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Averting maternal death and disability

A cost effective small hospital in Bangladesh: what it can mean for emergency obstetric care

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Abstract

Mortality has improved dramatically in most of South Asia as a consequence of modest economic improvement, better nutrition and a combination of health education, immunization, family planning and home treatment of certain common diseases, especially diarrhea and respiratory infections. However, death rates are still much higher than in parts of the world with fully developed health services and residual mortality is largely due to conditions which require very basic hospital services such as surgery for complications of pregnancy, infections and trauma, transfusion, intravenous fluids, oxygen and intensive antibiotics. All of these can be made available in very simple and unsophisticated hospital facilities. It has generally been assumed that the cost of such facilities would be high, and cost effectiveness much less than that of preventive, educational and home care programs. In 1995, our 50 bed hospital in rural Bangladesh had a cost per patient-day of 525 Bangladesh Takas (US$13.15) and a cost per capita for the population served of 25 Takas (US$0.62) per year. Every month 180 patients were admitted, one-third with clearly life-threatening or disabling conditions which could be successfully treated in such a facility. We adapted the Disability Adjusted Life Year (DALY) method of cost effectiveness analysis to calculate the DALYs (years of disability-free life) preserved for individual patients during a 3-month period, using what we considered to be very conservative estimates of the threat to life and the efficacy of treatment. The total cost of all hospital activities over the 3 months was divided by the sum of the DALYS for those patients who were successfully treated for clearly life threatening or disabling conditions, to give a cost per DALY of 437 Takas (US$10.93). This compares favorably with estimates by others of a cost per DALY of US$30 for measles immunization, $20 for acute lower respiratory infection detection and home treatment, or $2 for tetanus immunization of pregnant women. Sixty-two percent of the DALYS saved came from emergency obstetric care (EmOC) related activities. We conclude that cost effective basic hospital service can be added to immunization, family planning and other basic health services now available in countries like Bangladesh with a very low increase in total cost and that the benefits which would accrue, particularly for maternal and perinatal mortality, would be great.

Keywords: Cost-effective; Emergency obstetric care; Hospital; Bangladesh

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1. Introduction

Most developing countries have experienced dramatic improvement in health with associated decline in mortality, especially child mortality, in the last 20 years. In Bangladesh, under-5 mortality has dropped from 247 per 1000 live births in 1960, to 127 in 1992 [1]. In our project area under-5 mortality is now 75. Almost all of this improvement has resulted from modest economic improvement (stabilization of the price of rice and absence of recurrent famine) plus program activities that have been conducted outside of hospitals or even clinics—education in the use of oral rehydration solution, immunization, family planning, antenatal care and improved water supply. Better home treatment by our health workers as well as by local medical practitioners has probably also played an important role—especially the widespread availability of antibiotics for respiratory and other infections.

There can be no doubt that it was correct to give the original program emphasis to community activities. It is now generally accepted by the public in most Bangladesh villages that immunization and better sanitation lead to better health, that certain diseases, especially diarrhea and respiratory infections, can be successfully treated at home and that it is possible and a good idea to control fertility. The government infrastructure to provide immunization, family planning and other public health programs has been established and notwithstanding its inefficiencies and inequities it has produced important benefits. Probably more important than any single factor is the increasing awareness, especially among women, that it is possible to do something about health. This has led to a tremendous increase in the demand for effective modern medical care.

However, important residual health problems remain, and many of them require for their resolution services provided outside the home by persons with more training than that presently available in most villages. These problems include:

