Barriers and drivers to childhood vaccinations in Forcibly Displaced Myanmar Nationals (FDMN)/ Rohingya refugees in Cox's Bazar, Bangladesh: A scoping review

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Abstract

About 900,000 Forcibly Displaced Myanmar Nationals (FDMN)/Rohingya refugees live in the refugee camps of Cox's Bazar, experiencing recurring vaccine-preventable disease outbreaks despite established vaccination programs.

This scoping review focused on the evidence for individual and context barriers, drivers, and interventions for childhood vaccination uptake of FDMN/Rohingya refugees in Cox's Bazar. Four databases and grey literature were systematically searched. Theoretical frameworks were used to organize findings. 3,654 records were screened, and 18 articles included. Literature was heterogenous. Barriers and drivers for FDMN/ Rohingya refugees receiving vaccination focused on motivation relating to trust, beliefs and fears (16 factors in nine articles), access to vaccination and information availability (13 factors in nine articles), as well as knowledge (five factors in seven articles), social support and gender-related norms (five factors in seven articles). For health service providers facilitating vaccinations, context factors, such as availability of vaccines and staff, were most frequently identified (13 factors in 12 articles). Interventions mostly related to vaccination campaigns and information/education. They were poorly described and lacked formal evaluations.

Future research and interventions on childhood vaccination should consider gender-related social norms and the diversity of the camp population, explore the role of community/religious leaders and improve intervention reporting and evaluation.

Keywords: Vaccination; childhood; Rohingya; FDMN/ Forcibly displaced Myanmar Nationals; Cox's Bazar; Review

1. Introduction

1.1 Background

Vaccines are one of the most cost-effective and lifesaving public health measures to date, importantly reducing the burden of vaccine-preventable diseases (VPD) such as poliomyelitis, measles and rubella globally [1]. However, vaccines have not been able to reach their full potential in vulnerable groups like refugee populations. The global literature reports that the latter experience higher VPD burden and lower immunisation rates than other populations due to several reasons [2, 3]: Overall, conditions in refugee camps such as overcrowding and poor water, sanitation, and hygiene (WASH) conditions facilitate the rapid spread of VPD [3, 4]. Multiple challenges exist in accessing and delivering health services (including vaccines) in refugee camps on the context level [5]. Vaccine hesitancy can cause delay or refusal of vaccinations despite their availability, on an individual level [6]. This is a common phenomenon globally due to numerous reasons, such as vaccine misinformation, unfamiliarity with health systems, language barriers, and sociocultural differences[7].

One group especially at risk are Forcibly Displaced Myanmar Nationals (FDMN)/ Rohingya refugees. In 2017, 700,000 FDMN/Rohingya fled to Cox's Bazar, Bangladesh, following an increase in longstanding ethnic and religious persecution of Rohingya people in Myanmar [8]. They joined approximately 200,000 previously settled refugees. Denied of citizenship in Myanmar, FDMN/ Rohingya refugees are the largest stateless population in the world [9]. Access to health services and vaccinations in Myanmar was found to be highly inequitable for Rohingya with a study showing 60% of Rohingya children arriving in Bangladesh had never previously been vaccinated [10]. Densely-populated makeshift settlements, coupled with a poor health status and low immunization coverage led to several VPD outbreaks [4], including the largest reported diphtheria outbreak in refugee settings so far [11]. To control and prevent further outbreaks, mass vaccination campaigns were initiated in September 2017, and routine immunization services established in February 2018 [12]. Official numbers for vaccination coverage of Rohingya children in Cox's Bazar are lacking, though modelling studies have suggested that VPD outbreaks are still likely and a threat to FDMN/ Rohingya refugees as well as host communities [11, 13]. Understanding vaccination behaviour is crucial in improving vaccination coverage [14]. Until December 2022, the available evidence on barriers, drivers and interventions for childhood vaccination for FDMN/Rohingya refugees in Cox's Bazar has not been reviewed.

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1.2 Aim and objectives

The aim of this scoping review is to gain understanding and review the research landscape of childhood vaccination in FDMN/Rohingya refugees to inform future research and strategies to increase vaccination uptake.

The objectives are to identify individual and context barriers and drivers in Cox's Bazar to *receiving* childhood vaccination amongst FDMN/Rohingya refugee caregivers and *facilitating* childhood vaccinations by health service providers (HSP). Exploring these different perspectives ensures that both the demand and supply side of vaccination coverage are considered[14]. A further objective is to identify vaccination interventions that have been implemented, recommended or evaluated in this population.

2. Methods

2.1 Scoping review approach

This review has been conducted as part of a broader scoping review focusing on COVID-19 protective behaviours (including vaccinations) and childhood vaccinations of FDMN/Rohingya refugees and HSP in Cox's Bazar. This paper presents the childhood vaccination part only.

