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Cholera outbreak in Forcibly Displaced Myanmar National (FDMN) from a small population segment in Cox's Bazar, Bangladesh, 2019

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Short Title:	A small Cholera outbreak in Forcibly Displaced Myanmar National
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Keywords:	Cholera, under-five children, displaced population, emergency and crisis settings, case management
Abstract:	<p>Objective: Bangladesh experienced a sudden, large influx of forcibly displaced persons from Myanmar in August 2017. A cholera outbreak occurred in the displaced population during September–December 2019. This study aims to describe the characteristics of cholera cases, their care-seeking pattern, camp-wise distribution of Forcibly Displaced Myanmar National (FDMN) cases, sources of drinking water, toilet use pattern, oral cholera vaccine (OCV) status, and share the experiences from effective interventions to prevent a cholera outbreak.</p> <p>Methods : Diarrhea Treatment Center (DTC) based surveillance was carried out among the FDMN in Teknaf and Leda DTCs for cholera during September–December 2019.</p> <p>Results: During the study period, 147 cases of cholera were hospitalized. The majority, 72% of cases reported to Leda DTC. Nearly 65% sought care from FDMN settlements. About 47% of the cholera cases were children less than 5 years old and 42% were aged 15 years and more. Half of the cholera cases were females. FDMN often reported from Camp # 26 (45%), followed by Camp # 24 (36%), and Camp # 27 (12%). Eighty-two percent of the cases reported watery diarrhea. Some or severe dehydration was observed in 65% of cholera cases. Eighty-one percent of cases received pre-packaged ORS at home. About 88% of FDMN cholera cases reported consumption of public tap water. Pit latrine without water seal was often used by FDMN cholera cases (78%).</p> <p>Conclusion: Vigilance for cholera cases by routine surveillance, preparedness, and response readiness for surges and OCV campaigns can alleviate the threats of cholera.</p>
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1 **Cholera outbreak in Forcibly Displaced Myanmar National (FDMN) from a**
2 **small population segment in Cox's Bazar, Bangladesh, 2019**

3

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19

20 **Abstract**

21 **Objective:** Bangladesh experienced a sudden, large influx of forcibly displaced persons from
22 Myanmar in August 2017. A cholera outbreak occurred in the displaced population during
23 September-December 2019. This study aims to describe the characteristics of cholera cases, their
24 care-seeking pattern, camp-wise distribution of Forcibly Displaced Myanmar National (FDMN)
25 cases, sources of drinking water, toilet use pattern, oral cholera vaccine (OCV) status, and share
26 the experiences from effective interventions to prevent a cholera outbreak.

27 **Methods:** Diarrhea Treatment Center (DTC) based surveillance was carried out among the
28 FDMN in Teknaf and Leda DTCs for cholera during September-December 2019.

29 **Results:** During the study period, 147 cases of cholera were hospitalized. The majority, 72% of
30 cases reported to Leda DTC. Nearly 65% sought care from FDMN settlements. About 47% of
31 the cholera cases were children less than 5 years old and 42% were aged 15 years and more. Half
32 of the cholera cases were females. FDMN often reported from Camp # 26 (45%), followed by
33 Camp # 24 (36%), and Camp # 27 (12%). Eighty-two percent of the cases reported watery
34 diarrhea. Some or severe dehydration was observed in 65% of cholera cases. Eighty-one percent
35 of cases received pre-packaged ORS at home. About 88% of FDMN cholera cases reported
36 consumption of public tap water. Pit latrine without water seal was often used by FDMN cholera
37 cases (78%).

38 **Conclusion:** Vigilance for cholera cases by routine surveillance, preparedness, and response
39 readiness for surges and OCV campaigns can alleviate the threats of cholera.

40

41 **Keywords.** Cholera, under-five children, displaced population, emergency and crisis settings,
42 case management