- *Maternal mortality and morbidity.* While there are fewer maternal deaths because of declining fertility, the risk of childbirth (the maternal mortality ratio) is essentially the same as it was 20 years ago. Even though most families today would look outside the home for help when complications occur during childbirth, facilities to provide help are not generally accessible. Unfortunately antenatal care has had relatively little effect, because the problems leading to maternal death nearly all occur during or just before delivery and the 'risk factors' used to predict complications have turned out to be inefficient because of low specificity and a high rate of false positives [2]. It has been proposed that networks of emergency obstetric centers should be established in developing countries to care for simpler obstetric and neonatal problems with referral hospitals for cesarean section and other more complicated problems [3]. Practical considerations in Bangladesh, where patients are unwilling to be in a hospital far from home and transport is difficult, dictate that referral hospitals should be as close to the patient as possible and therefore that small hospitals serving populations of 200 000–300 000 should have the capacity to perform cesarean section and other basic surgery.
- *Perinatal mortality* fell when neonatal tetanus was largely eliminated by maternal immunization, but there has been almost no further improvement. In our project area 74% of loss of life under five now results from perinatal deaths and 60% of perinatal deaths are due either to low birthweight or obstetric complications. Most of the low birth weight and almost all of the obstetric perinatal deaths could be prevented in a facility with personnel trained and equipped to provide obstetric care, resuscitate newborns (mouth to mouth breathing and aspiration) and provide supportive care to infants weighing 1200–2000 g until breast feeding is established.
- *Residual mortality* from acute lower respiratory tract infection and diarrhea is largely due to severe cases which require hospital care—oxygen and intravenous antibiotics in the case of respiratory infections and intravenous fluids in the case of severe diarrhea.
- *Medical termination of pregnancy*, usually by vacuum aspiration, is widely available in Bang-

ladesh, but care for the complications which sometimes occur is harder to find. A hospital is the best place for this.

In addition to these four most common problems there is a range of other frequently encountered serious conditions which do not require sophisticated medical care but do require an inpatient facility with a knowledgeable staff, available around the clock: trauma, typhoid fever, severe *Shigella* infections, severe malaria, the acute abdomen and other major surgical infections are examples.

All of these problems can be effectively managed in very small hospitals. Private clinics are springing up all over Bangladesh to meet this need, but unfortunately the cost of these clinics is generally too high to make them accessible to more than a fraction of the population. It is commonly believed that it would be prohibitively expensive to provide the basic hospital services required, to the entire population in very poor countries like this one.

In 1995 our project expanded to 50 beds, a 12-bed hospital attached to a rural health project and upgraded the training of hospital personnel so that they could provide the necessary services to care for the conditions described above. Since the project provided service to all of the 160 000 people in the project area, including the poorest, and since we were trying to finance the project as much as possible through a system of insurance plus graduated fees-for-service, it was important for us to know how much this hospital added to the cost and to estimate the cost effectiveness of the hospital in comparison to the other health services provided. In this study we have calculated total hospital cost for a 3-month period and estimated 'effectiveness' in terms of death and disability averted, using an adaptation of the 'DALY' methods developed by Murray [4] and used by Jameson and others to compare cost effectiveness of health programs in developing countries [5].

There are many conceptual and even moral questions which have been raised about the use of the DALY as a measure of effectiveness in health programs [6,7]. We agree that the assumptions underlying the calculation of a 'DALY' are imperfect and that no number can be the sole basis for a political decision to allocate scarce resources. However, DALYs have been used extensively to estimate cost effectiveness of health measures in developing countries, and we are not aware of other attempts to apply this method to small hospitals in these countries.

1.1. The project and the hospital

Gonoshasthaya Kendra is an independent non-government organization providing health services in 11 project areas in Bangladesh, serving a total of 400 000 people. Paramedics make regular home visits to provide immunization, health education, antenatal care and family planning services and oral rehydration salts (ORS) and antibiotic treatment for diarrhea and respiratory infections. Clinics are held twice a week at subcenters and every day at the clinic adjacent to the hospital. An insurance program and fees for service graduated according to income cover approximately 45% of the cost. Preventive services are free and are provided to everyone in the service area, with or without insurance.

At the largest project site, Savar, which covers 160 000 people, there has been a very small hospital, a basic laboratory and an X-ray facility for more than 20 years, but round the clock surgical service was not regularly available until the hospital was expanded to 50 beds in January, 1995. Four subcenters conduct independent clinics and refer patients as needed to the main center where the hospital is located. Three temporary and three permanent specialist consultants were added at the time the hospital was expanded, to train general physicians to provide basic surgical and other services. The temporary consultants left at the end of 1995 and specialist consultation is now available twice a week, coming from Dhaka, 20 miles away.