This scoping review followed the methodology of the Joanna Briggs Institute (JBI) [15] based on the Arksey and O'Malley framework for scoping reviews [16]. A protocol was uploaded onto the Open Science Framework (OSF) website prior to accessing the data (https://osf.io/n6d3z). The Preferred Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR) [17] guided the reporting (see Appendix A for PRISMA-ScR Checklist).

2.2 Theoretical Background: Modified COM-B framework and Behaviour Change Wheel

This review is underpinned by the Capability-Opportunity-Motivation-Behaviour (COM-B) framework and Behaviour Change Wheel (BCW) [18], modified for vaccination behaviors (see Figure 1 and Table 1).

The modified COM-B framework suggests that four inter-linked factors influence vaccination behaviour: Capability (e.g., knowledge, skills), physical opportunity (information, access, health systems), social opportunity (support, norms) and motivation (attitudes, confidence,

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trust). All factors affect an individual's motivation. The framework's comprehensive approach, incorporating both individual and context influences [14], was deemed particularly appropriate to categorize the barriers and drivers.

The modified BCW links the four COM factors with eight types of interventions: Information/education, persuasion, incentivization, coercion, training, restriction, environmental restructuring, and modelling. These intervention types have proved effective at addressing specific COM-factors, and hence ensure that the appropriate interventions are employed [18]. Table 1 describes the intervention types and shows which COM-factors they effectively address. The four COM-factors and eight intervention types of the BCW were used throughout this review to organize the barriers, drivers, and intervention data respectively.

Table 1. Linking intervention types to COM-factors [14, 18]

Intervention type	Intervention description	COM-factor addressed by the intervention type			
		Capability	Physical Opportunity	Social Opportunity	Motivation
Information/ education	Increasing knowledge or understanding	X			X
Persuasion	Using communication to induce positive/negative feelings or stimulate action				X
Incentivisation	Creating an expectation of a reward				X
Coercion	Creating an expectation of punishment or cost				X
Training	Imparting skills	X	X		X
Restriction	Using rules to reduce the opportunity to engage in the target behaviour or in competing behaviours		X	X	
Environmental restructuring	Changing the physical or social context.		X	X	X
Modelling	Providing an example of people to aspire to or imitate.			X	X

2.3 Search strategy and information sources

The electronic databases Ovid MEDLINE, Excerpta Medica database (Embase), Global Health and Web of Science were searched using Boolean operators, keywords, and subject headings. Initial database searches and screening were conducted simultaneously for both topics up to October 2021. In July 2022, an updated search was conducted for the childhood

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vaccination part only to find more recent publications. Details on search strings are provided in Appendixes B1 and B2. Grey literature was searched in a systematic way through the websites Google, *Reliefweb.int* and *Humanitarianresponse.info*. In addition, individual websites from development partners of the Ministry of Health, United Nations (UN) and non-governmental organizations (NGO) in Cox's Bazar were searched (see Appendix C). A snowball search of reference lists was conducted.

2.4 Eligibility criteria

The protocol used the Population, Concept, Context (PCC) framework for inclusion and exclusion criteria [15] (see Appendix D).
Childhood vaccinations in this review are defined as vaccinations given to a person aged 0-18 years of age as part of routine or supplemental immunisation programs (such as mass vaccination campaigns).
Regarding the concept of vaccination, different target behaviours were defined. *Receiving* vaccinations was defined as FDMN/Rohingya refugee caregivers to bring their child for vaccination; *facilitating* vaccinations as health service providers (HSP) to provide vaccinations.

2.5 Study selection

Articles were screened at title/abstract level (using Rayyan [19]) and full-text level (using Mendeley) by two independent investigators (ZY, SR). A third researcher (CJ) was involved when there were disagreements on eligibility.

2.6 Data extraction and synthesis

A data extraction matrix based on the PCC framework was developed in Microsoft Excel, and data on barriers, drivers and interventions were extracted from full texts by one researcher (ZY). This followed a pilot data extraction of three studies in which results were compared with two other researchers for consistency (SR, CJ). Queries were discussed among the researchers and agreed by consensus. Records and data were managed with Mendeley and Excel programs.

Data synthesis was guided by the principles of textual narrative synthesis [20], for which a table of COM-factors and target behaviours (receiving, facilitating) was developed to organise

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barriers and drivers. It was also noted whether this was the perspective of FDMN/Rohingya refugees, HSP, or both. Where data permitted, similarities and differences across camps and population groups (e.g., age, gender) were identified. Similarly, a table was developed to organise intervention data into recommended, implemented or evaluated interventions and by intervention types of the Behaviour Change Wheel (BCW) [18]. Here, only similarities and differences across target populations (and their respective behaviours) were identified.

