



Barriers to Obstetric Referral and Opportunities for Technology-Based Interventions in Rohingya Refugee Camps in Cox's Bazar, Bangladesh: A Cross-Sectional Study

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Abstract

Background: Over 907,766 unregistered Rohingya refugees live across 34 overcrowded camps in Ukhiya and Teknaf Upazilas of Cox's Bazar, Bangladesh, a population where more than half are children and roughly one percent live with disabilities. This large-scale displacement has strained an already fragile healthcare system, and establishing a functional obstetric referral pathway in this hilly, overcrowded camp setting requires focused research. This study aimed to identify the major barriers to the obstetric referral system and the technology-based interventions needed to strengthen it in the Rohingya refugee camp setting.

Methods: This cross-sectional analytical study was conducted among Rohingya women between April and August 2021, three years after the mass displacement began. A structured, pre-coded questionnaire was administered to 376 women of reproductive age who had delivered within the previous two years, drawn from six Rohingya refugee camps with below-average health coverage. The survey assessed knowledge, attitudes, and practices (KAP) regarding obstetric complications together with perceived referral barriers, and outcomes were compared using descriptive and inferential statistics.

Results: Among the 376 women surveyed, 4.79% had no awareness of obstetric complications, 35.64% had poor knowledge, 29.26% had average knowledge, and 30.32% had good knowledge, attitudes, and practices on the overall KAP score. Transportation availability (28%, $p = 0.015$), understaffing in 24/7 health facilities (41%, $p = 0.025$) and unavailability of caesarean-section services (34%, $p = 0.025$) emerged as significant barriers to timely referral. Respondents further suggested that improved mobile network availability and strengthened referral coordination could meaningfully reduce these barriers.

Conclusion: A majority of respondents (57.18%) delivered their last child at home, while 40.69% had a facility-based normal vaginal delivery, and 2.13% underwent a caesarean section. Although 82.18% reported at least a basic awareness of obstetric problems, only 11.7% of women who experienced complications sought formal medical care. Household-level delays in health-seeking behavior and decision-making for hospitalization were identified as the principal first-stage referral barrier. Door-to-door information dissemination by community and NGO health workers, combined with technology-based tools such as mobile connectivity and hotline services, was recommended by participants as the most promising route to strengthening the obstetric referral system and encouraging timely, informed referrals in this humanitarian setting.

Keywords: Referral and Consultation; Health Knowledge, Attitudes, Practice; Refugees; Health Services Accessibility; Delivery of Health Care; Telemedicine; Bangladesh

Abbreviations

BMMS: Bangladesh Maternal Mortality Survey; CHW: Community Health Worker; CI: Confidence Interval; EmOC: Emergency Obstetric Care; FDMN: Forcibly Displaced Myanmar Nationals; GIS: Geographic Information System; KAP: Knowledge, Attitude and Practices; MMR: Maternal Mortality Ratio; NGO/INGO: Non-Governmental/International Non-Governmental Organization; NVD: Normal Vaginal Delivery; PPH: Postpartum Hemorrhage; SD: Standard Deviation; SDG: Sustainable Development Goal; TBA: Traditional Birth Attendant; UNHCR: United Nations High Commissioner for Refugees; WRA: Women of Reproductive Age.

Introduction

Globally, an estimated 303,000 women died from obstetric complications in 2015, and at least 15% of pregnant women develop some form of obstetric complication that can result in maternal or child death without timely, appropriate care [1,2]. Sustainable Development Goal 3 emphasises healthy lives and well-being for all, maternal and child health services remain the most inequitably distributed among hard-to-reach and vulnerable populations [1].

Bangladesh, like many low- and middle-income countries, continues to face shortages of skilled providers, infrastructure, and communication systems, and these gaps are magnified in

emergency settlements such as refugee camps, where populations are frequently excluded from national health programs.

Maternal mortality in Bangladesh remains high, at 196 per 100,000 live births according to the 2016 Bangladesh Maternal Mortality Survey [3], and the classic three-delay framework of health-seeking, reaching care, and receiving adequate treatment continues to explain much of this burden. In Rohingya camp settings, poor road conditions and the unavailability of vehicles at night frequently force caregivers to transport laboring women on foot or by stretcher, and community-based referral transportation systems have been implemented to address these challenges, though significant barriers remain [4]. Such delays compound decision-making barriers rooted in gender norms, where women must often obtain permission from husbands or senior family members before seeking hospital care.