The nurses and the laboratory technicians in the hospital are the same paramedics who do the field work, rotating for 1 week at a time to work in the hospital. There is one permanent X-ray technician and three paramedics have been assigned full time to supervise the delivery room, the operating room and the hospital wards. As there is no hospital

kitchen, patients' families provide food and personal care for patients who cannot care for themselves. When no family is available, food is brought from the project mess and paramedics give nursing care as needed. There is no blood bank, but fresh blood is available by typing and cross-matching blood from the family or other donors. Occasionally commercial blood is brought from Dhaka.

At the time of this analysis almost all of the ward care and approximately half of the surgical operations were done by the general physicians permanently assigned to the hospital. Since January, 1996, all emergency care is provided by the permanent staff although temporary consultants still visit regularly and perform certain elective operations, such as vaginal hysterectomy. A gradual increase in the volume of work at the hospital has continued since the departure of the full time consultants. There has been no change in the results of treatment, as discussed below.

2. Methods

The Disability Adjusted Life Year (DALY), is calculated by estimating the years of life preserved or disability averted by a health activity, 'adjusting' the absolute number of years to take into account the assumption that a year of life preserved or disability averted today is worth more than a year preserved many years in the future. The absolute number of years saved is calculated by subtracting the age at which a patient encounters a health activity from the average life expectancy in a place where good health conditions obtain and multiplying this by an estimate of the effectiveness of the health activity for prevention of death or disability. This absolute number of years is then 'discounted' at a rate of 3%, the way a bank would discount a loan sold to another bank, to take into account the assumed relative value of a year of life today and a year of life one or more years in the future. For a population being served by a program the age distribution and disease incidence in the population affected is related to the estimated effectiveness of the program to come up with a calculation of the number of DALYs produced by the program. The total cost of the program can then be divided by the DALYs to give the cost per DALY. In this paper we have evaluated each individual patient admitted to our hospital in a 3-month period, using what we believe to be very conservative estimates of the risk of death or disability and the effectiveness of treatment to arrive at a DALY estimate for each patient. If risk of death or disability was considered to be less than 5%, it was entered as '0', so that even though the great majority of patients came with acute and treatable conditions, only 33% of admitted patients contributed to the total DALYs in the 3 months. The total hospital cost for *all* patients was then divided by the sum of DALYs obtained to give the cost per DALY of the hospital as a program.

Hospital cost was calculated for 3 months, 20 July–20 October 1995. All costs were included—the cost of the consultants, all of whom were then present, as well as the depreciated cost of equipment, furniture and the construction of the 50-bed hospital (Table 1). Most of the staff working in the hospital were rotated from duties in other parts of the project, but the total person-days of staff at various levels assigned to the hospital over the 3 months could be calculated and this number multiplied by the average salary and benefits for this category of worker. No attempt was made to analyze the cost of a specific activity, such as EmOC, separately from the total cost of the hospital since the objective was to demonstrate the cost-effectiveness of the hospital taken as a whole.

Daily rounds in the hospital were made by the senior hospital staff, the doctor assigned to ward duty on a weekly rotation and at least one of the temporary consultants. All discharges were analyzed weekly and categorized as to diagnosis, treatment, severity of disease (in terms of the threat to life or the possibility of permanent disability in the absence of hospital treatment) and the efficacy of treatment to save life or prevent disability.

A scoring system was developed for severity of disease and efficacy of treatment (Table 2). The severity score for deaths averted estimates the percentage chance of death if a given patient had no access to a hospital but did have access to the medical treatment available in villages near our hospital and project. We believe we used very

Table 1
Gonoshastathaya Kendra Hospital, Savar: summary of total cost for 3 months

