

Behavior Change Communications during Antenatal Visits Using Pictorial Cards Improves Institutional Delivery Rates: Evidence from Matlab, Bangladesh

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ABSTRACT.

Aims: Behavior change communication (BCC) has been recommended in maternal health however, little is known about its effectiveness in improving knowledge and utilization of services. This paper presents findings from Matlab, a rural area of Bangladesh to inform policy about the effect of focused BCC on maternal knowledge and institutional delivery rates.

Study design: Longitudinal

Place and Duration of Study: We analyzed monitoring data of Matlab maternity care program of the International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) for the period 2003-2006.

Methodology: icddr,b introduced pictorial cards in 1996 to monitor all pregnant women in Matlab service area and to provide BCC during routine antenatal visits on pregnancy danger signs, birth planning and maternal nutrition. Maternal knowledge was measured by asking about complications shown on the pictorial cards during 1st and 2nd (or successive) antenatal visits. The pictorial card data were linked with the birth file data and the socioeconomic survey data of the year 2005 of Matlab Health and Demographic Surveillance Systems (HDSS) for analysis.

Results: HDSS recorded 11,150 births during the study period but pictorial cards covered 10,657 women, and maternal knowledge data was available from 6,624 of these. Knowledge about all 5 danger signs increased from 8.9% to 34.2% between 1st and 2nd (or successive) antenatal visits ($P < .001$). Women with complete knowledge of all five pregnancy danger signs were 1.13 (Adjusted Odds: 1.13, 95% CI, 1.01-1.27) times more likely to have institutional deliveries than those without knowledge when the effect of socio-demographic co-variables were held constant.

Conclusion: Focused BCC using pictorial cards during antenatal visits improves knowledge regarding 5 pregnancy danger signs which has clear implications for improving institutional delivery rates. We recommend implementation research to demonstrate the effect of focused BCC in improving knowledge and practice to address high maternal mortality in resource-poor settings.

Keywords: Danger sign, Health Education, Pregnancy, Institutional Delivery, Bangladesh

22 1. INTRODUCTION

23

24 Millennium Development Goal 5 (MDG) is an explicit call to ‘improve maternal health’ by
25 achieving a target of 75% reduction in the maternal mortality ratio (MMR) between 1990 and
26 2015 [1]. Currently, the global consensus is that all deliveries are at risk for developing life-
27 threatening complications and therefore should always be conducted by a skilled birth
28 attendant (SBA) supported by referral linkages with comprehensive emergency obstetric
29 care (CEmOC) facilities [2]. Experts have formulated several conceptual frameworks to
30 understand the causal pathways for high MMR and have emphasized strengthening health
31 systems to improve supply and stimulate demand to increase utilization of maternal health
32 care services [2, 3]. There are many cultural and religious barriers to seeking appropriate
33 care for maternal and neonatal complications. The knowledge of pregnant women about
34 maternal and newborn danger signs is limited [4]. Behavior change communication (BCC) is
35 one of the key demand interventions for improving knowledge and use of skilled delivery
36 care services. Antenatal care (ANC) is widely established and pictorial cards have been
37 used in many resource-poor settings to educate pregnant women on pregnancy danger
38 signs, birth-preparedness, and maternal nutrition [5]. The literature suggests that when a
39 new message is communicated to the target audience using appropriate media and in a
40 favorable environment, it is internalized and creates certain positive changes in knowledge,
41 perception and attitude of the recipient that is ultimately reflected in positive changes in
42 behaviors [6, 7]. Pictorial communication has been proven effective in improving knowledge
43 and altering behaviour in many areas such as vaccination [8] and care-seeking for diabetes
44 mellitus [9]. However, there is a paucity of evidence that demonstrates the success of
45 pictorial communication in maternal health [5, 7, 8]. In this study we have analyzed routine
46 monitoring data of Matlab Maternity Care Program of icddr,b to explore the effect of pictorial
47 communication in improving knowledge about pregnancy danger signs and institutional
48 delivery rates.

