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# BMJ Open

## Public provision of emergency obstetric care services in two districts of Pakistan

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Manuscripts

1           1       **PUBLIC PROVISION OF EMERGENCY OBSTETRIC CARE SERVICES IN TWO**  
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4           2                               **DISTRICTS OF PAKISTAN**

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## 21 ABSTRACT

22 *Objectives:* The provision of adequate emergency obstetric care (EmOC) is considered of  
23 great importance to ensure safe deliveries and to reduce the maternal and neonatal mortality  
24 and morbidity burden. This study aims to determine the status of the delivery of essential  
25 obstetric care provided by the public health sector in two districts in Khyber Pakhtunkhwa  
26 (KP), Pakistan for the year 2015.

27 *Methods:* We analyze data from a survey of 22 health facilities and 85 community midwives.  
28 Using a structured questionnaire facilities and midwives have been interviewed about the  
29 performance of EmOC signal functions and patient statistics. In addition, an equipment, drug  
30 and infrastructure assessment has been conducted.

31 *Results:* Deliveries by public health cadres account for about 30% of the total number of  
32 deliveries in these districts. According to the United Nations benchmark, only a small fraction  
33 of Basic EmOC (2/18) and half of the Comprehensive EmOC (2/4) facilities of the  
34 recommended minimum number are available to the population in both districts. Only a  
35 minority of health facilities and CMWs carry out several signal functions. Only 8% of the  
36 total deliveries in one of the study districts are performed in public EmOC health facilities.  
37 This is well below the United Nations recommendation.

38 *Conclusions:* Both districts show a significant shortage of available public EmOC service  
39 provisions. Development priorities need to be realigned to improve the availability,  
40 accessibility and quality of EmOC service provisions by the public health sector alongside  
41 with existing activities to increase institutional deliveries.

42  
43 *Keywords:* Obstetric care, EmOC, Community Midwife, Pakistan, Khyber Pakhtunkhwa,  
44 Public health care, Institutional delivery

1 45 **STRENGTHS AND LIMITATIONS OF THIS STUDY**

2  
3 46 \* This study applies primary data to study the quality of obstetric care in two districts of  
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5  
6 47 Pakistan, in a region for which very little is known about the public health system and its  
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8 48 performance.  
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10  
11 49 \* It provides an example where public health facilities and providers are not well prepared to  
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13  
14 50 serve women who are encouraged to deliver in public facilities.  
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20 52 \* It is a case study with limited external validity.  
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## 53 BACKGROUND

54 Low-and middle-income countries (LMICs) continue to struggle to meet the target reductions  
55 of maternal and child mortality [1][2]. In Pakistan, estimates in 2015 approximate a maternal  
56 mortality rate of 178 women per 100,000 live births and a neonatal mortality rate of 46 neonates  
57 per 1,000 live births. A particular challenge is Pakistan's high rate of neonatal mortality in  
58 comparison to its neighbouring countries [1, 3, 4].

59 In an effort to address the high burden of neonatal and maternal mortality in LMICs, the World  
60 Health Organization (WHO) has emphasized the need to transition births from home deliveries  
61 to institutional deliveries [5, 6]. This strategy is also acknowledged by the Government of  
62 Pakistan, which realigned development priorities to strengthen and expand the institutional  
63 service delivery system [7]. There is also literature questioning the effectiveness of this  
64 approach, as the capability of many public health facilities to provide safe deliveries cannot be  
65 guaranteed in many LMIC settings [8, 9].

66 The expansion of institutional deliveries can only be successful if the public health system has  
67 the capacity and quality to ensure safe deliveries. Seven key medical services have been  
68 identified by the United Nations (UN), which form the basic emergency obstetric care  
69 (BEmOC) services [10]. They comprise the administration of parenteral antibiotics, uterotonic  
70 drugs, parenteral anticonvulsants, the manual removal of placenta, the removal of retained  
71 products of conception, assisted vaginal delivery and neonatal resuscitation. In addition to these  
72 BEmOC services, health care institutions are regarded as Comprehensive EmOC (CEmOC)  
73 providers if blood transfusions and caesarean sections are offered [10]. Providing these services  
74 to every mother and child is considered of overarching importance to reduce the maternal and  
75 neonatal mortality and morbidity burden [11–15].

76 The existing literature for Pakistan highlights the need to improve the availability and quality  
77 of EmOC services in the public sector. A study from 2002 shows a significant shortage of

1 78 available BEmOC facilities compared to its recommended numbers in three provinces of  
2  
3 79 Pakistan [16].

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5  
6 80 In 2006 the Ministry of Health of the Government of Pakistan established a national Maternal,  
7  
8 81 Neonatal & Child Health Program (MNCH) which emphasized training and deploying  
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10 82 community midwives (CMW) [17]. CMWs represent a cadre of non-facility-based skilled birth  
11  
12 83 attendants who perform home-based deliveries to increase skilled birth attendance in  
13  
14 84 underserved communities. They act as a first level of contact for women in the community and  
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16 85 are supported by successive levels of referral facilities such as Basic Health Units (BHU) or  
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18 86 Civil Hospitals.

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22 87 In this study we determine the status of the successful delivery of EmOC, including CMWs, in  
23  
24 88 two rather rural districts in Khyber Pakhtunkhwa (KP), Pakistan, for the year 2015. The analysis  
25  
26 89 reveals that several designated BEmOC and CEmOC facilities were not able to provide these  
27  
28 90 services.

## 31 32 91 **METHODS**

### 33 34 92 **Study setting**

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37 93 Based on an estimated total population of 985,000 in Haripur, 1.24 million in Nowshera, and a  
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39 94 national crude birth rate of 29.2 per 1,000 population [18], there is an estimated number of  
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41 95 28,760 livebirths for Haripur and 36,200 livebirths in Nowshera.

42  
43 96 Primary and secondary level facilities in Haripur and Nowshera offer public obstetric care.  
44  
45 97 Primary health care institutions are comprised of BHUs, rural health centers (RHC) and  
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47 98 maternal and child health centers (MCHC). Civil Hospitals and District Headquarter Hospitals  
48  
49 99 (DHQH) are secondary level facilities that provide specialized care in larger towns and district  
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51 100 capitals. Tertiary care facilities are not available in both districts. In cases of severe  
52  
53 101 complications, health providers in Haripur and Nowshera refer to tertiary health care hospitals  
54  
55 102 in the neighbouring districts; namely hospitals in Peshawar and Mardan for pregnancy  
56  
57 103 complications in Nowshera and hospitals in the district of Abbottabad for Haripur. CMWs in

1 104 both districts provide antenatal, intra-partum, delivery, postnatal and newborn care in their  
2  
3 105 communities.  
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### 8 107 **Study sample**

10 108 A list of public health facilities and trained CMWs in the two districts was obtained from the  
11  
12  
13 109 provincial government. The initial sample covered all 103 public health facilities in these  
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15 110 districts: 70 BHUs, 13 RHCs, 8 MCHCs, 10 Civil Hospitals and 2 DHQs. Health facilities  
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17 111 with no or less than an average of three deliveries per month in the past 6 months were excluded  
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19  
20 112 from the survey. Out of the 70 BHUs in Haripur, only 7 (10%) reported deliveries in the  
21  
22 113 previous 6 months. Similar findings are noted for the MCHCs, with only one facility out of 8,  
23  
24 114 providing delivery services. The survey covered 22 health facilities in total, with 14 health  
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26 115 facilities in Haripur and 8 in Nowshera (see Figure 1).

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29 116 Before conducting the baseline survey, the identified CMW sample consisted of a total of 102  
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31 117 CMWs, 35 CMWs in Haripur and 67 CMWs in Nowshera. Interviews were done with 32  
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33 118 CMWs in Haripur and 53 CMWs in Nowshera. The remaining CMWs were either unavailable  
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35  
36 119 or did not allow us to visit them for security reasons.  
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38 120

40 121 Figure 1: Spatial distribution of interviewed health care providers.

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45 123 The facility assessment and service availability survey was administered throughout January  
46  
47 124 2016. In total, 12 enumerators with a medical background in obstetric care were trained over a  
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49 125 7-day period to conduct the survey.

50  
51 126 Health facilities and CMWs were interviewed about general characteristics about the facilities,  
52  
53 127 such as opening hours and location, staffing, basic and specialized delivery service provision  
54  
55 128 and patient statistics. In addition, an equipment, drug and infrastructure assessment has been  
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57 129 conducted. The enumerators verified the information through observations.  
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1 130 Health facility interviews took place at the respective facility face-to-face with staff directly  
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3 131 engaged in delivery services. Interviews with the CMW took place at her midwifery home. The  
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5 132 health facility interviews have been conducted paper-based while interviews with CMWs were  
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7  
8 133 entered directly into tablets using ODK software. Data was analysed using STATA14 [19].  
9

## 10 134 **Patient and Public Involvement**

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13 135 Patients were not involved in the design of the study, because the focus of the study is a better  
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15 136 understanding of the performance of health facilities and no direct interactions with patients  
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17 137 were studied. Results were disseminated to health facilities and public health officials of the  
18  
19 138 region through a written report and a series of workshop presentations.  
20  
21

## 22 139 **Analysis**

23  
24 140 To describe the functionality and capacity of health cadres in addressing life-threatening  
25  
26 141 obstetric complications, health providers were asked if they have conducted the nine key  
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28 142 interventions described above in the last three months prior to the interview. Following the UN  
29  
30 143 handbook on monitoring EmOC, health facilities and CMWs have been classified as a BEmOC  
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32 144 or CEmOC health provider accordingly [10].  
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## 37 145 **RESULTS**

### 38 146 **Number of Deliveries**

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41 147 The total number of deliveries recorded in public health facilities is approximately 14,429  
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43 148 between January and December 2015 with 7,260 and 7,169 deliveries taking place in Haripur  
44  
45 149 and Nowshera respectively. The majority of these public health facility deliveries, about 80%  
46  
47 150 in Haripur and 50% in Nowshera, were performed at the corresponding DHQH. The remaining  
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49 151 deliveries in Haripur were primarily conducted in BHUs, while about 40% of the total deliveries  
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51 152 in Nowshera were conducted in civil hospitals.  
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55 153 Between January and December 2015 there was a total of 5,371 deliveries: 1,626 deliveries at  
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57 154 the 32 CMWs in Haripur and 3,745 deliveries at the 53 CMWs in Nowshera. This gives a yearly  
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1 155 average of 51 deliveries per CMW in Haripur and 71 deliveries per CMW in Nowshera, with  
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4 156 rather large variation within the districts.

