

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

Rahman A¹, Anwar I¹(Aminur Rahman, Iqbal Anwar)

¹ Centre for Reproductive Health, icddr,b, 68 Shaheed Tajuddin Ahmed Sarani, Mohakhali, Dhak-1212, Bangladesh,

Aims: In Bangladesh various interventions are imparted to address high maternal mortality. Behavior change communications (BCC) have been recommended to improve knowledge and thus to impact use of services. However, little is known about effect of BCC upon knowledge and care-seeking in maternal health. A study was conducted to explore the effect of BCC upon maternal knowledge and institutional delivery rates.

Study design: Cross section

Place and Duration of Study: The study took place in Matlab, Bangladesh between 2003-2006.

Methodology: International Centre for Diarrheal Disease Research, Bangladesh (icddr,b) introduced pictorial cards in the Matlab SMP in 1996 to monitor all women during pregnancy, childbirth and 42 days postpartum and to educate them about five important pregnancy danger signs (bleeding, headache, edema, mal-presentation, prolong labour). The knowledge was measured by asking the pregnant women about complications shown on the pictorial cards during 1st and 2nd (or successive) antenatal visits. In this study we analyzed pictorial card data after linking with the birth file data and 2005 socioeconomic survey data of Matlab Health and Demographic Surveillance System.

Results: A total of 11,150 births took place during the study period. Pictorial cards covered 10,657 of them and knowledge data was available from 6,624 women. Knowledge of five pregnancy danger signs increased from 8.9% to 34.2% between first and 2nd (or successive) antenatal visits ($p < 0.0001$). Women with knowledge about 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 variables were held constant.

Conclusion: Focused BCC during antenatal visits with pictorial cards improves knowledge of pregnant women about 5 pregnancy danger signs that has clear implications for improving institutional delivery rates. We recommend implementation research to demonstrate the effect of focused BCC in increasing institutional delivery.

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

1. INTRODUCTION

Millennium Development Goal 5 (MDG) is an explicit call to 'improve maternal health' with a 75% reduction of maternal mortality ratio (MMR) between 1990 and 2015 [1]. All deliveries are at risk to develop life-threatening complications and should always be conducted by a skilled birth attendant (SBA) supported by referral linkages with comprehensive emergency obstetric care (CEmOC) facilities [2]. Experts have formulated several conceptual frameworks to understand the causal pathways for high MMR and emphasized strengthening health systems to improve supply and stimulating demand to increase utilization of cost-effective maternal health care services [2 3]. There are many cultural and religious barriers to seeking appropriate care for maternal and neonatal complications. The knowledge of pregnant women about maternal and newborn danger signs is limited [4]. Behavior change communication (BCC) is considered as one of the key demand interventions for improving knowledge and thus access to and utilization of available maternal health care services. Antenatal care (ANC) is widely established and pictorial cards have been used in many resource-poor settings to educate pregnant women on maternal and neonatal danger signs, birth-preparedness, and maternal nutrition [5]. Literature suggests that when a new message is communicated using appropriate media, and in a favorable environment, it gets internalized, makes certain positive changes in knowledge, perception and attitude which is ultimately reflected by a positive change in behavior [6,7]. Pictorial communication has been proven effective in improving knowledge and altering care-seeking for many health problems such as vaccination [8] and care-seeking for diabetes mellitus [9]. However, there is paucity of data to demonstrate success of pictorial communication in maternal and newborn health [5,7-8]. In this study we have analyzed routine monitoring data of Matlab Safe Motherhood Program of icddr,b to explore the effect of pictorial communication in improving knowledge about pregnancy danger signs and institutional delivery rates.

2. MATERIAL AND METHODS

2.1 Study setting

This study was conducted in Matlab, a rural area of Bangladesh where ICDDR,B has been maintaining a health and demographic surveillance system (HDSS) since 1966 covering a population of about 225,000 (in 2006). The HDSS collects information on births, deaths, marriages and migration through routine home-visits by trained community health workers (CHWs). In Matlab HDSS area, socio-economic censuses are conducted periodically (1974, 1982, 1996, and 2005) [10].