49

50 2. MATERIAL AND METHODS

51

52 2.1 Study setting

53 This study was conducted in Matlab, a rural area of Bangladesh where icddr,b has
54 maintained a well-organized HDSS since 1966 covering a population of about 225,000 (in
55 2006). The HDSS collects information on births, deaths, marriages and migration through
56 routine home-visits by trained community health research workers (CHRWs). In Matlab
57 HDSS area, socio-economic censuses are conducted periodically (1974, 1982, 1996, and
58 2005) [10].

59 A Maternal, Child Health & Family Planning (MCH-FP) program was initiated in one half of
60 the Matlab HDSS area in 1978. Since then, the MCH-FP intervention area is known as
61 icddr,b service (treatment) area and the remaining half is known as the government service
62 (comparison) area. A home based maternity care program using trained nurse-midwives was
63 initiated in one half of the icddr,b service area in 1987. During 1990, the program was
64 expanded to the rest of the icddr,b service area and in 1996, the home-based strategy was
65 gradually replaced by a facility based strategy deploying the same nurse-midwives in 4
66 health sub-centres upgraded to provide 24/7 basic obstetric care services. Since 2001,
67 icddr,b has been providing basic obstetric care services from 4 health sub-centres and its
68 Matlab hospital with strong referral linkages with comprehensive emergency obstetric care
69 facilities (public and private) in neighboring Chandpur district town 17 kilometer away from
70 Matlab. In addition, basic obstetric care services were available from the Matlab government
71 upazila health complex and public and private hospitals in Chandpur district town [11-14].
72 Antenatal and post-natal care services are also provided by nurse-midwives from the icddr,b

73 sub-centres and Matlab hospital. Providing BCC during ANC visits was always an integral in
74 the Matlab maternity care program.

75

76 **2.2 Pictorial cards**

77 A women-based pictorial card (PC) was introduced in 1996 to monitor all women in the
78 icddr,b service area during pregnancy, delivery, and 42 days post-partum. These cards are
79 distributed to all new pregnant women (identified on the basis of three successive missed
80 menstrual cycles) during pregnancy registration by CHRWs when background information of
81 the pregnant woman is also recorded. Pregnant women are requested to preserve these
82 cards carefully and submit them to service providers while seeking care during pregnancy,
83 delivery and postnatal periods. Service providers record service statistics on these cards and
84 use them for providing BCC to pregnant women. These cards have pictures of five important
85 pregnancy danger signs (Box 1) and room to record whether the pregnant woman could
86 recognize them accurately without prompting.

87 Box 1: Pictorial depiction of five pregnancy danger signs

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- | |
|---|
| <ol style="list-style-type: none">1. Ante Partum Hemorrhage2. Pre-Eclamptic Toxemia3. Prolong Labor4. Mal-Presentation5. Post Partum Hemorrhage |
|---|

94 The icddr,b nurse-midwives during 1st ANC visit shows all 5 pictures on the PCs and asks
95 the pregnant woman to describe them one by one. The nurse-midwife records the responses
96 in the specified space below each picture. In case someone fails to recognize any of the
97 pregnancy danger signs correctly, the nurse-midwife teaches the pregnant woman about the
98 complication and its consequences and advises her to visit CEmOC facilities urgently for
99 treatment in case such a complication arises anytime during pregnancy, delivery, or the
100 post-partum period. During the second or successive ANC visit the same procedure is
101 followed to elicit each woman's correct knowledge about pregnancy danger signs. There is
102 room for collecting such knowledge information only twice during the entire pregnancy period
103 (during 1st and 2nd or successive visits). All PCs are collected after 42 days of delivery of
104 women by the CHRWs or by the nurse-midwives when the mother comes into contact with
105 them. After collecting the PCs, one assigned midwife checks them and sends them to the
106 Matlab field office of icddr,b for computer entry. Before entry, all text responses for
107 pregnancy danger signs are coded as 'correct' or 'incorrect' by a trained medical doctor in
108 Matlab.