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6 157 Taking the sum of total deliveries by health facilities and CMWs results in 19,800 deliveries  
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8 158 conducted by public health cadres. Based on the estimations of total livebirths in both districts,  
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10 159 those deliveries account for roughly 30% of all deliveries in the Districts Haripur and  
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12  
13 160 Nowshera.

## 15 161 **Provision of Emergency Obstetric Care**

### 17 162 Health Facilities

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20 163 As depicted in Table 1, the assessment of the provision of full BEmOC services shows that only  
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22 164 two facilities in each district qualify as BEmOC facilities. In the last three months before  
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24 165 assessment, the DHQH and one hospital in Haripur, report performing basic emergency  
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26 166 obstetric care services. In Nowshera one RHC and one hospital provided all BEmOC services  
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29 167 It is remarkable that the DHQH in Nowshera does not qualify as BEmOC facility as it reported  
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31 168 to not have administered Oxytocin for the treatment of post-partum haemorrhage. One out of  
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33 169 five RHC administered magnesium sulfate in the previous three months and one RHC in  
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35 170 Nowshera was able to provide all seven interventions necessary to be classified as a BEmOC  
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37 171 facility. A minority of the health providers support assisted vaginal delivery, neonatal  
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39 172 resuscitation, and the administration of magnesium sulphate.

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43 173 In order to qualify as a CEmOC facility, health facilities need to provide caesarean sections and  
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45 174 blood transfusions, in addition to the seven BEmOC service functions. In Haripur, the DHQH  
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47 175 is the only facility providing caesareans and blood transfusion. In Nowshera, two public health  
48  
49 176 providers, one hospital, and the DHQH report to maintain these additional comprehensive  
50  
51 177 services. Overall, as the DHQH in Nowshera does not qualify as a BEmOC facility, it  
52  
53 178 consequentially does not qualify as a CEmOC facility. Given these results, there is one CEmOC  
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55 179 facility available in each district with one additional facility classified as a BEmOC facility.

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182 Table 1: BEmOC signal functions of public health facilities

	Haripur					Nowshera		
	BHU (n=7 )	MCH C (n=1)	RHC (n=2 )	Hospita I (n=3)	DHQ H (n=1)	RHC (n=5 )	Hospita I (n=2)	DHQ H (n=1)
Parenteral administration of antibiotics	5	1	2	3	1	5	2	1
Parenteral administration of oxytocin	7	1	2	2	1	5	2	0
Parenteral administration of mag sulfate	4	0	1	1	1	1	1	1
Assisted vaginal delivery	1	0	0	2	1	3	2	1
Manual removal of placenta	6	0	2	2	1	5	2	1
Removal of retained products of conception	7	0	1	2	1	5	1	1
Neonatal resuscitation with bag and mask	4	1	1	2	1	3	2	1
<b>BEmOC Facility</b>	0	0	0	1	1	1	1	0
Caesarean section	0	0	0	0	1	0	1	1
Blood transfusions	0	0	0	0	1	0	1	1
<b>CEmOC Facility</b>	0	0	0	0	1	0	1	0

183

184 CMWs

185 Prior to the survey, only two CMWs from Nowshera out of 85 performed all seven BEmOC  
 186 services. The frequency of different BEmOC services, carried out by the CMWs varies quite  
 187 substantially (Table 2). In both districts, over 80% of the CMWs provide parenteral  
 188 administration of oxytocin and neonatal resuscitation. Manual removal of the placenta is  
 189 provided by a larger percentage of CMWs in Nowshera (91%), while only 69% of CMWs in  
 190 Haripur can perform it. Parenteral administration of antibiotics has been provided in both  
 191 districts by more than 60% of the CMWs. Removal of retained products of conception, assisted  
 192 vaginal delivery and parenteral administration of magnesium sulfate has been provided in both  
 193 districts by less than 40% of the CMWs.

1 194

2 195

5 196 Table 2: BEmOC provision by CMWs

BEmOC Services	Haripur		Nowshera	
	(n=32)		(n=53)	
	n	%	n	%
Parenteral administration of antibiotics	22	69	39	74
Parenteral administration of oxytocin	29	91	45	85
Parenteral administration of magnesium sulfate	8	25	12	23
Assisted vaginal delivery	11	34	28	53
Manual removal of placenta	22	69	48	91
Removal of retained products of conception	12	38	21	40
Neonatal resuscitation	28	88	43	81
<b>Number of CMWS providing all BEmOC services</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>4</b>

34 197

38 198 **DISCUSSION**40 199 **Availability of EmOC**

200 Considering the reported provision of services by health facilities and the strict UN benchmarks  
 201 [10], a critical shortage of the availability of EmOC services in the two districts can be  
 202 identified.

203 The minimal acceptable level of EmOC availability is defined as at least four BEmOC and one  
 204 CEmOC health facility, serving a population of 500,000 [10]. For Haripur and Nowshera, these  
 205 recommendations would result in a minimum number of ten and twelve EmOC health facilities  
 206 respectively, including two CEmOC facilities in each district (see Table 3). Following this  
 207 benchmark and our obtained results from both districts, Haripur lacks seven BEmOC facilities

208 and one CEmOC facility and Nowshera has a shortage of nine BEmOC facilities and one  
 209 CEmOC facility. Although health cadres outside of health institutions do not use these  
 210 benchmarks to assess the adequacy of service provision, considering the results of the CMW  
 211 assessment with only two CMWs in Nowshera providing all BEmOC services, the district of  
 212 Nowshera still lacks seven BEmOC health providers. Taking the data from Nowshera and  
 213 Haripur together shows that both districts have only 11% (2 out of 18 recommended) BEmOC  
 214 and 50% (2 out of 4) CEmOC facilities of the recommended minimum number of facilities  
 215 available to its estimated population of about 2.3 million.

216

217 Table 3: Shortage of BEmOC and CEmOC facilities

Classification	Haripur			Nowshera		
	Assessed	WHO	Shortage	Assessed	WHO	Shortage
	Availability	recommendation		Availability	recommendation	
BEmOC	1	8	7	1	10	9
CEmOC	1	2	1	1	2	1

218

219 **Low performance of signal functions**

220 A minority of health facilities and CMWs conduct several signal functions. There are various  
 221 reasons for these findings. Following the UN guidelines [10], signal functions need to be  
 222 performed in the 3 months prior to the assessment. Despite the fact that our sample only covered  
 223 health facilities with an average of at least three deliveries per month, it can be assumed that  
 224 there has not been enough cases to perform all of the signal functions. It is specified by the local  
 225 health authorities that high-risk cases should be referred before complications occur; especially  
 226 for primary health facilities and CMWs,  
 227 In the event of maternal and newborn complications, the large majority of CMWs, BHUs and  
 228 RHCs report to refer the cases to the local DHQH and to tertiary health care providers in  
 229 Abbottabad and Peshawar.

230 Another aspect concerns the availability of equipment and medication needed to support the  
231 interventions. For instance, only 23% of all CMWs and 45% of all health facilities administer  
232 magnesium sulfate (see Table 1 and Table 2). The findings from the drug assessment revealed  
233 that only 13% of CMWs and 45% of health facilities had magnesium sulfate available on the  
234 day of the interview. Three health facilities from each district (27%) and 35 CMWs (42%) never  
235 had magnesium sulfate available. Of the CMWs and health facilities that generally had access  
236 to magnesium sulfate, 49% and 33% of those, reported to be out of stock in the past 3 months.

### 237 **Proportion of births in EmOC public sector facilities**

238 The UN minimum recommendations propose that at least 15% of all births should occur in  
239 health facility settings, based on the assumption that about 15% of women face complications  
240 during delivery [10]. For Haripur, 5,740 (20%) deliveries took place in EmOC facilities, mainly  
241 the DHQH. In Nowshera the proportion of deliveries that occurred in public EmOC health  
242 facilities equates to only 8% (2815 deliveries) of the estimated 36,200 livebirths in this district;  
243 well below the UN benchmark.

### 244 **LIMITATIONS**

245 The generalizability of our results might be limited. Considering the large heterogeneity  
246 within KP and Pakistan, the availability and accessibility of EmOC is likely to vary  
247 substantially. The survey in this paper focuses on the provision of essential obstetric care by  
248 the public health sector. Accounting for the availability of private health care providers and its  
249 associated costs will help to obtain a comprehensive understanding of the accessibility of  
250 EmOC services in these districts.

### 251 **CONCLUSION**

252 We conclude that the districts of Haripur and Nowshera in KP, Pakistan, show a significant  
253 shortage of available public BEmOC and CEmOC facilities. With only 11% of the  
254 recommended number of BEmOC facilities available in both districts, we find a strong under

1 255 provision of basic obstetric health care. Overall, 30 % of the estimated total live births in both  
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3  
4 256 districts are conducted by CMWs and public health facilities. An estimated 22% of all  
5  
6 257 deliveries take place in public health facilities in both districts, of which 41% were conducted  
7  
8 258 at health facilities that did not meet the BEmOC criteria. Further efforts to increase  
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10 259 institutional deliveries should keep the BEmOC and CEmOC capabilities of the public health  
11  
12 260 facilities in mind and improve capabilities and quality along with the expansion of  
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14  
15 261 institutional deliveries. We would like to note that the study findings are a snapshot  
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17 262 representative for the period when the data were collected. Local health authorities were  
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19 263 informed about the study findings prior to the publication and it is possible that this  
20  
21  
22 264 information has led to changes. The study documents that universal institutional deliveries  
23  
24 265 were prioritized before the available health facilities had sufficient BEmOC and CEmOC  
25  
26 266 capabilities. Public health authorities in other low- and middle-income regions are encouraged  
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28  
29 267 to assess BEmOC and CEmOC capabilities to complement policies that aim at increasing  
30  
31 268 institutional deliveries.

