

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, Dhaka-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: They 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].

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 and room to record whether pregnant woman could recognize them accurately without prompting.

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. 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. Knowledge was measured as a dichotomy variable; 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 rather than in terms of income or consumption [16]. Socio-economic survey data of year 2005 was used to construct asset quintiles. Equity was defined as equal use for equal need [17]. 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 dependent and independent variables was measured in terms of odds ratios (OR) and 95% confidence intervals of odds ratios adjusting for socio-demographic co-variates using binary logistic regression model in SPSS 16.

3. RESULTS AND DISCUSSION

3.1 Socio-Demographic Characteristics

[The mean age of pregnant women in the study 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).

170
171
172

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

Knowledge of pregnancy danger sign	2003		2004		2005		2006		Total	
	1 st ANC	Successful ANC	1 st ANC	Successful ANC	1 st ANC	Successful ANC	1 st ANC	Successful ANC	1 st ANC	Successful ANC
	N=219	N=2159	N=1551	N=1528	N=1660	N=1622	N=134	N=1315	N=6747	N=6624
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*

173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190

**p=.00001 in McNemar test*

In bi-variate analysis, knowledge was found to vary significantly by age, parity, education and asset index of women. In multivariate analysis, when the effects of covariates were controlled statistically, using binary logistic regression model, asset-index lost its significant relationship with knowledge while maternal education, parity and age of mother sustained significant relationship with the outcome variable, i.e., the knowledge about 5 pregnancy danger signs. Our analysis suggests that education, age and parity are significant predictors of knowledge but asset-index is not. Knowledge was found to increase with education and decrease with increase of age (Table 3).

191 **Table 3: Logistic regression results from pictorial card data for socio-demographic**
 192 **correlates of recognized 5 pregnancy danger signs during 2nd ANC visit by pregnant**
 193 **women in ICDDR, B service area, 2003-2006**
 194

Dependant variable: knowledge about 5 pregnancy danger signs					
		Univariate model		Multivariate 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 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. In bi-variate analysis, 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 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 5 danger signs while the same rate was 54.6% among mothers who had knowledge about 5 pregnancy danger signs (Table 4).

221 **Table 4: Association between facility delivery and knowledge on five pregnancy**
 222 **danger signs among pregnant women during succeeding ANC visit during 2003-2006**
 223

Independent variables (Regressors)	Have	Dependant variable: Delivered in facility			
	Delivery at facility 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
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 years	65.1	4.21	3.76-4.71	3.16	2.78-3.58

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 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 bi-variate 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. 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 after controlling the effects of socio-demographic covariates such as age, parity, education and asset-index. 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 [18], family planning [19], improved hygienic practices [6] and care-seeking for sick neonates [20] from different resource-poor settings. Fewer studies have reported success of BCC interventions using PCs in increasing knowledge and uptake of

254 skilled delivery care services in low-income countries. One study in South Uganda reported
255 a 50% increase in skilled birth attendants for conducting deliveries among women with birth-
256 preparedness interventions than women without birth-preparedness interventions [21].
257 Similar successful results with demand interventions have been reported from Burkina Faso
258 [22] and Bangladesh [23]. Also there is a need to upscale this demand intervention nationally
259 to impact high MMR.

260 About two-third of the women in Matlab HDSS service area were not aware of all five
261 pregnancy danger signs. Similar levels of poor knowledge of pregnant women have been
262 reported from other poor countries such as Burkina Faso, Gambia, Nepal and Tanzania [22,
263 24-26]. However, these studies reported recall information from women after their delivery
264 and did not analyze all the danger signs together. A study in one northern district of
265 Bangladesh [23] reported that about 45% of women had knowledge about 3 or more
266 pregnancy danger signs but the study did not explore the effect of knowledge upon use of
267 maternity care services. Our study suggests that there is further scope to enhance
268 knowledge of pregnant women to increase facility delivery rates in Matlab, Bangladesh.

269 The knowledge of women about 5 pregnancy danger signs increased significantly in the
270 present study due to BCC intervention with PCs by nurse-midwives. Similar success with
271 BCC has been reported in enhancing knowledge about pregnancy danger signs from
272 elsewhere in the low and middle income countries [27]. Literature suggests that improved
273 knowledge about pregnancy danger signs reduces the 1st and 2nd delay of the 3 Delay
274 Model and in Bangladesh the first delay was found to be the most important barrier for
275 accessing obstetric care from appropriate EmOC facilities [7]. Failure to recognize the
276 graveness of situation and lack of money for transport were important reasons for 1st delay
277 in seeking care. To reduce delays to seek care and to improve access to EmOC in rural
278 Bangladesh, interventions should be intensified to enable communities to recognize
279 'pregnancy-danger signs'. This strategy should be combined with ongoing community-based
280 SBA efforts and decentralization of EmOC to contribute in reducing high maternal mortality
281 ratios [7, 28, 29].

