Availability and Quality of Emergency Obstetric and Newborn Care in Bangladesh

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Abstract. Bangladesh's maternal mortality and neonatal mortality remain unacceptably high. We assessed the availability and quality of emergency obstetric care (EmOC) and emergency newborn care (EmNC) services at health facilities in Bangladesh. We randomly sampled 50 rural villages and 50 urban neighborhoods throughout Bangladesh and interviewed the director of eight and nine health facilities nearest to each sampled area. We categorized health facilities into different quality levels (high, moderate, low, and substandard) based on staffing, availability of a phone or ambulance, and signal functions (six categories for EmOC and four categories for EmNC). We interviewed the directors of 875 health facilities. Approximately 28% of health facilities did not have a skilled birth attendant on call 24 hours per day. The least commonly performed EmOC signal function was administration of anticonvulsants (67%). The quality of EmOC services was high in 33% and moderate in 52% of the health facilities. The least common EmNC signal function was kangaroo mother care (7%). The quality of EmNC was high in 2% and moderate in 33% of the health facilities. Approximately one-third of health facilities lack 24-hour availability of skilled birth attendants, increasing the risk of peripartum complications. Most health facilities offered moderate to high quality services for EmOC and low to substandard quality for EmNC.

INTRODUCTION

Maternal mortality, the second-most common cause of death among women aged 15–44 years worldwide, is responsible for 14.6% of all deaths in this age group.¹ Most deaths occur during labor, delivery, and in the immediate postpartum period² due to postpartum hemorrhage, infection, unsafe abortion, and eclampsia. Meanwhile, neonatal deaths account for 40.3% of all deaths among children under 5 years of age, with 3.1 million deaths annually.³ Most neonatal deaths occur within the first week of life.⁴ An estimated 35.1% of neonatal deaths are caused by prematurity, 23.3% by intrapartum-related complications (birth asphyxia), and 26.9% by infection-related causes (sepsis/meningitis, pneumonia, tetanus, and diarrhea).³

An important component of reducing maternal mortality and morbidity and intrapartum-related neonatal deaths is to increase the availability, quality, and demand for skilled care at birth.^{5–7} One way that this can be achieved is to ensure that health facilities have adequate capacity to provide emergency obstetric care (EmOC) and emergency newborn care (EmNC), collectively referred to as emergency obstetric and newborn care (EmONC). Studies in South Africa have shown that 20.0% of deaths in rural areas are preventable,⁸ with processes such as labor management, fetal monitoring, and neonatal resuscitation.^{8,9} A systematic review of interventions with modeling of effect and cost¹⁰ showed that it is possible to avert 71% of neonatal deaths by increasing coverage and quality of health interventions with most of the effect attributable to facility-based care. Neonatal deaths can be reduced through interventions for obstetric complications (41%), followed by care of small and newborn babies (30%).¹⁰

Bangladesh is a low-income country in south Asia. In 2013, Bangladesh's maternal mortality (170/100,000 live births) and neonatal mortality (24 deaths/1,000 live births) remained

high.¹¹ Use of health facilities for obstetric and newborn care has been growing steadily in recent years in Bangladesh, probably due to economic development, modernization, and increasing education of women. The proportion of facility-based deliveries have increased from 16.0% in 2006¹² to 29.0% in 2012.¹³ However, people living in rural areas are still less likely than those in urban areas to deliver in health facilities (8.2% versus 31.0%) and to receive caesarean section (5.0% versus 15.5%).¹⁴ The urban–rural gaps with regard to availability and quality of EmONC services have not been assessed. In addition, private health care is common and popular in Bangladesh^{15,16} due to the perceived better quality of service compared with government hospitals,¹⁷ despite the higher costs of care.¹⁸ Patients who continue to rely on government health care are generally those with low socioeconomic status who cannot afford care at private hospitals,¹⁹ and yet the public–private sector gaps on availability and quality of EmONC services have not been assessed.

Assessments of availability and quality of EmONC services have direct relevance to health policy and planning, as all health facilities are expected to be able to respond to basic EmOC and EmNC needs. With such data, health planners and policymakers can identify service gaps, and then allocate resources to fill these gaps.