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1 277 **LIST OF ABBREVIATIONS**

2  
3 278 BEmOC, Basic Emergency Obstetric Care

4  
5  
6 279 BHU, Basic Health Unit

7  
8 280 CEmOC, Comprehensive Emergency Obstetric Care

9  
10 281 CMW, Community Midwife

11  
12 282 DHQH, District Headquarter Hospital

13  
14 283 EmOC, emergency obstetric care

15  
16 284 KP, Khyber Pakhtunkhwa

17  
18 285 MCHC, Maternal and Child Health Center

19  
20 286 MNCH, Maternal, Neonatal & Child Health Program

21  
22 287 RHC; Rural Health Center

23  
24 288 UN, United Nations

25  
26 289 WHO, World Health Organization

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32 290 **DECLARATIONS**

33  
34 291 **Competing interests**

35  
36 292 The authors declare that they have no competing interests.

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50  
51  
52  
53 299 **Authors' contributions**

54  
55 300 PB wrote the first draft of the paper, supported the acquisition of the data, conceptualized the  
56  
57 301 study, and analyzed data.



1 302 AH and MK supported the acquisition of the data and contributed to the conceptualization of  
2  
3 303 the study.

4  
5  
6 304 JK supported the acquisition of the data, conceptualized the study, and contributed to the  
7  
8 305 interpretation of results and writing.

9  
10  
11 306 SV supervised the project, conceptualized the study and contributed to the interpretation of  
12  
13 307 results and writing.

### 14 15 16 17 308 **Ethics approval and consent to participate**

18  
19 309 Ethical approval was granted by the National Bioethics Committee (NBC) Pakistan, Research  
20  
21 310 Ethics Committee, with the ethical approval number No.4-87/15/NBC-190/RDC/994

22  
23 311 Written informed consent was obtained before data collection. All participants were informed  
24  
25 312 that they could withdraw from the study at any time.

### 26 27 28 313 **Consent for publication**

29  
30 314 Not applicable

### 31 32 315 **Availability of data and material**

33  
34 316 The datasets used and analysed during the current study are available from the corresponding  
35  
36 317 author on reasonable request.

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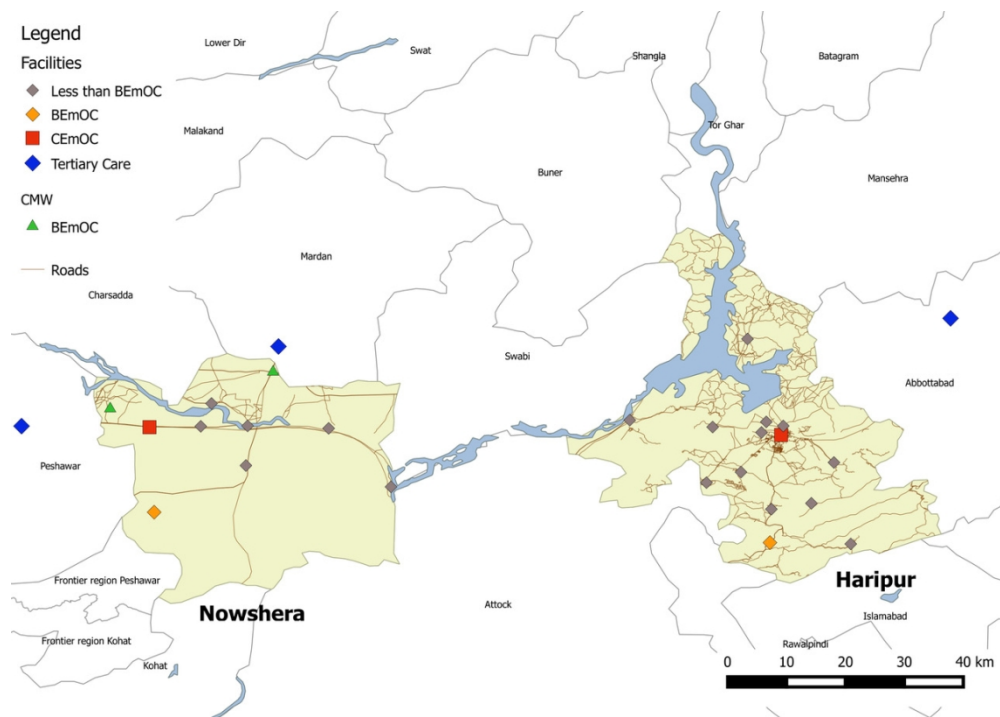


Figure 1: Spatial distribution of interviewed health care providers

108x76mm (300 x 300 DPI)

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## Public provision of emergency obstetric care: A case study in two districts of Pakistan

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Manuscripts

1       1   **PUBLIC PROVISION OF EMERGENCY OBSTETRIC CARE: A CASE STUDY IN**  
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3       2   **TWO DISTRICTS OF PAKISTAN**

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6       3   Peter Brückmann<sup>1</sup>, Ashfa Hashmi<sup>2</sup>, Marina Kuch<sup>3</sup>, Jana Kuhnt<sup>4</sup>, Ida Monfared<sup>5</sup>, Sebastian  
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56       20   *Keywords:* Obstetric care, EmOC, Community Midwife, Pakistan, Khyber Pakhtunkhwa,

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58  
59       21   Public health care, Institutional delivery

60

1 22 Word count: 3321  
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4 23 **ABSTRACT**  
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6 24 *Objectives:* Pakistan is one out of five countries where together half of the global neonatal  
7  
8 25 deaths occur. As the provision of services and facilities is one of the key elements vital to  
9  
10 26 reducing this rate as well as the maternal mortality rate, this study investigates the status of the  
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12 27 delivery of essential obstetric care provided by the public health sector in two districts in  
13  
14 28 Khyber Pakhtunkhwa (KP) in 2015 aiming to highlight areas where critical improvements are  
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16 29 needed.  
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21 30 *Setting:* We analysed data from a survey of 22 primary and secondary healthcare facilities as  
22  
23 31 well as 85 community midwives in Haripur and Nowshera districts.  
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25

26 32 *Participants:* Using a structured questionnaire we evaluated the performance of EmOC signal  
27  
28 33 functions and patient statistics in public health facilities. Also, 102 community midwives were  
29  
30 34 interviewed about working hours, basic and specialized delivery service provision, referral  
31  
32 35 system and patient statistics.  
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36 36 *Primary outcome measures:* We investigate the public provision of emergency obstetric care  
37  
38 37 using seven key medical services identified by the United Nations (UN).  
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41

42 38 *Results:* Deliveries by public health cadres account for about 30% of the total number of births  
43  
44 39 in these districts. According to the United Nations benchmark, only a small fraction of Basic  
45  
46 40 EmOC (2/18) and half of the Comprehensive EmOC (2/4) facilities of the recommended  
47  
48 41 minimum number were available to the population in both districts. Only a minority of health  
49  
50 42 facilities and CMWs carry out several signal functions. Only 8% of the total births in one of the  
51  
52 43 study districts are performed in public EmOC health facilities.  
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56 44 *Conclusions:* Both districts show a significant shortage of available public EmOC service  
57  
58 45 provisions. Development priorities need to be realigned to improve the availability,  
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1 46 accessibility and quality of EmOC service provisions by the public health sector alongside with  
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3 47 existing activities to increase institutional births.  
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1     48     **STRENGTHS AND LIMITATIONS OF THIS STUDY**

2  
3     49     \* This study provides an example where public health facilities are not well prepared.

4  
5  
6     50     \* It adds to the body of evidence needed to improve the quality of neonatal care in low-income  
7  
8     51     settings.

9  
10  
11     52     \* It is a cross-sectional study thus carries the limitations of such studies.

12  
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14  
15     53     \* It is a case study with limited external validity.

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## 54 BACKGROUND

55 Low-and middle-income countries (LMICs) continue to struggle to meet the target reductions  
56 of maternal and child mortality [1][2]. In Pakistan, estimates in 2015 approximate a maternal  
57 mortality rate of 178 women per 100,000 live births and a neonatal mortality rate of 46 neonates  
58 per 1,000 live births. A particular challenge is Pakistan's high rate of neonatal mortality in  
59 comparison to its neighbouring countries [1, 3, 4].

60 In an effort to address the high burden of neonatal and maternal mortality in LMICs, the World  
61 Health Organization (WHO) has emphasized the need for a transition from home births to  
62 institutional [5, 6]. This strategy is also acknowledged by the Government of Pakistan, which  
63 realigned development priorities to strengthen and expand the institutional service delivery  
64 system [7]. There is also literature questioning the effectiveness of this approach, as the  
65 capability of many public health facilities to provide safe births cannot be guaranteed in many  
66 LMIC settings [8, 9]. The expansion of institutional births can only be successful if the public  
67 health system has the capacity and quality to ensure safe births. Seven key medical services  
68 have been identified by the United Nations (UN), which form the basic emergency obstetric  
69 care (BEmOC) services [10]. They comprise the administration of parenteral antibiotics,  
70 uterotonic drugs, parenteral anticonvulsants, the manual removal of placenta, the removal of  
71 retained products of conception, assisted vaginal delivery and neonatal resuscitation. In addition  
72 to these BEmOC services, health care institutions are regarded as Comprehensive EmOC  
73 (CEmOC) providers if blood transfusions and caesarean sections are offered [10]. Providing  
74 these services to every mother and child is considered of overarching importance to reduce the  
75 maternal and neonatal mortality and morbidity burden [11–15].

76 The existing literature for Pakistan highlights the need to improve the availability, accessibility  
77 and quality of EmOC services in the public sector. [16]. Several programs were introduced to  
78 address this issue. As such, in 2006, the Ministry of Health of the Government of Pakistan  
79 established a national Maternal, Neonatal & Child Health Program (MNCH) which emphasized  
80 training and deploying community midwives (CMW) [17]. CMWs represent a cadre of non-

1 81 facility-based skilled birth attendants who perform births either at the midwifery or patient  
2  
3 82 homes to increase skilled birth attendance in underserved communities. They act as a first level  
4  
5 83 of contact for women in the community and are supported by successive levels of referral  
6  
7 84 facilities such as Basic Health Units (BHU) or Civil Hospitals, however, they are not expected  
8  
9  
10 85 to conduct births at these facilities. Through this and some other similar programs attempts  
11  
12 86 were made to decentralise the healthcare infrastructure and strengthen and improve the  
13  
14 87 provision of EmONC at the national level, however, the degree of success of integration of  
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16  
17 88 MNCH at the district level remained less known [18].

