

Determinants of the Continuum of Maternal Health Care in Cambodia: an analysis of the Cambodia Demographic Health Survey 2014

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2 an analysis of the Cambodia Demographic Health Survey 2014

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29 **Abstract**

30 **Introduction:**

31 Cambodia has achieved significant progress in maternal health, yet remains in the group of countries
32 with the highest maternal mortality ratio in South-East Asia. Extra efforts are needed to improve
33 maternal health through assessing the coverage of maternal health services as a continuum of care
34 (CoC) and identifying the gaps. Our study aims to explore the coverage level of the Optimal CoC by
35 (1) measuring the continuity of optimal antenatal care (ANC), skilled birth attendance (SBA) and
36 optimal post-natal care (PNC), (2) identifying the determinants of dropping out from one service to
37 another and (3) of not achieving the complete CoC.

38 **Method:**

39 The study employed data from the Cambodia Demographic Health Survey 2014. We restricted our
40 analysis to married women who had a live birth in the five years preceding the survey (n=5678). Bi-
41 variate and multivariate logistic regression were performed using STATA version 14.

42 **Results:**

43 Almost 50% of women had achieved the complete optimal CoC, while the remaining have used only
44 one or two of the services. The result shows that the level of women's education was positively
45 associated with the use of optimal ANC, the continuation to using optimal PNC and achieving the
46 complete CoC. More power of women in household decision making was also positively associated
47 with receiving the complete CoC. The birth order was negatively associated with achieving the
48 complete CoC, while exposure to the mass media and having health insurance increased the odds of
49 achieving the complete CoC. Household wealth consequently emerged as an influential predictor of
50 dropping out and not achieving the complete CoC. Receiving all different elements of ANC care
51 improved the continuity of care from optimal ANC to SBA and from SBA to optimal ANC.

52 **Conclusion:**

53 The findings urge policy makers to approach maternal health care as a continuum of care with
54 different determinants at each step. Household wealth was found to be the most influential factor, yet
55 the study discovered also other barriers to optimal maternal health care which need to be addressed:

56 future intervention should thus not only aim to increase wealth or health insurance coverage but also
57 stimulate the education of women and empower women to claim power in household decision-making.

58

59 **Key Words:** Maternal Health Care, Optimal, Continuum of Care, Determinant, Dropping Out,

60 Demographic Health Survey, Cambodia.

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64 **I. Introduction:**

65

66 Cambodia has achieved significant progress in the area of maternal and child health, meeting
67 Millennium Development Goal 4 (MDG) to reduce child mortality and MDG5a to reduce maternal
68 mortality [1]. Based on the 2014 Cambodia Demographic Health Survey (CDHS), under-five mortality
69 has decreased from 124 deaths per 1000 live births in 2000 to 35 deaths per 1000 live births in 2014
70 [2]. Within this period, there was also a decline in maternal mortality from 206 to 170 deaths per 100
71 000 live births. However, Cambodia remains in the group of countries with the highest maternal
72 mortality ratio in South-East Asia [3]. Therefore, extra effort is needed to achieve the new health
73 target of Sustainable Development Goal (SDG 3.1) to lower the maternal mortality ratio to less than
74 70 per 100 000 live births by 2030 [4].

75 To achieve this target effectively, adequate and high-quality care for maternal health (MH) is
76 required along the continuum of care (CoC). The coverage of MH services is regarded as one of the
77 main contributions to the reductions of maternal mortalities [5].

78 Previous studies have largely focused on individual components along the continuum of care
79 separately, especially Antenatal Care (ANC) [6-8] and to Skilled Birth Attendant (SBA) [9, 10], but
80 that Post-natal Care (PNC) has received less attention until recently [11]. Coverage along each
81 component can be measured by counting ANC which pregnant women should have adequate and
82 high-quality ANC during pregnancy with at least optimum four visits as recommended by World
83 Health Organization (WHO) [12] or eight visits following the new WHO 2016 guideline [13]. Women
84 should have SBA which refers to delivery care provided by qualified and experienced health
85 professional (a midwife, doctor or nurse) [14, 15]. After delivery, PNC, especially within the first 48
86 hours after birth, is critical to the management of postpartum complications [16].

87 However, targeting the coverage of MH services separately does not ensure that every woman
88 receives all essential MH services throughout pregnancy, childbirth and postpartum periods [17].
89 There is an increasing focus on applying a CoC approach, which indicates the continuation of care
90 throughout the lifecycle and implies that MH services are closely linked and action must be taken in
91 an integrated manner [18]. The CoC is widely divided into two key dimensions: time and place. The

92 time dimension addresses the situation where women receive MH services from pre-pregnancy to
93 post-delivery and it addresses the importance of continuity of packages of MH service over time at
94 different stages of pregnancy, childbirth and postpartum [18-20]. The place dimension measures
95 various components of services provided at health facilities, communities and home and addresses the
96 coordination among family level, community-level and health facility-level [18, 20].

97 In this paper, we focus on the time dimension in the CoC because it reflects Cambodia's
98 policy goal that every woman should receive key packages of services across the pregnancy to
99 postpartum continuum. Our study advances findings from previous continuum of care studies by
100 uniquely considering whether the care components along the continuum were 'optimal' based on the
101 recommendations of National Strategy of Reproductive and Sexual Health Cambodia [21]. These
102 include four or more ANC visit with the first visit at the first trimester of pregnancy (optimal ANC),
103 delivery assisted by SBA and at least 2 PNC visits within 41 days or six weeks of childbirth with the
104 first PNC check is within 48 hours after birth (optimal PNC).

105 Improving coverage along the continuum of care relies on a better understanding of factors
106 contributing to gaps. Despite progress in MH indicators during the last decade in Cambodia,
107 substantial coverage gaps remain [22] and more efforts are still needed to improve life-saving MH
108 services. In this study, we aim (1) to investigate coverage along of the continuum of care, and (2) to
109 identify determinants that are associated with mother's continuation of service use along the
110 continuum, and (3) to identify determinants of achieving a complete continuum of care.