43 **Author Summary**

44 Bangladesh observed an unexpected, large-scale arrival of forcibly displaced individuals from
45 Myanmar in August 2017. The Bangladesh Government, UN agencies, and international and
46 national non-governmental organizations responded immediately with extensive humanitarian
47 response. However, because of the exceptionally large size of the displaced population, and the
48 presence of inadequate lifesaving infrastructures of sanitation, threats of acute watery diarrhea,
49 cholera, and shigellosis outbreaks were prevailing. The Government of Bangladesh as lead, with
50 technical support from icddr,^b collaborating with international agencies undertook a massive oral
51 cholera vaccination (OCV) campaign immediately as a pre-emptive measure to alleviate threats
52 of cholera outbreak. Despite that mass OCV campaign, threats of cholera outbreak among
53 Forcibly Displaced Myanmar Nationals were existing due to new arrivals of the displaced
54 population with compromised host susceptibility, frequent visits to settlements by Bangladesh
55 nationals without exposure to OCV and, the declining vaccine immunity among OCV recipients
56 as well as an increasing number of cohort children without any exposure to OCV. The population
57 faced a cholera outbreak during September-December 2019. This study aims to describe the
58 characteristics of cholera cases from that outbreak, their care-seeking pattern, camp-wise
59 distribution, source of drinking water, sanitation facility, OCV status, and share the experiences
60 from effective interventions to prevent a cholera outbreak. Vigilance for cholera cases by routine
61 surveillance, preparedness, and response readiness for surges and OCV campaigns can alleviate
62 the threats of cholera.

63

64 **Introduction**

65 In August 2017, Bangladesh witnessed a sudden influx of an estimated 745,000 Forcibly
66 Displaced Myanmar Nationals (FDMN) including more than 400,000 children within 17 weeks
67 from neighboring Rakhine state in Myanmar who settled in the Cox's Bazar district situated in
68 the south-east of the country. Their journey to Bangladesh was hazardous with limited access to
69 food and water, often had diverse injuries and illnesses, crossed through jungles and
70 mountainous terrain and finally, most of them had a boat ride to cross the Naf river while some
71 confronted risky sea voyage across the Bay of Bengal. The Bangladesh Government, UN
72 agencies, and a large number of international and national non-governmental organizations
73 (NGOs) reacted immediately with a large-scale humanitarian response. Camps were established
74 quickly but soon humanitarian agencies started struggling to meet the exorbitant demand for
75 assistance and supplies. The displaced population urgently needed critical supplies like medicine,
76 clean water, food, and shelter with special attention to children, women, the elderly, and disabled
77 individuals. Many of the hurriedly built camps were vulnerable to monsoon flooding and storm
78 surges. Those families who started living in hillsides were prone to landslides. Latrines and
79 shallow and deep tube wells were constructed to protect against public health issues and ensure
80 access to clean water. However, because of the arrival of a large number of displaced
81 populations and the presence of insufficient lifesaving infrastructures of sanitation, like latrines
82 and water points, the environment soon became a breeding ground for waterborne diseases
83 including acute watery diarrhea, cholera, and shigellosis. These risks were further heightened by
84 high population density in camps and an excess number of severely malnourished children who
85 yield even more quickly to preventable and treatable diseases as well as outbreaks of acute
86 watery diarrhea (AWD), cholera, and shigellosis [1–7].

87 Almost immediately, following the huge influx and settlement of these displaced populations,
88 UNICEF-Bangladesh and icddr,b jointly conducted a brief field assessment in Ukhia and Teknaf
89 sub-districts of Cox's Bazar. The assessment anticipated potential threats of diarrheal disease
90 outbreaks including cholera and shigellosis, and strategies were immediately set to initiate
91 mitigation measures. A partnership between icddr,b, and UNICEF under the umbrella of Health
92 Sector targeted (i) training doctors, nurses, and community health workers of the government
93 and NGO run facilities serving FDMN in the settlements as well as host population living in the
94 neighborhood housing; (ii) managing cases of dehydrating diarrheal episodes and associated
95 malnutrition through a network of five diarrhea treatment centers (DTCs); and carrying out DTC
96 based diarrheal disease surveillance as it is known to be critical for early detection of outbreaks.
97 Activities of the diarrheal disease surveillance team included data collection, a one-step rapid
98 diagnostic test for the presence of *Vibrio cholerae* in stool specimen of hospitalized patients, and
99 microbial tests to detect common enteric pathogens including *Vibrio cholerae* by submitting
100 fecal specimens directly as well as after inoculation into Cary-Blair Transport Medium to the
101 Clinical Microbiology Laboratory of icddr,b in Dhaka, Bangladesh.

