Prevalence of hepatitis C virus seropositivity and active infection in a Rohingya refugee population in Cox's Bazar camps, Bangladesh: a cross-sectional study

Birgit Schramm, Khondaker A Ashakin, Wasim Firuz, Md Hadiuzzaman, Jihane Ben-Farhat, Andrés Arias-Rodríguez, Anisur Rahman, Pradip Sen Gupta, Abu Toha Rezuanul Haque Bhuiyan, Marve Duka, Suna Balkan, Farah Hossain

Summary

Background Hepatitis C virus (HCV) infection is a significant public health concern. Limited data have shown unusually high HCV seroprevalence among Rohingya refugees residing in camps in Cox's Bazar, Bangladesh. We aimed to assess the prevalence of HCV seropositivity and active infection and identify risk factors to inform the HCV response.

Methods A cross-sectional survey was conducted between May 10 and June 14, 2023, in adult (≥18 years) residents of seven camps in Cox's Bazar. Households were selected by simple random geosampling and one participant per household was selected at random. Participants were screened for HCV antibodies with a rapid finger prick blood test and, if seropositive, venous samples were tested for HCV viral load. A structured questionnaire collected information about demographics, HCV knowledge, and exposure risks. Survey-adjusted prevalence estimates of HCV seropositivity and active infection were generated by applying sampling weights. Factors associated with HCV seropositivity were identified using univariable and multivariable current status analysis and those associated with active infection via logistic regression.

Findings The survey included 641 participants, of whom 425 (66%) were women and for whom the median age was 34 years (IQR 28–46). 191 individuals tested positive for HCV antibodies. 187 of these individuals were tested for active infection and 124 had a detectable HCV viral load. The survey-adjusted prevalence estimate of HCV seropositivity was 30·4% (95% CI 26·5–34·5), and that of active infection 19·8% (95% CI 16·5–23·4). Current status analysis identified higher odds of HCV seropositivity among individuals reporting medical injection(s) (adjusted odds ratio 1·8 [95% CI 1·2–2·8]) or surgery (5·9 [1·9–18·4]), and among women (2·1 [1·3–3·2]). 328 (51%) of 641 participants had never heard of hepatitis C. Five (4%) of 124 participants with HCV viraemia reported previous HCV treatment.

Interpretation There is a substantial burden of active HCV infection among adult Rohingya camp residents, highlighting the urgent need to scale up testing and treatment capacities. The survey had constraints in identifying risk factors and could not provide data on HCV incidence. Reassessing infection prevalence after mass interventions and prospective surveillance are recommended to monitor ongoing transmission. A well-concerted multi-stakeholder action plan is needed to prevent future large-scale burden of severe liver disease and halt ongoing transmission.

Funding Médecins Sans Frontières.

Lancet Gastroenterol Hepatol 2025

Published Online
April 30, 2025
https://doi.org/10.1016/S2468-1253(25)00094-9

Epicentre, Paris, France (B Schramm PhD, J Ben-Farhat PhD, A Arias-Rodríguez PhD); **Médecins Sans Frontières, Cox's Bazar, Bangladesh** (K A Ashakin MPH, W Firuz MBBS, M Hadiuzzaman MPH, A Rahman BSc, M Duka MD); **Bangladesh University of Health Sciences, Dhaka, Bangladesh** (Prof P Sen Gupta MD); **Office of The Refugee Relief and Repatriation Commission, Cox's Bazar, Bangladesh** (A T R H Bhuiyan MPH); **Médecins Sans Frontières, Paris, France** (S Balkan MD); **Médecins Sans Frontières, Tokyo, Japan** (F Hossain MD)

Correspondence to:
Dr Birgit Schramm, Epicentre, Paris, 75019 France
Birgit.Schramm@epicentre.msf.org

Introduction

Hepatitis C virus (HCV) infection is a significant global health concern. Around 50 million people are living with chronic HCV infection globally, and, in 2022, an estimated 244 000 deaths were attributed to hepatitis C, mainly caused by cirrhosis and liver cancer.[1,2] Acute HCV infections are usually asymptomatic, and about 15–25% of individuals clear the infection spontaneously within the first 6 months. However, the remaining 75–85% develop chronic HCV infection, which, if left untreated, can progress to cirrhosis or hepatocellular carcinoma in 20–30% of cases.[3]