111

112 **II. Methods:**

113 **II.1. Data Source & Study Participants**

114 This paper used data from the 2014 Cambodia Demographic Health Survey [2], a nationally
115 representative household survey. The primary purpose of this survey is to provide detailed information
116 on fertility and family planning; infant, child, adult and maternal mortality; maternal and child health;
117 nutrition, and knowledge of HIV/AIDS and other sexually transmitted infections. The survey used a
118 multi-stage clustered sampling design, which must be accounted for in statistical analyses.

119 Interviews were completed with 17,578 women of reproductive age (15-49). This study
120 focused on women who had a live birth in the five years preceding the survey and were currently
121 married (n=5678), as questions on household decision-making were only asked to married women.
122 Also, the prevalence of married women had a live birth was considerably high which was almost 95%
123 of the total women in the study [2]. We further restricted our analysis to the women's most recent live
124 birth in the recall period as questions about ANC were only asked of the most recent birth. Detailed
125 methodology and questionnaires used in the survey can be found in CDHS full report [2].

126

127 **II.2. Measurement:**

128 **A. Dependent Variables:**

129 The continuum of care for MH services, composed of three dummy variables: optimal ANC,
130 SBA and optimal PNC, is the key outcome variable of this research. We defined optimal use for each
131 of the three care components based on WHO and Cambodian Ministry of Health guidelines.

132 We defined optimal ANC as having received ANC at least four times during the pregnancy at
133 either a health facility or at home, with the first ANC visit during the first trimester, based on WHO
134 recommendations at the time the survey was conducted. The Cambodian Ministry of Health also
135 encourages women to have their first ANC visits in their first trimester and count it as a crucial
136 indicator in the National Strategies for Sexual and Reproductive Health [21, 23]. Thus, we treated it as
137 a binary variable "optimal ANC" whereby code 1 is assigned to those who met the Ministry of Health
138 recommendation and code 0 is assigned to those who did not meet this recommendation. Women
139 reporting fewer than four visits or who did not begin ANC in the first trimester were considered to
140 have not received optimal ANC.

141 SBA coverage referred to delivery assistance provided by health professional (a doctor, nurse,
142 or midwife) either at home or health facility [24]. We employed it as a binary variable, where "skilled
143 birth attendance" is assigned to those whose delivery was assisted by a doctor, nurse or midwife (code
144 as 1) and "non-SBA" to those assisted by a traditional birth attendant, relative, friend, other non-
145 health, or no one (code as 0), based on skilled attendant definitions used in the 2014 CDHS report [2].

146 We defined optimal PNC as checks on the woman's health within 41 days or six weeks after
147 childbirth. This reflects indicators used in the National Strategy for Reproductive and Sexual Health
148 that women should receive at least 2 PNC checks between 48 hours and six weeks post-partum and
149 that the first check should occur in the first 48 hours after delivery, regardless of delivery place. We
150 coded 1 if women receive the first postnatal check up in the first 48 hours after delivery and at least 2
151 PNC checks between 48 hours and six weeks of post-partum and 0 if otherwise.

152

153 **B. Independent variables**

154 Predictors in the models include women's socio-demographic (1), socio-economic (2) and
155 cultural (3) factors which were found in the previous literatures to be associated with the use of
156 maternal health services [25-30].

157 (1) Socio-demographic factors are maternal age at the recent birth (<20 years old, 20-34 years
158 old, and ≥ 35 years old), women's level of education (none, primary, and secondary or higher), and
159 their husband's level of education (none, primary, and secondary or higher). (2) Cultural factors are
160 any exposure to mass media (yes if they expose to one of the activities: reading newspaper or listening
161 to radio or watching television at least once a week and no if they are not exposed to all of the three
162 activities) and an index of decision-making power in the household (no power, some power and full
163 power). Decision-making power in the household was based on the woman's self-reported
164 participation in a given decision related to three areas of decision-making in the household:
165 determining own healthcare, making large household purchase and visiting family or relatives [2, 31].
166 We gave score 1 for each of the three areas of decision-making involving the woman or jointly with
167 her husband and score 0 for each decision taken without the woman's involvement (decision made by
168 husband alone or other). We summed the score and assigned "no power" for index value 0, "some
169 power in the decision-making" for index value 1 to 2, and "full power in decision-making" for index
170 value 3.

171 (3) Socio-economic factors included place of residence (urban or rural), employment
172 categories of women and husband (did not work, non-agricultural work, or agricultural work),

173 household wealth quintiles (poorest, poorer, middle, richer or richest) and health insurance coverage
174 (yes or no).

175 We further considered the type of care received at previous stages in the continuum as
176 predicting continuation to the next stage. For continuation to SBA, we examined four elements of
177 ANC care which are the indicators of quality of optimal ANC care: whether the woman reported that
178 (1) she was informed of signs of pregnancy complications, (2) had blood pressure measured, (3) had a
179 urine sample taken and (4) had a blood sample taken. We classified women as having “received all
180 different elements of ANC care” as “yes” if pregnancy women received all of the four services for
181 their ANC check-up and as “no” if they were missing any one component. For continuation to PNC,
182 we further considered delivery by caesarian section (yes or no) and whether the woman gave birth in a
183 health facility (yes or no) as potential predictors of receiving PNC after receiving both ANC and SBA.
184

185 **II.3. Data Analysis**

186 We conducted a descriptive analysis of the characteristics of the study population and the level
187 of coverage for each maternal health service along of the continuum (ANC, SBA and PNC), separately
188 and together as a combined outcome. We examined the bivariate relationship between the independent
189 variables and each dependent variable using chi-square tests and logistic regression was performed to
190 estimate the associations with outcomes of interest while taking the other independent variables into
191 account. Adjusted odds ratio (AOR) with 95% confidence intervals (CI) and p-values were calculated.
192 The significance level was assigned at $p \leq 0.05$. Sample weights and complex survey design were
193 accounted for in both descriptive and logistic regression analyses. If missing value is less than 1%, that
194 value will be automatically excluded from the analysis.