102
103 The Government of Bangladesh as lead, with technical support from icddr,b collaborating with
104 international agencies, and international and national NGOs under the wider platform of Health
105 Sector, undertook a massive oral cholera vaccination (OCV) campaign immediately as a pre-
106 emptive measure to alleviate threats of cholera outbreaks [8–10]. Despite that mass oral cholera
107 vaccination campaign, threats of cholera outbreaks among FDMN were existing due to new
108 arrivals of the displaced population with compromised host susceptibility, frequent visits to
109 settlements by Bangladesh nationals living in the neighboring community without exposure to

110 OCV and, the decay of vaccine immunity ~~is~~ among OCV recipients as well as an increasing
111 number of cohort children without any exposure to OCV. Preparedness for combating surges
112 and vigilance for cholera cases were the most important public health priorities because of
113 prevailing threats of cholera in both the host and displaced population [11,12].

114
115 icddr,b, and UNICEF jointly organized a dissemination session for the local stakeholders on their
116 activities for the FDMN living in the settlements in March 2019. Between September and
117 December 2019, there have been 147 cases of culture-confirmed cholera who presented and
118 subsequently hospitalized with acute dehydrating diarrhea episodes in Leda and Teknaf DTCs.
119 Thus, it became essential to share this cholera outbreak control experience with policymakers,
120 public health teams, program managers, academia, and wider stakeholders acquired from a
121 perspective of sufficiently prepared, field-based, and well-tailored strategy in an emergency and
122 crisis setting. Such experience sharing is not a common and widespread phenomenon,
123 particularly in humanitarian emergencies. An update of this kind is likely to enable stakeholders
124 to undertake necessary preparedness to prevent cholera outbreaks from occurring and to respond
125 successfully when the outbreaks have occurred.

126
127 This paper aims to (i) describe the characteristics of cholera cases including that of FDMN care
128 seekers, their reporting pattern to DTCs, camp-wise distribution, and OCV status, (ii) compare
129 drinking water sources and toilet use pattern between FDMN and host community cholera cases,
130 (iii) describe comparative clinical and demographic characteristics between cholera cases who
131 sought care from Cox's Bazar DTCs, and Dhaka Hospital of icddr,b during the same period, and
132 (iv) share the experiences that were obtained from this cholera outbreak that occurred in a small

133 segment of the FDMN living in settlements of Cox's Bazar, Bangladesh.

134

135 **Methods**

136 Setting and study population

137 This was a DTC based cross-sectional diarrheal disease surveillance for FDMN and host
138 community individuals hospitalized in DTCs.

139 In late September 2019, two cholera cases for the first time after two years of the arrival of
140 FDMN were detected in Teknaf DTC which is run by icddr,b. They sought care from settlements
141 (one from Camp # 25 and the other from Camp # 26). Such an incident was reported
142 immediately to the Epidemiology Team Lead and Early Warning, Alert and Response System
143 (EWARS) of WHO-Cox's Bazar, as well as UNICEF-Cox's Bazar. The next day, Cox's Bazar
144 Health Sector's Joint Assessment Team (JAT) consisting of Health and WASH Sector partners
145 investigated the hotspots and affected camps. The JAT reported worsening hygiene practices and
146 sanitary conditions as a result of an acute shortage of safe drinking water, and the use of stagnant
147 contaminated water for domestic purposes. Several recommendations were made on that day
148 including hygiene promotion in the hot spots, desludging of latrines as soon as possible,
149 distribution of water purifying tablets, pre-packaged ORS, soap, and chlorine by the WASH
150 Sector, and availability of a handwashing facility in the latrine areas. The stagnant contaminated
151 pools of water were fenced to prevent access to it by people living in its surroundings. Urgent
152 refresher training on risk assessment for health teams was recommended. Within 24 hours, one
153 temporarily closed down DTC in Leda close by the affected settlements was reopened to serve
154 the increasing number of AWD cases.

155

156 The Health Systems of Bangladesh Government joined WHO-Cox's Bazar in streamlining
157 activities of EWARS. Such an exertion strengthened monitoring of the cases of AWD and
158 cholera in the camps for early detection and response to outbreaks. Moreover, a meeting of the
159 Directorate General of Health Services and leading international agencies responsible for
160 emergency responses in Cox's Bazar was followed by the institution of immediate alleviation
161 measures that included the supply of safe drinking water and improvement of the sanitation
162 system. To ensure adequate clinical management of AWD cases following a standard
163 management protocol, the existing network of DTCs was strengthened by UNICEF-Cox's Bazar.
164 WHO and the Health Sector recommended that those cases presenting to the out-patient clinics
165 with dehydrating diarrhea should be immediately referred to Diarrhea Treatment Centres (DTCs)
166 run by icddr,b, or, if there were no DTCs nearby, to primary health care centers (PHCs) with
167 isolation facilities. Leda DTC (14 beds) and Teknaf DTC (30 beds) located in the neighborhood
168 of settlements remained open as usual round-the-clock. Six batches of the health workforce were
169 immediately trained by icddr,b on the clinical management of AWD cases. Community health
170 workers were also assigned by UNICEF-Cox's Bazar in outreach activities including promotion
171 of good hygiene practices and combatting diarrhea episodes at the household level with the use
172 of pre-packaged ORS as soon as there is the onset of these episodes [13–16].