HCV is transmitted through exposure to infected blood. The highest transmission risks are needle sharing during injection drug use, unsafe medical injections, or unscreened blood transfusions. Other common transmission routes include unsafe medical or cosmetic procedures involving sharps and sexual practices involving exposure to blood. No vaccine for HCV exists, but effective oral treatments became available around 2015 in the form of direct-acting antivirals such as sofosbuvir and daclatasvir. Pan-genotypic direct-acting antiviral regimens have high cure rates after 12–24 weeks of treatment. Despite the availability of effective treatment, major gaps remain in HCV diagnosis and treatment access, especially in low-income and middle-income countries. Between 2015 and 2022, only an estimated 36% of people living

Research in context

Evidence before this study

We searched MEDLINE using the terms "Hepatitis" AND "Rohingya" for articles assessing hepatitis C virus (HCV) infection in the Rohingya population published since Jan, 2013. We identified only three publications. The National Liver Foundation of Bangladesh reported 8% HCV seropositivity among 300 pregnant women tested at antenatal care services in the Cox's Bazar camps, Bangladesh, between 2017 and 2019. A larger community survey in three camp blocks in 2019 reported 22% HCV seroprevalence among adults. An investigation of an outbreak of acute jaundice syndrome from 2018 in the Cox's Bazar camps identified 9% HCV seropositivity among 275 samples derived from health facilities (mainly from adults). A pilot survey carried out in 2019 in one small camp reported 13·2% HCV RNA positivity among 53 tested blood samples. Furthermore, a 51% HCV seropositivity and a viraemic rate of 71% among seropositive patients was found among 10 610 individuals in inpatient and outpatient departments who were screened within the Médecins Sans Frontières (MSF) programme in the camps between Oct, 2020, and December, 2022. A representative estimate of the burden of active HCV infection and HCV exposure risk factors in the camp population was lacking.

Added value of this study

Our survey methodology used random geospatial sampling and a sufficiently large sample from seven camps to provide a robust estimate of HCV seroprevalence and, for the first time, a representative estimate of active HCV infection among the general adult Rohingya population residing in the camps. The findings underline that a high number of adults in the camps have active HCV infection requiring diagnosis and treatment. The survey also indicates a lack of HCV knowledge and factors associated with HCV exposure, which would guide prevention and intervention measures.

Implications of all the available evidence

Tackling this high HCV burden in densely crowded camps, which host nearly a million people, requires a well-concerted multi-stakeholder action plan to prevent future large-scale burden of severe liver disease and halt likely ongoing transmission. In support of this, we call for international funding and commitment to rapidly scale up HCV test-and-treat capacities in the camps, provide sustainable access to affordable treatment, and increase infection prevention and control measures and community awareness in the camps.

with HCV infection globally were diagnosed and about 20% received curative treatment, with corresponding estimates of 13% and 3%, respectively, for the WHO Africa region and 26% and 14% for the WHO Southeast Asia region.[1] Some populations, such as refugees and forcibly displaced people, are at increased risk of HCV infection.[4]

Following the escalation of violence against Rohingya people in Myanmar in 2017, millions of Rohingya fled their country.[5] As of June, 2024, nearly a million Rohingya (905 878 individuals including 436 001 adults) live in the world's largest and most-densely populated refugee camp in Cox's Bazar in southern Bangladesh.[6] Médecins Sans Frontières (MSF) has been providing specialised medical services to the forcibly displaced Myanmar nationals sheltered in Cox's Bazar since 2017.[7,8] From Oct, 2020, drawing on previous experience in Cambodia,[9] MSF has included screening, diagnosis, and treatment for hepatitis C among the services offered free of charge at two MSF-supported health facilities in the camps (Jamtoli clinic and Hospital on the Hill). The programme's capacity was set at a maximum of 150 new patients per month, aiming to provide quality care, focusing on people aged 40 years or older and patients with chronic diseases such as diabetes or hypertension. Between Oct, 2020, and December, 2022, 10 610 patients were screened and 3208 initiated HCV treatment at MSF facilities,[10] with MSF being the only actor providing HCV treatment in the camps. Demand for HCV care has been high since services began.

Studies have indicated an alarmingly high level of HCV seropositivity among the population in the Cox's Bazar camps. HCV seroprevalence among Rohingya has been reported as: 8% among 300 pregnant women screened for HCV in 2017;[11] 9% in 275 samples analysed during an outbreak investigation of acute jaundice syndrome in Cox's Bazar in 2018;[12] and 22% among adults residing in two camp blocks estimated from a survey conducted by the National Liver Foundation of Bangladesh in 2019.[11] A small pilot survey carried out in 2019 in one camp (Lambasia, <300 residents) reported a concerning 13·2% HCV RNA positivity among 53 samples tested.[13] Representative information on the prevalence of active HCV infection and risk factors of HCV exposure in the camps was lacking. To address this urgent need to quantify the true burden of HCV disease and guide future treatment and prevention efforts, we conducted a survey of adult Rohingya individuals in seven Cox's Bazar camps.