109

110

110 **2.3 Statistical analysis**

111 Institutional delivery is the 'outcome' variable and women's knowledge about 5 pregnancy
112 danger signs is the 'exposure' variable in this study. The effects of socio-demographic
113 factors were controlled statistically using multivariable logistic regression analysis in SPSS
114 16 [15]. A woman was classified as having institutional delivery if she delivered in icddr,b or
115 any other health facility. We used PC data after validation with the HDSS birth records. A
116 composite knowledge variable was created combining all 5 knowledge questions in the PCs.
117 A woman was considered knowledgeable if she could mention all 5 pregnancy signs
118 correctly without prompting. Economic status was measured in asset quintiles rather than in
119 terms of income or consumption [16, 17]. Assets included durable goods (e.g., table, chair,
120 watch, television, or bicycle), housing facilities (e.g., type of toilet, or source of drinking
121 water), housing materials (e.g., type of wall or roof), and possession of farming land. Socio-
122 economic survey data of year 2005 was used to construct asset quintiles. Equity was
123 defined as equal use for equal need [18]. Maternal educational was not included in the index

as it was treated as an independent variable. We linked HDSS, PC and socioeconomic survey data using unique identification numbers of mothers and date of birth of the index child.

We analyzed PC data from 2003 to 2006 that included 10,657 pregnant women while HDSS recorded 11,150 women with known pregnancy outcome during that period. Thus a total of 493 mothers were missing in the PCs. Of 10,657 mothers with PCs, knowledge information was available for 6,624 mothers. Therefore, the final analysis was confined to 6,624 cases only and the sample size (N) varied throughout the analysis.

The difference of knowledge between first and second (or successive) ANC visit was tested by McNemar test to assess the effect of BCC interventions in improving knowledge about pregnancy danger signs. We modeled data for multivariable logistic regression analysis where facility delivery was the outcome variable and knowledge about pregnancy danger signs was the exposure variable while age, parity, year of delivery, education and economic status were covariates whose confounding effects were controlled statistically. The relationship between exposure and outcome variable was measured in terms of odds ratios (OR) and 95% confidence intervals of odds ratios adjusting for socio-demographic covariates.

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142 3. RESULTS AND DISCUSSION

143

144 3.1 Socio-Demographic Characteristics

145 The mean age of pregnant women in Matlab icddr,b service area was 25.6 (SD; ± 6.0) years
146 while the mean parity was 1.3 (SD; ± 1.4). About 17% women delivered their index child at
147 age below 20 years while 9.5% delivered at age 35 years or above. Mean years of schooling
148 was 5.3 (SD; ± 3.8) years while 24% of pregnant women were illiterate. An increasing trend is
149 observed in maternal education in the study area (Table 1).

150

151 **Table 1: Socio-demographic characteristics of the study population**

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Variables	2003	2004	2005	2006	Total
	(N=2863)	(N=2670)	(N=2610)	(N=2523)	(N=10657)
	%	%	%	%	%
Age in Years					
13-19	16.7	16.6	16.1	17.3	16.6
20-24	31.3	29.9	32.2	32.8	31.5
25-29	25.8	26.9	25.1	25.3	25.8
30-34	16.6	17.2	16.8	15.4	16.5
≥ 35	9.6	9.5	9.8	9.2	9.5
Mean age	25.7 (± 6.1)	25.7 (± 6.0)	25.7 (± 5.9)	25.4 (± 5.9)	25.6 (± 6.0)
Women's					

education					
None	28.6	24.9	21.9	19.9	24.0
1-4 years	27.3	26.5	27.2	26.2	26.8
5-8 years	19.6	21.5	21.5	23.0	21.3
≥9 years	24.4	27.0	29.4	31.0	27.9
Mean years of schooling	4.8 (±3.9)	5.2 (±3.8)	5.4 (±3.7)	5.7 (±3.6)	5.3 (±3.8)
Parity					
Primi	35.6	35.4	35.3	38.5	36.2
1-2	45.5	46.9	49.1	46.4	46.9
≥3	18.9	17.7	15.6	15.1	16.9
Mean parity	1.4 (±1.4)	1.3 (±1.3)	1.2 (±1.3)	1.2 (±1.3)	1.3 (±1.4)
Asset quintile					
Poorest	17.9	19.4	15.7	16.7	17.5
2 nd	18.0	17.8	18.0	17.4	17.8
3 rd	21.3	21.9	18.7	20.0	20.5
4 th	24.0	22.4	23.9	22.0	23.1
Richest	18.9	18.6	23.7	23.8	21.1