173
174 Preparations and response readiness were undertaken for the acceleration of the existing cholera
175 vaccination campaign as an increasing trend of dehydrating diarrhea cases in DTCs was
176 revealed. As a result, the International Coordinating Group for Cholera Vaccine (ICG)
177 Secretariat approved a request for additional 1.2 million doses of OCV. Ministry of Health and
178 Family Welfare, Bangladesh playing the leading role with the support of WHO, UNICEF, and

179 other partners, the campaign started vaccinating those individuals living in the neighborhood
180 host community but yet to receive any OCV. The OCV campaign (including operational cost)
181 was funded by GAVI, the Vaccine Alliance. The vaccination operation aimed mostly to reach
182 displaced children aged 12-59 months. In the host community, the campaign looked for any
183 person aged 1 year or more, because approximately 80% of host community people residing
184 near the settlements were never targeted to receive OCV in previous campaigns although they
185 were equally vulnerable like the FDMN [13,14].

186
187 Routine enteric pathogen detection activities that included a collection of a single stool specimen
188 (of at least 3 g) directly from the patients following hospitalization were ongoing. Soon after
189 collection, a one-step rapid diagnostic test was performed by SD BIOLINE cholera antigen
190 O1/O139 (44FK30) test kit, supplied by WHO-Cox's Bazar, which is an
191 immunochromatographic test for the qualitative detection of *Vibrio cholerae* O1/O139 in human
192 stool specimens (manufactured by STANDARD DIAGNOSTICS, INC located in Suwon city,
193 Kyonggi province, Republic of Korea). To facilitate microbial culture to confirm the rapid
194 diagnostic test results; the provisionally diagnosed specimens (the stool) of cholera cases were
195 inoculated into Cary-Blair Transport Medium; and the medium was then sent as soon as possible
196 to the Clinical Microbiology Laboratory, icddr,b, based in Dhaka, Bangladesh to isolate the
197 colony as well as perform antibiotic susceptibility tests with immediate sharing of the results to
198 the concerned DTC, Epidemiology Team Lead of WHO-Cox's Bazar and UNICEF-Cox's Bazar.
199 Other non-positive by rapid diagnostic test specimens were submitted routinely once or twice a
200 week [17–19].

201

202 In daily monitoring, evaluation, and reporting, icddr,b followed its expertise gathered from its
203 hospital-based Diarrheal Disease Surveillance System (DDSS) which is in operation in icddr,b's
204 urban Dhaka (since 1979), and rural Matlab (since 1999) facilities. The Diarrheal Disease
205 Surveillance System (DDSS) at Dhaka Hospital enrolls a 2% systematic sample of patients
206 reporting to the triage area. Patients seeking care from the Matlab Hospital who are residents of
207 the Demographic Surveillance System (DSS) area are enrolled into the DDSS. Trained
208 enumerators using structured questionnaires interview patients and/or their attendants to collect
209 relevant information on socioeconomic and demographic profile, housing and settings of the
210 adjacent environment, feeding practices particularly of infants and toddlers, and use of drugs and
211 fluid therapy at home before reporting to the facility. Additional information that is recorded
212 includes clinical features, anthropometric measurements, treatments received in the facilities, and
213 the outcome of the patients. Microbiological assessments are performed to identify common
214 diarrheal pathogens and document the microbial susceptibility pattern of the bacterial pathogens.
215 The activity offers useful information to hospital clinicians in their clinical decision-making
216 courses and empowers icddr,b to detect the emergence of new enteric pathogens and early
217 recognition of outbreaks and their locations, thereby guiding the host government to take suitable
218 preventive and control measures [17–19]. Ongoing data collection by trained research assistants
219 entailed administering structured questionnaires, from all hospitalized patients in DTCs and/or
220 their attendants to gather information such as presenting clinical features, socioeconomic and
221 demographic contexts, water, sanitation and hygiene, housing and its surrounding environment,
222 feeding practices, particularly of 0-35 months old, and use of drugs and pre-packaged ORS at
223 home before coming to DTC continued round-the-clock.