Methods

Study design

We conducted a cross-sectional point prevalence survey between May 10 and June 14, 2023, to estimate the prevalence of HCV seropositivity and HCV viraemia (ie, active HCV infection) in the general adult Rohingya population residing in camps in Ukhia, Cox's Bazar District, Bangladesh. A secondary objective aimed to identify factors associated with HCV exposure. The survey was approved by the Ethical Review Committee of the

Bangladesh University of Health Sciences (ERC BUSH), and the Ethical Review Board of Médecins Sans Frontières (MSF ERB). Heads of households or representatives provided verbal informed consent; participants provided written informed consent.

Participants

The survey included adult forcibly displaced Myanmar nationals living in the seven camps (8W, 12, 13, 16, 17, 18, and 19) that comprise the catchment area of MSF Operational Centre Paris (OCP) in the camps in Ukhia, Cox's Bazar District. Camp 11 (also part of OCP's catchment area) was excluded due to a massive fire that occurred shortly before the survey.

A household was defined as a shelter with one or more registered families. Households were identified through simple random geospatial sampling (ie, randomly selected GPS coordinates corresponding to roof structures visible on the latest available satellite image of the camps; Google maps, Cox's Bazar, Jan 30, 2022) using delimitation polygons of the respective camps.[14] The sampling frame was the number of families per camp and sampling was performed proportionate to the number of families listed by UNHCR in each of the seven camps[15] (proportional to size method). One eligible participant per household was randomly selected by numbering household members from the family registration card and using a random numbering application on the interviewer's tablet. To be eligible, participants had to be aged 18 years or older, registered as a member of the household, and willing and able to provide informed consent. With the high rate of illiteracy in the camp population, a trained community volunteer fluent in Rohingya supported the explanation of the survey using the participant information sheet. A literate witness fluent in Rohingya, chosen by the participant—who could also be the Rohingya community worker—signed the consent form, while the illiterate participant provided a thumbprint. For feasibility reasons, adults who were absent during the household visit and not returning within the next 3 days were excluded from the list of eligible household members for random participant selection. If the head of household or (at the second step) the randomly selected adult was absent and returning within 3 days, a catch-up visit was scheduled. Households for which the head of household or selected individuals declined participation or were absent after one catch-up visit were not replaced.

Procedures

All participants during household visits were tested for HCV seropositivity with a rapid finger prick blood test (Biolin HCV, Abbott Diagnostics Korea, Yongin-si, Gyeonggi-do, South Korea), and results were explained to the participant. If the test was positive, a venipuncture sample was collected and sent to the MSF laboratory in the camp, where it was tested for active infection using Xpert HCV Viral Load test (Cepheid, Sunnyvale, CA, USA). Participants were given a date to pick up the results of the HCV viral load test, and they were linked to care if they had an active infection.

Trained survey staff administered two types of questionnaires in the Rohingya language to all participants: a brief questionnaire collecting information about the number of eligible adult household members, and a comprehensive participant questionnaire, collecting self-reported sociodemographic information, year of arrival in Cox's Bazar camps, education, and marital status, as well as information on knowledge about HCV infection, previous HCV diagnosis and treatment, and exposure to unsafe medical or recreational or cosmetic procedures that have a high risk of HCV transmission.

Statistical analysis

The sample size was calculated to be 680 households, each with one randomly selected adult (≥18 years) meeting the eligibility criteria, to ensure detection of active HCV infection prevalence of 35% with a 95% CI and ±4·0% precision, and accounting for 5% technical issues and up to 20% absenteeism or decline in participation.

Survey data (rapid test result and questionnaire data) were directly entered into a Kobo Collect database using tablets. Results of HCV viral load tests were entered separately and merged for analysis. STATA software version 16 was used for data cleaning and analysis. Participant characteristics and exposure to risk factors were described using proportions, medians, and IQRs.