2.7 Critical appraisal of individual sources of evidence

Though critical appraisal is optional for scoping reviews [16], it was deemed useful in the context of mapping out the evidence base and assessing the quality. Three tools were used to critically appraise different article types: The Mixed Method Assessment Tool (MMAT) for research studies [21], the Authority, Accuracy, Coverage, Objectivity, Date, Significance Checklist (AACODS) for grey literature[22], and the JBI Checklist for text and opinion pieces [23]. This was done by two researchers independently (ZY, SL). Scores were compared and agreed by consensus (see Appendix E).

3. Results

3.1 Overview of results

The systematic search identified a total of 3,654 entries. After de-duplication, title/abstract screening of 3,548 and full-text screening of 147 records, nine articles were found to be eligible, and nine additional articles were added through grey literature searches and citation screening (see Figure 2 *PRISMA Flow Chart*). Other articles were excluded as not aligned with the target population, scoping review concepts or context (as per PCC Appendix A2). No additional articles were found through the update search.

An overview of all included articles is provided in Tables 2.1 and 2.2. The research landscape consists of heterogenous article types, and different research methods were used in research articles. Articles were mostly opinion pieces [4, 24-28], followed by non-peer reviewed primary research [29] and evaluations [9, 30, 31] as part of grey literature, peer reviewed research [32-35] and grey literature reports [12, 36, 37]. For research based articles, mixed-methods were predominantly applied [9, 30, 31, 38], followed by quantitative (cross-sectional) [33-35] and qualitative [29, 32] approaches.

Most articles included barriers and drivers from the perspectives of FDMN/Rohingya refugees population [4, 25-27, 29, 32-35], or both HSP and FDMN/Rohingya refugees [9, 24, 28, 30, 31, 36-38]. Only two articles related to HSP views only [12]. Information on location in the camps and population subgroups was collected. However, it was not possible to organise findings by these characteristics due to a lack of details.

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Table 2.1. Characteristics of included peer-reviewed literature

First author, year	Evidence source		Type of research			Target group			Location		Target behaviour		Critical appraisal (Quality criteria met/ Total)
	Primary research	Opinion piece	Quanti-tative	Qualitative	Mixed methods	FDMN/ Rohingya refugees	HSP	Both	Cox's Bazar – general	Specific camps	Receiving	Facilitating	
Chan, 2018 [24]		■					■			■		■	6/6
Feldstein, 2020[34]	■		■			■							6/7
Jalloh, 2019[32]	■			■		■				■	■		7/7
Jalloh, 2020[25]		■				■			■		■		5/6
Hsan, 2019[27]		■				■			■		■		5/6
Hsan, 2020[26]		■				■			■			■	5/6
Khan 2019[33]	■		■			■				■		■	6/7
Qadri, 2018[28]		■						■		■	■		5/6
Rahman, 2019[4]		■				■			■		■		5/6
Summers, 2018[35]	■		■			■				■	■	■	6/7

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Table 2.2. Characteristics of included grey literature

First author, year	Evidence source				NGO/UN		Target group			Location		Target behaviour		Critical appraisal (Quality criteria met/ Total)
	Primary research	Report	Response evaluation report	Situation report	NGO	UN agency	FDMN/ Rohingya refugees	HSP	Both	Cox's Bazar – general	Specific camps	Receiving	Facilitating	
Bangladesh Health Watch 2019[37]		■			■				■		■	■		22/29
BBC Media Action, Translators without Borders, 2019[29]	■				■		■				■	■		16/24
BRAC, 2019[38]	■				■				■		■	■		28/30
Red R India, 2018[30]			■		■				■	■		■	■	22/30
UNHCR, 2018[9]			■			■			■	■		■	■	28/30
UNICEF, 2018[31]			■			■			■	■		■	■	28/30
UNICEF, 2020[36]				■		■	■			■		■	■	15/23
SEARO WHO, 2019[12]		■				■		■		■		■	■	22/29

possible due heterogeneity of studied outcomes and lack of details. All articles were published between 2018 and 2020. Most interventions were reported from 2017 and 2018 [4, 9, 12, 24-28, 30, 32-35, 37], and one from 2020 [36]. As no evaluation studies on vaccination specific interventions were found, the impact of interventions was reviewed through post vaccination campaign coverage surveys, authors reflections about interventions and general evaluations of the NGO/UN response.

Critical appraisal found that included articles met a moderate to high range (between 65-100%) of quality criteria. On average, 80% of quality criteria were met for grey literature appraised with the AACODS, 86% for opinion pieces appraised with the JBI checklist and 89% for research studies appraised with the MMAT. Most research studies lost scores on the risk of non-response bias, whilst grey literature lost scores for lack of peer-review and editing by reputable authority (see Appendix A5).