18  
19 89 Focusing on two rural districts, Nowshera and Haripur in Khyber Pakhtunkhwa (KP), one of  
20  
21 90 the four main provinces in Pakistan, this study investigates the status of the successful delivery  
22  
23 91 of EmOC as well as services provided by CMWs. While similar studies were carried out in  
24  
25 92 other provinces (e.g. in Punjab and North West Frontier Province (NWFP) [19][20] and Sindh  
26  
27 93 [21]) evidence from districts in KP to the date of the present study were scarce. By gathering  
28  
29 94 knowledge from these rural areas, this study addresses the fact that successful implementation  
30  
31 95 of programmes such as MNCH depends on having an assessment of the status of the existing  
32  
33 96 services without which efficient and effective improvements cannot be made. This study  
34  
35 97 presents the results collected during January 2016 that is almost a decade after the introduction  
36  
37 98 of MNCH and by when the goals of Millennium Development Goals 4 and 5 were expected to  
38  
39 99 be achieved.

## 45 100 **METHODS**

### 47 101 **Study setting**

48 102 According to Pakistan Social and Living Standards Measurement Survey (PSLM) 2013-14,  
49  
50 103 among provinces, KP had the slowest rate of increase in the number of women in rural areas  
51  
52 104 who received a postnatal consultation within 6 months after birth with only 2 percentage point  
53  
54 105 improvement [22] between 2007 and 2014, falling behind other provinces noticeably. During  
55  
56 106 this period, in KP there has been a slow change in the type of place of giving birth shifting from  
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1 107 home to government hospitals/RHC/BHU and private facilities where in 2007 in rural areas  
2  
3 108 71%, 9% and 19% of cases were in home, g. hospitals, and private clinics changing to 52%,  
4  
5 109 15%, and 32% in 2014, respectively.

7 110 Within province, Haripur and Nowshera are two districts where in comparison with urban areas,  
8  
9  
10 111 rural regions have particularly less access to any type of health facilities yet in 2014-15. In  
11  
12 112 Nowshera 62% of pre-natal consultations took place in government hospitals versus 31% taking  
13  
14 113 place in private clinics (this rate is unknown for Haripur) [23]. Haripur has an estimated  
15  
16 114 population of 985,000 and for Nowshera that is 1.24 million. Based on the national crude birth  
17  
18 115 rate of 29.2 per 1,000 population [24], the estimated number of livebirths for Haripur and  
19  
20 116 Nowshera is 28,760 and 36,200, respectively.

23 117 Primary and secondary level facilities in Haripur and Nowshera offer public obstetric care.  
24  
25 118 Primary health care institutions are comprised of BHUs, rural health centers (RHC) and  
26  
27 119 maternal and child health centers (MCHC). Civil Hospitals and District Headquarter Hospitals  
28  
29 120 (DHQH) are secondary level facilities that provide specialized care in larger towns and  
30  
31 121 district capitals. Tertiary care facilities are not available in both districts. In cases of severe  
32  
33 122 complications, health providers in Haripur and Nowshera refer to tertiary health care hospitals  
34  
35 123 in the neighbouring districts; namely hospitals in Peshawar and Mardan for pregnancy  
36  
37 124 complications in Nowshera and hospitals in the district of Abottabad for Haripur. CMWs in  
38  
39 125 both districts provide antenatal, intra-partum, delivery, postnatal and newborn care in their  
40  
41 126 communities.

### 47 127 **Study sample and survey questionnaires**

48  
49 128 A list of public health facilities and trained CMWs in the two districts was obtained from the  
50  
51 129 provincial government. The initial sample covered all 103 public health facilities in these  
52  
53 130 districts: 70 BHUs, 13 RHCs, 8 MCHCs, 10 Civil Hospitals and 2 DHQHs. Health facilities  
54  
55 131 with no or less than an average of three births per month in the past 6 months were excluded  
56  
57 132 from the survey. Out of the 70 BHUs in Haripur, only 7 (10%) reported births in the previous  
58  
59 133 6 months. Similar findings are noted for the MCHCs, with only one facility out of 8 providing

1 134 birth services. A questionnaire covering various aspects including basic and specialized birth  
2  
3 135 service provision, monitoring and communication in the team, incoming and outgoing referrals,  
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5 136 and resource and drug assessment was carried out in 22 health facilities in total, with 14 health  
6  
7 137 facilities in Haripur and 8 in Nowshera (see Figure 1). The survey was administered throughout  
8  
9 138 January 2016. In total, 12 enumerators with a medical background in obstetric care were trained  
10  
11 139 over a 7-day period to conduct the survey.

12  
13  
14 140 Within the two districts, 32 and 53 CMWs were interviewed in Haripur and Nowshera,  
15  
16 141 respectively, making a total of 102 interviews providing a fair representative of both areas (the  
17  
18 142 remaining CMWs were either unavailable or did not allow us to visit them for security reasons).  
19  
20 143 Through this questionnaire, CMWs were asked about basic characteristics of the CMW and her  
21  
22 144 catchment area, basic and specialized delivery service provision, incoming and outgoing  
23  
24 145 referrals, work environment and procedures, supervision, self-assessment, record keeping and  
25  
26 146 reporting, patient statistics, equipment and infrastructure assessment, and drug assessment.

27  
28  
29 147 Medical officers and lady health supervisors in health facilities were also interviewed using a  
30  
31 148 structured questionnaire asking about general characteristics of the facilities such as opening  
32  
33 149 hours and location, staffing, basic and specialized delivery service provision. In addition, an  
34  
35 150 assessment of equipment and drug availability and the facility as well as midwifery homes  
36  
37 151 infrastructure was carried out. The enumerators verified the information through observations.  
38  
39 152 Health facility interviews took place at the respective facility face-to-face with staff directly  
40  
41 153 engaged in delivery services. Interviews with the CMWs took place at midwifery homes. The  
42  
43 154 health facility interviews have been conducted paper-based while interviews with CMWs were  
44  
45 155 entered directly into tablets using ODK software.

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51 156 Figure 1: Spatial distribution of interviewed health care providers.

### 52 53 157 **Patient and Public Involvement**

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55  
56 158 Patients were not involved in the design of the study and no direct interactions with patients  
57  
58 159 were studied. Results were disseminated to health facilities and public health officials of the  
59  
60 160 region through a written report and a series of workshop presentations.

**161 Analysis**

162 The data from the survey asking about seven key interventions, namely the administration of  
163 parenteral antibiotics, uterotonic drugs, parenteral anticonvulsants, the manual removal of  
164 placenta, the removal of retained products of conception, assisted vaginal delivery and neonatal  
165 resuscitation conducted in the last three months prior to the interview, were analysed  
166 descriptively. Following the UN handbook on monitoring EmOC, health facilities and CMWs  
167 have been classified as a BEmOC or CEmOC health provider accordingly [10]. STATA 14 [25]  
168 was used to analyse the data.

**169 RESULTS****170 Number of Births**

171 The total number of births recorded in public health facilities is approximately 14,429 between  
172 January and December 2015 with 7,260 and 7,169 births taking place in Haripur and Nowshera,  
173 respectively. Of births taking place in public health facilities the majority, about 80% in Haripur  
174 and 50% in Nowshera, were performed at the corresponding DHQH. The remaining births in  
175 Haripur were primarily conducted in BHUs, while about 40% of the total births in Nowshera  
176 were conducted in civil hospitals.

177 Between January and December 2015 there was a total of 5,371 births: 1,626 births at the 32  
178 CMWs in Haripur and 3,745 births at the 53 CMWs in Nowshera. This gives a yearly average  
179 of 51 and 71 births per CMW in Haripur and Nowshera, respectively, with rather large variation  
180 within the districts.

181 Taking the sum of total births by health facilities and CMWs results in 19,800 births conducted  
182 by public health cadres. Based on the estimations of total livebirths in both districts, those births  
183 account for roughly 30% of all births in the Districts Haripur and Nowshera.

184

## 185 Provision of Emergency Obstetric Care

### 186 Health facilities

187 As depicted in Table 1, the assessment of the provision of full BEmOC services shows that only  
 188 two facilities in each district qualify as BEmOC facilities. In the last three months before  
 189 assessment, the DHQH and one hospital in Haripur, report performing basic emergency  
 190 obstetric care services. In Nowshera one RHC and one hospital provided all BEmOC services  
 191 It is remarkable that the DHQH in Nowshera does not qualify as BEmOC facility as it reported  
 192 to not have administered Oxytocin for the treatment of post-partum haemorrhage. One out of  
 193 five RHC administered magnesium sulfate in the previous three months and one RHC in  
 194 Nowshera was able to provide all seven interventions necessary to be classified as a BEmOC  
 195 facility. A minority of the health providers support assisted vaginal delivery, neonatal  
 196 resuscitation, and the administration of magnesium sulphate.  
 197 In order to qualify as a CEmOC facility, health facilities need to provide caesarean sections and  
 198 blood transfusions, in addition to the seven BEmOC service functions. In Haripur, the DHQH  
 199 is the only facility providing caesareans and blood transfusion. In Nowshera, two public health  
 200 providers, one hospital, and the DHQH report to maintain these additional comprehensive  
 201 services. Overall, as the DHQH in Nowshera does not qualify as a BEmOC facility, it  
 202 consequentially does not qualify as a CEmOC facility. Given these results, there is one CEmOC  
 203 facility available in each district with one additional facility classified as a BEmOC facility.