224

225 **Ethics statement**

226 The data collection process of this study was part of the ongoing activities entitled: *Surveillance*
227 *for etiologic agents, care-seeking behavior, the status of IYCF and WASH practices among*
228 *patients or their caregivers from Rohingya refugees as well as host population in Cox's Bazar*
229 *district attending icddr,b operated Diarrhea Treatment Centers* was approved by icddr,b's
230 (International Centre for Diarrhoeal Disease Research, Bangladesh) IRB comprising Research
231 Review Committee (RRC) and Ethical Review Committee (ERC). Voluntary written informed
232 consent was obtained from the parent/guardian before starting the interviewing process.

233

234 **Statistical analysis**

235 Data were analyzed by STATA (StataCorp version 13) and analyses included descriptive
236 methods. Variables were described using frequencies with percentages. Exposure categories
237 were compared using Pearson χ^2 tests for categorical variables. Relevant data from the ongoing
238 DDSS database of Dhaka Hospital were extracted for the period September-December, 2019 for
239 a comparative analysis of clinical and demographic profiles of visiting culture-proven cholera
240 cases between Cox's Bazar DTCs and Dhaka Hospital of icddr,b.

241

242 **Results**

243 Between September and December 2019, there were 147 cases of culture-confirmed cholera who
244 presented and were subsequently hospitalized with acute dehydrating diarrhea episodes in Leda
245 and Teknaf DTCs. The majority, 72% of cases reported to Leda DTC. Nearly 65% of these
246 cholera cases sought care from FDMN settlements. FDMN often reported to DTCs from Camp #
247 26 (45%), followed by Camp # 24 (36%), and Camp # 27 (12%). About 94% of the cholera cases

248 from the host community and 65% of the cholera cases from FDMN living in settlements did not
 249 receive any OCV before their onset of culture-proven cholera episodes (Table 1).

250 **Table 1** Distribution of characteristics of culture-confirmed cholera patients (n=147) in Leda and
 251 Teknaf DTCs in Cox’s Bazar settlements, September-December 2019

Variables name	n (%)
Sought care from	
Leda DTC	106 (72.1)
Teknaf	41 (27.9)
Currently living in	
Settlements	95 (64.6)
Host community	52 (35.4)
From settlements	
Camp # 26	43 (45.3)
Camp # 24	34 (35.8)
Camp # 27	11 (11.6)
Camp # 25	4 (4.2)
Camp # 15	2 (2.1)
Camp # 23	1 (1.1)
Not exposed to OCV	
FDMN	62 (65.3)
Host community individuals	49 (94.2)

252 DTC: Diarrhea treatment center; OCV: Oral cholera vaccine

253 The major sources of drinking water of the hospitalized displaced cholera cases were public tap
 254 installed in the settlements, deep tube-well, and shallow tube well. Use of public tap water was
 255 significantly more frequent in cholera cases from settlements than from the host community
 256 (88% vs. 10%; $p < 0.001$). However, the use of deep tube well (6% vs. 21%; $p = 0.005$) and
 257 shallow tube well (2% vs. 54%; $p < 0.001$) water was significantly less common in the cholera
 258 cases from settlements. Nearly 78% of the displaced cholera cases used pit latrines without water
 259 seal as opposed to 44% of the cholera patients from the host community ($p < 0.001$). However, the
 260 use of a pit latrine with a water seal was identical in both the groups (Table 2).

261 **Table 2** Water source and toilet use by the culture-confirmed cholera patients in Leda and
 262 Teknaf DTCs in Cox’s Bazar settlements, September-December 2019

Variables	FDMN n=95 (%)	Host community n=52 (%)	P-value
Water source			
Public tap	84 (88.4)	5 (9.6)	<0.001
Deep tube well	6 (6.3)	11 (21.2)	
Shallow tube well	2 (2.1)	28 (53.8)	
Others	3 (3.2)	8 (15.4)	
Toilet use pattern			
Pit latrine without water seal	74 (77.9)	23 (44.2)	<0.001
Pit latrine with water seal	21 (22.1)	12 (23.1)	
Others	0 (0.0)	17 (32.7)	

