143.3	34.8	178.1
Labor Ward Logistics	25.4	2.8	28.2
Drugs	1.4	1.4	2.8
Total (in Taka)	**531.1**	**295.0**	**826.1**
Total (in US$)	**7.1**	**3.9**	**11.0**

USD 1 = Taka 75

The cost of strengthening HFWCs in a typical upazila can also be calculated. In the country an average upazila has 9 unions, including the sadar one where the UHC is located. It also appears from observation that upazila headquarter (and UHC) is located adjacent to one or two unions in addition to the sadar union. We can safely assume that in a typical upazila the people of two unions have easier access to UHC for delivery care. Therefore, the remaining seven union facilities should be strengthened. The cost for a one-storied HFWC in two years is Tk. 678,020. Hence, the total cost for strengthening HFWCs in the entire upazila will be Tk. 4,746,140.

It can be mentioned here that under the new service delivery model a HFWC will provide both delivery care and new born care. The amount of new born care provided may not be sufficient for two reasons. First, some newborns may require for a longer period than their mothers will stay in the facility. Second, some women having had safe and uncomplicated delivery at HFWC may give birth to child with complications. These children should not be treated at HFWC; rather they will be referred to the UHC. However, some care will definitely be provided to each newborn. But the amount of it will be very low compared to that of the delivery care provided per woman. Besides, we can assume that newborn care is the by-product of delivery care (and/or a newborn is a free rider).The delivery care and newborn care together constitute what is called in economics a joint output case, since the same inputs simultaneously produce two separate but interlinked outputs. Given all these, we have not considered the number of newborns as a separate output. However, if we consider newborn care (number of newborns) as a separate output of the intervention, then per client cost of the intervention will drastically decline, which will become almost half the cost shown above, since there will be newborn care for each delivery care in most cases.

Discussion

In order to implement the intervention in all upazilas of the country, the required amount of expenditure in the first year of implementation will be:

721220* 1500+631220*2200+531220*99 =TK. 252.31 crore.

The amount in the second year will be TK. 117.37 crore. The amount will remain TK. 117.37 crore in each of the subsequent year.

In 2011-12 the total budgeted expenditure (proposed) of the government is TK. 130,000 crore, of which 5.5% is allocated for the health and population sector – the sector will receive TK. 7150 crore. The amount of expenditure for the proposed intervention is only 3.6 percent (252/7150) of the total expenditure of the sector. The sector can undertake the intervention by reorganizing its cost centers and line items. The alternative way to do so is to increase the allocated amount for the sector by only TK. 252 crore (or by 0.20 percent). In each of the later years, the amount of expenditure for the intervention will be around 1.5 percent of the sector's expenditure.

This small amount of investment will produce a large volume of output if the estimated output is adjusted for the importance of the output. The total number of pregnancies in an average union is 650 in a year. At present the proportion of institutional delivery is 19 percent in the rural areas of the country. We assume three possible scenarios to emerge after implementing the intervention. First, HFWCs of the country will be able to raise the proportion of institutional delivery to 45 percent, of which 11 percent will be the amount of normal delivery care provided by the HFWCs and 15 percent (i.e, 97 out of 650 pregnancy cases in each union) complicated cases will be referred to the UHCs or other higher level facilities by the HFWCs. We assume that the relationship between increase in institutional delivery and decline in MMR is proportional. As the institutional delivery care increases to 26 percent (from 19 percent to 45 percent), MMR will decline from 194 to 144, at the same rate—by 26 percent, MDG 4 will be achieved. Second, the HFWCs will raise the rate of institutional delivery to 55 percent: normal delivery care to 21 percent of pregnant women at HFWCs and 15 percent complicated cases referred to UHCs. The proportion of institutional delivery will then increase by 36 percent (from 19 to 55). MMR will decline by 36 percent, to 124. The country will move beyond achieving MDG 4. Third, the intervention will enable the HFWC to conduct normal deliveries for 360 women in a year (one every day) and refer all the complicated cases to the UHC or DH. The total number of institutional delivery in the union will be 360+97= 457. Thus, the intervention will cover with institutional delivery 70 percent of pregnant women in the country, raising the proportion of institutional delivery to about 90 percent from the present 19 percent. As a result, the country will achieve not only the relevant MDGs but also the relevant Vision 2021 goal within the stipulated time frame.

It, thus, clearly appears that the benefit-cost ratio for the intervention will be quite high. However, it is difficult under this assignment to assess the exact level of cost effectiveness of the intervention.