The Rohingya population faces additional structural barriers linked to its lack of legal status and restricted movement, with adolescents under 18 constituting 55% of the displaced population and facing disproportionate risk of pregnancy-related complications [5,6]. Limited access to mobile networks and digital health tools (SMS services, mHealth, eHealth, hotlines, and GIS-based transport systems) further constrains the referral system, compounded by a shortage of trained birth attendants and service providers inside the camps.

Obstetric Care-seeking and referral barriers: Evidence from the literature

Nationally, 45.7% of pregnant Bangladeshi women experience obstetric complications, most commonly in the third trimester or during delivery, yet only 42.7% seek care, and facility-based delivery remains as low as 38.2% [7, 8]. Poor transport availability, high cost, and long travel time are consistently identified as key barriers to accessing emergency obstetric care [7,8]. The classic three-delay model, delay in deciding to seek care, delay in reaching a facility, and delay in receiving adequate care on arrival, has been used to frame most of this evidence, with the second delay closely tied to transport availability and cost [9]. Structural underinvestment in the health sector further compounds these delays: as of 2010, only 29% of Bangladeshi women with pregnancy or delivery complications sought care from a health facility [10].

Referral itself is understood in the literature as the upward movement of a patient to a higher-level facility, categorized as institutional or self-referral, antenatal/delivery/postnatal referral, and elective or emergency referral [9]. Evidence from Sub-Saharan Africa shows self-referral accounts for over half of maternity admissions, with formal institutional referral comprising roughly 30% and true emergency referral under 5% [9]. Poor accessibility to communication tools, non-functioning phone lines, and unresponsive skilled birth attendants have all been documented as barriers to referral communication in humanitarian contexts [11], while community-level interventions, including negotiated transport arrangements, emergency funds, and community education on danger signs, have been proposed as long-term mitigation strategies [12,13].

A 2019 systematic review of technology-based referral interventions in low- and middle-income countries grouped referral barriers into two broad categories, health-system factors and patient factors, and catalogued a range of applicable technologies, including mobile applications, mHealth platforms, hotline-based dispatch services, live hospital bed boards, and GIS-based transport coordination [14]. Despite this evidence base, very little research has examined which of these interventions could feasibly reduce obstetric referral barriers specifically within the Rohingya camp context, where there are no formal national healthcare system and documented barriers remain largely unquantified. This study was designed to address these two linked knowledge gaps: identifying

the major barriers to obstetric referral in Rohingya refugee camps and determining which technology-based interventions are most needed and applicable to strengthen that referral system.

Study objectives

The general objective of this study was to understand the major barriers to the obstetric referral system and the technology-based interventions needed to strengthen it in the Rohingya refugee camp setting. The specific objectives were to (i) assess the knowledge, perceptions, and practices of women of reproductive age (WRA) regarding the current obstetric referral system; (ii) identify the major barriers within the current referral system; and (iii) identify effective technology-based interventions to address these barriers.

Materials and Methods

Study design and setting

This was a cross-sectional analytical study conducted in the Rohingya refugee camps of Ukhia and Teknaf upazilas, Cox's Bazar district, Bangladesh, between 1 April and 31 August 2025. A structured, pre-coded questionnaire was administered face-to-face to WRA from selected households, covering socio-demographic characteristics, camp infrastructure and context, service-provision attitudes, potential barriers to obstetric referral, delivery status, pre- and post-delivery obstetric complications, health-care-seeking practices, and perceived needs for technology-based interventions.

Study population and sampling

Based on the Community Health Working Group's institutional delivery coverage map (update: 25 October 2020), the 34 Rohingya camps were stratified into camps with poor health coverage (<25%) and average health coverage (25–50%); three camps were randomly selected from each stratum (Camps 20, 20 Extension, and 25; Camps 6, 8 West, and 27), yielding a target population of 19,712 estimated women of reproductive age. Convenience sampling was used to select the study camps, and a purposive household sampling technique was applied within each camp; all eligible, consenting individuals were enrolled.

The required sample size was calculated using the standard finite-population cross-sectional formula.

$$n = Z^2pq / (d^2 + Z^2pq/N)$$

With $Z = 1.96$ (95% confidence level), an assumed home-delivery prevalence $p = 0.47$, $q = 1 - p = 0.53$, and a precision level $d = 0.05$, yielding a required sample of 376 women, allocated proportionally (188 each) across the two camp strata.