A Maternal, Child Health & Family Planning (MCH-FP) program was initiated in half of Matlab HDSS area in 1978. Since then, MCH-FP intervention area is known as ICDDR,B service (treatment) area and the remaining half as the government service (comparison) area. A community based maternity care program was initiated in one half of the ICDDR,B service area in 1987. During 1990, the program was expanded to the rest of icddr,b service areas and in 1996, the home-based strategy was gradually replaced by a facility based strategy deploying the same trained nurse-midwives in 4 upgraded health sub-centres to provide 24/7 basic obstetric care services. Since 2001, ICDDR,B is providing basic obstetric care services from 4 health sub-centres and a Matlab hospital with strong referral linkages with comprehensive emergency obstetric care facilities (public and private) in Chandpur district town. In addition, basic obstetric care services are now available from Matlab government upazila health complex and public and private hospitals in Chandpur district town 17 kilometer away from Matlab [11-14]. Imparting BCC during ANC was an integral part of Matlab Safe Motherhood Program.

2.2 Pictorial cards

Matlab Safe Motherhood Program introduced women-based pictorial cards (PC) in 1996 to monitor all mothers during pregnancy, delivery, and 42 days post-partum. Pictorial cards are distributed to all new pregnant women during pregnancy registration (having 3 successive missing periods) by CHWs during their routine home-visits when background information of the pregnant women is also recorded on the PCs. Pregnant women are requested to preserve these PCs carefully and submit them to service providers during ANC visits, delivery and PNC visits. Service providers record service statistics and clinical findings on these pictorial cards. Other important use of PC is for imparting BCC to pregnant women. There are pictures on five important pregnancy danger signs (Box: 1) and room to record whether pregnant woman could recognize them accurately without prompting.

Box: 1 List of pregnancy danger signs

1. Ante Partum Hemorrhage
2. Pre-Eclamptic Toxemia
3. Prolong Labor
4. Mal-Presentation
5. Post Partum Hemorrhage

The ICDDR,B nurse-midwives during 1st ANC visit, shows the pictures on the PCs and ask the pregnant woman to mention each complication shown. The nurse-midwife records the answer in the specified space below each picture. In case, someone fails to recognize any pregnancy danger signs correctly, the nurse-midwife teaches the pregnant woman about the complication and advises her to visit CEmOC facilities urgently for treatment in case any such complication arising anytime during pregnancy, child-birth or post-partum period. There are also questions on birth planning and complication readiness on the pictorial cards. During second or successive ANC visit, the same procedure is followed to elicit each woman's correct knowledge about five pregnancy danger signs. There is room for collecting such knowledge information only twice during entire pregnancy period (during 1st and 2nd or successive visits). All PCs are collected after 42 days of delivery of women by the CHWs or by the nurse-midwives when the mother comes in contact with them. After collection, one assigned midwife checks the PCs and sends them to the Matlab field office for computer entry. Before entry, all text responses for pregnancy danger signs is coded as 'correct' or 'incorrect' answer by a trained medical doctor in Matlab.

2.3 Statistical analysis

Institution delivery was the ultimate outcome variable and the knowledge about 5 pregnancy signs of women was the exposure variable in this study. The effects of socio-demographic factors were controlled statistically using logistic regression model in SPSS 16 [15]. A woman was classified as having institutional delivery if she delivered in ICDDR,B or any other health facility. For use of services we used PC data after validation with the HDSS birth records. A composite knowledge variable was computed combining all 5 knowledge questions in the PCs. A woman was considered knowledgeable if she could mention all 5 pregnancy signs correctly on the pictorial cards without prompting. Economic status was measured in asset quintiles following principal component and factor analysis methods rather than in terms of income or consumption [16,17]. Assets included durable goods (eg, table, chair, watch, television, or bicycle), housing facilities (e.g., type of toilet, or source of drinking water), housing materials (e.g., type of wall or roof), and possession of firming land. Socio-economic survey data of year 2005 was used to construct asset quintiles. Equity was defined as equal use for equal need [18]. Maternal educational was not included in the index rather considered as an independent variable. Linking of HDSS, PC and socioeconomic