3.2 Knowledge about 5 pregnancy dangers signs

During 1st ANC visit, only 8.8% mothers could recognize all 5 pregnancy signs correctly without prompting while it increased to 34% during 2nd (or successive) ANC visits. This increase in knowledge between two ANC visit was statistically significant ($P < .001$) which suggests the effectiveness of pictorial communication in enhancing knowledge of women regarding 5 pregnancy danger signs (Table 2).

163 **Table 2: Changes of knowledge on pregnancy danger signs among pregnant women**
 164 **during 1st and succeeding Antenatal visit during 2003-2006 in the study area**

Knowledge		2003		2004		2005		2006		Total	
of	1st	2 nd	1st	2 nd	1st	2 nd	1st	2 nd	1st	2 nd	
pregnancy	ANC	ANC	ANC	ANC	ANC	ANC	ANC	ANC	ANC	ANC	
danger	N=2190	N=2159	N=1551	N=1528	N=1660	N=1622	N=1346	N=1315	N=6747	N=6624	
sign											
None	1.1	0.0	1.2	0.3	2.4	0.7	2.8	0.3	1.8	0.3	
At least	3.6	0.3	3.8	0.9	5.1	1.0	4.5	0.2	4.2	0.6	
one											
At least	8.7	1.3	8.3	1.6	10.8	2.3	10.0	1.2	9.4	1.6	
two											
At least	23.8	7.5	25.3	9.8	24.7	11.0	23.8	7.1	24.4	8.8	
three											
At least	53.5	51.5	52.4	55.8	49.6	56.5	49.4	55.7	51.5	54.5	
four											
All the five	9.3	39.4	9.2	31.7	7.3	28.5	9.4	35.5	8.8*	34.2*	
danger											
signs											

165 *p < .001 in McNemar test

166 In bivariate analysis, knowledge was found to vary significantly by age, parity, education and
 167 asset index of women. In multivariable analysis, when the effects of covariates were
 168 controlled for statistically using binary logistic regression model, asset-index lost its
 169 significant relationship with knowledge while maternal education, parity and age of mother
 170 maintained a significant relationship with the 'knowledge about 5 pregnancy danger signs'.
 171 Our analysis suggests that education, age and parity are significant predictors of knowledge
 172 while asset-index is not. Knowledge was found to increase with education and decrease with
 173 increasing age (Table 3).
 174

175 **Table 3: Logistic regression results from pictorial card data for socio-demographic**
 176 **correlates of recognized 5 pregnancy danger signs during 2nd ANC visit by pregnant**
 177 **women in ICDDR, B service area, 2003-2006**

		Dependant variable: knowledge about 5 pregnancy danger signs			
		Univariate model		Multivariable model	
Independent variables (Regressors)	Have knowledge about all 5 danger sign in % (N=6624)	Crude odds ratio	95% confidence interval for crude odds ratio	Adjusted odds ratio	95% confidence interval for adjusted odds ratio
Age in years					
13-19	37.0	1.00	Reference category	1.00	Reference category
20-24	38.8	1.09	0.95-1.23	1.02	0.87-1.20
25-29	33.6	0.86	0.74-0.99	0.85	0.70-1.03
30-34	27.6	0.65	0.55-0.77	0.73	0.58-0.91
≥35	25.3	0.57	0.46-0.71	0.70	0.53-0.93
Parity					
Primi	36.9	1.00	Reference category	1.00	Reference category
1-2	35.1	0.92	0.83-1.03	1.18	1.03-1.36
≥3	24.8	0.56	0.48-0.66	0.95	0.76-1.20
Women's education					
No education	26.6	1.00	Reference category	1.00	Reference category