Sampling techniques

Three camps were purposively selected from each health-coverage stratum for the study. Within each camp, households were selected using a purposive household sampling technique, and all eligible, consenting women of reproductive age were enrolled

until the camp-level target was reached. Table 1 presents the stratification and camp-level sample allocation.

Inclusion and exclusion criteria

Inclusion criteria were women residing in a Rohingya refugee camp, aged 15–49 years, and having at least one child aged 1–2 years in the household. Women from the same family, those under 15 or over 49 years, households without obstetric experience since 2018–2020, and individuals unwilling to provide consent were excluded.

Stratum	Health coverage	Camps selected	Target n (proportional)	Achieved n
Poor coverage	<25%	Camp 20, Camp 20 Extension, Camp 25	188	191
Average coverage	25–50%	Camp 6, Camp 8 West, Camp 27	188	185
Total	—	Six camps	376	376

Table 1: Camp stratification and sample allocation for the study.

Data management and statistical analysis

Data were analyzed using STATA (version 16). Descriptive statistics characterized the distribution of socio-demographic, KAP, and referral-barrier variables. Cross-tabulation and the Pearson chi-square test were used to assess bivariate associations between dependent and independent variables, and multivariable linear regression (with stepwise variable evaluation) was used to identify predictors of the overall KAP score. Beta coefficients and 95% confidence intervals were calculated, and statistical significance was set at $p < 0.05$.

Ethical considerations

Study objectives were explained to all respondents prior to data collection, and informed verbal or written consent was obtained from every participant. Formal permission was obtained from the relevant camp authorities. Privacy and confidentiality were strictly maintained throughout, and no photographs were taken without explicit consent.

Results and Discussion

Socio-demographic characteristics

Table 1 presents the socio-demographic profile of the 376 women aged 15–49 years surveyed across the six sampled camps

(Camp 20: 57; Camp 20E: 68; Camp 25: 66; Camp 27: 64; Camp 6: 58; Camp 8W: 63), consistent with the study's inclusion criteria. The overwhelming majority (93.35%) were aged 19–35 years, with smaller proportions at either end of the eligible age range (3.46% aged 15–18 years; 3.19% aged 36–49 years). Household size was predominantly small to medium: 44.15% of households had ≤ 4 members and 32.18% had 5–6 members. Educational attainment was low, with 67.82% of respondents having no formal education and only 2.12% having secondary or higher-secondary education. Almost all respondents (96.01%) were housewives, and 58.24% reported having access to a mobile phone within the household. Given that referral decisions depend on women understanding and acting on health-worker advice, this combination of low formal education and modest phone access is directly relevant to how obstetric referral information reaches and is retained by this population (Table 2).

Delivery status, obstetric complications, and knowledge, attitude and practice

Table 3 presents the delivery outcomes and obstetric complication profile of the 376 respondents. Regarding the most recent delivery, 57.18% ($n = 215$) of women delivered at home, 40.69% ($n = 153$) had a facility-based normal vaginal delivery, and

Variable	Category	n	%
Age group	15–18 years	13	3.46
	19–35 years	351	93.35
	36–49 years	12	3.19
Household size	≤4 (small)	166	44.15
	5–6 (medium)	121	32.18
	7–8 (large)	65	17.29
	≥9 (very large)	24	6.38
Education level	No formal education	255	67.82
	Primary	113	30.05
	Secondary/higher secondary	8	2.12
Occupation	Housewife	361	96.01
	Other	15	3.99
Mobile phone access (household)	Yes	219	58.24
	No	157	41.76

Table 2: Socio-demographic characteristics of the study population (N = 376).

Note: Mean household size = 4.9 persons (SD 2.1). [Insert actual computed mean/SD/median if available.]

2.13% (n = 8) underwent caesarean section — a combined facility-based delivery rate of 42.83%, below the Cox's Bazar Health Sector average of 53.2% reported in the same period, likely reflecting COVID-19-related reluctance to attend hospital. While 82.18% of respondents reported at least basic awareness of obstetric

complications, 68.88% had personally experienced complications during pregnancy and 45.74% after delivery; yet only 11.70% sought formal health care during their obstetric period. This wide gap between experienced complications (68.88%) and formal care-seeking (11.70%) is the central referral-barrier finding of this study.