This study is part of the 2013 Bangladesh National Hygiene Assessment, conducted by the International Center for Diarrhoeal Disease Research, Bangladesh (icddr). The 2013 Bangladesh National Hygiene Assessment was a national-level cross-sectional study of hygiene knowledge, facilities, and practices in households, schools, restaurants among food vendors, and health facilities in Bangladesh.^{20,21} One of the secondary aims of the assessment was to document the provision and quality of EmONC signal functions in health facilities. We characterized the provision and quality of EmONC services at health facilities in Bangladesh by rural versus urban area of data collection and by public versus private health-care systems.

MATERIALS AND METHODS

Study design. The National Hygiene Assessment was a cross-sectional study conducted in 54 of 64 districts in all seven

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divisions of Bangladesh. A map of the districts included in the study can be found in Figure 1. We collected data from 50 villages from rural areas and 50 neighborhoods (mahallas) from urban areas. The neighborhood, the lowest administrative boundary in urban areas, is formed with a certain number of households bounded by road or canals. We created two separate sampling frames: one for rural villages and one for urban neighborhoods. We made two sampling frames due to the differences between rural and urban areas. The 50 rural clusters were selected based on national-level rural population data in the Bangladesh Census 2011 report using probability proportion to size (PPS) sampling. The 50 urban clusters were selected using the urban population data from the Bangladesh Census 2011 report, and the clusters were selected from eight statistical domains in the census using PPS sampling method. We requested the subdistrict-/district-level government health department officials to provide a list of health facilities and identified eight and nine health facilities nearest to the sampled households. Eligible health facilities consisted of government and private/nongovernmental organization (NGO) health facilities that provided overnight inpatient health service. Health facilities for which the director/manager/head of department gave informed consent for the interview were included in the analysis.

Health facilities were classified into various categories. Government maternal and child welfare centers are government facilities with an average size of eight beds staffed by health professionals. Government district-level hospitals are government facilities with the average size of 141 beds, staffed by health professionals. Government upazila (subdistrict)-level hospitals are government facilities with the common sizes of 31 and 50 beds, staffed by health professionals. Government

union-level hospitals/clinics refer to government facilities with an average size of 10–20 beds, staffed by health professionals. Nongovernmental specialized/medical college hospitals are facilities run by the private sector (except NGOs), with at least 250 beds and staffed by health professionals. Nongovernmental/private hospitals/clinics are facilities run by the private sector (except NGOs) with inpatient services and staffed by full-time health professionals. NGO hospitals/clinics are facilities run by NGOs with inpatient services and staffed by full-time health professionals.

At each health facility, we conducted a face-to-face interview with the supervisor of maternity and/or newborn care wards about the facility's characteristics, services, staffing, and availability of ambulance and phone for referring patients. Interviewers also made observations on availability of records and guidelines (staff schedule, delivery register, national guidelines for EmOC and EmNC), equipments for EmNC (newborn bag, newborn mask, resuscitation table with heat source, infant scale, soap or hand disinfectant), and drugs used in EmNC (injectable gentamicin, nevirapine, or other drugs recommended for prevention of mother-to-child transmission of human immunodeficiency virus [HIV] [PMTCT], corticosteroids, injectable uterotonics, and magnesium sulfate). The interview was conducted using a standardized questionnaire by trained enumerators.²¹ Because of time, logistical, and feasibility constraints during fieldwork, we could not verify the information obtained from the interview.

Signal functions and classification of health facilities by quality level. A list of essential procedures in EmONC, known as “signal functions,” is used by the World Health Organization (WHO) as a guideline for monitoring and evaluation of EmONC programs.²² EmOC signal functions include services that address infection, postpartum hemorrhage, eclampsia and hypertensive disorders of pregnancy, prolonged labor, and placenta accreta, whereas EmNC signal functions include services that address cardiorespiratory distress, complications from preterm births, neonatal sepsis, and, as appropriate, PMTCT.

We evaluated signal functions for EmOC and EmNC based on existing literature^{22–24} and defined availability of signal functions based on the definition used by WHO and Averting Maternal Death and Disability Program²²: a health facility was considered to have provided a signal function if the procedure for the signal function had been performed at the facility within 3 months before survey.

For EmOC, the signal functions were 1) parenteral administration of antibiotics, 2) parenteral administration of oxytocin (uterotonics), 3) parenteral administration of anticonvulsant for hypertensive disorder of pregnancy, 4) assisted vaginal delivery, 5) manual removal of placenta, and 6) removal of retained products after delivery.