195 We conducted two logistic regression models. The first (A) contained of three sub-models (A-
196 1, A-2 and A-3) which determined the extent of dropout along different points on the continuum of
197 care and the second (B) contain a regression to determine factors associated with complete CoC.

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201 **Model A** (figure 1):

202 **Model A-1** assessed the determinants of receiving optimal antenatal care (ANC) among married
203 women with a live birth in the last five years (Code 1 if a woman received optimal ANC and 0 if
204 woman do not receive optimal ANC).

205 **Model A-2** assessed the determinants of receiving skilled delivery (skilled birth attendance (SBA))
206 among the women who received optimal ANC care (Code 1 if for receiving optimal ANC and SBA, 0
207 for receiving optimal ANC but not SBA).

208 **Model A-3** assessed the determinants of receiving optimal postnatal care (PNC) among women who
209 received optimal ANC and SBA (Code 1 for receiving optimal ANC, SBA and optimal PNC, 0 for
210 receiving optimal ANC and SBA but not optimal PNC).

211

212 **Figure 1: Model A illustrate the continuum of maternal health and the drop out from one**
213 **service to another**

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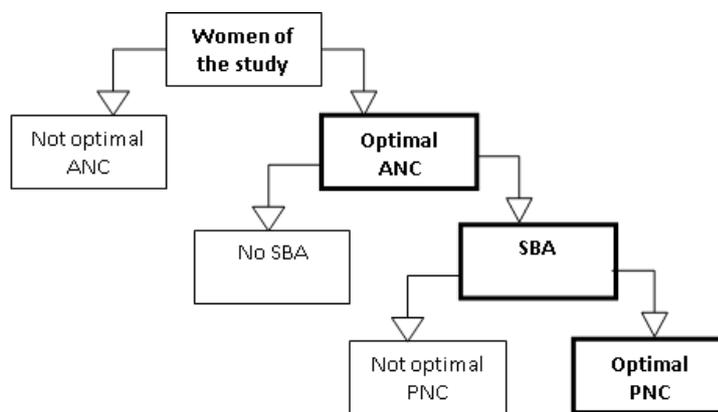
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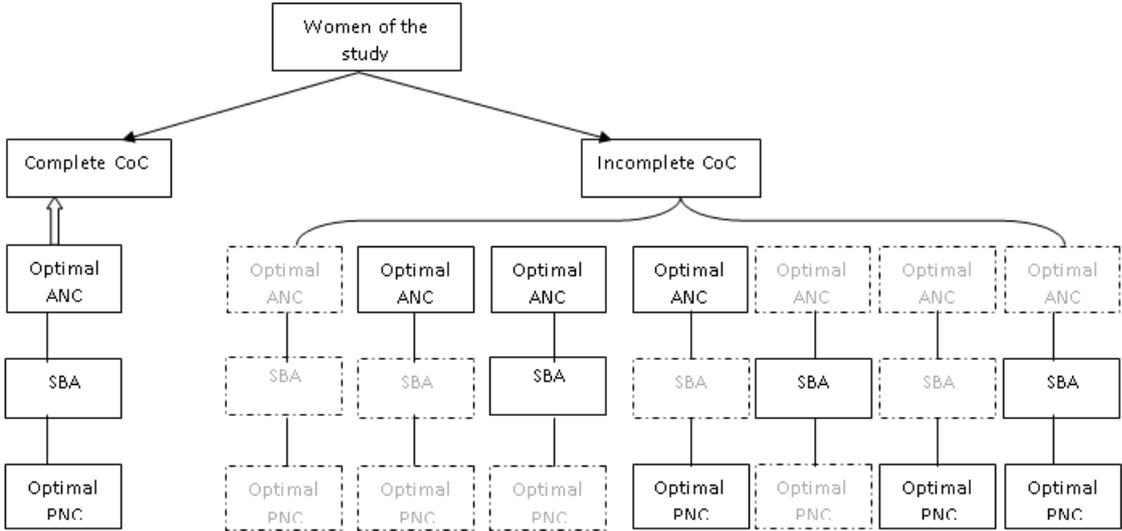
224 **Model B** (figure 2) assessed the determinants of achieving complete CoC among all women. Code 1 is
225 assigned to those women who achieved the complete CoC by receiving all of the three main outcomes
226 and code 0 to those who received none or one or two of the three maternal health services.

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Figure 2: Model B illustrates the complete CoC VS incomplete CoC



III. Results:

III.1. Characteristics of Women in the study:

The background characteristics of the married women who had at least one birth in the past five years interviewed are shown in Table 1. Most of the women included in the study had their most recent birth between the age of 20 and 34, had one or two children, completed more than primary level of education and were employed in non-agricultural sector. 86.0% of them were living in rural area and almost 65.0% has accessed to mass media, but only 17.0% of them was covered by health insurance. There is a homogenous proportion of each level of the wealth quantiles.