263

264 During September-December 2019, a total of 216 culture-confirmed cholera cases were

265 hospitalized in icddr,b's Dhaka Hospital, and none had received OCV. During the same period,

266 DTC logs reported the admission of 147 culture-proven cholera cases in Leda and Teknaf DTCs.

267 Among these cholera cases, infants ($p<0.001$) and overall children <5 years old ($p<0.001$)

268 presented more frequently to the DTCs (functioning to treat FDMN living in settlements as well

269 as host community individuals) compared to cholera children presenting to Dhaka Hospital from

270 Dhaka city and its suburbs (47% vs. 12%; $p<0.001$). However, for individuals aged 15 years and

271 higher, more cholera patients reported to Dhaka Hospital as opposed to cholera cases living in

272 settlements and seeking care from DTCs (76% vs. 42%; $p<0.001$) (Table 3). Significantly more

273 female cholera cases visited DTCs as opposed to female cholera patients presenting to Dhaka

274 Hospital (50% vs. 38%, $p<0.043$). Cholera cases in Dhaka Hospital more commonly presented

275 with watery diarrhea than cholera patients of DTCs (100% vs. 82%, $p<0.001$), sought care more

276 frequently with some or severe dehydration (98% vs. 65%, $p<0.001$), and had more access to

277 ORS at home before seeking care (91% vs. 81%, $p<0.010$) (Table 3).

278 **Table 3** Age stratified cholera cases in Dhaka Hospital and DTCs in Cox's Bazar settlements,

279 September-December 2019

Variables	Dhaka hospital	DTCs in settlements	p-value
-----------	----------------	---------------------	---------

	n=216 (%)	n=147 (%)	
Age (Year)			
<1	3 (1.4)	14 (9.5)	<0.001
<5	25 (11.6)	69 (46.9)	
5-14	28 (13.0)	17 (11.6)	
15 and more	163 (75.5)	61 (41.5)	
Range	7 months – 74 years	3 months – 85 years	
Female	83 (38.4)	73 (49.7)	0.043
Duration of diarrhea			
<1 day	153 (70.8)	100 (68.0)	0.300
1-3 days	57 (26.4)	38 (25.9)	
4 days and more	6 (2.8)	9 (6.1)	
Watery stool	216 (100.0)	120 (81.6)	<0.001
Some or severe dehydration	211 (97.7)	95 (64.6)	<0.001
Pre-packaged ORS us at home	196 (90.7)	119 (81.0)	0.010

280 DTC: Diarrhea treatment center; ORS: Oral rehydration solution

281 Discussion

282 Humanitarian emergencies increase the risk of infectious disease transmission including cholera
283 and shigellosis, and the prevalence of other health conditions such as severe undernutrition. An
284 effective disease surveillance system is critical for early detection of disease outbreaks before
285 any spread to other family members as well as individuals living in the neighborhood,
286 unnecessarily costing lives and challenging the disease control efforts. Thus, our ongoing DTC
287 based diarrheal disease surveillance system with timely laboratory back-up and immediate
288 reporting was noteworthy in this emergency and crisis setting. The surveillance system was
289 involved not only in collecting reliable data since the inception of the DTC network but also in
290 reporting immediately to help significantly in anticipating and detecting early potential cholera
291 outbreaks. Findings from surveillance system guided intervention strategies that lead to the
292 timely undertaking of preventive measures and preparedness including training of health care
293 staff and prepositioning of supplies and additional human resources. Additionally, surveillance
294 data helped in identifying vulnerable populations living in high-risk areas who might have been
295 benefitted from preventive OCV use. Thus, reliable epidemiological data was critical in the

296 efficient implementation of preventive as well as control measures. The present study observed
297 that 94% of the host community individuals and two-third of the FDMN with laboratory-
298 confirmed cholera were not exposed to OCV before getting hospitalized with AWD.

299
300 A recent experience from Bangladesh and India indicated that the protective efficacy of
301 Shanchol OCV (produced in India) among those more than five years against cholera is 53-65%.
302 The study mentioned the positive role of OCV as a pre-emptive measure in endemic settings, in
303 natural or man-made disasters even in disruptive situations with a breakdown of WASH and
304 absence of other disease control and public health measures [20]. WHO and Global Task Force
305 for Cholera Control (GTFCC) recommend that a comprehensive multi-sectoral involvement is
306 important for the successful elimination of cholera [21]. Mass OCV campaigns with high
307 coverage are feasible even after the arrival of a large number of displaced populations in a
308 distressed state in resource poor-settings like Bangladesh [8,9]. According to another study,
309 OCV induced optimal immune responses in FDMN adults and children which were similar to
310 that observed in Bangladesh's population of diverse age groups or individuals living in other
311 cholera endemic countries [10].