Signal functions for EmNC in this study included 1) performed resuscitation of nonbreathing baby with bag and mask within the past 3 months, 2) administered corticosteroids in preterm labor within past 3 months, 3) practiced kangaroo mother care (KMC) for premature/very small babies, and 4) had injectable antibiotics for neonatal sepsis (facility has at least one valid unit of injectable gentamicin or provides ampicillin). We did not consider PMTCT to be a signal function for high-quality EmNC due to the low prevalence of HIV infection in Bangladesh at 0.8 cases per 100,000 population.^{25,26}

FIGURE 1. Districts of Bangladesh included in the assessment of emergency obstetrics and newborn care, Bangladesh, 2013.

Information about more advanced signal functions (EmOC: surgery including caesarean section with anesthesia, blood transfusion; EmNC: intravenous fluids, safe administration of oxygen) representing comprehensive EmONC, was not collected in this study.^{23,24}

We categorized the health facilities by quality level based on composite criteria used in recent studies conducted in low-income settings.^{23,24} The quality categories serve to indicate the ability to provide care for common obstetric and newborn emergencies and make referrals if needed. The criteria for quality levels included the number of signal functions provided in the 3 months before the survey, staffing, and availability of ambulance and phone—the basic necessities for referring patients to more advanced health facilities (Table 1). For EmOC, we retained the criteria for number of signal functions and availability of vehicle or phone, and defined staffing adequacy as having three or more skilled health professionals present on the day of the interview. We considered a health facility to be of high-quality EmOC or EmNC if it had provided all related signal functions within the past 3 months, had three or more skilled health professionals present at the day of interview, and had referral of obstetrics and neonatal complications with a functioning ambulance or phone. If the health facility did not meet any of the three criteria, it was classified at the next highest level of quality for which all the requirements were met.²⁴

Sample size calculation. Sample size calculations for health facility survey were conducted to ensure adequate statistical power and representativeness for the key hygiene-related indicators relevant to the primary objective of the National Hygiene Assessment, that is, to detect a 10% difference in prevalence of having soap and water at a handwashing station. The method of calculation has been described elsewhere.²⁰ The required sample size was 875 health facilities.

Statistical analysis. For categorical variables, we used frequency and percentage for descriptive statistics, and Pearson's χ^2 test to test for difference between frequency distributions. For continuous variables (number of births attended in the facility during the month before the survey, and number of births attended in the facility in the past 3 months), we used the Shapiro–Wilk test to assess normality of distribution. The distributions were non-normal ($P < 0.05$) for both variables, thus we used the median with interquartile range for descriptive statistics and tested for differences between groups with the Wilcoxon rank-sum test. Data were analyzed using the R statistical software (R Development Core Team, Vienna, Austria)²⁷ and Epicalc package (Virasakdi Chongsuvivatwong, Hat Yai, Thailand).²⁸

We explained the research study objectives clearly to the study participants. Before taking part in the study, health facility staff provided written informed consent. The study protocol was approved by the icddr,b (International Center for Diarrhoeal Disease Research, Bangladesh) Ethical Review Committee.

RESULTS

All the 875 health facilities that we approached agreed to participate in the study, of which 432 served rural villages and 443 served urban neighborhoods. In all, 23 health facilities (2%) did not have maternity and/or newborn care wards and thus were not included, leaving 852 (98%) for the analysis.

TABLE 1
Criteria used for classifying health facilities serving the study area's population by quality of EmOC and EmNC services*

Quality	EmOC			EmNC		
	No. of signal functions†	Staff availability	Others	No. of signal functions‡	Staff availability	Others
High	All six basic functions	≥ 3 skilled HPs present at the day of interview	Referral of obstetrics complications + any type of ambulance or phone available	All four functions	≥ 3 skilled HPs present at the day of interview	Referral of neonatal complications + any type of ambulance or phone available
Moderate	≥ 4 functions	≥ 2 skilled HPs present at the day of interview, or; ≥ 3 skilled HPs present but no staff on call at all times (24 hours a day)	Phone available	≥ 3 functions	≥ 2 skilled HPs present at the day of interview, or; ≥ 3 skilled HP present but no staff on call at all times (24 hours a day)	Phone available
Low	≥ 2 functions	≥ 1 HP present and ≥ 1 skilled HP	Phone available	≥ 2 functions	≥ 1 HP present and ≥ 1 skilled HP	Phone available
Lowest/Substandard	< 2 functions	No requirement	No requirement	< 2 functions	No requirement	No requirement

EmNC = emergency newborn care; EmOC = emergency obstetric care; HP = health professional.