259 **Table 1: Socio-demographic characteristics of married women who had at least one birth in the five years**
 260 **preceding the survey (weighted sample size = 5678 & unweight sample size = 5585)**

261

Background Characteristic	Weighted Number (n=5678)	Percentage (%)
Mother's age at birth		
<20	583	10.0
20-34	4525	80.0
35+	570	10.0
Birth order		
1	1962	34.5
2	1772	31.2
3	947	16.7
4 or more	997	17.6
Mother's education		
None	751	13.2
Primary	2971	52.3
Secondary or higher	1956	34.5
Husband or partner's level of education		
None	530	9.0
Primary	2558	45.0
Secondary or higher	2586	46.0
Missing	4	0.1
Mother's employment		
None	1401	25.0
Non-agricultural	2290	40.0
Agricultural	1986	35.0
Missing	1	0.01
Husband's employment		
None	48.5	1
Non-agricultural	2903	51
Agricultural	2721	48
Missing	6	0.1
Residence		
Urban	818	14
Rural	4859	86
Wealth Quintile		
Poorest	1303	23
Poorer	1156	20
Middle	1067	19
Richer	1020	18
Richest	1132	20
Exposure to mass media		
No	2068	36.4
Yes	3610	63.6
Health insurance coverage		
No	4688	82.6
Yes	990	17.4

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266 **III.2. Overall use of maternal health services in Cambodia:**

267 Table 2 shows descriptive analysis results indicating that Cambodia has achieved high
 268 antenatal care coverage. Over 79.0% had the recommended four or more visits, and almost 80.0% of
 269 women in the study had their first ANC visit in the first trimester. Overall coverage of optimal ANC
 270 was nearly 70.0%.

271 More than 90.0% of women delivered with a skilled birth attendant. Over 80.0% delivered at
 272 health facility, of which almost 70.0% of deliveries took place at public sector facilities and 15.0% at
 273 private sector facilities.

274 For postnatal care, 90.0% of women had a PNC check after delivery, regardless of their
 275 delivery place. Of which 88.0% had a PNC checkup in the first 48 hours after birth and around 80.0%
 276 had at least two checks between 48 hours and 6 weeks' post-partum, as recommended by the National
 277 Strategy for Sexual and Reproductive Health. The proportion of women with optimal PNC was 70.0%.

278 **Table 2: Number and Percentage of married women and their use of maternal health services**

characteristics	Weighted Number (n total =5678)	Percentage (%)
Attend 4+ ANC visits (ANC≥4)		
No	1367	24.0
Yes	4310	76.0
Attended first ANC at the first trimester		
No	1175	21.0
Yes	4503	79.0
Optimal ANC (ANC≥4 and 1st trimester)		
No	1792	31.5
Yes	3886	68.5
Delivery by SBA		
Not Skilled Attendant	544	9.6
Skilled Attendant	5130	90.4
None	2	0.04
Missing	22	0.03
Woman with a postnatal checkup in the crucial first two days after birth		
First 48 hours	5033	88.6
More than 48 hours	67	1.2
No PNC	578	10.2
PNC≥2 between 48 hours and 6 weeks postpartum		
PNC<2	1082	19.0
PNC≥2	4596	81.0

PNC optimal (first PNC <48hours and PNC visit \geq2 between 48 hours and 6 weeks)		
No	1709	30.0
Yes	3969	70.0

279

280

III.3. Pathways of Maternal Healthcare

281 The three main outcomes (optimal ANC, SBA and optimal PNC) created eight different
 282 combinations of maternal health service use from complete use of all three maternal health services to
 283 not receiving any of the three services (Table 3). The three services defined in the study are the
 284 continuation from (1) having optimal ANC (ANC \geq 4 and first ANC at the first trimester), (2) having
 285 delivery attended by skilled birth attendant (doctor, nurse or midwife) and (3) having optimal PNC
 286 (PNC \geq 2 between 48 hours and 6 weeks' post-partum and the first PNC in the first crucial two days
 287 after delivery).

288 Less than half of women in the study (49.4%) received all three maternal health services along
 289 the continuum, shown in pathway 4. Notably, 4.0% of women did not receive any of the three
 290 maternal health services examined in the study (pathway 1). Three groups that attended only one of
 291 the three services (pathways 2, 6 and 7) accounted for 2.0%, 8.5% and 3.0% of women, respectively.
 292 Thirdly, the three groups that received only two of the three services (pathways 3, 5 and 8) accounted
 293 for 16.0%, 1.2% and 16.5% of women, respectively.

294 **Table 3: Percent distribution of women by different types of maternal health services, Cambodia 2014**

Pathway	optimal ANC (1) (\geq 4 and at the 1 st trimester)	SBA (2)	optimal PNC (3) (\geq 2 and within 48 hours after delivery)	%	N
1	-	-	-	4.0	214
2	+	-	-	2.0	106
3	+	+	-	16.0	906
4	+	+	+	49.4	2807
5	+	-	+	1.2	67
6	-	+	-	8.5	482
7	-	-	+	3.0	161
8	-	+	+	16.5	935

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III.4. Results from the regression analyses:

A. Factors associated with the use of optimal ANC among all women in the study:

Model I analyses factors associated with the use of optimal ANC care among all the women in the study (Table 4). The results show that the use of optimal ANC is significantly associated with maternal age at birth, birth order, woman's level of education, husband's level of education, power in household decision making, husband's occupation, wealth quintile, exposure to mass media, and health insurance coverage.

Women between 20-34 years old (AOR= 1.93, 95%CI= 1.48-2.50) and more than 35 years old (AOR = 1.80, 95%CI= 1.28-2.53) are more likely to use optimal ANC care than those below 20 years old. Women who have completed secondary school or higher education (AOR=1.28, 95%CI= 1.07-1.54) were more likely to use optimal ANC than women who completed primary education. Women whose husband completed secondary school or higher education (AOR= 1.68, 95% CI= 1.41-2.00) and did not work (AOR=5.22, 95% CI=1.69-16.05) have greater odds of having optimal ANC care. Any exposure to mass media (reading newspaper, listening to radio or watching TV at least once a week) increased the odds of having optimal ANC care by 39.0% (AOR=1.39, 95% CI=1.17-1.65). Women who have some power (AOR= 0.78, 95% CI = 0.61-0.99) in the household decision-making were less likely to use optimal ANC care than women had full power in making decision in their household.