survey data was done using unique identification numbers of mothers and date of birth of the index child. We analyzed PC data of the period 2003-2006 that covered 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. Thus the final analysis was confined within 6624 cases only and the number (N) varied throughout the analysis. The difference of knowledge between first and successive ANC visit was tested by McNemar test to assess the effect of BCC interventions in improving knowledge about pregnancy danger signs. The relationship between 'knowledge about 5 danger signs' and 'institutional delivery' was measured in terms of odds ratios (OR) and 95% confidence intervals of odds ratios adjusting for socio-demographic covariates using binary logistic regression model in SPSS 16.

3. RESULTS AND DISCUSSION

3.1 Socio-Demographic Characteristics

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

Table 1: Socio-demographic characteristics of the study population

Variables	2003 (N=2863) %	2004 (N=2670) %	2005 (N=2610) %	2006 (N=2523) %	Total (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 while the same proportion was 34% during 2nd (or successive) ANC visits. This increase in knowledge between two ANC visit was statistically significant ($p < 0.0001$) and implies effectiveness of pictorial communication in enhancing knowledge of women about 5 pregnancy danger signs (Table 2).

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

Know ledge	2003		2004		2005		2006		Total	
of	1 st	Succes	1 st ANC	Succes	1 st ANC	Successi	1 st	Success	1 st ANC	Success
pregnancy	ANC	sive	N=1551	sive	N=1660	ve ANC	ANC	ive ANC	N=6747	ive ANC
danger sign	N=219	ANC		ANC		N=1622	N=134	N=1315		N=6624

	0	N=2159			N=1528			6		
None	1.1	0.0	1.2	0.3	2.4	0.7	2.8	0.3	1.8	0.3
At least one	3.6	0.3	3.8	0.9	5.1	1.0	4.5	0.2	4.2	0.6
At least two	8.7	1.3	8.3	1.6	10.8	2.3	10.0	1.2	9.4	1.6
at least three	23.8	7.5	25.3	9.8	24.7	11.0	23.8	7.1	24.4	8.8
at least four	53.5	51.5	52.4	55.8	49.6	56.5	49.4	55.7	51.5	54.5
All the five danger signs	9.3	39.4	9.2	31.7	7.3	28.5	9.4	35.5	8.8*	34.2*

160 **p*=.00001 in McNamara test

161
162 In bivariate analysis, knowledge was found to vary significantly by age, parity, education and
163 asset index of women. In multivariate analysis, when the effects of covariates were
164 controlled statistically, using binary logistic regression model, asset-index lost its significant
165 relationship with knowledge while maternal education, parity and age of mother sustained
166 significant relationship with the 'knowledge about 5 pregnancy danger signs'. Our analysis
167 suggests that education, age and parity are significant predictors of knowledge but asset-
168 index is not. Knowledge was found to increase with education and decrease with increase of
169 age (Table 3).

170
171 **Table 3: Logistic regression results from pictorial card data for socio-demographic**
172 **correlates of recognized 5 pregnancy danger signs during 2nd ANC visit by pregnant**
173 **women in ICDDR, B service area, 2003-2006**
174

		Dependant variable: knowledge about 5 pregnancy danger signs			
Independent variables (Regressors)	Have knowledge about all 5 danger sign in %	Univariate model		Multivariate model*	
		Crude odds ratio	95% confidence interval for crude odds ratio	Adjusted odds ratio	95% confidence interval for adjusted odds ratio

(N=6624)

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	26.6	1.00	Reference category	1.00	Reference category
education					
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 the study period (2003-2006), about 47.3% deliveries in Matlab icddr,b service area were conducted in health facilities. An increasing trend is observed over time; 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, asset quintile and year of delivery while the rate decreased with increase of age and parity. Knowledge about 5 pregnancy danger signs could significantly influence 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 individual 5 danger signs, only knowledge about prolonged labour could predict the institutional delivery rates; not other 4 pregnancy danger signs (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 (Regressors)	Have Delivery at facility in %	Dependant variable: Delivered in facility			
		Univariate model		Multivariate model	
		Crude odds ratio	95 confidence interval for crude odds ratio	Adjusted odds ratio	95 confidence interval for adjusted odds ratio
5 danger sign knowledge	N=6624				
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