312
313 In this study, we have explored the clinical, demographic, and hygienic practices of the displaced
314 as well as the host population living in settlements and neighboring host communities. The
315 findings of this study have public health implications and may be useful for the Health System of
316 Government of Bangladesh for anticipation, preparedness, and implementation of preventive and
317 mitigation measures in settings with public health threats such as endemic disease surges like
318 cholera or it is breaking out into epidemic proportions. Additionally, vigilance for cause-specific

319 diarrhea surges in both the populations such as host and FDMN is critical. Several findings
320 related to care-seeking from DTCs were noteworthy. Unlike Dhaka hospital, children living in
321 settlements and host communities were more often hospitalized for culture-proven cholera
322 episodes than their peers from Dhaka city and its suburbs. These observations underscore the
323 need for OCV campaigns. Females aged 15 years and higher living in settlements were more
324 often hospitalized with cholera than their peers seeking care from Dhaka Hospital. This may be
325 due to the increased vulnerability of females living in settlements to cholera because of their
326 higher compromised immunity or excess exposure to contaminated water and food during
327 household activities. Excess reporting of male cholera cases in Dhaka Hospital may be due to
328 increased mobility of male individuals as well as their frequent exposures to day-time unhygienic
329 out-door street-side meals or snacks from vendors in the overcrowded megacity.

330

331 ORS use at home was significantly lower in the cholera cases seeking care from DTCs than those
332 cholera cases living in Dhaka city and its suburbs. Likely explanations include less access to
333 ORS packets at the household or community level because of less organized outreach activities
334 to promote ORS at the household level in settlements. Alternatively, the displaced population
335 was not optimally motivated to start ORS before coming to DTCs. Access to more safe water
336 (chlorinated water supplied through taps installed) was observed in settlements mostly for
337 FDMN as provided by international agencies and NGOs. However, their access to deep and
338 shallow tube well water was less commonly observed compared to that of admissions from the
339 host community. Cholera cases with significantly more frequent watery stool and with more
340 frequent evidence of some or severe dehydration in Dhaka hospital could be due to more full-
341 blown clinical features of cholera episodes which may be because of larger inoculum size that

342 may be ingested by those living in the more contaminated environment particularly in slums with
343 gross lack of water and sanitation services as well as worsening hygienic practices in Dhaka city
344 and its suburbs.

345
346 In Sudan among the displaced populations, the risks for cholera were considerably higher among
347 children less than five years living in refugee camps [22]. A Cochrane review indicated
348 significantly lower protective efficiency of OCV in under-five children compared to children
349 who are older than them as well as adults [23]. Vigilance for cholera cases as well as
350 preparedness for prevention and mitigation measures for surges and mass OCV campaigns for
351 FDMN as well as host population can reduce the threats of cholera in both the host and FDMN
352 [24–29].

353
354 One of the limitations of the study was that these activities were DTC based as a result only
355 those cholera cases with admissions in DTCs have been included in the study. Cholera patients
356 with less severe disease who reported to the DTCs and received care on an out-patient basis for a
357 brief period and those cases that occurred at the community and did not report to DTCs have not
358 been studied. Thus, results may not be generalizable. However, the study of a fairly large number
359 of cholera cases captured during an outbreak as well as quality laboratory performance were the
360 strengths of the study.

361

362 **Conclusion**

363 Threats of cholera outbreaks among the FDMN are continuing due to new arrivals with
364 compromised host susceptibility, the declining immunity to the vaccine among OCV recipients

365 as well as an increasing number of cohort children without any exposure to OCV. Quality
366 surveillance and rapid microbial confirmation of provisionally diagnosed suspected cases have
367 important public health implications in emergencies and crises. Preparedness for surges and
368 vigilance for cholera cases should be the priority undertakings of the Health Systems of
369 Government of Bangladesh because of existing threats of cholera in both the host and displaced
370 populations.

371

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385

386 **Declarations of Interest**

387 None to declare.

388 **Availability of data and material**

389 This dataset and materials are available via the corresponding author and can be accessed on a
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