204

205 Table 1: BEmOC signal functions of public health facilities

	Haripur					Nowshera		
	BHU (n=7)	MCHC (n=1)	RHC (n=2)	Hospital (n=3)	DHQH (n=1)	RHC (n=5)	Hospital (n=2)	DHQH (n=1)
Parenteral administration of antibiotics	5	1	2	3	1	5	2	1
Parenteral administration of oxytocin	7	1	2	2	1	5	2	0
Parenteral administration of mag sulfate	4	0	1	1	1	1	1	1
Assisted vaginal delivery	1	0	0	2	1	3	2	1

1	Manual removal of placenta	6	0	2	2	1	5	2	1
2	Removal of retained								
3	products of conception	7	0	1	2	1	5	1	1
4	Neonatal resuscitation with								
5	bag and mask	4	1	1	2	1	3	2	1
6	<b>BEmOC Facility</b>	0	0	0	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>
7	Caesarean section	0	0	0	0	1	0	1	1
8	Blood transfusions	0	0	0	0	1	0	1	1
9	<b>CEmOC Facility</b>	0	0	0	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>

206

207 **CMWs**

208 Prior to the survey, only two CMWs from Nowshera out of 85 performed all seven BEmOC  
 209 services. The frequency of different BEmOC services, carried out by the CMWs varies quite  
 210 substantially (Table 2). In both districts, over 80% of the CMWs provide parenteral  
 211 administration of oxytocin and neonatal resuscitation. Manual removal of the placenta is  
 212 provided by a larger percentage of CMWs in Nowshera (91%), while only 69% of CMWs in  
 213 Haripur can perform it. Parenteral administration of antibiotics has been provided in both  
 214 districts by more than 60% of the CMWs. Removal of retained products of conception, assisted  
 215 vaginal delivery and parenteral administration of magnesium sulfate has been provided in both  
 216 districts by less than 40% of the CMWs.

217

218 Table 2: BEmOC provision by CMWs

BEmOC Services	Haripur (n=32)		Nowshera (n=53)	
	n	%	n	%
Parenteral administration of antibiotics	22	69	39	74
Parenteral administration of oxytocin	29	91	45	85
Parenteral administration of magnesium sulfate	8	25	12	23
Assisted vaginal delivery	11	34	28	53
Manual removal of placenta	22	69	48	91
Removal of retained products of conception	12	38	21	40
Neonatal resuscitation	28	88	43	81



Number of CMWS providing all BEmOC services	0	0	2	4
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### 220 **Proportion of births in EmOC public sector facilities**

221 The UN minimum recommendations propose that at least 15% of all births should occur in  
 222 health facility settings, based on the assumption that about 15% of women face complications  
 223 during delivery [10]. For Haripur, 5,740 (20%) births took place in EmOC facilities, mainly the  
 224 DHQH. In Nowshera the proportion of births that occurred in public EmOC health facilities  
 225 equates to only 8% (2815 births) of the estimated 36,200 livebirths in this district; well below  
 226 the UN benchmark.

### 227 **Availability of EmOC**

228 The minimal acceptable level of EmOC availability is defined as at least four BEmOC and one  
 229 CEmOC health facility, serving a population of 500,000 [10]. For Haripur and Nowshera, these  
 230 recommendations would result in a minimum number of ten and twelve EmOC health facilities  
 231 respectively, including two CEmOC facilities in each district (see Table 3). Following this  
 232 benchmark and our obtained results from both districts, Haripur lacks seven BEmOC facilities  
 233 and one CEmOC facility and Nowshera has a shortage of nine BEmOC facilities and one  
 234 CEmOC facility. Although health cadres outside of health institutions do not use these  
 235 benchmarks to assess the adequacy of service provision, considering the results of the CMW  
 236 assessment with only two CMWs in Nowshera providing all BEmOC services, the district of  
 237 Nowshera still lacks seven BEmOC health providers. Taking the data from Nowshera and  
 238 Haripur together shows that both districts have only 11% (2 out of 18 recommended) BEmOC  
 239 and 50% (2 out of 4) CEmOC facilities of the recommended minimum number of facilities  
 240 available to its estimated population of about 2.3 million.

241

242 Table 3: Shortage of BEmOC and CEmOC facilities

Haripur	Nowshera
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Classification	Assessed Availability	WHO recommendation	Shortage	Assessed Availability	WHO recommendation	Shortage
BEmOC	1	8	7	1	10	9
CEmOC	1	2	1	1	2	1

243

### 244 **Low performance of signal functions**

245 A minority of health facilities and CMWs conduct several signal functions. There are various  
 246 reasons for these findings. Following the UN guidelines [10], signal functions need to be  
 247 performed in the 3 months prior to the assessment. Despite the fact that our sample only covered  
 248 health facilities with an average of at least three births per month, it can be assumed that there  
 249 has not been enough cases to perform all of the signal functions. It is specified by the local  
 250 health authorities that high-risk cases should be referred before complications occur; especially  
 251 for primary health facilities and CMWs.

252 In the event of maternal and newborn complications, the large majority of CMWs, BHUs and  
 253 RHCs report to refer the cases to the local DHQH and to tertiary health care providers in  
 254 Abbottabad and Peshawar.

### 255 **Medical equipment and drugs availability**

256 Another aspect concerns the availability of equipment and medication needed to support the  
 257 interventions. For instance, only 23% of all CMWs and 45% of all health facilities administer  
 258 magnesium sulfate (see Table 1 and Table 2). The findings from the drug assessment revealed  
 259 that only 13% of CMWs and 45% of health facilities had magnesium sulfate available on the  
 260 day of the interview. Three health facilities from each district (27%) and 35 CMWs (42%) never  
 261 had magnesium sulfate available. Of the CMWs and health facilities that generally had access  
 262 to magnesium sulfate, 49% and 33% of those, reported to be out of stock in the past 3 months.

263 Overall, these findings highlight that in these regions, provision of the safe and affordable  
 264 childbirth facilities are far from acceptable levels and even the existing services including  
 265 CMWs face major difficulties as such were having adequate access to equipment and  
 266 medication. These observations are not limited to KP and results from studies of CMWs

1 267 conditions in other regions in Pakistan e.g. in districts of northern Punjab [26] reported the same  
2  
3 268 issues. It should be noted that alongside the lack of facilities, cultural and low level of literacy  
4  
5 269 skills among women in poorer regions of Pakistan adds to the complexity of its case where  
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7 270 interventions at the demand side is equally required [27].  
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## 10 271 **DISCUSSION**

11 272 As the KP Health Sector Strategy for 2010-2017 stated, one of the key challenges in this region  
12  
13 273 is widespread poverty. For those in rural areas with poorer population it is even more difficult  
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15 274 to access private facilities which adds to the burden of household out-of-pocket spending on  
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17 275 healthcare [28]. Following the introduction of MNCH and similar government and global  
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19 276 initiatives, this study reviewed the status of the provision of care by CMWs and government  
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21 277 hospitals aiming to identify any shortcomings by considering seven key medical services that  
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23 278 form the basic emergency obstetric care.  
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29 279 We conclude that the districts of Haripur and Nowshera in KP, Pakistan, show a significant  
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31 280 shortage of available public BEmOC and CEmOC facilities. With only 11% of the  
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33 281 recommended number of BEmOC facilities available in both districts, we find a strong under  
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35 282 provision of basic obstetric health care. Overall, 30 % of the estimated total live births in both  
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37 283 districts are conducted by CMWs and public health facilities. An estimated 22% of all births  
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39 284 take place in public health facilities in both districts, of which 41% were conducted at health  
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41 285 facilities that did not meet the BEmOC criteria. Further efforts to increase institutional births  
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43 286 should keep the BEmOC and CEmOC capabilities of the public health facilities in mind and  
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45 287 improve capabilities and quality along with the expansion of institutional births. We would like  
46  
47 288 to note that the study findings are a snapshot representative for the period when the data were  
48  
49 289 collected. Local health authorities were informed about the study findings prior to the  
50  
51 290 publication and it is possible that this information has led to changes. The study documents that  
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53 291 universal institutional births were prioritized before the available health facilities had sufficient  
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55 292 BEmOC and CEmOC capabilities. The survey in this paper focuses on the provision of essential  
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1 293 obstetric care by the public health sector. Accounting for the availability of private health care  
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3 294 providers and its associated costs will help to obtain a comprehensive understanding of the  
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5 295 accessibility of EmOC services in these districts.

7 296 Public health authorities in other low- and middle-income regions are encouraged to assess  
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9  
10 297 BEmOC and CEmOC capabilities to complement policies that aim at increasing institutional  
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12 298 births. For Pakistan, a meta-analysis of existing literature and evidence gathered from various  
13  
14 299 provinces and districts to build a map of status of facilities at the national level could be  
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17 300 particularly helpful in identifying areas that are most deprived as well as providing  
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19 301 opportunities where it is possible to transfer experience and lessons learned across various  
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21 302 regions.

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1 304 **LIST OF ABBREVIATIONS**

2  
3 305 BEmOC, Basic Emergency Obstetric Care

4  
5 306 BHU, Basic Health Unit

6  
7 307 CEmOC, Comprehensive Emergency Obstetric Care

8  
9 308 CMW, Community Midwife

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11 309 DHQH, District Headquarter Hospital

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13 310 EmOC, emergency obstetric care

14  
15 311 KP, Khyber Pakhtunkhwa

16  
17 312 MCHC, Maternal and Child Health Center

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19 313 MNCH, Maternal, Neonatal & Child Health Program

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21 314 RHC, Rural Health Center

22  
23 315 UN, United Nations

24  
25 316 WHO, World Health Organization

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1 318 **DECLARATIONS**

2  
3 319 **Competing interests**

4  
5 320 The authors declare that they have no competing interests.

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7  
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16 325 expressed in this manuscript are those of the authors and do not necessarily reflect those of  
17  
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21  
22 327 **Authors' contributions**

23  
24 328 PB wrote the first draft of the paper, supported the acquisition of the data, conceptualized the  
25  
26 329 study, and analyzed data.

27  
28  
29  
30 330 AH and MK supported the acquisition of the data and contributed to the conceptualization of  
31  
32 331 the study.

33  
34  
35 332 JK supported the acquisition of the data, conceptualized the study, and contributed to the  
36  
37 333 interpretation of results and writing.

38  
39  
40 334 IM conceptualized the study and contributed to the writing.