194

195

196

197

198

199

200

201

202

In multivariate analysis when confounding effects of all covariates in the model were controlled statistically using binary logistic regression model in SPSS 16, knowledge about 5 danger signs could influence institutional deliveries significantly; a mother with knowledge about 5 danger signs was 13% (OR 1.13; 95% CI 1.01, 1.27) more likely to deliver in a health facility than a mother without complete knowledge of 5 pregnancy danger signs (Table-4). All socio-demographic variables sustained their significant relationship with utilization of services even after controlling the effects of 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 an increasing age, while in multivariate analysis when the confounding effects of covariates (particularly that of parity) were controlled statistically; age seemed to have a positive influence on the use of services. A similar finding was also reported in another paper from Matlab Bangladesh [19]. Our multivariate analysis also shows that probability to deliver 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 facility delivery (Table 4).

3.4 Discussion

Our study has clearly demonstrated that BCC with pictorial cards during ANC visit is effective in improving knowledge of pregnant mothers about pregnancy danger signs and more importantly, the enhanced knowledge could significantly improve the facility delivery rates even after controlling the confounding effects of socio-demographic covariates such as age, parity, education and asset-quintile. 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 use of cost-effective services is not well studied in safe motherhood 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] from different resource-poor settings. Fewer studies have reported success of BCC interventions using PCs in increasing knowledge and uptake of skilled delivery care services in low-income countries. One study in South Uganda reported a 50% increase in skilled birth attendants for conducting deliveries among women with birth-preparedness interventions than women without birth-preparedness interventions [23]. Similar successful results with demand interventions have been reported from Burkina Faso [24] and Bangladesh [25].

About two-third of the women in Matlab HDSS service area were not aware of all five pregnancy danger signs. Similar levels of poor knowledge of pregnant women have been reported from other poor countries such as Burkina Faso, Gambia, Nepal and Tanzania [23, 26-28]. However, these studies reported recall information from women after their delivery and did not analyze all 5 pregnancy danger signs together. A study in one northern district of Bangladesh [25] reported that about 45% of women had knowledge about 3 or more pregnancy danger signs but the study did not explore the effect of knowledge upon institutional delivery rates. Our study suggests that there is further scope to enhance knowledge of pregnant women to increase facility delivery rates in Matlab, and elsewhere in Bangladesh.

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

253 The current study has documented that pregnant women with knowledge about all the five
254 danger signs are more likely to deliver in the facility than who did not have knowledge about
255 all 5 pregnancy danger signs. Logically speaking, specific knowledge about the risks of
256 childbirth and the benefits of skilled attendance should increase preventive care-seeking,
257 while recognition of danger signs and knowledge about available beneficial interventions
258 should increase care-seeking for obstetric complications. Our study has shown that the
259 knowledge about 5 pregnancy danger signs increases the rate of preventive care seeking;
260 which mean, more and more women prefer the institutional delivery once they are aware
261 about 5 pregnancy danger signs. A similar positive effect of enhanced knowledge upon
262 institutional delivery is reported from Africa and Asia. Women in Zambia who knew danger
263 signs in pregnancy are more likely to deliver in a health facility as compared to those without
264 such knowledge [32] and a similar but not significant tendency was observed in Southern
265 Laos [33]. Also, in Mali and Tanzania, women who were told about complications at
266 antenatal care are more likely to give birth in a facility [27, 34].

267 Currently Bangladesh is focusing on increasing the institutional delivery rates to facilitate
268 achieving the targets for MDG 5 [35]. Hence, appropriate BCC during ANC using PCs for
269 pregnant women should be initiated to enable women, communities and their gatekeepers to
270 reduce delays to seek care. This is in particular, needed for women with life-threatening
271 obstetric complications, such as APH, PPH, eclampsia and prolonged/obstructed labour. In
272 this context we recommend an implementation research with BCC with PCs during ANC visit
273 in a real life context in collaboration with the policy program managers of GoB to explore the
274 challenges to facilitate nationwide up-scaling process to increase the facility delivery rates
275 and thus to contribute in MDG 5.