3.1. Main barriers and drivers identified

Individual factors

As demonstrated in Tables 3.1 and 3.2, barriers and drivers relating to the **capability factor** of the COM-B model were only identified for FDMN/ Rohingya refugees receiving vaccination (six barriers and drivers reported by seven articles) and were mostly related to knowledge. These included barriers such as a lack of knowledge about how to access vaccination [33, 34], such as details on the time and place of campaigns, as well as lacking knowledge regarding vaccines themselves [32, 36]. In addition, one article mentioned sickness causing inability to bring children for vaccination [33]. Another article reported on vaccination misinformation as a barrier to receiving vaccinations [29]. In line with this, the main driver was knowledge of why childhood vaccinations are important [29, 30, 32, 36].

Also, **motivation-related factors** were predominantly found for receiving vaccination (six barriers and drivers reported by seven articles). These included barriers such as fear of vaccines [37], pain [32, 33], side effects[4, 29, 32, 33], needles [34], weakness and death [29, 32]. Fear of contracting COVID-19 from vaccination facilities was also mentioned in one article [36]. In addition, various beliefs around vaccinations were mentioned such as vaccines causing people to become Christian, leaving marks that prevent from going to heaven [29, 32], or that they were designed to kill the Rohingya population [32]. Only one article described trust in vaccines preventing diseases as a driver to receive vaccinations [32].

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Confidence and trust were described as important factors with conflicting data regarding the role of community/religious leaders and vaccinators, being both a driver and a barrier to receiving vaccination. For example, evidence of both confidence in receiving good care from vaccinators, as well as a lack of trust in vaccinators or volunteers were found [32]. Correspondingly, a barrier to facilitating vaccinations discussed by one article was the difficulty in convincing parents to bring children for vaccination in makeshift and spontaneous settlements [12]. One article mentioned trust in community leaders, and in particular religious leaders, as a driver to receive vaccinations when they recommended these. For caregivers and religious leaders, trust also appeared to be correlated with time and experience, having increased confidence in vaccines from not seeing or hearing children of serious side effects following vaccination campaigns [32, 37]. Four articles discussed competing priorities, e.g., around poor health, collection of drinking water, relief collection and attending school, impacting the motivation to actively seek for receiving vaccinations [32-34]. One article mentioned 'campaign fatigue' as a barrier for facilitating vaccinations especially for multidose vaccines, when too many campaigns were undertaken [34].

Context factors

Social opportunity barriers and drivers referred to social and gender-related norms. One barrier was related to norms in Myanmar where it was reported to be common to receive one single vaccination a day instead of multiple or combination vaccines offered in Cox's Bazar [32, 33]. Social support was shown to be a driver for both receiving as well as for facilitating vaccinations: This included FDMN/Rohingya refugees being able to ask questions to NGO or camp staff, and HSP having collaborative partnerships and good relationships with the government [12, 29, 31]. A lack of community engagement was seen as a barrier to facilitating vaccinations [31].

Gender-related barriers were reported for receiving and facilitating vaccination in three articles [12, 25, 32]. These included women and girls not being able to interact or show parts of their body to men outside their family [25, 32], and religious leaders not recommending vaccinations as they disapproved of women and girls being publicly vaccinated by men [32]. On the other hand, female vaccinators were described to act as drivers as they encouraged teenage girls to get vaccinated [12].

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Physical opportunity factors were the most reported COM-factors, evident in 15 articles, with key barriers to receiving and facilitating vaccinations being the availability of resources (e.g., availability of vaccines[9, 26, 28, 33, 34] and vaccinators [32, 33]), geographic access [30, 33, 38] and influx and movement of refugees ([12, 24, 28, 33-35]). Logistical issues were also found (e.g. time and convenience problems [33]) and specifically, the relatively complex administration of multidose and/or intramuscular vaccinations [26, 33, 34] in comparison to oral vaccines[33]. A further frequently mentioned barrier and driver to receiving and facilitating vaccinations concerned the (un)availability of information. This included issues such as a lack of information about vaccines and vaccination campaigns/ services, language barriers [32, 33] and a lack of evidence of, or problems recording children's vaccination status [32, 33]. Corresponding to above-mentioned social opportunity barriers, a lack of female vaccinators and lack of privacy or gender sensitivity in vaccination sites reduced the appeal of vaccination facilities and camps [25, 32], and women preferred to receive vaccinations during household visits [32]. One article mentioned the suspension of vaccination services and movement restrictions during the COVID-19 pandemic as a barrier to receiving and facilitating vaccinations [36].