Women from wealthier households used optimal ANC care at higher rate than those women from less wealthier households. Women from the middle wealth households (AOR= 1.33, 95% CI= 1.03-1.73), richer households (AOR= 1.33, 95% CI= 1.33-2.41), and richest households (AOR=1.84, 95% CI=1.21-2.81) all had higher odds of optimal ANC compared with those from the poorest households.

Being covered by health insurance was more likely to use the optimal ANC services than those whose were not (AOR=1.22, 95% CI=1.03-1.45).

323 **B. Factors associated with the continuation of using SBA among those who have**
324 **optimal ANC**

325 Model II showed the factors predicting the maternal health service continuity of using skilled
326 birth delivery (SBA) among women who have received optimal ANC care (Table 4).

327 Out of the women who have received optimal ANC care, women from the middle wealth households
328 (AOR= 2.18, 95% CI= 1.03-4.61), richer households (AOR= 2.47, 95% CI= 1.02-5.98), and richest
329 households (AOR=3.57, 95% CI=1.07-11.89) had higher odds of receiving both optimal ANC and
330 SBA care compared with those from the poorest households. Women whose husband completed
331 secondary or higher education (AOR=1.64, 95%CI =1.11-2.43) were more likely to continue using
332 SBA after had used optimal ANC.

333 Received all different elements of ANC care increases the odds of continuity of care from optimal
334 ANC service to SBA (AOR=1.63, 95% CI=1.01-2.65).

335

336 **C. Factors associated with the continuation of using optimal PNC among those**
337 **who have both optimal ANC and SBA:**

338 Model III showed the predictive factors of the maternal health service continuity of using
339 optimal PNC among those who have received both optimal ANC and SBA (Table 4). Having
340 completed secondary or higher education increased the odds of having optimal PNC by 34.0%
341 (AOR=1.34, 95%CI=1.05-1.70). Among the women who already received optimal ANC and SBA,
342 those had no power (AOR=0.30, 95%CI= 0.14-0.64) were significantly less likely to use optimal PNC
343 than those women who has full power in making decision in their household.

344 Women living in an urban area (AOR=1.74, 95% CI= 1.17-2.59) and from wealthier
345 households continued using maternal health services and thus optimal PNC care compared to
346 comparable women living in rural areas and from the poorest households. Women from the middle
347 wealth households (AOR= 1.46, 95% CI= 1.05-2.02) and richest households (AOR=2.13, 95%
348 CI=1.19-3.80) were more likely to use optimal PNC care compared to those who were from the
349 poorest households.

350 Out of the women who have both optimal ANC and SBA, the odds of continued optimal
351 maternal health care and thus optimal PNC was higher for women with the received all different
352 elements of ANC care (AOR= 1.47, 95% CI= 1.19-1.83) and whose birth delivery was done through
353 caesarian (AOR=2.21, 95% CI= 1.34-3.64).

354

355 **D. Factors associated with achieving the complete Continuum of Maternal** 356 **Health Care**

357 Model B analyses the predictors of receiving a complete CoC (receiving optimal ANC +
358 optimal SBA + optimal PNC) (Table 4) and the results showed that women between 20 to 34 years old
359 (AOR= 1.43, 95% CI=1.10-1.85) and over 35 years old (AOR =1.47, 95%CI= 1.04-2.08) were more
360 likely to complete the continuum than those who were younger than 20 years old. Also, women who
361 had their second birth (AOR= 0.80, 95%CI= 0.67-0.97), third birth (AOR= 0.75, 95%CI= 0.60-0.95)
362 and above (AOR=0.47, 95%CI= 0.36-0.62) had lower odds of achieving the complete CoC than those
363 who had their first birth. The completion of secondary or higher education (AOR=1.30, 95% CI= 1.08-
364 1.560 and her husband (AOR=1.40, 95% CI=1.17-1.68) was a significant predictor of a complete CoC.
365 Exposure to any mass media also increased the odds of achieving the complete CoC. Women with no
366 power (AOR= 0.39, 95% CI= 0.18-0.80) and some power (AOR = 0.79, 95%CI= 0.64-0.96) in
367 household decision-making were less likely to complete the entire CoC compared to those who had
368 full power to decide.

369 The odds of women achieving the complete CoC were higher among middle income (AOR=1.58,
370 95%CI= 1.20-2.08), richer (AOR=1.80, 95%CI= 1.35-2.39) and the richest households (AOR=2.36,
371 95%CI= 1.54-3.62) compared to the poorest households. Women whose husband did not work were
372 three times more likely to complete the entire CoC (AOR=3.60, 95%CI= 1.64-7.85) compared to
373 women whose husband performed agricultural work. Having health insurance coverage significantly
374 increased the odds of completing the entire of CoC.