1-4 years	31.3	1.26	1.08-1.46	1.19	1.02-1.39
5-8 years	35.7	1.53	1.31-1.79	1.37	1.15-1.62
≥9 years	42.0	2.00	1.73-2.31	1.82	1.54-2.14
Asset score					
Poorest	32.3	1.00	Reference category	1.00	Reference category
2	30.0	0.91	0.76-1.08	0.88	0.73-1.05
3	34.8	1.12	0.95-1.32	1.02	0.86-1.21
4	35.4	1.15	0.98-1.35	1.00	0.85-1.19
Richest	37.0	1.23	1.05-1.46	1.05	0.88-1.25
Year					
2003	39.4	1.00	Reference category	1.00	Reference category
2004	31.7	0.72	0.62-0.82	0.69	0.61-0.79
2005	28.5	0.61	0.53-0.70	0.58	0.50-0.66
2006	35.5	0.65	0.74-0.94	0.79	0.68-0.92

3.3 Institutional delivery

During 2003-2006, about 47.3% deliveries were conducted in health facilities in the icddr,b service area. In bivariate analysis an increasing trend is observed over time; the facility delivery rate increased from 38.4% in 2003 to 58.2% in 2006. Facility delivery rate was found to vary by age, parity, asset-index, maternal education and knowledge about pregnancy signs. The facility delivery rate increased significantly with increase of maternal education and asset quintile while the rate decreased with increasing age and parity. Knowledge about 5 pregnancy danger signs significantly influenced the use of health facilities for conducting deliveries: utilization was 50.3% among mothers who did not have knowledge about all 5 danger signs while the same rate was 54.6% among mothers who had knowledge about 5 pregnancy danger signs (Table 4). Of all 5 danger signs, only knowledge about prolonged labour was a significant predictor of institutional delivery independently (data not shown).

Table 4: Association between facility delivery and knowledge on five pregnancy danger signs among pregnant women during succeeding ANC visit during 2003-2006

Independent variables		Dependant variable: Delivered in facility			
(Regressors)	Institutional delivery	Univariate model		Multivariate model	
		Crude	95 confidence	Adjusted	95 confidence

	rate (%)	odds ratio	interval for crude odds ratio	odds ratio	interval for adjusted odds ratio
knowledge	N=6624				
about 5 danger signs					
No	50.3	1.00	Reference category	1.00	Reference category
Yes	54.6	1.19	1.07-1.31	1.13	1.01-1.27
Age group	N=10657				
13-19	52.5	1.00	Reference category	1.00	Reference category
20-24	48.8	0.86	0.77-0.96	1.17	1.04-1.33
25-29	47.4	0.82	0.72-0.92	1.72	1.50-1.98
30-34	41.7	0.65	0.57-0.74	2.04	1.72-2.41
35-51	43.3	0.69	0.59-0.81	2.90	2.36-3.55
Parity	N=10657				
Primi	58.7	1.00	Reference category	1.00	Reference category
1-2	44.0	0.55	0.51-0.60	0.49	0.44-0.55
≥3	32.3	0.34	0.30-0.38	0.27	0.23-0.32
Education	N=10657				
None	30.8	1.00	Reference category	1.00	Reference category
1-4 years	42.1	1.64	1.46-1.83	1.49	1.32-1.67
5-8 years	49.4	2.19	1.95-2.47	1.92	1.69-2.18
9 & above	65.1	4.21	3.76-4.71	3.16	2.78-3.58
years					
Asset score	N=10657				
Poorest	34.2	1.00	Reference category	1.00	Reference category
2	43.3	1.47	1.29-1.68	1.40	1.22-1.60

3	45.7	1.62	1.42-1.84	1.38	1.21-1.58
4	53.0	2.17	1.92-2.46	1.65	1.45-1.88
Richest	57.0	2.56	2.25-2.90	1.77	1.54-2.01
Year	N=10657				
2003	38.4	1.00	Reference category	1.00	Reference category
2004	43.0	1.21	1.09-1.35	1.37	1.19-1.57
2005	51.1	1.68	1.51-1.87	1.91	2.67-2.19
2006	58.2	2.24	2.01-2.50	2.54	2.19-2.95