3.2 Assessing differences

All four COM factors were relevant to FDMN/Rohingya refugees whilst all COM factors except for capability applied to HSP. For receiving vaccinations, motivation related barriers and drivers were the most identified, whereas for administrating vaccination physical opportunity related barriers and drivers were most mentioned. There were not enough details evident to make comparisons between specific locations in the camps or certain subgroups.

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Table 3.1. Overview of barriers (-) and drivers (+) to *receiving* vaccinations (FDMN/Rohingya refugees) arranged by COM-Factors

Individual factors		Context factors	
Capability Barriers and Drivers (N=6), Articles (N=7)	**Motivation** Barriers and Drivers (N=16), Articles (N=9)	**Social opportunity** Barriers and Drivers (N=5), Articles (N=7)	**Physical opportunity** Barriers and Drivers (N=13), Articles (N=9)
Knowledge + Knowledge of why childhood vaccination is important[29, 30, 32, 36] + Knowledge about own children's vaccination status[38] - Lack of knowledge about vaccination campaigns in camps[33, 34] - Lack of knowledge about vaccine preventable diseases, vaccination[33], vaccination schedule[36] and need to get multiple vaccinations on the same day[32] - Spread of misinformation via face-to-face and electronic communication with FDMN/Rohingya refugees in camps, hosts and home county[29] **Ability** - Sickness so cannot bring children for vaccination[33]	**Confidence/ trust** + Confidence from not seeing/hearing of children with serious side effects or dying after vaccination campaigns [32] + Confidence in receiving good care from vaccination campaign staff[32] +Trust in religious leaders, elders, village doctors, pharmacists, mothers trained by NGOs as sources of information [32] + Increased trust of SP from previous vaccination campaigns[37] - Lack of trust in appointed community leaders "mahjees" on health issues due to their liaison role with the army[32] - Feeling misled by some religious leaders due to their initial instructions to refuse vaccination[32] or their practices not grounded in Qur'an[32] - Lack of trust in vaccinators' skills and treatment of children[32] - Lack of trust in volunteers reassurance about not becoming Christian after vaccination[29] - Being denied access to healthcare in home country [4, 26, 27] **Values/ beliefs** + Belief that vaccines prevent disease[32] - Belief that combination vaccinations are designed to kill the Rohingya population[32] - Beliefs that vaccination will leave mark forbidden in Islam and people will become a Christian if vaccinated[29, 32] - Competing priorities e.g., poor health, drinking water, relief collection of adult[32, 33] and of child[34] **Emotions/ impulses/ feelings** **Emotions/ impulses/ feelings** - Fear of vaccine[37] or multiple vaccines[32] side effects[4, 29, 32, 33] including weakness, death[29, 32] and needles[34] - Fear of contracting COVID-19 in vaccination facility[36] - Fear of pain for child[33] and fear amongst children when see other children in pain who receive vaccinations[32]	**Social and Cultural Norms** -Women and girls cannot interact or show part of their body to men outside their family[25, 32] - Norm in Myanmar for children to receive one vaccination (not combination vaccinations)[32, 33] - Norm to seek healthcare outside of formal healthcare system[35, 38] **Social Support** + Use of female vaccinators, who encourages vaccinations for women and girls and provides opportunity to ask questions[12] + Ability to ask questions to HSP and inform Camp in Charge if concerns arise[29]	**Availability of information** + Receiving information about immunization via Friday prayers, household visit, community meetings, information centres, megaphones, video documentary[12, 31, 32] - Lack of information from vaccinators about vaccines and side effects[32], on why cholera vaccination is needed [33] and on time and place of vaccination campaigns[33] - Language barriers between service providers and caregivers[32, 33] **Geographical access** + Preference for vaccination sites to be in close proximity[30, 38] - Vaccination sites located too far away[33] - First access to vaccines upon arrival in camps[38] **Convenience, appeal, and appropriateness of vaccination** - Long queues at vaccination sites[33] - Short campaign durations[33] - No privacy or gender sensitivity in place at vaccination sites[25, 32] leading to preference amongst women for household visits[32] **Availability of resources** - Insufficient vaccines at vaccination sites[9, 33] - Insufficient vaccinators[32, 33] and predominantly male[32] **Rights/ regulation/ legislation** - Vaccination services suspended due to COVID-19 pandemic[36] - Restrictions on movement during COVID-19 pandemic[36]

Table 3.1. Overview of barriers (-) and drivers (+) to *facilitating* vaccinations (FDMN/Rohingya refugees) arranged by COM-Factors