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377

378 **Table 4: Result from Multivariate logistic regression**

Characteristics	Model A						Model B (N=5678)	
	Model A-1 (N= 5678)		Model A-2 (N=3882)		Model A-3 (N=3710)			
	Optimal ANC		Optimal ANC and SBA		Optimal ANC, SBA and optimal PNC		Achieve Complete CoC	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Mother's age at birth								
<20	1		1		1		1	
20-34	1.93***	1.48-2.50	1.85	0.89-3.83	1.14	0.80-1.61	1.68***	1.29-2.17
35+	1.80***	1.28-2.53	0.77	0.33-1.80	1.07	0.65-1.74	1.47*	1.04-2.08
Mother's education								
None	0.72**	0.57-0.90	0.64	0.36-1.15	0.97	0.66-1.41	0.72*	0.55-0.95
Primary	1		1		1		1	
Secondary or higher	1.28**	1.07-1.54	1.24	0.70-2.17	1.34*	1.05-1.70	1.36***	1.14-1.62
Birth Order								
1	1		1		1		1	
2	0.83	0.67-1.02	0.32***	0.19-0.55	0.95	0.75-1.22	0.80*	0.67-0.97
3	0.56***	0.44-0.72	0.24***	0.13-0.45	1.08	0.78-1.48	0.65***	0.52-0.82
4 or more	0.28***	0.22-0.37	0.21***	0.10-0.41	0.87	0.59-1.30	0.36***	0.28-0.46
Husband's level of education								
None	0.97	0.75-1.26	1.12	0.62-2.03	1.17	0.80-1.72	1.07	0.82-1.41
Primary	1		1		1		1	
Secondary or higher	1.68***	1.41-2.00	1.64**	1.11-2.43	1.17	0.93-1.48	1.55***	1.30-1.85
Decision making power in the household								
No Power	0.76	0.37-1.54	2.71	0.28-25.68	0.30**	0.14-0.64	0.35**	0.16-0.74
Has some power	0.78*	0.61-0.99	0.79	0.42-1.46	0.86	0.62-1.17	0.79*	0.64-0.96
Full power	1		1		1		1	
Exposure to mass media								
No	1		1		1		1	
Yes	1.39***	1.17-1.65	1.45	0.91-2.29	1.15	0.93-1.44	1.37***	1.16-1.62
Mother's Occupation								
None	1		1		1		1	
Non-agricultural	1.19	0.94-1.50	1.45	0.79-2.69	1.08	0.81-1.43	1.18	0.96-1.44
Agricultural	0.99	0.76-1.31	0.83	0.48-1.46	1.07	0.80-1.43	1.01	0.79-1.28
Husband's occupation								
None	5.22**	1.69-16.05	1.04	0.14-7.55	2.51	0.89-7.09	3.60***	1.64-7.85
Non-agricultural	1		1		1		1	
Agricultural	1.04	0.85-1.27	1.05	0.67-1.63	1.02	0.79-1.31	1.04	0.85-1.26
Place of residence								
Urban	0.88	0.64-1.21	1.78	0.67-4.71	1.74**	1.17-2.59	1.28	0.96-1.71
Rural	1		1		1		1	
Wealth quantile								
Poorest	1		1		1		1	
Poorer	1.08	0.85-1.36	1.13	0.60-2.13	1.05	0.77-1.43	1.11	0.89-1.40
Middle	1.33*	1.03-1.73	2.18*	1.03-4.61	1.46*	1.05-2.02	1.58***	1.20-2.06
Richer	1.79***	1.33-2.41	2.47*	1.02-5.98	1.35	0.96-1.90	1.80***	1.35-2.39
Richest	1.84**	1.21-2.81	3.57*	1.07-11.89	2.13**	1.19-3.80	2.36***	1.54-3.62
Health insurance coverage								
No	1		1		1		1	
Yes	1.22*	1.03-1.45	1.32	0.74-2.35	1.30	0.97-1.74	1.35**	1.12-1.63
Received all different elements of ANC care								
No			1		1			
Yes			1.63*	1.01-2.65	1.47***	1.19-1.83		
Mode of Delivery (C-section)								
No					1			
Yes					2.12**	1.34-3.64		

Delivery at Health Facility								
Not health facility					1			
Health Facility					1.33	0.87-2.04		

379

380 (* p ≤0.05, ** p ≤0.01, *** p ≤ 0.001)

381

382 **IV. Discussion:**

383 Ensuring optimal service use along the continuum of maternal health care is a critical part of
384 Cambodia’s national strategy to improve the health of mothers and newborns. This study contributes
385 important knowledge to understanding the gaps, where women are lost from one service to another,
386 and why women are unable to achieve the complete CoC.

387 Our findings indicated that more women dropping out from the continuum of care between
388 optimal ANC and delivery than between delivery and optimal post-delivery. Less than half of women
389 in our study received optimal coverage of the full continuum of care. This reflects the progress of the
390 government in the past years; however, extra efforts and effective fill-the-gap intervention from the
391 government and relevant organizations are still needed to accelerate the level of optimal coverage
392 through connecting the three services (optimal ANC, SBA and optimal PNC) together.

393

394 Women dropping out from one service to another due to some influential factors. Our finding
395 that indicated the significant association between the use of optimal ANC with higher level of
396 education, household wealth quintile and any exposure to mass media was consistent with previous
397 studies which found that maternal education, husband education, household income, and media
398 exposure were factors affecting ANC uptake in Pakistan [29], Uganda [32] and some developing
399 countries [33].

400 Moreover, the finding that the higher levels of education of husband, and women from
401 wealthier household positively associated with the continuity of using SBA among those had optimal
402 ANC is in line with the result of an analysis of the Ethiopian Demographic and Health Survey which
403 found that women whose husband completed at least secondary school were more likely to use skilled
404 birth delivery assistant [34]. However, our study did not show a significant effect of women’s

405 education on the continuity of having SBA among those had optimal ANC. Among married women
406 who have both optimal ANC and SBA, over 60% were educated and came from at least medium
407 income family. In this context, was wealth quintile became the most influential factor associated with
408 the continuity of using SBA among those who have optimal ANC.

409 Received all different elements of ANC care is found to be a significant predictor of
410 continuity of having SBA among those who had optimal ANC and continue to use optimal PNC
411 among those who had optimal ANC and SBA. The elements of ANC care receiving during ANC visit
412 make women better aware about their pregnancy condition and more likely to understand the
413 importance of safe delivery and post-delivery care. A similar findings from a multi-country study of
414 Africa indicated that the element of ANC care has a positive impact on delivery assistance and PNC
415 use [35]. This demonstrate the importance of maintaining the quality of ANC care through enriching
416 its content. WHO 2016 New ANC model also mentioned that “ANC should be delivered in term of
417 both timing and content of each ANC contact” [36].