41  
42  
43 335 SV supervised the project, conceptualized the study and contributed to the interpretation of  
44  
45 336 results and writing.

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48  
49 337 **Ethics approval and consent to participate**

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51 338 Ethical approval was granted by the National Bioethics Committee (NBC) Pakistan, Research  
52  
53 339 Ethics Committee, with the ethical approval number No.4-87/15/NBC-190/RDC/994  
54  
55  
56 340 Written informed consent was obtained before data collection. All participants were informed  
57  
58 341 that they could withdraw from the study at any time.  
59  
60

1 342 **Consent for publication**

2  
3 343 Not applicable

4  
5 344 **Availability of data and material**

6  
7  
8 345 The datasets used and analysed during the current study are available from the corresponding  
9 author on reasonable request.

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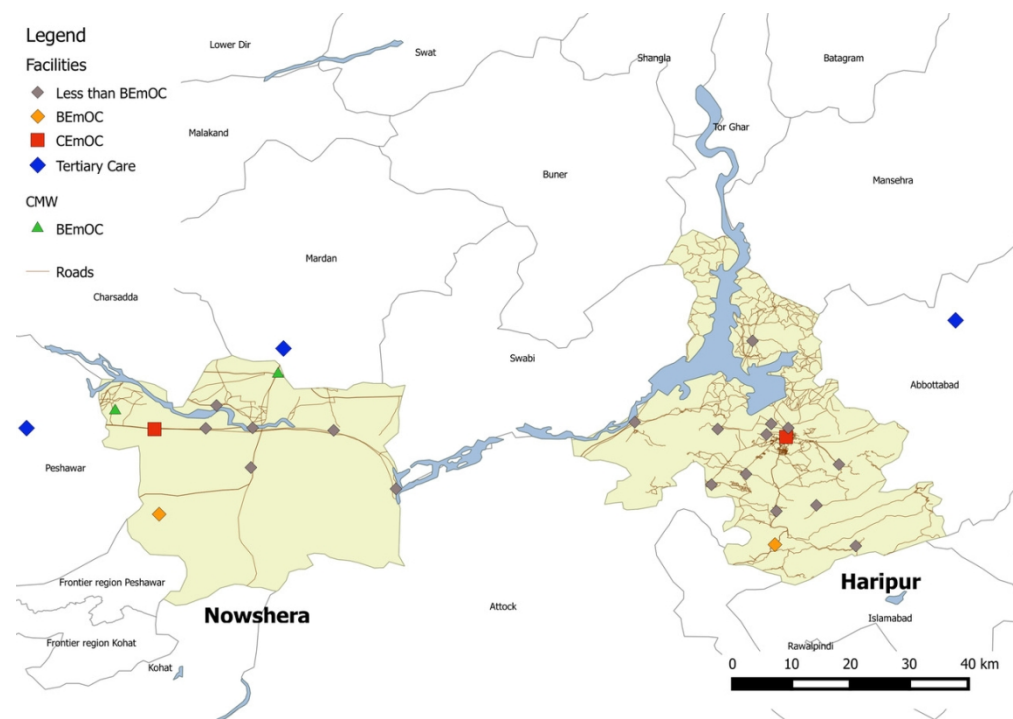


Figure 1: Spatial distribution of interviewed health care providers

108x76mm (300 x 300 DPI)

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

Section/Topic	Item #	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7 & 9
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	na
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	9
		(c) Explain how missing data were addressed	na
		(d) If applicable, describe analytical methods taking account of sampling strategy	na
		(e) Describe any sensitivity analyses	na
<b>Results</b>			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	na
		(b) Indicate number of participants with missing data for each variable of interest	na
Outcome data	15*	Report numbers of outcome events or summary measures	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	na
		(b) Report category boundaries when continuous variables were categorized	na
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	na
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Public provision of emergency obstetric care: A case study in two districts of Pakistan

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Manuscripts

1 **PUBLIC PROVISION OF EMERGENCY OBSTETRIC CARE: A CASE STUDY IN**  
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3  
4 **TWO DISTRICTS OF PAKISTAN**

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6 Peter Brückmann<sup>1</sup>, Ashfa Hashmi<sup>2</sup>, Marina Kuch<sup>3</sup>, Jana Kuhnt<sup>4</sup>, Ida Monfared<sup>5</sup>, Sebastian  
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57 *Keywords:* Obstetric care, EmOC, Community Midwife, Pakistan, Khyber Pakhtunkhwa,  
58  
59 Public health care, Institutional delivery  
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1 Word count: 3321  
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4 **ABSTRACT**

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6 *Objectives:* Pakistan is one out of five countries where together half of the global neonatal  
7 deaths occur. As the provision of services and facilities is one of the key elements vital to  
8 reducing this rate as well as the maternal mortality rate, this study investigates the status of the  
9 delivery of essential obstetric care provided by the public health sector in two districts in  
10 Khyber Pakhtunkhwa (KP) in 2015 aiming to highlight areas where critical improvements are  
11 needed.  
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21 *Setting:* We analysed data from a survey of 22 primary and secondary healthcare facilities as  
22 well as 85 community midwives in Haripur and Nowshera districts.  
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27 *Participants:* Using a structured questionnaire we evaluated the performance of EmOC signal  
28 functions and patient statistics in public health facilities. Also, 102 community midwives were  
29 interviewed about working hours, basic and specialized delivery service provision, referral  
30 system and patient statistics.  
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37 *Primary outcome measures:* We investigate the public provision of emergency obstetric care  
38 using seven key medical services identified by the United Nations (UN).  
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43 *Results:* Deliveries by public health cadres account for about 30% of the total number of births  
44 in these districts. According to the United Nations benchmark, only a small fraction of Basic  
45 EmOC (2/18) and half of the Comprehensive EmOC (2/4) facilities of the recommended  
46 minimum number were available to the population in both districts. Only a minority of health  
47 facilities and CMWs carry out several signal functions. Only 8% of the total births in one of the  
48 study districts are performed in public EmOC health facilities.  
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57 *Conclusions:* Both districts show a significant shortage of available public EmOC service  
58 provisions. Development priorities need to be realigned to improve the availability,  
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1 accessibility and quality of EmOC service provisions by the public health sector alongside with  
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4 existing activities to increase institutional births.  
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## STRENGTHS AND LIMITATIONS OF THIS STUDY

\* This study presents primary data from a rural region in Pakistan for which very little is known about the quality of obstetric care.

\* Through assessing key service functions identified by UN, this study provides an example where public health facilities fail to meet the requirements for BEmOC.

\* It adds to the body of evidence needed to improve the quality of neonatal care in low-income settings.

\* This is a cross-sectional study using descriptive method thus carries associated limitations of such studies.

\* It is a case study with limited external validity.

## BACKGROUND

Low-and middle-income countries (LMICs) continue to struggle to meet the target reductions of maternal and child mortality [1][2]. In Pakistan, estimates in 2015 approximate a maternal mortality rate of 178 women per 100,000 live births and a neonatal mortality rate of 46 neonates per 1,000 live births. A particular challenge is Pakistan's high rate of neonatal mortality in comparison to its neighbouring countries [1, 3, 4].

In an effort to address the high burden of neonatal and maternal mortality in LMICs, the World Health Organization (WHO) has emphasized the need for a transition from home births to institutional [5, 6]. This strategy is also acknowledged by the Government of Pakistan, which realigned development priorities to strengthen and expand the institutional service delivery system [7]. There is also literature questioning the effectiveness of this approach, as the capability of many public health facilities to provide safe births cannot be guaranteed in many LMIC settings [8, 9]. The expansion of institutional births can only be successful if the public health system has the capacity and quality to ensure safe births. Seven key medical services have been identified by the United Nations (UN), which form the basic emergency obstetric care (BEmOC) services [10]. They comprise the administration of parenteral antibiotics, uterotonic drugs, parenteral anticonvulsants, the manual removal of placenta, the removal of retained products of conception, assisted vaginal delivery and neonatal resuscitation. In addition to these BEmOC services, health care institutions are regarded as Comprehensive EmOC (CEmOC) providers if blood transfusions and caesarean sections are offered [10]. Providing these services to every mother and child is considered of overarching importance to reduce the maternal and neonatal mortality and morbidity burden [11–15].

The existing literature for Pakistan highlights the need to improve the availability, accessibility and quality of EmOC services in the public sector. [16]. Several programs were introduced to address this issue. As such, in 2006, the Ministry of Health of the Government of Pakistan established a national Maternal, Neonatal & Child Health Program (MNCH) which emphasized training and deploying community midwives (CMW) [17]. CMWs represent a cadre of non-

1 facility-based skilled birth attendants who perform births either at the midwifery or patient  
2 homes to increase skilled birth attendance in underserved communities. They act as a first level  
3 of contact for women in the community and are supported by successive levels of referral  
4 facilities such as Basic Health Units (BHU) or Civil Hospitals, however, they are not expected  
5 to conduct births at these facilities. Through this and some other similar programs attempts  
6 were made to decentralise the healthcare infrastructure and strengthen and improve the  
7 provision of EmONC at the national level, however, the degree of success of integration of  
8 MNCH at the district level remained less known [18].

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19 Focusing on two rural districts, Nowshera and Haripur in Khyber Pakhtunkhwa (KP), one of  
20 the four main provinces in Pakistan, this study investigates the status of the successful delivery  
21 of EmOC as well as services provided by CMWs. While similar studies were carried out in  
22 other provinces (e.g. in Punjab and North West Frontier Province (NWFP) [19][20] and Sindh  
23 [21]) evidence from districts in KP to the date of the present study were scarce. By gathering  
24 knowledge from these rural areas, this study addresses the fact that successful implementation  
25 of programmes such as MNCH depends on having an assessment of the status of the existing  
26 services without which efficient and effective improvements cannot be made. This study  
27 presents the results collected during January 2016 that is almost a decade after the introduction  
28 of MNCH and by when the goals of Millennium Development Goals 4 and 5 were expected to  
29 be achieved.