Individual factors		Context factors	
Capability Barriers and Drivers (N=0), Articles (N=0)	**Motivation** Barriers and Drivers (N=3), Articles (N=3)	**Social opportunity** Barriers and Drivers (N=6), Articles (N=4)	**Physical** Barriers and Drivers (N=13), Articles (N=12)
	Emotions/ impulses/ feelings - Campaign fatigue with multiple dose vaccinations and continuous influx[34] **Confidence/ trust** - Difficulties in convincing parents to bring children for vaccination in MSs and spontaneous settlements[12] + Confidence amongst religious leaders after several months of vaccination campaigns[32]	**Social, cultural norms and values** + Female vaccinators have easier access to families and teenage girls[12] - Socio-cultural issues[34] - Disapproval amongst religious leaders of women and girls being publicly vaccinated by men[32] **Social support** + Collaborative and efficient partnerships with other organizations[12] + Good relationship with government[12, 31] - Lack of community engagement[31]	**Availability of resources** + WHO/ GAVI deliver OCV vaccinations free of charge[12] - Lack of evidence of Rohingya children's vaccination status[32, 33] - Problems with vaccination record management[24] - Challenges establishing fully functioning health facilities[31] - Vaccination services suspended due to COVID-19 pandemic[36] - Insufficient vaccines at vaccination sites[9, 26, 28, 34] - Insufficient vaccinators[32] **Geographical access** - Scattered settlements over a large area[33] - Constant new arrivals during vaccination campaign[28, 33-35] and population movement[12, 24, 33] - Rapidly evolving conflict situation[34] **Convenience** - Inconvenience of administering multiple vaccinations compared to one[26] and intramuscular vaccinations compared to oral vaccinations[33, 34] **Rights/ regulation/ legislation** - Rohingya are unregistered[24, 35] - Political and resource constraints [34]

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3.3 Interventions related to childhood vaccinations

Interventions to remove barriers and strengthen drivers to childhood vaccination behaviours are shown in Table 4. Implemented interventions were identified in 16 articles, of which 15 articles included information on the intervention impact through authors' reflections [4, 24, 26], post-campaign vaccination coverage surveys [25, 32-35], or as part of reports [12, 36, 37] and response evaluations (NGO/ UN response evaluation reports) [9, 30, 31, 38]. However, no formal evaluation studies of interventions were reported. Generally, descriptions of interventions were brief and lacked detail, which made separate charting of interventions for different populations and their target behaviours impossible.

Interventions were described both for supplemental [4, 9, 12, 24, 26-28, 31, 33-38] and routine immunization campaigns [12, 30, 31, 33, 36, 38]. Intervention types included mostly environmental restructuring interventions (10 interventions reported by 14 articles) [4, 9, 12, 24-28, 30-38], followed by information/ education (six interventions reported by five articles) [12, 25, 31, 32, 37], modelling (two interventions reported by four articles) [25, 28, 32, 37], with least interventions in the areas of persuasion (one interventions reported by three articles) [25, 28, 37] and training (two interventions reported by three articles) [12, 25, 33]. No interventions relating to incentivisation, coercion and restriction were identified.

We also reviewed the author's recommendations for possible future interventions. Given the dynamic and evolving conflict situation, some, at times older, articles mentioned recommendations that have already been implemented elsewhere and therefore have not been summarised below. Four articles recommended five interventions [24, 26, 32, 38] for which from the included literature no evidence of their implementation was found. Recommendations were rather broad and included information/education type interventions such as investigating interactions between vaccinators and caregivers[32], exploring alternative vaccination schedules[38], and providing vaccination cards and medical summaries[24]. Correlating with previously mentioned drivers to vaccination uptake, it was recommended to work closely with religious leaders to identify appropriate passages from the Qur'an and Hadith which can be used to support vaccination uptake.

Table 4. Implemented and evaluated interventions charted by COM-factor and intervention type from the BCW