418 From the analyses, women’s decision-making power in the household was associated only
419 with the use of optimal ANC care and the continuity of using of optimal PNC care for those had
420 optimal ANC and SBA. This aligns with previous studies in Indonesia and Bangladesh which found
421 that decision-making power had a positive effect on ANC and PNC coverage [37, 38]. In our study,
422 decision-making power had no association with the continuity of using SBA after receipt of optimal
423 ANC care. This is similar to another study in Indonesia in which women’s decision making power
424 had no effect on the use of a skilled birth attendant [28], but different from the systematic review
425 which found that women’s empowerment was positively associated with the use of maternal health
426 service including skilled birth attendance in developing countries [39]. The difference in results from
427 one to another study may be explained by the different measurement approaches to capturing women’s
428 decision-making power [40]. One plausible explanation for why decision-making power is not a
429 significant predictor on the continuity of using of SBA was that in delivery context, decision-making
430 is not necessary and SBA is a usual event which a choice cannot be decided by only women and her
431 family.

432 Our study also showed the predictors on the achievement of complete CoC. Decision-making
433 power was also found in our study to be a significant predictor of achieving a complete CoC. This
434 confirms a previous study in Nepal, using the same three outcomes, which found that women's
435 autonomy in decision-making had a positive effect on the use of all three maternal health services
436 [41]. This suggests the new MH programs should refocus to empower women in making their own
437 decision which in turn might accelerate the use of maternal health service.

438 The educational levels of both women and husbands were significantly associated with achieving
439 the complete continuum and thus offer a promising strategy for improving maternal health services in
440 the country. The significant association between health insurance coverage and the complete
441 achievement of CoC might due to the expansion of health-equity fund or mother health voucher
442 schemes by the Ministry of Health Cambodia could also constitute a promising avenue. This reflects
443 the coverage of social health protection program could encourage women to use services. Surprisingly,
444 jobless husband was found to have greater odds for married women to achieve complete CoC. This
445 could be the case since over 86.0% of the jobless group were from at least medium income family
446 which they can afford the usage of services regardless of employment.

447 Consistent with many other studies, household wealth strongly predicted service use and
448 achievement of the continuum of maternal care. A study in Gabon also found that maternal health
449 service utilization was higher in women from wealthy households [42]. This implies that wealth can
450 also be barrier to access to care if the government has no strategies in removing financial barriers or
451 financial hardship for women in using the services. Multi-sectoral actors and different attentions are
452 needed to improve the continuity of care in Cambodia.

453

454 **V. Limitations:**

455 This study is subject to several limitations. The study was a cross-sectional study which we cannot use
456 to make causal interpretations. The secondary data source used did not allow us to take the factors of
457 maternal complications and need for care into analyses. Selection of the four indicators to define the
458 complete elements of ANC care were based on data availability, and future studies would be
459 strengthened by collecting data on and considering the role of quality of care received as predicting

460 continuation to the next service. Due to skip patterns in the questionnaire, we were limited to
461 examining only decision-making power among married women which the prevalence of married
462 women giving birth was considerably high at around 95% in CDHS 2014 [2]. Because of the cross-
463 sectional design of the study, all of the variables analyzed in the logistic regression especially
464 decision-making power came from the time of the survey, the result can only provide statistical
465 association and cannot show cause-effect relationship. Finally, the outcomes of our analyses relied on
466 self-report, with the potential for misreporting of care received several years before the interview.

467 **VI. Conclusions:**

468 Even with high coverage of each individual maternal health care service, Cambodia has achieved
469 only a moderate proportion of women who complete the Continuum of Care from pregnancy to post-
470 delivery with optimal care. This coverage would have been higher had only the count on the number
471 of visits for ANC and PNC been considered, but our study further considered whether the visits were
472 at the recommended time to help identify potential gaps of care. This is the ever first analysis
473 examining optimal service use along the continuum and what factors should be taken into account or
474 invested to improve the coverage of care. Policy makers should not only focus on the routine or
475 common factors across all three services separately but also study the continuum in an integrated
476 manner to identify how problems differ along the continuum. Future maternal health intervention
477 should consider including a component to empower women in decision-making and engage their
478 spouse as well as other family member to understand the importance of using maternal health service
479 as a continuum.

480 **VII. Declaration:**

481 **Ethics approval and consent to participate**

482 The CDHS 2014 was approved by the National Ethics Committee for Health Research (Ref: 056
483 NECHR), Cambodia and the Institutional Review Board (IRB) of ICF in Rockville, Maryland, USA.
484 The researchers received permission to use the dataset from the Demographic and Health Survey
485 program and have maintained the confidentiality of the data. The protocol of this study was approved
486 by National Ethic Committee for Health Research (NECHR) of the Ministry of Health Cambodia
487 (166NECHR).

488 **Consent for publication**

489 Not applicable.

490 **Availability of data and materials**

491 Required permission was obtained from the DHS programme to access the data analysed for this
492 study. All data and DHS-related materials used are available from the website:

493 <https://dhsprogram.com/>.

494 **Competing interests**

495 The authors declare that they have no competing interests.

496 **Funding**

497 This study did not receive funding

498 **Authors' contributions**

499 S.C and E.R designed research ideas and protocols. S.C conducted the analysis and prepared
500 manuscript. E.W, V.B and P.I provided input on the study design, and revised of manuscript. E.W
501 and V.B contributed to data analysis and the result interpretation. All authors have read and approved
502 the final manuscripts.