The cost-effectiveness analysis (CEA) requires the existence of more than one intervention to produce the same outcome for comparison of the outcome-cost ratios and identify the intervention for which the ratio is highest. We have assessed above the outcome-cost ratio for only one intervention: strengthening of HFWC. We can still assess, very tentatively though, the cost-effectiveness of the intervention by comparing its outcome-cost ratio with that of two alternative interventions. First, all pregnant women of each upazila will be allowed to stay in a public hostel in the upazila headquarter, near the UHC, for a specified period so that they can be provided the appropriate care as and when necessary. The government of the Scotland has been using this method for the pregnant women living in the small islands on the north. Second, the providers of the UHC s can be asked to provide the delivery care at the houses of the pregnant women. It can be argued based on simple reasoning that none of these options is feasible in the present socio-economic condition of the country, and even if anyone is feasible at all, cost per client will be much higher for that. Viewed thus, it can be said that the proposed intervention is very cost-effective.

It may be noted that the cost of delivery care will be higher than the estimate obtained in this assignment if all the interventions needed both on the supply and the demand sides are taken into account. As is well known, expansion of supply of services alone cannot increase use of delivery care. In order for the use rate to significantly rise, both supply and demand are to increase. Strengthening of HFWC will basically expand the supply side. Although the availability of delivery care in the locality, near the household of the clients, is expected to increase demand for institutional delivery, the magnitude of increase resulting from this may not sufficient to cause full utilization of the capacity of the HFWC. In other words, the amount of demand may be less than the amount of supply in the initial periods. In that case, the amount of use of institutional delivery care may be lower than the amount postulated above. Hence, in order to increase demand to a level which can exhaust the capacity of HFWC, some additional measures on the demand side should adopted. Intensive behavior change communication (BCC) activities including interpersonal communication in the households, community mobilization, mass media, etc. are the possible measures to compliment the strengthening of HFWC. If costs of these activities are included, total cost of delivery care will increase. However, this will not increase the per client cost of delivery care to any considerable extent.

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Annexure

Table 1 Estimated costs for strengthening a one-storied HFWC by line item

Category of input	Unit cost (in Tk.)	Quantity of inputs (in No.)	Recurrent cost and current price of capital inputs (in Tk.)	Life time of capital inputs (in year)	Annual cost of capital input (in Tk.)	First year cost (in Tk.)	Second year cost (in Tk.)	Cost for 2 years (in Tk.)
A. Human Resource								
Family Welfare Visitor/ Midwife nurse	8,000.00	1	96,000.00			96,000.00	96,000.00	192,000.00
Aya/ Staff Nurse	6,000.00	1	72,000.00			72,000.00	72,000.00	144,000.00
Cleaner	4,000.00	1	48,000.00			48,000.00	48,000.00	96,000.00
Sub total						**216,000.00**	**216,000.00**	**432,000.00**
B. Physical Infrastructure								
Additional room	100,000.00	2	200,000.00	20	10,000.00	10,000.00	10,000.00	20,000.00
Installation of pipeline water supply system with motor pump	20,000.00	1	20,000.00	20	1,000.00	1,000.00	1,000.00	2,000.00
Maintenance of the water supply system	6,000.00	1	6,000.00			6,000.00	6,000.00	12,000.00
Repair and maintenance of facility and residence	10,000.00	1	10,000.00			10,000.00	10,000.00	20,000.00
Sub total						**27,000.00**	**27,000.00**	**54,000.00**
C. Equipments & Furniture								
Generator	35,000.00	1	35,000.00	10	3,500.00	3,500.00	3,500.00	7,000.00
Fuel and maintenance for generator	2,000.00		24,000.00			24,000.00	24,000.00	48,000.00
Chair for doctor's room	5,000.00	1	5,000.00	10	500.00	500.00	500.00	1,000.00
Table for doctor's room	6,000.00	1	6,000.00	10	600.00	600.00	600.00	1,200.00
Chairs for visitors	3,000.00	4	12,000.00	10	1,200.00	1,200.00	1,200.00	2,400.00
Examination table for doctor's room	2,000.00	1	2,000.00	10	200.00	200.00	200.00	400.00
Almirah for store	8,000.00	1	8,000.00	10	800.00	800.00	800.00	1,600.00
Shelves for store and doctor's room	6,000.00	2	12,000.00	10	1,200.00	1,200.00	1,200.00	2,400.00
Fan	2,500.00	2	5,000.00	10	500.00	500.00	500.00	1,000.00
Sub total						**32,500.00**	**32,500.00**	**65,000.00**

Table 1 (Continued)