282 The current study has documented that pregnant women with knowledge about all the five
283 danger signs are more likely to deliver in the facility than who did not have knowledge about
284 all 5 pregnancy danger signs. Logically speaking, specific knowledge about the risks of
285 childbirth and the benefits of skilled attendance should increase preventive care-seeking,
286 while recognition of danger signs and knowledge about available beneficial interventions
287 should increase care-seeking for obstetric complications. Our study has shown that the
288 knowledge about 5 pregnancy danger signs increases the rate of preventive care seeking;
289 which mean, more and more women prefer the institutional delivery once they are aware
290 about 5 pregnancy danger signs. A similar positive effect of enhanced knowledge upon
291 institutional delivery is reported from Africa and Asia. Women in Zambia who knew danger
292 signs in pregnancy are more likely to deliver in a health facility as compared to those without
293 such knowledge [30] and a similar but not significant tendency was observed in Southern
294 Laos [31]. Also, in Mali and Tanzania, women who were told about complications at
295 antenatal care are more likely to give birth in a facility [25, 32].

296 Currently Bangladesh is focusing on increasing the institutional delivery rates to facilitate
297 achieving the targets for MDG 5. Hence, appropriate BCC during ANC using PCs for
298 pregnant women to recognize pregnancy-danger signs should be initiated to enable women,
299 communities and their gatekeepers to reduce delays to seek care. This is in particular,
300 needed for women with life-threatening obstetric complications, such as APH, PPH,
301 eclampsia and prolonged/obstructed labour. In this context we recommend an
302 implementation research with BCC with PCs during ANC visit in a real life context in

303 collaboration with the policy program managers of GoB to explore the challenges to facilitate
304 nationwide up-scaling process to increase the facility delivery rates and thus to contribute in
305 MDG 5.

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

310 The major limitation of the study is that a considerable proportion of women who delivered in
311 the area during the study period could not be captured through PCs and more importantly
312 relevant information on 5 danger signs were missing for many women in the PCs and there
313 is also no comparable group in this study which might interfere with the generalisability of the
314 study findings. However, the SES of women with PC was similar to those without PC in
315 regards to socio-demographic indicators suggesting little bias in estimating effect size of
316 interventions. Also this is a Matlab based study which has been criticized for not being
317 representative for other rural areas of Bangladesh for long and multiple interventions in the
318 field of health, population and nutrition in this area [33]. Hence there is a need to undertake
319 an implementation research to demonstrate the effects of pictorial communication during
320 ANC in improving knowledge and practice in MNH districts outside Matlab.

321

322 **4. CONCLUSION**

323 Routine ANC at home or at a health facility provides unique opportunity to educate women
324 about pregnancy danger signs which could help the country fully achieve targeted MDG 5 by
325 2015. This is strongly supported by the current study. If pregnant women can demonstrate
326 knowledge of all the five pregnancy danger signs during their routine ANC it can increase the
327 institutional delivery rate by 13%. Therefore, Bangladesh should emphasize making PCs
328 available in rural areas and educate all pregnant mother during ANC to understand all five
329 pregnancy danger signs.

330

331 **ACKNOWLEDGEMENTS**

332

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

339

340

341 **COMPETING INTERESTS**

342

343 Authors have declared that no competing interests exist.

344

345 **AUTHORS' CONTRIBUTIONS**

346

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

350

351 **CONSENT (WHERE EVER APPLICABLE)**

352

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

355

356

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

358

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

360

361

362 **REFERENCES**

363

364 1. United Nations General Assembly. United Nations Millennium Declaration. New York,
365 2000.

366 2. Campbell OM, Graham WJ. Strategies for reducing maternal mortality: getting on with
367 what works. *Lancet*. 2006;368:1284 - 99

368 3. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med*.
369 1994;38(8):1091-110.

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

372 5. McPherson RA, Tamang J, Hodgins S, Pathak LR, Silwal RC, Baqui AH, et al. Process
373 evaluation of a community-based intervention promoting multiple maternal and neonatal care
374 practices in rural Nepal. *BMC Pregnancy Childbirth*;10:31

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

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

381 8. Owais A, Hanif B, Siddiqui AR, Agha A, Zaidi AK, et al. Does improving maternal
382 knowledge of vaccines impact infant immunization rates? A community-based randomized-
383 controlled trial in Karachi, Pakistan. *BMC Public Health*. 2011;11:239.

384 9. Awasthi S, Srivastava NM, Agarwal GG, Pant S, Ahluwalia TP. Effect of behaviour change
385 communication on qualified medical care-seeking for sick neonates among urban poor in
386 Lucknow, northern India: a before and after intervention study. *Trop Med Int Health*
387 2009;14(10):1199-209.

388 10. HDSS. Annual Reports. Secondary Annual Reports 2012. Access 20 October 2012.
389 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)
390 [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)

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

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

396 13. Mizanur R, Julie D, Abdur R. The Role of Pregnancy Outcomes in the Maternal Mortality
397 Rates of Two Areas in Matlab, Bangladesh. *International Perspectives on Sexual and*
398 *Reproductive Health* 2010;36(4):170-77.