* On the basis of those used by Nesbitt and others.¹⁷

† Signal functions for EmOC included 1) parenteral administration of antibiotics, 2) parenteral administration of oxytocin (uterotonics), 3) parenteral administration of anticonvulsant for hypertensive disorder of pregnancy, 4) assisted vaginal delivery, 5) manual removal of placenta, and 6) removal of retained products after delivery.

‡ Signal functions for EmNC included 1) resuscitation with bag and mask of nonbreathing baby, 2) corticosteroids in preterm labor, 3) Kangaroo mother care for premature/very small babies, and 4) injectable antibiotics for neonatal sepsis (gentamicin or ampicillin).

TABLE 2
Characteristics of health facilities in assessment of emergency obstetric and newborn care, Bangladesh, 2013 (*N* = 852)

Indicator	Overall (<i>N</i> = 852) (%)	Rural (<i>N</i> = 428) (%)	Urban (<i>N</i> = 424) (%)	<i>P</i> value*
Type of health facility				
Government maternal and child welfare centers	12 (1)	6 (1)	6 (1)	< 0.001
Government district-level hospital	25 (3)	14 (3)	11 (3)	
Government upazila-level hospital	89 (10)	65 (15)	24 (6)	
Government union-level hospital/clinic	2 (0)	1 (0)	1 (0)	
Nongovernmental specialized/medical college hospital	7 (1)	2 (0)	5 (1)	
Nongovernmental/private hospital/clinic	679 (80)	328 (77)	351 (83)	
NGO hospitals/clinic	38 (4)	12 (3)	26 (6)	
Access to communication and transportation services				
Ambulance vehicle				
Not available	484 (57)	251 (59)	233 (55)	0.185
Available, but not functioning	19 (2)	6 (1)	13 (3)	
Available and functional in the last week	349 (41)	171 (40)	178 (42)	
Have telephone (either land or mobile)				
Not available at the time of interview	55 (6)	30 (7)	25 (6)	0.048
≥ 1 type available, but not functioning	31 (4)	9 (2)	22 (5)	
≥ 1 type available and functional in the last week	766 (90)	389 (91)	377 (89)	
Available staff				
Is a person skilled in conducting deliveries present at the facility or on call at all times (24 hours a day), including weekends, to provide delivery care?				
Yes, present, schedule observed	363 (43)	162 (38)	201 (47)	0.053
Yes, present, schedule reported, but not seen	158 (19)	85 (20)	73 (17)	
Yes, on call, duty schedule observed	10 (1)	4 (1)	6 (1)	
Yes, on call, duty schedule reported, but not seen	54 (6)	25 (6)	29 (7)	
Residential health worker duty schedule not maintained	25 (3)	14 (3)	11 (3)	
No staff on call 24 hours a day	242 (28)	138 (32)	104 (25)	
No. of staff				
Having ≥ 3 skilled HPs present at the day of interview	655 (77)	315 (74)	340 (80)	0.028
Obstetric services				
No. of births attended in this facility during the month before survey‡	17 (8, 36)	18 (8, 38)	16 (8, 35)	0.304
Total no. of births attended in this facility in the past 3 months‡	53 (25, 115)	56 (28, 120)	51 (23, 107)	0.248
Register availability for recording of births				
Yes, observed	595 (70)	309 (72)	286 (67)	0.020
Yes, reported, not seen	124 (15)	48 (11)	76 (18)	
No register available	133 (15)	71 (17)	62 (15)	
Complete birth outcome/weight recorded for 10 most recent births†	506 (85) (<i>N</i> = 595)	263 (85) (<i>N</i> = 309)	243 (85) (<i>N</i> = 286)	0.999

HP = health professional; NGO = nongovernmental organization.

*For comparison between health facilities near urban neighborhoods and health facilities near rural villages using Pearson's χ^2 test.

†In health facilities where the administrator mentioned that delivery register was available, the interviewer would ask the administrator to present the register. The interviewer then scanned the register and note whether birth outcome for the infant and birth weight were recorded for the past 10 births.

‡Median number and interquartile range of births.