Category of input	Unit cost (in Tk.)	Quantity of inputs (in No.)	Recurrent cost and current price of capital inputs (in Tk.)	Life time of capital inputs (in year)	Annual cost of capital input (in Tk.)	First year cost (in Tk.)	Second year cost (in Tk.)	Cost for 2 years (in Tk.)
D. Delivery Room Equipments and Supplies								
One labor table	8,000.00	1	8,000.00	5	1,600.00	1,600.00	1,600.00	3,200.00
Linen sets	1,500.00	4	6,000.00			6,000.00	6,000.00	12,000.00
Spot light	5,800.00	1	5,800.00	5	1,160.00	1,160.00	1,160.00	2,320.00
Spare bulbs	500.00	8	4,000.00			4,000.00	4,000.00	8,000.00
Screen for privacy	3,000.00	1	3,000.00	5	600.00	600.00	600.00	1,200.00
Sterilized delivery sets	2,500.00	3	7,500.00	5	1,500.00	1,500.00	1,500.00	3,000.00
Sterilized delivery kits	1,000.00	3	3,000.00			3,000.00	3,000.00	6,000.00
D&C set	5,700.00	1	5,700.00	5	1,140.00	1,140.00	1,140.00	2,280.00
Oxygen cylinder with carrier	23,000.00	1	23,000.00	20	1,150.00	1,150.00	1,150.00	2,300.00
Oxygen	1,500.00	2	1,500.00			1,500.00	1,500.00	3,000.00
Working BP machine	2,000.00	1	2,000.00			2,000.00	2,000.00	4,000.00
Stethoscope	1,000.00	1	1,000.00			1,000.00	1,000.00	2,000.00
IV stands	1,500.00	2	3,000.00	5	600.00	600.00	600.00	1,200.00
Thermometer	100.00	4	400.00			400.00	400.00	800.00
IV needles and cannula	20.00	360	7,200.00			7,200.00	7,200.00	14,400.00
Sucker machine	14,000.00	1	14,000.00	5	2,800.00	2,800.00	2,800.00	5,600.00
Sucker machine tube	500.00	2	1,000.00			500.00	500.00	1,000.00
Sterilized forceps	1,800.00	1	1,800.00	5	360.00	360.00	360.00	720.00
Spinal needle/epidermal kits	800.00	2	1,600.00			1,600.00	1,600.00	3,200.00
Episiotomy set	4,500.00	2	9,000.00	5	1,800.00	1,800.00	1,800.00	3,600.00
Radiant warmer (electric) overhead type for neonates	3,000.00	1	3,000.00	5	600.00	600.00	600.00	1,200.00
Room heater for neonates	4,000.00	1	4,000.00	5	800.00	800.00	800.00	1,600.00
Room heater cords	500.00	1	500.00			500.00	500.00	1,000.00
Pediatric stethoscope for neonates	1,800.00	1	1,800.00	5	360.00	360.00	360.00	720.00
Pulse oximeter with monitor	3,500.00	1	3,500.00	5	700.00	700.00	700.00	1,400.00
Nebulizer	4,500.00	1	4,500.00	5	900.00	900.00	900.00	1,800.00
Nebulizer drugs	1,000.00	2	2,000.00			2,000.00	2,000.00	4,000.00
Resuscitation tray for neonates (ambu bag, mouth gag, torch and laryngoscope with functioning light, endotracheal tube, butterfly, disposable syringe, three sheets for neonates)	2,950.00	1	2,950.00	5	590.00	590.00	590.00	1,180.00
Resuscitation tray for neonates (butterfly, disposable syringe, sheets for neonates)	500.00	2	1,000.00				1,000.00	1,000.00

	Sterile scissors to cut umbilical cord for neonates	75.00	4	300.00	5	60.00	60.00	60.00	120.00
	Umbilical cord clamps, plastic for neonates	8.00	360	2,880.00			2,880.00	2,880.00	5,760.00
	Red buckets with cover for waste disposal	600.00	2	1,200.00			1,200.00	1,200.00	2,400.00
	Box for sharp disposal	1,000.00	2	2,000.00			2,000.00	2,000.00	4,000.00
	Weighing scale for adult	800.00	1	800.00	5	160.00	160.00	160.00	320.00
	Weighing scale for newborn	1,650.00	1	1,650.00	5	330.00	330.00	330.00	660.00
	Trolley	1,500.00	1	1,500.00	5	300.00	300.00	300.00	600.00
	Wheel chair	3,800.00	1	3,800.00	5	760.00	760.00	760.00	1,520.00
	Sub total						**54,050.00**	**55,050.00**	**109,100.00**
E.	**Labor Ward Logistics**								
	Beds	5,600.00	2	11,200.00	5	2,240.00	2,240.00	2,240.00	4,480.00
	Lockers	3,000.00	2	6,000.00	5	1,200.00	1,200.00	1,200.00	2,400.00
	Tray	900.00	2	1,800.00	5	360.00	360.00	360.00	720.00
	IV stand	1,800.00	2	3,600.00	5	720.00	720.00	720.00	1,440.00
	Bed linens	300.00	4	1,200.00			1,200.00	1,200.00	2,400.00
	Mosquito nets	400.00	2	800.00			800.00	1,200.00	2,000.00
	Bedpan	200.00	4	800.0.			800.00	800.00	1,600.00
	Sub total						**7,320.00**	**7,720.00**	**15,040.00**
F.	**Drugs**								
	Drugs	1,440.00	1	_	1	-	1,440.00	1,440.00	2,880.00
	Sub total						**1,440.00**	**1,440.00**	**2,880.00**
Grand Total (A+B+C+D+E+F)							**338,310.00**	**339,710.00**	**678,020.00**