## 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 **METHODS**

### 47 48 **Study setting**

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50 According to Pakistan Social and Living Standards Measurement Survey (PSLM) 2013-14,  
51 among provinces, KP had the slowest rate of increase in the number of women in rural areas  
52 who received a postnatal consultation within 6 months after birth with only 2 percentage point  
53 improvement [22] between 2007 and 2014, falling behind other provinces noticeably. During  
54 this period, in KP there has been a slow change in the type of place of giving birth shifting from

1 home to government hospitals/RHC/BHU and private facilities where in 2007 in rural areas  
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3 71%, 9% and 19% of cases were in home, e.g. hospitals, and private clinics changing to 52%,  
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5 15%, and 32% in 2014, respectively.  
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8 Within province, Haripur and Nowshera are two districts where in comparison with urban areas,  
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10 rural regions have particularly less access to any type of health facilities yet in 2014-15. In  
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12 Nowshera 62% of pre-natal consultations took place in government hospitals versus 31% taking  
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14 palace in private clinics (this rate is unknown for Haripur) [23]. Haripur has an estimated  
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16 population of 985,000 and for Nowshera that is 1.24 million. Based on the national crude birth  
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18 rate of 29.2 per 1,000 population [24], the estimated number of livebirths for Haripur and  
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20 Nowshera is 28,760 and 36,200, respectively.  
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24 Primary and secondary level facilities in Haripur and Nowshera offer public obstetric care.

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26 Primary health care institutions are comprised of BHUs, rural health centers (RHC) and  
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28 maternal and child health centers (MCHC). Civil Hospitals and District Headquarter Hospitals  
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30 (DHQH) are secondary level facilities that provide specialized care in larger towns and  
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32 district capitals. Tertiary care facilities are not available in both districts. In cases of severe  
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34 complications, health providers in Haripur and Nowshera refer to tertiary health care hospitals  
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36 in the neighbouring districts; namely hospitals in Peshawar and Mardan for pregnancy  
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38 complications in Nowshera and hospitals in the district of Abbottabad for Haripur. CMWs in  
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40 both districts provide antenatal, intra-partum, delivery, postnatal and newborn care in their  
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42 communities.  
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#### 47 **Study sample and survey questionnaires**

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49 A list of public health facilities and trained CMWs in the two districts was obtained from the  
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51 provincial government. The initial sample covered all 103 public health facilities in these  
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53 districts: 70 BHUs, 13 RHCs, 8 MCHCs, 10 Civil Hospitals and 2 DHQHs. Health facilities  
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55 with no or less than an average of three births per month in the past 6 months were excluded  
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57 from the survey. Out of the 70 BHUs in Haripur, only 7 (10%) reported births in the previous  
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59 6 months. Similar findings are noted for the MCHCs, with only one facility out of 8 providing  
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1 birth services. A questionnaire covering various aspects including basic and specialized birth  
2 service provision, monitoring and communication in the team, incoming and outgoing referrals,  
3 and resource and drug assessment was carried out in 22 health facilities in total, with 14 health  
4 facilities in Haripur and 8 in Nowshera (see Figure 1). The survey was administered throughout  
5 January 2016. In total, 12 enumerators with a medical background in obstetric care were trained  
6 over a 7-day period to conduct the survey.  
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15 Within the two districts, 32 and 53 CMWs were interviewed in Haripur and Nowshera,  
16 respectively, making a total of 102 interviews providing a fair representative of both areas (the  
17 remaining CMWs were either unavailable or did not allow us to visit them for security reasons).  
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22 Through this questionnaire, CMWs were asked about basic characteristics of the CMW and her  
23 catchment area, basic and specialized delivery service provision, incoming and outgoing  
24 referrals, work environment and procedures, supervision, self-assessment, record keeping and  
25 reporting, patient statistics, equipment and infrastructure assessment, and drug assessment.  
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Medical officers and lady health supervisors in health facilities were also interviewed using a structured questionnaire asking about general characteristics of the facilities such as opening hours and location, staffing, basic and specialized delivery service provision. In addition, an assessment of equipment and drug availability and the facility as well as midwifery homes infrastructure was carried out. The enumerators verified the information through observations. Health facility interviews took place at the respective facility face-to-face with staff directly engaged in delivery services. Interviews with the CMWs took place at midwifery homes. The health facility interviews have been conducted paper-based while interviews with CMWs were entered directly into tablets using ODK software.

Figure 1: Spatial distribution of interviewed health care providers.

### **Patient and Public Involvement**

Patients were not involved in the design of the study and no direct interactions with patients were studied. Results were disseminated to health facilities and public health officials of the region through a written report and a series of workshop presentations.

## Analysis

The data from the survey asking about seven key interventions, namely the administration of parenteral antibiotics, uterotonic drugs, parenteral anticonvulsants, the manual removal of placenta, the removal of retained products of conception, assisted vaginal delivery and neonatal resuscitation conducted in the last three months prior to the interview, were analysed descriptively. Following the UN handbook on monitoring EmOC, health facilities and CMWs have been classified as a BEmOC or CEmOC health provider accordingly [10]. STATA 14 [25] was used to analyse the data.

## RESULTS

### Number of Births

The total number of births recorded in public health facilities is approximately 14,429 between January and December 2015 with 7,260 and 7,169 births taking place in Haripur and Nowshera, respectively. Of births taking place in public health facilities the majority, about 80% in Haripur and 50% in Nowshera, were performed at the corresponding DHQH. The remaining births in Haripur were primarily conducted in BHUs, while about 40% of the total births in Nowshera were conducted in civil hospitals.

Between January and December 2015 there was a total of 5,371 births: 1,626 births at the 32 CMWs in Haripur and 3,745 births at the 53 CMWs in Nowshera. This gives a yearly average of 51 and 71 births per CMW in Haripur and Nowshera, respectively, with rather large variation within the districts.

Taking the sum of total births by health facilities and CMWs results in 19,800 births conducted by public health cadres. Based on the estimations of total livebirths in both districts, those births account for roughly 30% of all births in the Districts Haripur and Nowshera.



## Provision of Emergency Obstetric Care

### Health facilities

As depicted in Table 1, the assessment of the provision of full BEmOC services shows that only two facilities in each district qualify as BEmOC facilities. In the last three months before assessment, the DHQH and one hospital in Haripur, report performing basic emergency obstetric care services. In Nowshera one RHC and one hospital provided all BEmOC services. It is remarkable that the DHQH in Nowshera does not qualify as BEmOC facility as it reported to not have administered Oxytocin for the treatment of post-partum haemorrhage. One out of five RHC administered magnesium sulfate in the previous three months and one RHC in Nowshera was able to provide all seven interventions necessary to be classified as a BEmOC facility. A minority of the health providers support assisted vaginal delivery, neonatal resuscitation, and the administration of magnesium sulphate.

In order to qualify as a CEmOC facility, health facilities need to provide caesarean sections and blood transfusions, in addition to the seven BEmOC service functions. In Haripur, the DHQH is the only facility providing caesareans and blood transfusion. In Nowshera, two public health providers, one hospital, and the DHQH report to maintain these additional comprehensive services. Overall, as the DHQH in Nowshera does not qualify as a BEmOC facility, it consequentially does not qualify as a CEmOC facility. Given these results, there is one CEmOC facility available in each district with one additional facility classified as a BEmOC facility.

Table 1: BEmOC signal functions of public health facilities

	Haripur					Nowshera		
	BHU (n=7)	MCHC (n=1)	RHC (n=2)	Hospital (n=3)	DHQH (n=1)	RHC (n=5)	Hospital (n=2)	DHQH (n=1)
Parenteral administration of antibiotics	5	1	2	3	1	5	2	1
Parenteral administration of oxytocin	7	1	2	2	1	5	2	0

1									
2	Parenteral administration of	4	0	1	1	1	1	1	1
3	mag sulfate								
4	Assisted vaginal delivery	1	0	0	2	1	3	2	1
5									
6	Manual removal of placenta	6	0	2	2	1	5	2	1
7									
8	Removal of retained	7	0	1	2	1	5	1	1
9	products of conception								
10									
11	Neonatal resuscitation with	4	1	1	2	1	3	2	1
12	bag and mask								
13									
14	<b>BEmOC Facility</b>	0	0	0	1	1	1	1	0
15									
16	Caesarean section	0	0	0	0	1	0	1	1
17									
18	Blood transfusions	0	0	0	0	1	0	1	1
19									
20	<b>CEmOC Facility</b>	0	0	0	0	1	0	1	0
21									

## CMWs

Prior to the survey, only two CMWs from Nowshera out of 85 performed all seven BEmOC services. The frequency of different BEmOC services, carried out by the CMWs varies quite substantially (Table 2). In both districts, over 80% of the CMWs provide parenteral administration of oxytocin and neonatal resuscitation. Manual removal of the placenta is provided by a larger percentage of CMWs in Nowshera (91%), while only 69% of CMWs in Haripur can perform it. Parenteral administration of antibiotics has been provided in both districts by more than 60% of the CMWs. Removal of retained products of conception, assisted vaginal delivery and parenteral administration of magnesium sulfate has been provided in both districts by less than 40% of the CMWs.

Table 2: BEmOC provision by CMWs

BEmOC Services	Haripur (n=32)		Nowshera (n=53)	
	n	%	n	%

1	Parenteral administration of antibiotics	22	69	39	74
2					
3	Parenteral administration of oxytocin	29	91	45	85
4					
5	Parenteral administration of magnesium sulfate	8	25	12	23
6					
7	Assisted vaginal delivery	11	34	28	53
8					
9	Manual removal of placenta	22	69	48	91
10					
11	Removal of retained products of conception	12	38	21	40
12					
13	Neonatal resuscitation	28	88	43	81
14					
15	<b>Number of CMWS providing all BEmOC services</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>4</b>
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### Proportion of births in EmOC public sector facilities

The UN minimum recommendations propose that at least 15% of all births should occur in health facility settings, based on the assumption that about 15% of women face complications during delivery [10]. For Haripur, 5,740 (20%) births took place in EmOC facilities, mainly the DHQH. In Nowshera the proportion of births that occurred in public EmOC health facilities equates to only 8% (2815 births) of the estimated 36,200 livebirths in this district; well below the UN benchmark.