Item	Bangladesh Takas
Operating room	256 000
Wards	497 000
Utilities, maintenance, laundry and transport	187 000
Consultants	285 000
Administration	49 000
X-Ray	21 500
Pathology	37 500
Trainees (net cost)	60 000
Food subsidy for 25 fulltime equivalents working hospital	15 000
Construction cost of hospital (depreciated over 30 years)	38 000
Total	1 446 000
Income from patient fees (3 months)	452 000
Net cost for 3 months (costs minus fees)	979 000
Cost per patient day: (Takas 1 446 000)/2754 patient days	
Bangladesh Takas	525
US$	13.15
Net cost per patient day: (Takas 979 000)/2754 patient days	
Bangladesh Takas	361
US$	9.00

conservative standards to apply these scores to individual cases: a cesarean section done for obstructed labor with the active stage of labor prolonged beyond 2 h would generally be scored as less than 5% (therefore zero) threat to life for the mother and 10% threat to life for the child. The same operation done for transverse lie with hand prolapse was scored as over 95% threat to the life of both mother and child. Appendectomy for acute appendicitis without rupture or gangrene was scored as 10% threat to life since most of these patients will respond to antibiotics, at least temporarily. Ruptured appendix or perforated ulcer with generalized peritonitis were scored 'over 95%'. Severe diarrhea requiring i.v. fluids because of failure to respond to oral rehydration was scored 50% threat to life; occasionally higher if the patient was admitted in shock. If a hospitalized patient with diarrhea responded to oral fluid therapy with either no i.v. supplementation or only a small amount of i.v. fluid, threat to life was considered less than 5%, or zero.

Since most patients thought to have a significant threat to life were acute emergencies, scoring for efficacy was usually simple—100% if the patient lived and 0 if the patient died. For major infectious diseases (like typhoid fever and pneumonia) only rough estimates could be made, since almost all had received outside antibiotics and our role was to alter antibiotics if necessary and give i.v. fluids, oxygen and other supportive care. Generally such patients, if they appeared close to death on arrival, were scored 50% for threat to life and 100% for efficacy if they survived. If not so serious on admission they were scored 10% for threat to life.

The scoring system for disability was the same as that used by Murray to calculate Disability Adjusted Life Years [4].

Disability Adjusted Life Years preserved as a result of hospital activity were calculated for every patient admitted in the 3-month period under study with a condition which represented a significant threat to life or physical capacity, using the methods outlined in Table 2. The sum of DALYs for all patients was calculated and cost per Disability Adjusted Life Year calculated as:

$$\text{Cost per DALY} = \frac{\text{(Total cost of the hospital in 3 months)}}{\text{(Sum of DALYs for all patients in the same 3 months)}}$$

Table 2
Scoring system

Score	Severity of disease
1.0	Above 95% fatal without hospital treatment
0.8	75–94% fatal without hospital treatment
0.5	25–74% fatal without hospital treatment
0.1	5–24% fatal without hospital treatment
0.0	<5% chance of death without hospital treatment
	Severity of disability
0.9	Needs assistance with activities of daily living such as eating, personal hygiene or toilet use
0.8	Needs assistance with instrumental activities of daily living such as meal preparation, shopping or housework
0.6	Limited ability to perform most activities in all of the following areas: recreation, education, procreation or occupation
0.4	Limited ability to perform activities in two or more of the following areas: recreation, education, procreation or occupation
0.2	Limited ability to perform most activities in one of the following areas: recreation, education, procreation or occupation
0.1	Limited ability to perform at least one activity in one of the following areas: recreation, education, procreation or occupation
	Efficacy of treatment (for either life or disability)
1.0	Above 95% chance of permanent cure of this problem
0.8	75–94% chance of permanent cure
0.5	25–74% chance of permanent cure
0.1	5–25% chance of permanent cure
0.0	<5% chance of permanent cure
Years	Age discounted life expectancy
32	Newborn
34	Age 0–4.9 years
36	Age 5–24 years
30	Age 25–29 years
25	Age 39–39 years
20	Age 49–49 years
14	Age 50–59 years
8	Age 60–69 years

Years of life preserved = severity × efficacy × discounted life expectancy. Sum of DALYs = sum of years of life + sum of years of disability.

Since *threat to life* was less than 5% for most patients the *sum of DALYs* refers only to patients with serious and immediately life threatening conditions and does not take into account hospital activities which might have prevented death in less serious conditions or in the future. Normal deliveries and treatment of malaria or other infections without complications, for example, are not included. *Total cost* is total cost for all patients and all aspects of hospital operation.

3. Results

From 20 July through 19 October 1995 there were 541 admissions to the hospital (Table 3). Sixty-eight percent were from the project area and 32% from outside. Forty-five percent were covered by the Gonoshasthaya Kendra insurance program. Sixty percent were female and 33% of all patients came for obstetric or gynecologic problems. There were 192 operations, 118 of them emergencies.