The characteristics of these health facilities are summarized in Table 2. Private health facilities accounted for 80% of the health facilities in the survey. Health facilities that served rural villages had the average size of 27 beds, whereas facilities that served urban neighborhoods had the average size of 36 beds.²⁰ More than 90% of the surveyed health facilities had a landline or mobile phone available. However, only 40% had a functioning ambulance. Approximately 72% of all health facilities reported that they had skilled birth attendants present at the facility or on call at all times, whereas 28% of health facilities did not. The lack of staff was frequently found in health facilities serving rural areas than urban communities, but the difference was not statistically significant (32% versus 25%, respectively; *P* = 0.053). The median number of births attended in the health facility during the month before survey was 17 (interquartile range = 8 and 36), and the median number of births attended in the 3 months before the survey was 53 (interquartile range = 25 and 115). Approximately 70% of health facilities had birth record registers available, among which 85% had complete information on birth outcome/weight for the past 10 births.

We obtained information on signal functions for EmOC and EmNC (Table 3) and assessed the quality of EmOC and EmNC services (Table 4). The most common EmOC signal

function available was parenteral administration of antibiotics (833 of 852 health facilities, or 98%) and the least common signal function was parenteral administration of anticonvulsant (567 of 852 health facilities, or 67%). There were significant differences between health facilities serving rural villages and those serving urban neighborhoods with regard to availability of EmOC signal functions. Health facilities serving rural areas were more likely than those serving urban areas to provide parenteral administration of antibiotics, assisted vaginal delivery, and manual removal of placenta. We found that 278 of 842 health facilities (33%) were deemed to be high quality for EmOC, whereas 439 of 852 (52%) were moderate quality, 48 of 852 (4%) were low quality, and 87 of 852 (10%) were substandard quality. Among health facilities serving rural villages, government health facilities were more likely than private health facilities to have high-quality EmOC (45% versus 27%, respectively; *P* = 0.002). In urban areas, the proportions of high-quality EmOC service facilities in government versus private health facilities were very similar (33% versus 34%, respectively; *P* = 0.999).

For EmNC, neonatal resuscitation with bag and mask was a relatively common signal function (766 of 852 health facilities, or 90%), but corticosteroids for preterm labor (365 of

TABLE 3
Availability of signal functions for EmOC and EmNC in health facilities serving population in rural and urban areas of Bangladesh

Signal function	Rural area				Urban area			P value*
	Overall	Overall	Government	Private	Overall	Government	Private	
	(N = 852) (%)	(N = 428) (%)	(N = 86) (%)	(N = 342) (%)	(N = 424) (%)	(N = 42) (%)	(N = 382) (%)	
EmOC								
1. Parenteral administration of antibiotics	833 (98)	424 (99)	83 (97)	341 (100)	409 (96)	41 (98)	368 (96)	†, ¶,
2. Parenteral administration of oxytocin (uterotonics)	771 (90)	392 (92)	81 (94)	311 (91)	379 (89)	41 (98)	338 (88)	—
3. Parenteral administration of anticonvulsant for hypertensive disorder of pregnancy	567 (67)	278 (65)	57 (66)	221 (65)	289 (68)	26 (62)	263 (69)	‡
4. Assisted vaginal delivery	820 (96)	420 (98)	84 (98)	336 (98)	400 (94)	40 (95)	360 (94)	†, ¶
5. Manual removal of placenta	731 (86)	375 (88)	79 (92)	296 (87)	356 (84)	35 (83)	321 (84)	†, ¶
6. Removal of retained products after delivery	783 (92)	401 (94)	83 (97)	318 (93)	382 (90)	35 (83)	347 (91)	§
EmOC health facility: provided all six basic functions	485 (57)	246 (58)	53 (62)	193 (56)	239 (56)	24 (57)	215 (56)	—
EmNC								
1. Resuscitation with bag and mask of nonbreathing baby	766 (90)	385 (90)	80 (93)	305 (89)	381 (90)	37 (88)	344 (90)	—
2. Corticosteroids in preterm labor	365 (43)	171 (40)	35 (41)	136 (40)	194 (46)	18 (43)	176 (46)	—
3. Injectable antibiotics for neonatal sepsis (gentamicin or ampicillin)	740 (87%)	370 (86)	66 (77)	304 (89)	370 (87)	29 (69)	341 (89)	‡, , **
4. KMC for premature/very small babies	63 (7)	32 (8)	14 (16)	18 (5)	31 (7)	5 (12)	26 (7)	‡,
Provided functions 1, 2, and 3	306 (36)	142 (33)	28 (33)	114 (33)	164 (39)	15 (36)	149 (39)	—
EmNC health facility: provided all four basic functions	31 (4)	17 (4)	6 (7)	11 (3)	14 (3)	3 (7)	11 (3)	‡

EmNC = emergency newborn care; EmOC = emergency obstetric care; KMC = kangaroo mother care.