399 14. Ronsmans C, Vanneste AM, Chakraborty J, Ginneken JV. Decline in maternal mortality
400 in Matlab, Bangladesh: a cautionary tale. *Lancet* 1997;350(9094):1810-4.

- 401 15. Field A. *Discovering Statistics Using SPSS*. 2nd ed. London: SAGE Publications Ltd;
402 2005.
- 403 16. Gwatkin DR, Rutstein S, Johnson K, Suliman E, Wagstaff A, Amouzou A. Socio-
404 economic differences in health, nutrition, and population within developing countries: an
405 overview. *Niger J Clin Pract*. 2007;10(4):272-82.
- 406 17. Culyer AJ. Equity - some theory and its policy implications. *J Med Ethics*.
407 2001;27(4):275-83.
- 408 18. Rossiter JC. The effect of a culture-specific education program to promote breastfeeding
409 among Vietnamese women in Sydney. *Int J Nurs Stud*. 1994;31(4):369-79.
- 410 19. Gupta N, Katende C, Bessinger R. Associations of mass media exposure with family
411 planning attitudes and practices in Uganda. *Stud Fam Plann*. 2003;34(1):19-31.
- 412 20. Srivastava NM, Awasthi S, Agarwal GG. Care-seeking behavior and out-of-pocket
413 expenditure for sick newborns among urban poor in Lucknow, northern India: a prospective
414 follow-up study. *BMC Health Serv Res*. 2009;9:61.
- 415 21. Kabakyenga JK, Stergren Per-OO, Turyakira E, Pettersson KO. Influence of Birth
416 Preparedness, Decision-Making on Location of Birth and Assistance by Skilled Birth
417 Attendants among Women in South-Western Uganda. 2012;7(4). doi:
418 10.1371/journal.pone.0035747.
- 419 22. Moran AC, Sangli G, Dineen R, Rawlins B, Yaméogo M, Baya B. Birth-Preparedness for
420 Maternal Health: Findings from Koupêla District, Burkina Faso. *The Journal of Health,*
421 *Population and Nutrition*. 2006;24(4):489 – 97.
- 422 23. Hossain J, Ross SR. The effect of addressing demand for as well as supply of
423 emergency obstetric care in Dinajpur, Bangladesh. *International Journal of Gynecology &*
424 *Obstetrics*. 2006;92(3):320-28.
- 425 24. Anya SE, Hydara A, Jaiteh LE. Antenatal care in The Gambia: missed opportunity for
426 information, education and communication. *BMC Pregnancy Childbirth*. 2008;8:9.
- 427 25. Pembe AB, Urassa DP, Carlstedt A, Lindmark G, Nystrom L, Darj E . Rural Tanzanian
428 women's awareness of danger signs of obstetric complications. *BMC Pregnancy Childbirth*
429 2009;9:12.
- 430 26. Manandhar DS, Osrin D, Shrestha BP, Natasha M, Joanna M, Man TK, et al. Effect of a
431 participatory intervention with women's groups on birth outcomes in Nepal: cluster-
432 randomised controlled trial. *The Lancet*;364(9438):970-79
- 433 27. Jennings L, Yebadokpo AS, Affo J, Agbogbe, M. Antenatal counseling in maternal and
434 newborn care: use of job aids to improve health worker performance and maternal
435 understanding in Benin. *BMC Pregnancy Childbirth*;10:75.
- 436 28. Perreira KM, Bailey PE, deBocchetti E, Hurtado E, , DeVillagrán SR, Matute SR, Mature,
437 J. Increasing Awareness of Danger Signs in Pregnancy Through Community- and Clinic-
438 Based Education in Guatemala. *Maternal and Child Health Journal*. 2002;6(1):19-28.

439 29. WHO. Mother-Baby package: Implementing safe motherhood in countries. Practical
440 guide. World Health Organization. Maternal Health and Safe Motherhood Programme.
441 Geneva: Division of Family Health, World Health Organization, 1994.

442 30. Stekelenburg J, Kyanamina S, Mukelabai M, et al. Waiting too long: low use of maternal
443 health services in Kalabo, Zambia. Tropical Medicine & International Health. 2004;9(3):390-
444 98.

445 31. Phoxay C, Okumura J, Nakamura Y, Wakai, S. Influence of women's knowledge on
446 maternal health care utilization in southern Laos. Asia Pac J Public Health. 2001;13(1):13 –
447 19.

448 32. Gage AJ. Barriers to the utilization of maternal health care in rural Mali. Social Science &
449 Medicine. 2007;65(8):1666-82.

450 33. Rasheed F, Karim E. STD research and policy formulation. The Lancet.
451 2000;355(9211):1275.

452
453 **DEFINITIONS, ACRONYMS, ABBREVIATIONS**

454 SMP: Safe Motherhood Programme

455 GoB: Government of Bangladesh

456 **APPENDIX**