276 Education of women emerged as the most powerful indicators for both knowledge and use of
277 services. Hence there is a need to strengthen ongoing female education program to secure
278 gain in maternal and neonatal health. Data also suggests that primigravidae and high parity
279 mothers should be targeted for maternal health interventions.

280 The major limitation of the study is that a considerable proportion of women who delivered in
281 the area during the study period could not be captured through PCs and more importantly
282 relevant information on 5 danger signs were missing for many women in the PCs and there
283 is also no comparable group in this study which might interfere with the generalisability of the
284 study findings. However, the SES of women with PC was similar to those without PC
285 suggesting little bias in estimating effect size of interventions. This is a Matlab based study
286 which has been criticized for not being representative for other rural areas of Bangladesh for
287 long and multiple interventions in the field of health, population and nutrition in this area [36].
288 Hence there is a need to undertake an implementation research to demonstrate the effects
289 of pictorial communication during ANC in improving knowledge and practice in districts
290 outside Matlab. Other limitation is that during the study period the women could get
291 information on pregnancy danger signs from other sources such as television, radio and
292 newspapers that might have affected the study results. However the external exposure was
293 similar to all women under study.

294 295 **4. CONCLUSION**

296 Routine ANC with focused BCC using PCs could help the country achieving MDG 5 targets
297 by 2015. This is strongly supported by the current study. If pregnant women can
298 demonstrate knowledge of all the five pregnancy danger signs during their routine ANC her
299 probability for institutional delivery increases by 13%. Therefore, Bangladesh should
300 emphasize making PCs available in rural areas and educate all pregnant mother during ANC
301 to understand all five pregnancy danger signs.
302

303 **ACKNOWLEDGEMENTS**

304

305 We sincerely admit the utmost effort of nurse-midwives and community health workers at
306 Matlab icddr,b to collect the Pictorial Cards information. We also acknowledge the data
307 organizing work done by Mr. Monjur Rahman, Senior programmer, Center for Equity and
308 Health System, icddr,b. The study was supported through European Union (EU) and
309 Department for International Development (DFID). The donors had no involvement in this
310 study except funding.

311

312

313 **COMPETING INTERESTS**

314

315 Authors have declared that no competing interests exist.

316

317 **AUTHORS' CONTRIBUTIONS**

318

319 Aminur Rahman contributed in field implementation, data organization, analysis and
320 preparing the first draft of the manuscript. Iqbal Anwar was involved in data analysis and
321 review of the manuscript. Both the authors read and approved the final manuscript.

322

323 **CONSENT (WHERE EVER APPLICABLE)**

324

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

327

328

329 **ETHICAL APPROVAL (WHERE EVER APPLICABLE)**

330

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

332

333

334 **REFERENCES**

335

336 1. United Nations. United Nations Millennium declaration. New York: United Nations;2000.
337 Accessed 20 October 2012. Available:
338 <http://www.un.org/millennium/declaration/ares552e.htm>

339 2. Campbell OM, Graham WJ. Strategies for reducing maternal mortality: getting on with
340 what works. *Lancet*. 2006;368(9543):1284-99

341 3. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med*.
342 1994;38(8):1091-110.

343 4. Syed U, Asiruddin Sk, Helal, MS, Mannan II, Murray J. Immediate and early postnatal
344 care for mothers and newborns in rural Bangladesh. *J Health Popul Nutr*. 2006;24(4):508-18.

345 5. McPherson RA, Tamang J, Hodgins S, Pathak LR, Silwal RC, Baqui AH, et al. Process
346 evaluation of a community-based intervention promoting multiple maternal and neonatal care
347 practices in rural Nepal. *BMC Pregnancy Childbirth*. 2010;10:31. doi: 10.1186/1471-2393-10-
348 31

349 6. Curtis V, Kanki B, Cousens S, Diallo I, Kpozehouen A, Sangare M, et al. Evidence of
350 behaviour change following a hygiene promotion programme in Burkina Faso. *Bull World*
351 *Health Organ*. 2001;79(6):518-27.