Intervention type*	COM-FACTOR ADDRESSED *	INTERVENTION
Information/ education	• Capability • Motivation	• Dissemination of vaccination messages in community settings: Friday prayers and faith-based messaging, household visits[37], residential community meetings, health centres[25, 32], narrowcasting[12] and community theatre[12] • Dissemination of vaccination messages in video-documentary format[32] • Reminders[25] and location[32] on day of vaccination campaign announced by community mobilisers through loudspeakers ("miking") and bullhorns[31] • Radio campaigns focused on when/where vaccination is available vaccination importance[12] and on caregiver vaccination concerns[25] • Trusted model mothers identified and engaged to answer vaccination questions[25] • Undertaking focus group discussions to understands community needs and improve target messages[12, 25, 31]
Persuasion	• Motivation	• Local volunteers, community health workers, religious leaders and mahjees enlisted to promote vaccination campaigns[25, 28, 37]
Incentivisation	• Motivation	/
Coercion	• Motivation	/
Training	• Capability • Physical Opportunity • Motivation	• Training of model mothers to answer questions about vaccination concerns [25] • Using skilled professionals for vaccination[12, 33]
Restriction	• Physical & Social Opportunity	/
Environmental restructuring	• Physical & Social Opportunity • Motivation	• Supplemental immunisation activities including time-limited, fixed-site vaccination campaigns[4, 9, 24, 26-28, 31, 33-36, 38], with community outreach by healthcare facilities with mobile teams[12, 35, 37] • Establishing EPI program[12, 30, 31, 33, 36, 38] as part of a two-pronged approach[12, 31] • 'Sweep' activity for vaccinating missed cases through identification of Rapid Convenience Monitoring[37] • Co-ordinated, inter-sectoral partnerships[12, 28, 31, 33, 35, 37] with long-term community engagement[32] • Social mobilisation/community mobilisers[12, 31, 36, 37] to identify eligible children[25, 32], for home visits for vaccination promotion[37], administration and follow-up[4, 37] • Yellow flags to indicate vaccination site[32] • Home visits[32], provision of private areas for women and adolescent girls to be vaccinated[25],and increasing number of female vaccinators[25] • COVID-19 infection prevention control measures at health facilities[36] • Opportunistic vaccination of contacts of diphtheria cases in home/ health facility[4] and contact tracing[4, 12] • Oral[33] and single-dose schedule vaccination administration where safe and effective[24, 26, 28]
Modelling	• Social Opportunity • Motivation	• Engaging model mothers and female hafiz[25, 32] • Local volunteers, community health workers, religious leaders and mahjees enlisted to promote vaccination campaigns[25, 28, 37]

*Based on TIP handbook and Michie et al. The behaviour change wheel: A new method for characterising and designing behaviour change interventions [18, 39]

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4. Discussion

We reviewed 18 articles that explored barriers, drivers and interventions regarding childhood vaccination behaviours in Cox's Bazar, guided by the COM-B framework [39] and BCW [18]. Most articles were opinion pieces followed by grey literature reports and response evaluations, with only four articles being peer-reviewed primary research. Evidence was available for barriers and drivers to FDMN/Rohingya refugee receiving and HSP facilitating vaccinations. The main COM factors were physical opportunity, followed by motivation. Most reported interventions reported had been implemented already and they mainly focused on environmental restructuring and information/education. No formal evaluations of interventions were found. Below we discuss the scope of, and gaps in the research landscape followed by a brief discussion of key barriers and their implications for interventions.

4.1. Barriers and drivers to childhood vaccinations

The review identified a range of barriers and drivers on both the demand (FDMN/Rohingya refugee) and supply (HSP) side. All four COM factors were evident for FDMN/Rohingya refugees receiving vaccination, whilst three COM factors (not capability) applied to HSP. Motivation factors (e.g., fears, trust) were most reported for FDMN/Rohingya refugees receiving vaccinations, whilst physical opportunity factors (e.g., availability of vaccines) were most reported for HSP facilitating vaccinations. Evidence gaps emerged with regard to different camps and subgroups of FDMN/Rohingya refugees, as there was insufficient detail to identify barriers and drivers that are specific to location or population group. Treating FDMN/Rohingya refugees as a homogeneous group prevents the development of tailored and targeted interventions [14].

The multiple individual and context influences on childhood vaccination behaviours identified in this review align closely with those reported in the WHO 'Global Evidence Review on Health and Migration' [40]. Wide-ranging environmental (physical opportunity) barriers for caregivers and HSP alike are not unexpected in a challenging environment such as Cox's Bazar where a lack of infrastructure and resources are an obvious and immediate barrier to service delivery [40, 41]. Additionally, motivation related barriers identified may be linked to vaccine hesitancy that is known to be influenced by political and medical mistrust [42-44]. For FDMN/Rohingya refugees in particular, this may be associated with persecution and violence in their home country [12, 31]. Furthermore, social support and community/religious

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leader engagement have been found to be crucial to effective vaccination programs [45]. Only one article explored community/religious leaders recommending vaccination. Understanding and addressing their barriers and drivers may be a potential opportunity for vaccination promotion [25, 46] as they play a central role in trust building for vaccination campaigns [47]. For many caregivers, Cox's Bazar provided first time exposure to vaccinations [34, 48] particularly combination vaccines, highlighting knowledge gaps and a lack of confidence. Gender norms are likely to be important for a Muslim community where teenage girls and women practice "purdah", the Islamic practice requiring women to be veiled from "public" gazes or remain within "private" spaces of the family [49].