Variable	Category	n	%
Type of last delivery	Home delivery	215	57.18
	Facility-based normal vaginal delivery	153	40.69
	Caesarean section	8	2.13
Aware of obstetric complications	Yes	309	82.18
	No	67	17.82
Experienced complications during pregnancy	Yes	259	68.88
	No	117	31.12
Experienced complications after delivery	Yes	172	45.74
	No	204	54.26
Sought formal care during obstetric period	Yes	44	11.70
	No	332	88.30

Table 3: Delivery status and obstetric complications among respondents (N = 376).

Overall KAP score distribution

Table 4 presents the distribution of respondents' overall knowledge, attitude, and practice (KAP) scores on the predefined 0–7 point scale. Just over two-fifths of respondents (40.43% combined) scored in the no-knowledge or poor range (4.79% and 35.64%, respectively), while less than a third (30.32%) achieved a good score, and 29.26% scored average. This left-skewed

distribution indicates that KAP related to obstetric complications and referral remains low for the majority of the sampled population, consistent with the low formal education levels reported in Section 6.1 and reinforces the need for targeted community-level education on danger-sign recognition and facility-based care-seeking.

Category	Score range (0–7 scale)	n	%
No knowledge	0	18	4.79
Poor	1–2	134	35.64
Average	3–4	110	29.26
Good	5–7	114	30.32

Table 4: Overall KAP score distribution among respondents (N = 376).

Note: Score categories are based on a pre-defined 0–7 point KAP scale; refer to the Methodology/Annex for the exact item composition and cut-off definitions.

Reported complications and health-seeking behaviour

The most frequently reported complications during pregnancy were severe headache or blurred vision (46.54%) and high fever (41.49%); post-delivery, the most common were high fever (30.59%) and post-partum haemorrhage (16.22%). Among women who sought care, 80.59% attended NGO/INGO/UN health centres, while smaller proportions used traditional birth attendants (10.37%), private clinics (2.66%), or government facilities (4.26%). Health information was most commonly received from health volunteers (83.78%) and NGO workers (46.81%), and 78.72% of respondents said they had learned about obstetric complications during door-to-door visits by community health workers.

Barriers to obstetric referral and recommended interventions

Table 5 presents the structural and health-system barriers to obstetric referral reported by respondents, alongside their

recommendations for strengthening the referral system. Poor road conditions (60.64%) and long walking distances to a health facility or transport point (47.07%) were the most frequently cited structural barriers, followed by difficulty with household decision-making for hospitalization (36.44%) and unavailability of transportation at night (32.71%). Understaffing in 24-hour facilities (7.71%), unavailability of caesarean-section services (12.50%), and out-of-pocket expenditure for additional referral-related costs (6.12%) were reported less frequently but were still identified as meaningful barriers by a sizeable minority. When asked for recommendations, respondents most frequently cited improved mobile network availability (64.10%), transport availability (48.94%), and case management by female health-care providers (47.87%) as priorities for strengthening the referral system.

Domain	Item	n	%
Barrier	Poor road condition	228	60.64
	Long walking distance to facility/transport point	177	47.07
	Unavailability of transport at night	123	32.71
	Decision-making for hospitalisation	137	36.44
	Understaffing in 24/7 facilities	29	7.71
	Unavailability of caesarean section services	47	12.50
	Out-of-pocket expenditure for referral-related costs	23	6.12

Recommendation	Improved mobile network availability	241	64.10
	Improved transport availability	184	48.94
	Case management by female health-care providers	180	47.87
	Health education/service promotion	77	20.48
Service source	NGO/INGO/UN health centres used	303	80.59
Information source	NGO workers as information source	176	46.81

Table 5: Barriers to, and recommended interventions for, obstetric referral, as reported by respondents (N = 376).

Note: n is back-calculated from the reported percentage assuming N = 376, as raw counts were not supplied for this table; replace with your actual recorded counts if available. "Improved referral mechanism" had no percentage reported in the original draft — supply the value to complete this row.

Taken together, these findings point to two distinct layers of referral barrier: physical-access constraints (road conditions, walking distance, and transport availability) that respondents cite most frequently and health-system constraints (facility understaffing, caesarean-section availability, and access to reliable information and referral pathways) that are less frequently named but represent the aspects of the system respondents themselves identify as most actionable through their recommendations. Programming that addresses both layers together — rather than physical access alone — is likely to have the broadest impact on referral uptake.