Table 3
Discharges from Gonoshastathaya Kendra Hospital, Savar, Bangladesh, 20 July 1995 to 20 October 1995

Discharge diagnosis	Discharge condition	
	Alive	Dead
Obstetric	136	1
Gynecologic	41	0
Trauma	73	2
Acute abdomen	20	1
Surgical infection	15	0
Gastritis and ulcer	30	1
Acute lower respiratory tract infection	20	1
Diarrhea	18	0
Dysentery	13	2
Poisoning	18	3
Snakebite	6	1
Fever of uncertain origin	13	0
Malaria	11	0
Typhoid fever	5	0
Tuberculosis	10	0
Lung abscess, empyema, pneumothorax	5	0
Cirrhosis	3	1
Renal failure	2	1
Cardiac failure	7	0
Other	95	0
Total	541	14
	Number	Percent
Medical	142	26
Obstetric and gynecologic	178	33
Pediatric	64	12
Surgical	157	29
Total	541	100

Relatively few patients came because of chronic problems—tumors, cardiac failure, cirrhosis and renal failure all together accounted for only 6% of admissions. There were 14 deaths, four of them operative deaths (2.1% operative mortality and 2.6% hospital mortality).

There were 137 obstetric patients, 70 requiring operation, these are summarized in Table 4. The percentage of cesarean sections is high (38%), reflecting the very high proportion of complicated deliveries (Table 5). There was one maternal death.

The estimated Disability Adjusted Life Years preserved by this hospital activity are summarized in Table 6. Most of them come from obstetric and gynecologic activity, reflecting a relatively large proportion of OB/GYN patients and a large number of infant deaths averted. Still, almost 40% of the DALYs come from pediatric, medical and general surgical activities.

When total hospital cost is divided by Disability Adjusted Life Years in the same 3 months the result is cost per year of death or disability averted (Table 6):

$$\text{Total Cost} = \frac{\text{Takas } 1\,446\,000}{3308.6} = \text{Takas } 437/\text{DALY} = \text{US\$10.83 per DALY}$$

$$\text{Net Cost} = \frac{\text{Takas } 979\,000}{3308.6} = \text{Takas } 296/\text{DALY} = \text{US\$7.40 per DALY}$$

When this is compared with the cost per DALY of various developing country health programs as estimated by Jameson and others (Table 7), it is clear that a small hospital linked to an active field health program can be one of the most cost effective activities on the list, costing a little more

Table 4
Obstetric cases admitted to Gonoshastathaya Kendra Hospital, Savar, Bangladesh, 20 July to 20 October 1995

Pregnancies and pregnancy complications	Number
Normal deliveries	56
Abnormal deliveries	52
Complications of abortion	27
Ectopic pregnancy	2
Total	137
Obstetric operations	
Cesarean section	41
D&C	23
Salpingectomy	2
Extraction of placenta	2
Suture of cervix	1
Emergency hysterectomy	1
Total	70
Deaths	
Maternal (eclampsia)	1
Fetus dead on admission	9
Fetal death after admission	2
Total fetal deaths	11

Table 5
Complicated deliveries at Gonoshastathaya Kendra Hospital, Savar, Bangladesh, 20 July 1995 to 20 October 1995

Complication	Number
Breech presentation	3
Transverse lie	6
Face presentation	2
Brow presentation	1
Occiput posterior	1
Other obstructed labor	19
Antepartum hemorrhage	4
Postpartum hemorrhage	1
Retained placenta	2
Premature rupture of membranes	3
Pre-eclampsia and eclampsia	10
Total	52

Table 6
Disability adjusted life years

	Life years	Newborn life years	Disability years	Total
Medical	177.0		6.5	183.5
OB/GY	897.5	1024.3	125.4	2047.2
Pediatric	371.5		10.8	382.3
Surgical	459.4		236.3	695.7
Total	1905.4	1024.3	378.9	3308.7

Total cost per DALY = Ts 1 446 000/3308.7 DALYs = Ts 437 = $10.93. Net cost per DALY = Ts 979 000/3308.7 = Ts 296 = $740

than tetanus immunization for neonatal tetanus or tuberculosis treatment programs, but less than ORS for diarrhea or measles immunization and about the same as vitamin A distribution.