*For comparison between government and private health facilities using Pearson's χ^2 test.

†Statistically significant difference ($P < 0.05$) between all health facilities serving the rural clusters and urban clusters.

‡Statistically significant difference between all government health facilities and all private health facilities.

§Statistically significant difference between government health facilities serving the rural clusters and government health facilities serving the urban clusters.

¶Statistically significant difference between private health facilities serving the rural clusters and private health facilities serving the urban clusters.

||Statistically significant difference between government and private health facilities serving the rural clusters.

**Statistically significant difference between government and private health facilities serving the urban clusters.

852, or 43%) and KMC for premature babies (63 of 852, or 7%) were infrequently performed. KMC was significantly more commonly recommended in government health facilities than in private facilities (19 of 128 health facilities or 15% versus 44 of 724 or 6%, respectively; $P < 0.01$), whereas private health facilities had significantly higher provision of injectable antibiotics for neonatal sepsis (gentamicin or ampicillin) than government health facilities (645 of 724 or 89% versus 95 of 128 or 74%, respectively; $P < 0.01$). Only 20 of 852 health facilities (2%) met the criteria for high-quality EmNC, whereas 284 of 852 (33%) were moderate quality, 362 of 852 (42%) were low quality, and 186 of 852 (22%) were substandard quality. There were no significant differences between rural and urban areas, or between the government and private health facilities, with regard to quality levels.

DISCUSSION

Although more than half of the health facilities provided all six signal functions (essential services) for EmOC, only 4% provided all four signal functions for EmNC. Although 31% of health facilities provided high-quality EmOC services, there remains a need for the majority of health facilities to achieve the same high quality. On the other hand, only 2% of health facilities provided high-quality EmNC services. These findings underscore the importance of ensuring that those health facilities are able to deliver optimal care for mothers and newborns.

The results of this study are similar to previous studies in low-income settings in terms of the lack of staff and essential

equipment,²⁹ particularly in public facilities.^{30–32} However, there were differences in the criteria used in assessing the quality of care compared with those used in a previous study,²⁴ that is, differences in number of signal functions for each category, no distinction of regular versus skilled health professionals, and no use of nonmedical functions.

The relatively lower availability of signal functions in EmNC than EmOC has been found in other low- and middle-income country settings.^{33–35} In our study, the difference between the higher prevalence of provision of signal functions and higher quality of services in EmOC compared with EmNC was due to the lack of two signal functions: KMC and provision of corticosteroids.

KMC has been determined to be a safe and feasible method for enabling infants to maintain a higher temperature within clinically acceptable limits,³⁶ and has been shown to reduce neonatal mortality and severe morbidity among newborn preterm infants.³⁷ Thus, the low availability of KMC has implications for the prevention of neonatal deaths attributable to preterm birth. This is particularly relevant for Bangladesh, which has a 14% preterm birth rate and the seventh highest number of preterm births in the world.³⁸ KMC was introduced to Bangladesh as a policy in 2007,^{39,40} but translation from policy to practice has been slow. KMC was more common in government health facilities, perhaps because there was a communication gap between national-level government stakeholders and nongovernmental health facilities.⁴⁰ KMC should be scaled up at health facilities in both government and private sectors throughout the country to reduce mortality among these particularly vulnerable newborns. On the basis of data from other low- and middle-income

TABLE 4
Health facilities by level of quality of EmOC and EmNC services

Quality	Rural area				Urban area			P value*
	Overall	Overall	Government	Private	Overall	Government	Private	
	(N = 852) (%)	Frequency (%) (N = 428)	Frequency (%) (N = 86)	Frequency (%) (N = 342)	Frequency (%) (N = 424)	Frequency (%) (N = 42)	Frequency (%) (N = 382)	
EmOC								
High	278 (33)	133 (31)	39 (45)	94 (27)	145 (34)	14 (33)	131 (34)	
Moderate	439 (52)	237 (55)	40 (47)	197 (58)	202 (48)	20 (48)	182 (48)	
Low	48 (6)	19 (4)	2 (2)	17 (5)	29 (7)	4 (10)	25 (7)	
Lowest/substandard	87 (10)	39 (9)	5 (6)	34 (10)	48 (11)	4 (10)	44 (12)	
EmNC								
High	20 (2)	11 (3)	5 (6)	6 (2)	9 (2)	2 (5)	7 (2)	—
Moderate	284 (33)	130 (30)	29 (34)	101 (30)	154 (36)	13 (31)	141 (37)	
Low	362 (42)	191 (45)	33 (38)	158 (46)	171 (40)	15 (36)	156 (41)	
Lowest/substandard	186 (22)	96 (22)	19 (22)	77 (23)	90 (21)	12 (29)	78 (20)	

EmNC = emergency newborn care; EmOC = emergency obstetric care.