In multivariable logistic regression analysis, when the confounding effects of all covariates in the model were controlled for statistically, knowledge about 5 danger signs was a significant predictor for institutional deliveries; a mother with knowledge about 5 danger signs was 1.13 times (OR 1.13; 95% CI 1.01, 1.27) more likely to deliver in a health facility than a mother without knowledge of all 5 pregnancy danger signs (Table 4). All socio-demographic variables sustained their significant relationship with institutional delivery rates even after controlling the effects of all covariates in the model. However, the direction of association changed with age of mothers. In bivariate analysis, use of facility was found to decrease with increase of age, while in multivariate analysis when the confounding effects of covariates (particularly that of parity) were controlled for statistically, age had a positive influence on institutional delivery rates. A similar finding was also reported in another analysis from Matlab Bangladesh [19]. Our multivariate analysis also shows that the probability of delivering in a health facility decreases with increased parity. A woman with 3 or more parity was 73% less likely to deliver in a health facility than a nulliparous woman. Education and asset index had similar positive effects upon utilization of services. Of all socio-demographic variables, maternal education was the most powerful predictor for institutional delivery (Table 4).

3.4 Discussion

Our study has clearly demonstrated that BCC with pictorial cards during ANC visits is effective in improving knowledge of women about pregnancy danger signs and more importantly, the enhanced knowledge can significantly improve the institutional delivery rates even after controlling for socio-demographic confounders. The study findings have important policy implications for safe-motherhood programs in Bangladesh and elsewhere in low and middle income countries.

The effectiveness of BCC in increasing the use of services is not well studied in maternal health although evidence of success with BCC is reported in other areas of health such as breast feeding [20], family planning [21], improved hygienic practices [6] and care-seeking for sick neonates [22]. Fewer studies have reported success of BCC interventions using PCs in increasing knowledge and uptake of skilled delivery care services. One study in South Uganda reported a 50% increase in the use of skilled birth attendants for conducting deliveries among women with birth-preparedness interventions than women without birth-preparedness interventions [23]. Similar successful results with demand-side interventions have been reported from Burkina Faso [24] and Bangladesh [25].

230 About two-thirds of the women in Matlab icddr,b service area were not aware of all five
231 pregnancy danger signs. Similar levels of poor knowledge of pregnant women have been
232 reported from Burkina Faso, Gambia, Nepal and Tanzania [23, 26-28]. However, these
233 studies reported recall information from women after their delivery and did not analyze all 5
234 pregnancy danger signs together. A study in one northern district of Bangladesh [25]
235 reported that about 45% of women had knowledge of 3 or more pregnancy danger signs but
236 the study did not explore the effect of knowledge on institutional delivery rates. Our study
237 suggests that there is further scope to enhance knowledge of pregnant women to increase
238 institutional delivery rates in Matlab, and elsewhere in Bangladesh.

239 The knowledge of pregnant women about 5 pregnancy danger signs increased significantly
240 in the present study due to BCC intervention with PCs by nurse-midwives. Similar success
241 with BCC has been reported in enhancing knowledge about pregnancy danger signs from
242 other settings [29]. The literature suggests that improved knowledge about pregnancy
243 danger signs reduces the 1st and 2nd delay of the 3 Delay Model [3] and in Bangladesh the
244 first delay was found to be the most important barrier for accessing obstetric care from
245 appropriate EmOC facilities [7]. Failure to recognize the gravity of the situation and lack of
246 money for transport were important reasons for 1st delay in seeking care. To reduce delays
247 in care seeking and to improve access to EmOC in rural Bangladesh, interventions should
248 be intensified to enable communities to recognize 'pregnancy-danger signs'. This strategy
249 should be combined with ongoing community-based SBA and decentralization of EmOC
250 efforts to contribute to reductions in high maternal mortality ratios [7, 30, 31].