### Availability of EmOC

The minimal acceptable level of EmOC availability is defined as at least four BEmOC and one CEmOC health facility, serving a population of 500,000 [10]. For Haripur and Nowshera, these recommendations would result in a minimum number of ten and twelve EmOC health facilities respectively, including two CEmOC facilities in each district (see Table 3). Following this benchmark and our obtained results from both districts, Haripur lacks seven BEmOC facilities and one CEmOC facility and Nowshera has a shortage of nine BEmOC facilities and one CEmOC facility. Although health cadres outside of health institutions do not use these benchmarks to assess the adequacy of service provision, considering the results of the CMW assessment with only two CMWs in Nowshera providing all BEmOC services, the district of

Nowshera still lacks seven BEmOC health providers. Taking the data from Nowshera and Haripur together shows that both districts have only 11% (2 out of 18 recommended) BEmOC and 50% (2 out of 4) CEmOC facilities of the recommended minimum number of facilities available to its estimated population of about 2.3 million.

Table 3: Shortage of BEmOC and CEmOC facilities

Classification	Haripur			Nowshera		
	Assessed Availability	WHO recommendation	Shortage	Assessed Availability	WHO recommendation	Shortage
BEmOC	1	8	7	1	10	9
CEmOC	1	2	1	1	2	1

### Low performance of signal functions

A minority of health facilities and CMWs conduct several signal functions. There are various reasons for these findings. Following the UN guidelines [10], signal functions need to be performed in the 3 months prior to the assessment. Despite the fact that our sample only covered health facilities with an average of at least three births per month, it can be assumed that there has not been enough cases to perform all of the signal functions. It is specified by the local health authorities that high-risk cases should be referred before complications occur; especially for primary health facilities and CMWs.

In the event of maternal and newborn complications, the large majority of CMWs, BHUs and RHCs report to refer the cases to the local DHQH and to tertiary health care providers in Abbottabad and Peshawar.

### Medical equipment and drugs availability

Another aspect concerns the availability of equipment and medication needed to support the interventions. For instance, only 23% of all CMWs and 45% of all health facilities administer magnesium sulfate (see Table 1 and Table 2). The findings from the drug assessment revealed

1 that only 13% of CMWs and 45% of health facilities had magnesium sulfate available on the  
2  
3 day of the interview. Three health facilities from each district (27%) and 35 CMWs (42%) never  
4  
5 had magnesium sulfate available. Of the CMWs and health facilities that generally had access  
6  
7 to magnesium sulfate, 49% and 33% of those, reported to be out of stock in the past 3 months.  
8  
9 Overall, these findings highlight that in these regions, provision of the safe and affordable  
10  
11 childbirth facilities are far from acceptable levels and even the existing services including  
12  
13 CMWs face major difficulties as such were having adequate access to equipment and  
14  
15 medication. These observations are not limited to KP and results from studies of CMWs  
16  
17 conditions in other regions in Pakistan e.g. in districts of northern Punjab [26] reported the same  
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19 issues. It should be noted that alongside the lack of facilities, cultural and low level of literacy  
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21 skills among women in poorer regions of Pakistan adds to the complexity of its case where  
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23 interventions at the demand side is equally required [27].  
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## 30 **DISCUSSION**

31  
32 As the KP Health Sector Strategy for 2010-2017 stated, one of the key challenges in this region  
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34 is widespread poverty. For those in rural areas with poorer population it is even more difficult  
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36 to access private facilities which adds to the burden of household out-of-pocket spending on  
37  
38 healthcare [28]. Following the introduction of MNCH and similar government and global  
39  
40 initiatives, this study reviewed the status of the provision of care by CMWs and government  
41  
42 hospitals aiming to identify any shortcomings by considering seven key medical services that  
43  
44 form the basic emergency obstetric care.  
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47

48 We conclude that the districts of Haripur and Nowshera in KP, Pakistan, show a significant  
49  
50 shortage of available public BEmOC and CEmOC facilities. With only 11% of the  
51  
52 recommended number of BEmOC facilities available in both districts, we find a strong under  
53  
54 provision of basic obstetric health care. Overall, 30 % of the estimated total live births in both  
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56 districts are conducted by CMWs and public health facilities. An estimated 22% of all births  
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58 take place in public health facilities in both districts, of which 41% were conducted at health  
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1 facilities that did not meet the BEmOC criteria. Further efforts to increase institutional births  
2  
3 should keep the BEmOC and CEmOC capabilities of the public health facilities in mind and  
4  
5 improve capabilities and quality along with the expansion of institutional births. We would like  
6  
7 to note that the study findings are a snapshot representative for the period when the data were  
8  
9 collected. Local health authorities were informed about the study findings prior to the  
10  
11 publication and it is possible that this information has led to changes. The study documents that  
12  
13 universal institutional births were prioritized before the available health facilities had sufficient  
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15 BEmOC and CEmOC capabilities. The survey in this paper focuses on the provision of essential  
16  
17 obstetric care by the public health sector. Accounting for the availability of private health care  
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19 providers and its associated costs will help to obtain a comprehensive understanding of the  
20  
21 accessibility of EmOC services in these districts.  
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26 Public health authorities in other low- and middle-income regions are encouraged to assess  
27  
28 BEmOC and CEmOC capabilities to complement policies that aim at increasing institutional  
29  
30 births. For Pakistan, a meta-analysis of existing literature and evidence gathered from various  
31  
32 provinces and districts to build a map of status of facilities at the national level could be  
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34 particularly helpful in identifying areas that are most deprived as well as providing  
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36 opportunities where it is possible to transfer experience and lessons learned across various  
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38 regions.  
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**LIST OF ABBREVIATIONS**

BEmOC, Basic Emergency Obstetric Care

BHU, Basic Health Unit

CEmOC, Comprehensive Emergency Obstetric Care

CMW, Community Midwife

DHQH, District Headquarter Hospital

EmOC, emergency obstetric care

KP, Khyber Pakhtunkhwa

MCHC, Maternal and Child Health Center

MNCH, Maternal, Neonatal & Child Health Program

RHC, Rural Health Center

UN, United Nations

WHO, World Health Organization

## DECLARATIONS

### Competing interests

The authors declare that they have no competing interests.

### Funding

The authors acknowledge funding from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The GIZ had no influence in the design of the study, data collection, analysis, interpretation of data, writing the manuscript or decision to publish. The views expressed in this manuscript are those of the authors and do not necessarily reflect those of the funder.

### Authors' contributions

PB wrote the first draft of the paper, supported the acquisition of the data, conceptualized the study, and analyzed data.

AH and MK supported the acquisition of the data and contributed to the conceptualization of the study.

JK supported the acquisition of the data, conceptualized the study, and contributed to the interpretation of results and writing.

IM conceptualized the study and contributed to the writing.

SV supervised the project, conceptualized the study and contributed to the interpretation of results and writing.

### Ethics approval and consent to participate

Ethical approval was granted by the National Bioethics Committee (NBC) Pakistan, Research Ethics Committee, with the ethical approval number No.4-87/15/NBC-190/RDC/994

Written informed consent was obtained before data collection. All participants were informed that they could withdraw from the study at any time.



1           **Consent for publication**  
2

3  
4           Not applicable  
5

6           **Availability of data and material**  
7

8           The datasets used and analysed during the current study are available from the corresponding  
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10          author on reasonable request.  
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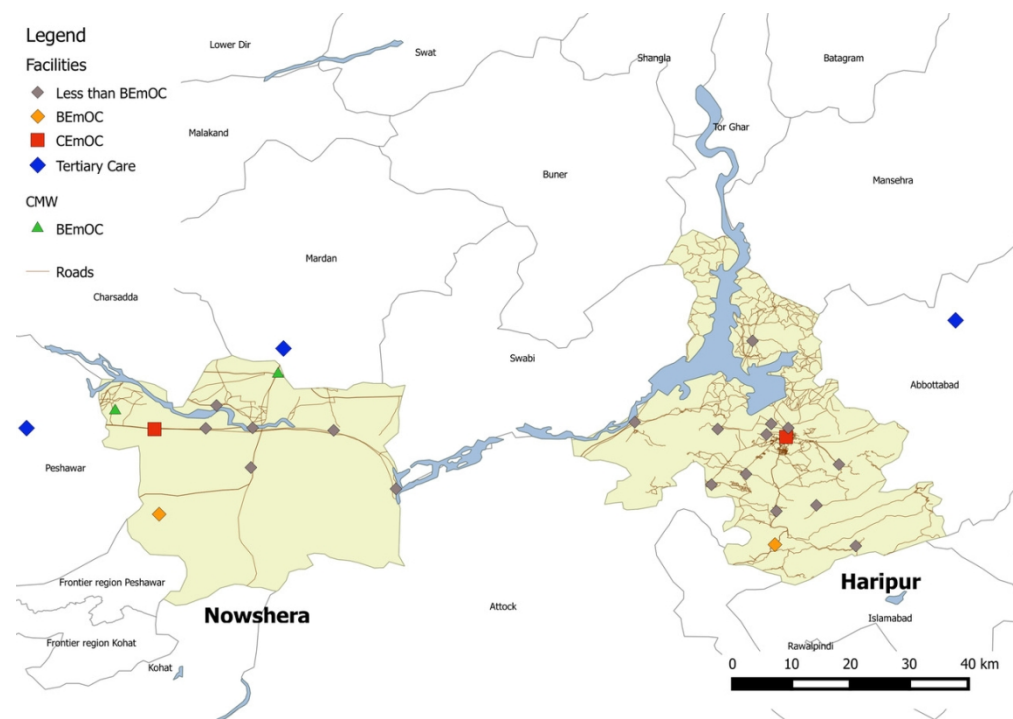


Figure 1: Spatial distribution of interviewed health care providers

108x76mm (300 x 300 DPI)

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

Section/Topic	Item #	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7 & 9
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	na
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	9
		(c) Explain how missing data were addressed	na
		(d) If applicable, describe analytical methods taking account of sampling strategy	na
		(e) Describe any sensitivity analyses	na
<b>Results</b>			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	na
		(b) Indicate number of participants with missing data for each variable of interest	na
Outcome data	15*	Report numbers of outcome events or summary measures	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	na
		(b) Report category boundaries when continuous variables were categorized	na
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	na
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).