*For comparison between government and private health facilities using Pearson's χ^2 test.

†Statistically significant difference ($P < 0.05$) between all health facilities serving the rural clusters and urban clusters.

‡Statistically significant difference between all government health facilities and all private health facilities.

§Statistically significant difference between government health facilities serving the rural clusters and government health facilities serving the urban clusters.

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**Statistically significant difference between government and private health facilities serving the urban clusters.

settings, potential barriers to KMC include constraints related to hospital staff and environment,⁴¹ lack of cooperation or support from family members,^{41,42} and the tendency of the hospital to discharge low birth weight infants within 72 hours.⁴³ Previously articulated strategies to overcome these challenges include training health workers,⁴⁴ and extending KMC to the community level,^{45,46} as well as effective training and postpartum support to achieve correct and adequate skin-to-skin contact practices in the community setting.⁴⁶

Corticosteroids have been shown to help accelerate lung maturation and reduce the incidence of respiratory complications,^{47,48} but fear of side effects^{48,49} could have contributed to the lack of provision. Administration of injectable antibiotics for neonatal sepsis (gentamicin and ampicillin), unlike KMC, is more common at private health facilities than government health facilities. The difference could be due to drug shortages at government health facilities.⁵⁰ Government health facilities must ensure that antibiotics for neonatal sepsis (gentamicin and ampicillin) are available.

The private health-care sector in Bangladesh has better perceived quality and availability of certain medical inputs.⁵¹ Out-of-pocket expenses are common in both government and private health facilities in Bangladesh, but costs at private health facilities are three to four times that of the government health facilities,¹⁸ thus not all patients can afford care at private health facilities. The quality of care at private health facilities may also vary by income.⁵² Among patients who can afford care, those with lower income may not receive as high level of care as those with higher income.

Previous studies show that in Asia, the most and least common EmOC signal functions vary by country, but all countries had facilities that did not meet the criteria for basic EmOC. The least common EmOC signal function varies from assisted vaginal delivery in Bangladesh⁵³ to administration of parenteral sedative in Pakistan.⁵⁴ However, only 68% of surveyed first-line referral facilities in Afghanistan could perform all basic EmOC signal functions,⁵⁵ whereas in India, 36% for private health facilities and 6% of government facilities were EmOC centers,⁵⁶ and 13% of public health facilities in Pakistan were basic EmOC facilities.⁵⁴ In the People's

Republic of China, a middle-income country, there was adequate comprehensive EmOC, but the number of basic EmOC facilities was still inadequate and township hospitals (primary care facilities) did not provide birthing services.⁵⁷ In this study, the use of anticonvulsants was higher than other countries in the region. In Maharashtra State, India, a study found that 61% of public health facilities had no stock of magnesium sulfate for management of eclampsia and preeclampsia.⁵⁸ In a pilot study in Pakistan, only teaching hospitals had stock of magnesium sulfate, and resources were scarce at nonteaching hospitals.⁵⁹ Anticonvulsants are needed to manage eclampsia, which is responsible for 20% of all maternal deaths in Bangladesh.⁶⁰ The use of anticonvulsants is associated with lower risk of eclampsia among preeclamptic women and lower risks of maternal death, recurrent seizure, and major morbidity among women with eclampsia.⁶¹ Therefore, administration of anticonvulsants to manage hypertensive disorders of pregnancy and their continuous availability in health facilities providing EmOC should be a priority, given the considerable proportion of deaths attributed to eclampsia.