352 7. Killewo J, Anwar I, Bashir I, Yunus M, Chakraborty J. Perceived Delay in Healthcare-
353 seeking for Episodes of Serious Illness and Its Implications for Safe Motherhood
354 Interventions in Rural Bangladesh. *J Health Popul Nutr*. 2006;24(4):403–12.

355 8. Owais A, Hanif B, Siddiqui AR, Agha A, Zaidi AK, et al. Does improving maternal
356 knowledge of vaccines impact infant immunization rates? A community-based randomized-
357 controlled trial in Karachi, Pakistan. *BMC Public Health*. 2011;11:239. doi: 10.1186/1471-
358 2458-11-239.

359 9. Awasthi S, Srivastava NM, Agarwal GG, Pant S, Ahluwalia TP. Effect of behaviour change
360 communication on qualified medical care-seeking for sick neonates among urban poor in
361 Lucknow, northern India: a before and after intervention study. *Trop Med Int Health*.
362 2009;14(10):1199-209.

363 10. HDSS. Annual Reports. Secondary Annual Reports 2012. Access 20 October 2012.
364 Available:[http://www.icddr.org/what-we-do/publications/cat_view/52-publications/10043-](http://www.icddr.org/what-we-do/publications/cat_view/52-publications/10043-icddr-documents/10049-hdss-annual-reports)
365 [icddr-documents/10049-hdss-annual-reports](http://www.icddr.org/what-we-do/publications/cat_view/52-publications/10043-icddr-documents/10049-hdss-annual-reports)

366 11. Chowdhury ME, Botlero R, Koblinsky M, Saha SK, Dieltiens G, Ronsmans C.
367 Determinants of reduction in maternal mortality in Matlab, Bangladesh: a 30-year cohort
368 study. *Lancet*. 2007;370(9595):1320-8.

369 12. Fauveau V, Stewart K, Khan SA, Chakraborty J. Effect on mortality of community-based
370 maternity-care programme in rural Bangladesh. *Lancet*. 1991;338(8776):1183-6.

371 13. Mizanur R, Julie D, Abdur R. The Role of Pregnancy Outcomes in the Maternal Mortality
372 Rates of Two Areas in Matlab, Bangladesh. *Int Perspect Sex Reprod Health*. 2010
373 ;36(4):170-7. doi: 10.1363/3617010