4.2 Interventions

The high number of articles describing implemented interventions with some information on impact is a strength of the literature, and the implemented intervention identified resonate with a global review of interventions to reduce VPD burden amongst migrants and refugees [50]. However, the interventions lacked detail on intervention rationale, theoretical underpinning, and target populations or -behaviours. Furthermore, evaluating their impact was difficult and evidence of intervention impact very limited with a lack of formal evaluation studies, and instead reliance on author's reflections or using single indicators to measure vaccination coverage. It is therefore difficult to understand if and how these interventions work, and if they should be replicated. This lack of detailed description and evaluation is evident in the wider vaccination [51-53] and public health [54, 55] intervention literature. Standardized reporting checklists for interventions [54] and publishing monitoring and evaluation reports [54, 56] would allow effective interventions to be transferred and scaled up, and increase overall transparency [51, 57, 58].

Interventions to remove barriers and strengthen drivers to childhood vaccination behaviours encompassed five intervention types [18, 39] - mainly environmental restructuring and information/education, less often modelling, persuasion and training - which means that in theory, all COM factors can be addressed (see Table 1).
Environmental restructuring interventions reduce the physical and social opportunity and motivation related barriers and strengthen these drivers, whilst education interventions address capability and motivation related barriers and drivers. Overall, the interventions found correlate theoretically with the COM-factors with most identified barriers and drivers.

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However, no article described incentivisation, coercion or restriction interventions, which may offer additional strategies.

The limited available intervention impact data suggests that vaccination campaigns, routine immunisation services, community mobilisation and gender specific interventions may improve vaccination uptake [4, 9, 12, 25, 26, 30-33, 35-38], aligning with findings of a systematic review [40, 52]. Tailored environmental restructuring interventions, such as the provision of female vaccinators and private vaccination areas, were found to address gender specific barriers to vaccination uptake [12, 25], and strengthening these would be in line with the Global Immunization Agenda 2030 [59] which includes gender equity as a strategic priority. In addition, collaborating with community leaders may offer alternative, culturally appropriate intervention strategies [25, 60].

4.3 Research landscape
Regarding the research landscape, encouragingly, critical appraisal found the articles themselves to be of moderate to high quality. However, the evidence in the literature for both parts of the review was frequently scattered and difficult to collate as embedded in different parts of articles and described in varying detail. This is in keeping with the known difficulty in humanitarian conflict settings to collate and share information systematically, due to logistical challenges, problematic data collection and a lack of health information sharing mechanisms [61, 62].

4.4 Strengths and limitations
To our knowledge, this is the first literature review on childhood vaccinations in the Rohingya population. Its strengths include the comprehensive search strategy applying the JBI methodology, and analysis utilising the COM-B model and BCW that are useful in understanding and addressing public health challenges[18, 39]. In addition, given the scattered evidence base this review adds value by providing and overarching overview of barriers and drivers. Furthermore, this review provides a nuanced examination of vaccination behaviours related to receiving and facilitating vaccinations, thereby reviewing demand and supply side.

However, several limitations should be acknowledged. Despite an extensive search strategy and screening four databases, reference lists, and grey literature sources, further literature may exist. Additionally, even though no language restrictions were set, we used only English

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search terms and we found only English articles. We were unable to differentiate barriers and drivers by the specific type of vaccine or disease due to limited detail of the data, and it would be useful for future research to investigate this. In addition, we used the Google Advanced Search function which has a low reproducibility, but it was useful as we found reports which were not displayed on the respective organization's websites. This emphasises again the need for improved mechanisms to share and collate evidence. The results may also be affected by publication bias, as especially in conflict settings, frontline organizations and researchers may not have the capacity to publish findings [62]. Lastly, it is important to recognize that frequency counts were undertaken to describe the range of evidence and identify most reported barriers or drivers. However, frequency of reporting may not correlate with the impact of this barrier or driver, and configuration of the data as a whole is equally important.

5. Conclusion

A wide range of barriers and drivers for vaccination uptake for the Rohingya population in Cox's Bazar exist. Physical barriers were most identified. Community and faith leaders have been shown to have central roles in Rohingya culture, and they may therefore be key partners to collaborate with and to strengthen the vaccination programmes and community mobilisation efforts. Additionally, salient gender and social norm issues were found to influence both target behaviours. However, data available is too limited to appreciate geographical or subgroup differences within Cox's Bazar and tailor interventions accordingly. Encouragingly, numerous interventions were identified that potentially could address the identified barriers and drivers, though details of interventions lacked detail and the intervention impact and evaluation very limited. This emphasized the importance of further research, and in particular, improved reporting, monitoring and evaluations of interventions so that effective interventions can be designed to increase vaccination uptake in the Rohingya population in Cox's Bazar.

Conflict of interest

None.

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