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646 **IX. List of Abbreviations:**

647 MDG: Millennium Development Goal

648 SDG: Sustainable Development Goal

649 CoC: Continuum of Care

650 MH: Maternal Health

651 WHO: World Health Organization

652 ANC: Antenatal Care

653 SBA: Skilled Birth Delivery

654 PNC: Postnatal Care

655 HIV/AIDS: Human Immunodeficiency Virus infection and acquired immunodeficiency syndrome

656 CDHS: Cambodia Demographic Health Survey

657 AOR: Adjusted odds ratio

658 CI: Confidential Interval

659 C-section: Caesarian Section

Figures

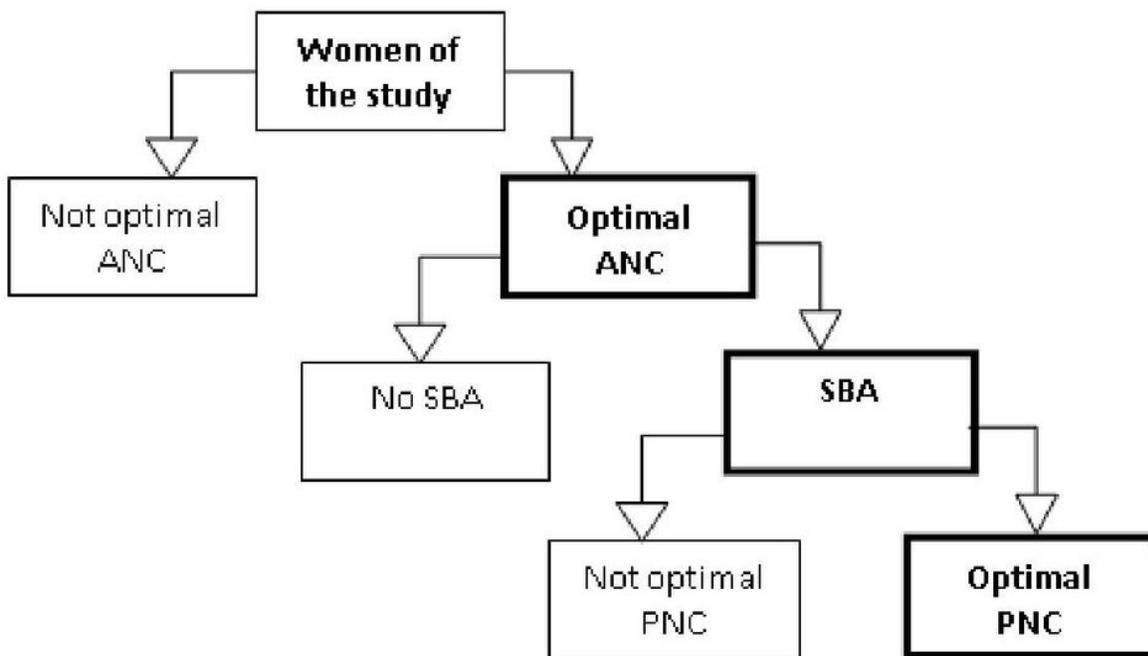


Figure 1

Model A illustrate the continuum of maternal health and the drop out from one service to another

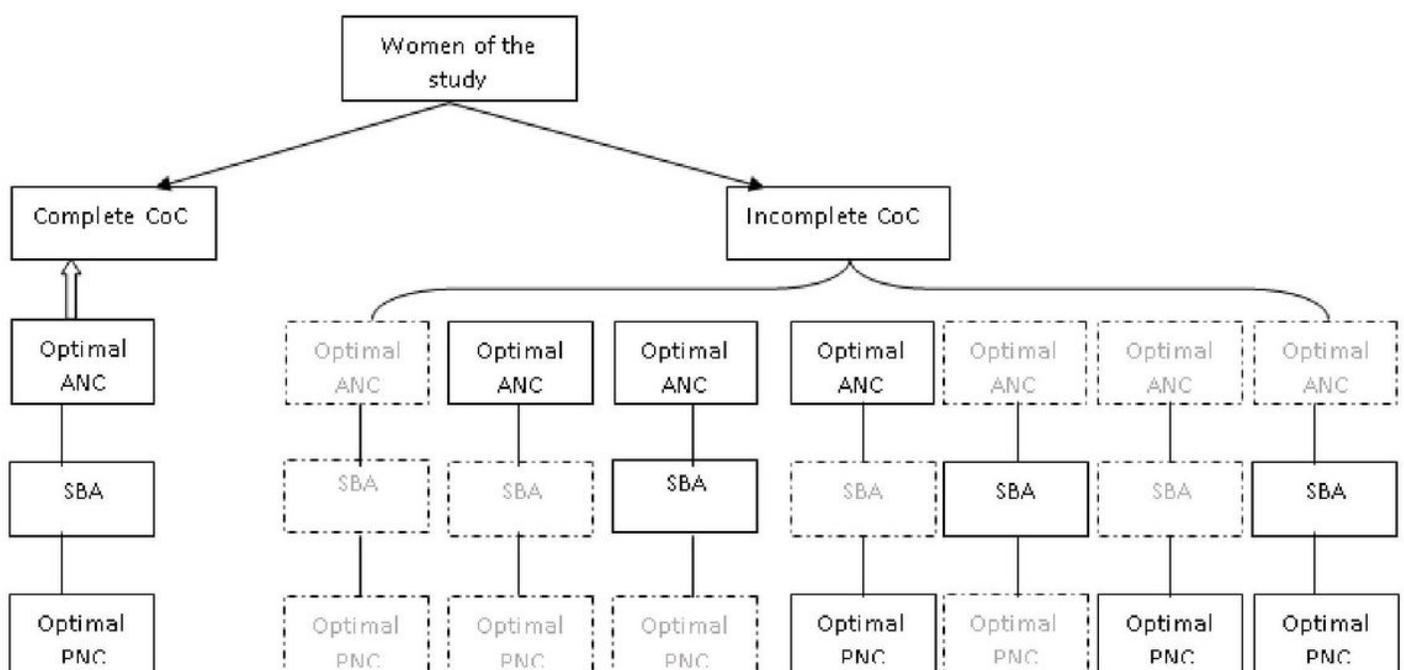


Figure 2

Model B illustrates the complete CoC VS incomplete CoC