The two permanent surgical consultants left just after completion of this review. By this time local general physicians (several of them with more than 5 years experience in practice at the GK Project) were capable of independently caring for most of the emergencies encountered. Since November 1995, almost all emergency treatment has been under the supervision of these physicians although temporary consultants continue their twice weekly visits and do elective surgical procedures. Review of obstetric experience in the 4 months following 1 November 1995 shows a 10% rise in obstetric admissions; the percentage of obstetric cases with complications continued to be just under 50% and the case fatality rate for obstetric complications was unchanged, at 2%. The cesarean section rate fell to 28%.

4. Conclusions

Several important factors contribute to the efficiency of a hospital like this one. The most important, probably, is the work which has gone before to control the important causes of mortality, improve sanitation and nutrition and raise the consciousness, especially among women, that appropriate medical care can both prevent and treat the important causes of morbidity and mortality. In 1973, almost no women came to us for delivery and then usually in the advanced stages of a complication. By 1995, 15% of women in our project area had an institutional delivery, most of them in our hospital. This improvement in health

Table 7
Estimated cost per disability adjusted life year (DALY) of various health interventions in developing countries

Intervention	Cost per DALY
ALRI detection and treatment	$20
ORS for diarrhea	$35
Breast feeding promotion	$30
Measles immunization	$15
Tetanus immunization	$ 2
Vitamin A distribution	$ 9
Tuberculosis treatment	$ 3
Gonoshasthaya Kendra Hospital, Total cost per DALY	$10.93
Net cost per DALY	$ 7.40

(Costs other than GK Hospital costs are program cost estimates, taken from Jameson [5]. When a range of estimates was given, the lowest estimate was used.)

and change in attitude can be traced directly to field project activities, not just in our own project but also in others throughout Bangladesh, including those of the government. The hospital and the field project are complementary rather than competitive and will continue to be so.

Self selection is another factor. We had very few admissions for conditions that we could not help. The hospital cost is low, but it is high for poor people. The difficulties encountered by a family to bring a patient to hospital with the available transport and provide care for them while they are in hospital are significant. People learn quickly what a hospital can and cannot do, and behave accordingly. The proportion of serious and curable cases was somewhat higher among those who came from outside the project area than for those from inside it (37% vs. 31%), suggesting that it is truly self selection and not selective referral by project personnel.

A different case-mix could have produced higher or lower costs. We have observed similar case-mix patterns in other small hospitals in South Asia, Africa and the Caribbean, probably the result of the same sort of self-selection by patient families, favoring acute and treatable conditions.

The low cost and high cost effectiveness of this sort of small hospital is reproducible in Bangladesh. If the existing network of such health facilities can be expanded and given the skills and resources needed, the health benefit will be enormous, most notably for the delivery of EmOC. The problem is not cost, but cost recovery from very poor people who need the services. Through our graduated fee system we recover only 30% of hospital cost. Our project insurance fees have never covered the full cost of the field project, so they are no help to the hospital. Furthermore, 32% of our patients come from outside the project area. Many of these are very poor and come with emergent conditions that cannot be turned away. We know that poor people in villages spend a large fraction of their income on health care and we continue to hope that availability of this sort of hospital service will make it possible to increase our insurance premiums to a more reasonable fraction of the true cost, but this will take time. Twenty-five years of experience with health insurance and fee schedules graduated according to income does not make us optimistic that we will ever be able to recover all of the cost and still take care of all of the population we serve [8]. Eighty-five percent of the people in our area are poor. They spend 80% or more of their income on food. In this situation insurance becomes a luxury even though it can be shown to be a good investment.

The subsidy needed is very small—the net cost of the hospital per capita in our project area is 25 Takas (62 cents, US) per year. The government is burdened with expensive programs for family planning, immunization, etc.—that contribute to our own program—and is not in a position to provide this sort of subsidy now. Imaginative ways must be sought to provide a moderate subsidy through cooperatives and other local organizations, probably with some outside support.

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