- 374 14. Ronsmans C, Vanneste AM, Chakraborty J, Ginneken JV. Decline in maternal mortality
375 in Matlab, Bangladesh: a cautionary tale. *Lancet*. 1997;350(9094):1810-4.
- 376 15. Field A. *Discovering statistics using SPSS*. 2nd ed. London: SAGE Publications Ltd;
377 2005.
- 378 16. Gwatkin DR, Rutstein S, Johnson K, Suliman E, Wagstaff A, Amouzou A. Socio-
379 economic differences in health, nutrition, and population within developing countries: an
380 overview. *Niger J Clin Pract*. 2007;10(4):272-82.
- 381 17. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data -- or tears: an
382 application to educational enrollments in states of India. *Demography* 2001;38:115-32.
383 PMID:11227840
- 384 18. Culyer AJ. Equity - some theory and its policy implications. *J Med Ethics*.
385 2001;27(4):275-83.
- 386 19. Anwar I, Sami M, Akhtar N, Chowdhury ME, et al. Bangladesh: Inequalities in Utilization
387 of Maternal Health Care Services - Evidence from MATLAB. HNP Discussion paper, 2004.
- 388 20. Rossiter JC. The effect of a culture-specific education program to promote breastfeeding
389 among Vietnamese women in Sydney. *Int J Nurs Stud*. 1994;31(4):369-79.
- 390 21. Gupta N, Katende C, Bessinger R. Associations of mass media exposure with family
391 planning attitudes and practices in Uganda. *Stud Fam Plann*. 2003;34(1):19-31.
- 392 22. Srivastava NM, Awasthi S, Agarwal GG. Care-seeking behavior and out-of-pocket
393 expenditure for sick newborns among urban poor in Lucknow, northern India: a prospective
394 follow-up study. *BMC Health Serv Res*. 2009;9:61. doi: 10.1186/1472-6963-9-61.
- 395 23. Kabakyenga JK, Östergren P-O, Turyakira E, Pettersson KO. Influence of birth
396 preparedness, decision-making on location of birth and assistance by skilled birth attendants
397 among women in South-western Uganda. *PLoS One*, 2012;7(4): e35747. doi:
398 10.1371/journal.pone.0035747.
- 399 24. Moran AC, Sangli G, Dineen R, Rawlins B, Yaméogo M, Baya B. Birth-preparedness for
400 maternal health: findings from Koupêla district, Burkina Faso. *J Health Popul Nutr*.
401 2006;24(4):489-97.
- 402 25. Hossain J, Ross SR. The effect of addressing demand for as well as supply of
403 emergency obstetric care in Dinajpur, Bangladesh. *Int J Gynaecol Obstet*. 2006;92(3):320-8.
- 404 26. Anya SE, Hydera A, Jaiteh LE. Antenatal care in The Gambia: missed opportunity for
405 information, education and communication. *BMC Pregnancy Childbirth*. 2008;8:9. doi:
406 10.1186/1471-2393-8-9.
- 407 27. Pembe AB, Urassa DP, Carlstedt A, Lindmark G, Nystrom L, Darj E. Rural Tanzanian
408 women's awareness of danger signs of obstetric complications. *BMC Pregnancy Childbirth*
409 2009;9:12. doi: 10.1186/1471-2393-9-12.
- 410 28. Manandhar DS, Osrin D, Shrestha BP, Natasha M, Joanna M, Man TK, et al. Effect of a
411 participatory intervention with women's groups on birth outcomes in Nepal: cluster-
412 randomised controlled trial. *Lancet*. 2004;364(9438):970-9

- 413 29. Jennings L, Yebadokpo AS, Affo J, Agbogbe, M. Antenatal counseling in maternal and
414 newborn care: use of job aids to improve health worker performance and maternal
415 understanding in Benin. BMC Pregnancy Childbirth. 2010;10:75. doi: 10.1186/1471-2393-10-
416 75.
- 417 30. Perreira KM, Bailey PE, deBocchetti E, Hurtado E, , DeVillagrán SR, Matute SR, Mature,
418 J. Increasing awareness of danger signs in pregnancy through community- and clinic-based
419 education in Guatemala. Matern Child Health J. 2002;6(1):19-28.
- 420 31. World Health Organization. Division of Family Health. Maternal Health and Safe
421 Motherhood Programme . Mother-baby package: implementing safe motherhood in
422 countries. Practical guide. Maternal Health and Safe Motherhood Programme. Division of
423 Family Health. World Health Organization. Geneva: World Health Organization;, 1994.
- 424 32. Stekelenburg J, Kyanamina S, Mukelabai M, et al. Waiting too long: low use of maternal
425 health services in Kalabo, Zambia. Trop MedIntHealth. 2004;9(3):390-8.
- 426 33. Phoxay C, Okumura J, Nakamura Y, Wakai, S. Influence of women's knowledge on
427 maternal health care utilization in southern Laos. Asia Pac J Public Health. 2001;13(1):13-9.
- 428 34. Gage AJ. Barriers to the utilization of maternal health care in rural Mali. Soc Sci Med.
429 2007;65(8):1666-82.
- 430 35. Ministry of Health and Family Welfare, Government of the People's Republic of
431 Bangladesh. Health and population nutrition sector development programme (HPNSDP),
432 2011-2016,Dhaka: Ministry of Health and Family Welfare, April,2011.
- 433 36. Rasheed F, Karim E. STD research and policy formulation. Lancet.
434 2000;355(9211):1275.
- 435 **DEFINITIONS, ACRONYMS, ABBREVIATIONS**
- 436 SMP: Safe Motherhood Programme
- 437 GoB: Government of Bangladesh
- 438 **APPENDIX**