There was a lack of adequate staffing in approximately one-third of health facilities surveyed, with the shortage being more common in health facilities serving rural villages than those serving urban areas. The lack of staff, particularly specialized staff, working in public obstetric and newborn care facilities, was also found in previous studies.^{21,32} Bangladesh faces the problem of shortage of and unequal distribution of qualified staff in obstetric and newborn care. A previous study found that lack of job openings in government health facilities for nurses was a common barrier to obstetric care programs in rural Bangladesh.⁶² The most common limitations to recruitment and retaining health staff include the lack of desire to work in remote rural areas, and low morale among staff working in public facilities that are often overcrowded and underequipped.⁶³ The lack of trained staff has been suggested as one of the major obstacles in ensuring high-quality neonatal care.⁶⁴ For example, health facilities in rural India often experience difficulty in retaining trained staff, and a majority of rural households must seek neonatal care from private providers, who may not be fully qualified.⁶⁴ Trained

healthcare staff can be retained through recognition,⁶⁵ positive appraisal,⁶⁶ financial incentive,^{65,67} and ensuring adequate resources and appropriate infrastructure.⁶⁵

This is one of the first studies to assess the availability of EmNC signal functions in Bangladesh. Studies on signal functions for EmNC are relatively new,^{23,24,68} and not as well established as studies on signal functions for EmOC.^{61,63,68–71} In addition, previous studies on signal functions were not based on national-level data. National-level data will allow policymakers to identify the focus areas where capacity building is needed and where priority for budget allocation should be given, which will serve as empirical evidence for public health policymaking.

The study has a number of limitations. First, signal functions for assessment of EmNC in this study did not include provision of prophylactic antibiotics to the mother in case of preterm or prolonged premature rupture of membranes, which may limit the ability to compare the findings with other studies. In addition, the number of basic EmONC facilities has fluctuated over the years,^{21,32,53,62} possibly due to supply failure or inability to deliver the service (e.g., lack of drugs or absence of a provider, and renovations of maternity wards). Studies that enable a better understanding of this gap will help to guide future preventive interventions.

Second, the study design did not allow all health facilities in the study area to be surveyed. Therefore, availability of EmONC services at other health facilities in the study area, the total number of individuals who needed the procedures, who received the procedures, and the total number of people living in the study area were unknown. Thus, the study could not estimate met need, that is, the proportion of pregnant women expected to have complications who are admitted for treatment, which is possibly the most important of process indicators previously proposed for EmOC.⁶⁸ The study also could not assess population-level availability of EmONC, a key process indicator adopted by the United Nations Children's Emergency Fund, WHO, and United Nations Population Fund.⁶⁸ The study did not assess signal functions for routine delivery care (e.g., prelabor monitoring, vital signs monitoring, routine postdelivery care of the newborn),²⁴ which help to prevent life-threatening complications such as asphyxia and hypothermia. The data source for signal functions was interview with health personnel, who may have overreported the provision of signal functions if they felt that their performance and/or professionalism were being evaluated. The interview questionnaire for EmNC services did not include a 3-month history of service for KMC and providing injectable antibiotics for neonatal sepsis, which was different from the criteria used by other studies.^{21,32} Future studies should include assessment of met need and other process indicators for EmONC to allow for a complete understanding of the availability and quality of EmONC services in Bangladesh.

This study did not include indicators of comprehensive EmONC,²⁴ nor did it evaluate the quality of care or respectful provision of care.⁷² The level of quality assessed in this study only pertains to signal functions, staffing, and availability of phone and ambulance for referring patients. Quality of care, on the other hand, generally includes the quality of the provision of care as well as the quality of the user's experience (i.e., client satisfaction).⁷² Future studies should include these indicators to make the information more useful

for assessing compliance with international guidelines for advanced care facilities.⁶⁸ Lastly, the ultimate aim of EmOC and EmNC care is to reduce adverse maternal and neonatal health outcomes (e.g., maternal mortality and neonatal mortality). Future studies should attempt to assess the association between process indicators, such as signal functions and quality of care as described in this study, and health outcomes to enable robust evidence-based advocacy for maternal and child health programs.

Assessment of the availability of EmONC signal functions can help policymakers to identify priority areas for capacity building and budget allocation. Our study suggested that health facilities in Bangladesh are of moderate to high quality for EmOC and of low to substandard quality for EmNC, and that EmNC services have not been adequately prioritized in Bangladesh. There is a need for a national strategy to improve the quality of health facilities to strengthen their capacity to deliver EmONC.

Received May 12, 2015. Accepted for publication May 2, 2016.

Published online June 6, 2016.

Acknowledgments: The icddr,b acknowledges with gratitude the study participants, the dedicated field team. icddr,b is thankful to the governments of Bangladesh, Canada, Sweden, and the United Kingdom for providing core/unrestricted support.

Financial support: This National Hygiene Assessment was funded by Water Aid Bangladesh (grant no. GR-01018) and additional data that were collected from health-care facilities pertaining to EmOC and EmNC were funded by the icddr,b.

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