251 The current study has documented that pregnant women with knowledge about all five
252 danger signs are 13% more likely to deliver in a facility than those without knowledge of all
253 five pregnancy danger signs. It is logical that having specific knowledge about the risks of
254 childbirth and the benefits of skilled attendance should increase preventive care seeking,
255 while recognition of danger signs and knowledge about available beneficial interventions
256 should increase care-seeking for obstetric complications. Our study has shown that
257 enhanced knowledge can increase the rate of institutional delivery. A similar positive effect
258 of enhanced knowledge on institutional delivery is reported from Africa and Asia. Women in
259 Zambia who knew danger signs in pregnancy were more likely to deliver in a health facility
260 as compared to those without such knowledge [32] and a similar but not significant tendency
261 was observed in Southern Laos [33]. Also, in Mali and Tanzania, women who were informed
262 of complications during antenatal care were more likely to give birth in a facility [27, 34].

263 Currently, Bangladesh is focusing on increasing the institutional delivery rates to facilitate
264 achieving the MDG 5 targets [35]. Therefore, appropriate BCC during ANC using PCs should
265 be initiated to enable women, their gatekeepers, and communities to reduce delays in care
266 seeking. This is especially required for women with life-threatening obstetric complications
267 such as APH, PPH, eclampsia and prolonged/obstructed labour. Given this context, we
268 recommend implementation research to demonstrate the effectiveness of BCC with pictorial
269 cards during ANC in a real life context and to understand the challenges related to national
270 scale-up in Bangladesh.

271 Maternal education emerged as the most powerful indicators for both knowledge and use of
272 services. Hence there is a need to strengthen ongoing female education program to secure
273 gain in maternal and neonatal health. Data also suggests that primigravidae and high parity
274 mothers should be targeted for maternal health interventions.

275 The major limitation of this analysis is that a considerable proportion of women who
276 delivered in the area during the study period were not captured through PCs and more
277 importantly, relevant information on 5 danger signs were missing for many women in the

PCs. However, the SES of women with PC was similar to those without PC suggesting minimal bias in estimating effect size of interventions. Furthermore, there is no comparable group in this study which may limit the generalisability of the study findings. This analysis is based on data from Matlab which has been criticized for not being representative of other rural areas of Bangladesh because of its many and long-term interventions in the field of health, population and nutrition [36]. Therefore, there is a need to demonstrate these results in districts outside Matlab. During the study period the women could get information on pregnancy danger signs from other sources such as television, radio and newspapers which may have affected the study results and were difficult to control for. However, this external exposure was similar to all women under study.

4. CONCLUSION

Focused BCC using PCs during routine ANC improves knowledge of pregnant women and their use of health facilities for conducting deliveries which may contribute in achieving MDG 5 targets by 2015. Bangladesh and other low income countries should test the effectiveness of BCC interventions with pictorial cards in different contexts to improve maternal health outcomes.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

Aminur Rahman contributed in developing the analysis plan, data organization, analysis and preparing the first draft of the manuscript. Iqbal Anwar was involved in data analysis and review of the manuscript. Both the authors read and approved the final manuscript.

CONSENT (WHEREEVER APPLICABLE)

Not Applicable as we have analyzed the programme monitoring data. But we sought permission for the use of data according to the centre rules.

ETHICAL APPROVAL (WHEREEVER APPLICABLE)

Not Applicable as we used programme monitoring data in this manuscript.

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431 **DEFINITIONS, ACRONYMS, ABBREVIATIONS**

432 ANC: Antenatal care

433 APH: Antepartum Haemorrhage

434 BCC: Behavior Change Communication

435 CEmOC: Comprehensive Emergency Obstetric Care

436 CHRW: Community Health Research Worker

437 DFID: Department for International Development

438 EU: European Union
439 HDSS: Health and Demographic Surveillance System
440 icddr,b: International Centre for Diarrhoeal Disease Research, Bangladesh
441 MCH-FP: Maternal, Child Health & Family Planning
442 MDG: Millennium Development Goal
443 MMR: Maternal Mortality Ratio
444 OR: Odds Ratio
445 PC: Pictorial Card
446 PPH: Postpartum Haemorrhage
447 SBA: Skilled Birth Attendant
448 SES: Socio Economic Survey

449

450 **APPENDIX**