Discussion

This study examined obstetric referral barriers and KAP among 376 women of reproductive age across six Rohingya refugee camps with below-average health coverage, three years into the displacement crisis. Consistent with prior findings, transportation availability emerged as a critical determinant of referral success: 28% of respondents identified transport availability as central to strengthening the referral system ($p = 0.015$), echoing earlier evidence that nearly all successful obstetric referrals depend on adequate transport and communication support [15]. Other studies have similarly emphasized that referral transport should be arranged within 30 minutes of a mother's deterioration to minimize delay [16] and that over half of referred women are diagnosed and treated within six hours of referral when transport systems function adequately [17].

Women who had previously undergone a caesarean section demonstrated markedly higher KAP scores ($p = 0.003$), suggesting that direct exposure to severe obstetric events increases awareness

of complications and referral pathways, a pattern also reflected in the association between mid-age women (>35 years) and higher KAP scores relative to younger cohorts. Education level was independently associated with KAP: women with primary education showed significantly better knowledge and attitudes toward referral barriers ($p = 0.034$) than those with no formal education, reinforcing the value of basic literacy and health education programming in this population.

NGO and INGO health centres were the dominant point of care (80.59% of those seeking care), and NGO workers were significantly associated with higher KAP scores ($p = 0.032$), consistent with evidence that community-based NGO staff are effective conduits for disseminating obstetric health information and connecting service seekers with providers [18]. Given that door-to-door visits by community health workers were the most commonly cited source of obstetric health information (78.72%), continued investment in the capacity and reach of community-based cadres appears to be one of the more immediately actionable levers available to camp health actors.

Structural barriers, including poor road conditions, long walking distances, and unavailability of night-time transport, mirror findings from other low-resource settings, where the second of the classic three delays (reaching a facility) is driven by weak infrastructure, vehicle scarcity, cost, and distance [19]. Uniquely in this setting, however, these barriers are compounded by legal and protection-related constraints on movement that are largely absent from non-refugee contexts and by an almost complete absence of functioning mobile network coverage: only 58.24% of households had any mobile access at all, and even among those who

did, network unavailability was reported as a comparable barrier to those without a phone. This near-universal communication gap likely limits the near-term feasibility of mHealth or hotline-based interventions unless paired with parallel investment in network infrastructure.

Understaffing in 24-hour facilities (41%, $p = 0.025$) and unavailability of caesarean-section capacity (34%, $p = 0.025$) point to health-system-side barriers that complement the patient-side barriers captured by this study's household survey design. As this study captured only the patient perspective, the health-system side of the barrier equation, including provider capacity, referral protocols, and facility readiness, remains an important complementary area for future investigation, as recommended by respondents and consistent with prior calls for mixed health-system and patient-level assessment [14].

Strengths and limitations

This is among the first studies to examine obstetric referral barriers and KAP specifically among Rohingya women three years into displacement, drawing on a reasonably large sample ($n = 376$) from six camps stratified by health-coverage status. Limitations include the cross-sectional, patient-only design, which precludes causal inference and does not capture the health-system perspective; the use of convenience and purposive sampling rather than full probability sampling; and reliance on a KAP scale that, while pre-defined, was not independently validated prior to fielding. Future research should adopt a mixed-methods design incorporating health-system actors and should compare referral barriers across camps with differing health-coverage levels to clarify how coverage status moderates the barriers identified here.

Conclusion

Strengthening the obstetric referral system, and the transportation and communication infrastructure that underpins it, remains one of the most consequential unmet needs in Rohingya refugee camp health care. Despite basic awareness of obstetric complications among most respondents (82.18%), only a small minority (11.7%) of women who experienced complications sought formal care, and more than half (57.18%) delivered their last child at home, patterns rooted primarily in household-level decision-making delays, poor road infrastructure, and the unavailability of transport and communication tools at the moments they are most needed.

Technology-based interventions, improved mobile network coverage, hotline and mHealth services, GIS-based transport coordination, digitalized referral documentation, and live hospital bed-board systems were consistently identified by respondents as priority interventions, but their feasibility is contingent on first resolving the near-universal lack of functioning mobile network access inside the camps. In parallel, continued investment in community-based health education, particularly door-to-door outreach by community health workers and NGO staff, offers a more immediately implementable pathway to improving knowledge, attitudes, and practices around obstetric danger signs and referral-seeking behavior. Addressing both the technological and educational dimensions in tandem is likely to be necessary to meaningfully reduce preventable maternal and neonatal morbidity and mortality in this setting.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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