During the analysis, each participant was assigned a weight, which was constructed as the inverse of the product of the probability of selection of the household within the camp and the probability of selection of the individual among the total number of eligible adults in each household. Survey-adjusted prevalence estimates

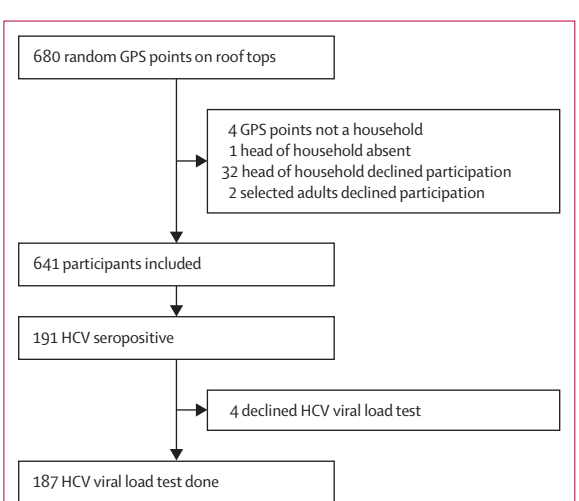

Figure 1: **Study flow chart**

	Participants (N=641)
Sex	
Female	425 (66%)
Male	216 (34%)
Age (years)	34 (28–46)
Age categories	
18–24 years	87 (14%)
25–34 years	239 (37%)
35–44 years	129 (20%)
45–54 years	93 (15%)
55–64 years	62 (10%)
≥65 years	31 (5%)
Born in Myanmar	641 (100%)
Years since arrival in the camps	5·7 (5·7–5·8)
Muslim religion	641 (100%)
Number of adults in household	
1 adult	62 (10%)
2 adults	400 (62%)
3–5 adults	150 (23%)
>5 adults	29 (5%)
Marital status	
Single	26 (4%)
Married or living in a couple	545 (85%)
Separated or widowed	68 (11%)
Declined to answer	2 (<1%)
Education	
Never attended school	493 (77%)
Primary level	93 (15%)
Intermediate level	46 (7%)
Higher level	6 (1%)
Data missing	3 (<1%)
Away from camp during past 12 months	
Never away	629 (98%)
<1 month	8 (1%)
>1 month	2 (<1%)
Data missing	2 (<1%)
Self-reported chronic diseases (probed)	
Heart disease	52 (8%)
Diabetes	49 (8%)
Asthma	17 (3%)
Hypertension*	15 (2%)
COPD	11 (2%)
Hepatitis C*	11 (2%)
Depression	8 (1%)
Liver disease	8 (1%)
Kidney disease	3 (<1%)
Living with HIV	2 (<1%)
Substance abuse	2 (<1%)
Cancer	1 (<1%)

Data are (%) or median (IQR). COPD=chronic obstructive pulmonary disease. *Unprobed self-reports, following the question whether the participant has "any other type of chronic disease, that was not mentioned [in the questionnaire]".

Table 1: **Sociodemographic characteristics of participants**

were provided as proportions with 95% CI. To account for male under-representation in the sample, a sex-adjustment weight was applied to match the population sex ratio. The final weight for this estimate combined the sampling and sex-adjustment weights. Viraemic ratio was defined as the survey-adjusted proportion of individuals with active infection among those who tested HCV seropositive and had a viral load test available.

Participant interviews focused on exploring HCV risk factors determined a priori (ie, primarily exposure characteristics related to health-seeking behaviours and hygiene practices). Factors associated with the binary outcomes of HCV seropositivity and HCV viraemia were identified through univariable analysis with χ^2 tests. A current status model was implemented using R 4.4.2 to examine the relationship between risk factors and HCV seropositivity, accounting for the unknown timing of seroconversion.[16] The model was implemented using a proportional odds framework with a logit link function, which models the probability of remaining seronegative beyond the observed age, incorporating the following covariates: sex, history of medical injections, surgical procedures, dental or gum treatments, blood transfusions, and reuse of needles, and adjusted for camp of residence. The model assumes a constant hazard rate for HCV seroconversion, based on the best fit with the exponential distribution, while both the Weibull and lognormal baseline distributions performed poorly. This implies that the instantaneous risk of seroconversion remains constant with age. The proportional odds model was selected over the proportional hazards model with a cloglog link based on a better Akaike Information Criterion (AIC) fit, with an exponential baseline hazard distribution for its interpretability and best fit in line with isotonicity requirement (increased probability of seroconversion in function of age). The proportional odds assumption was validated through survival curve analysis and interaction tests, with higher AIC in interaction models confirming proportional odds and justifying the logit link function. Model parameters were estimated using maximum likelihood estimation and covariate selection was performed through a backward elimination procedure guided by AIC. Odds ratios (ORs) reflect statistical associations rather than causal effects, as exposure timing relative to seroconversion is unknown.

Viraemia is a more dynamic state than seroprevalence and can fluctuate over time, making a current status model less suitable since it assumes a single transition event. Therefore, logistic regression was used to assess the association between detectable viraemia and the following covariates: reported history of HCV treatment, sex, and age, with adjustment for camp of residence. Crude and adjusted ORs are presented with 95% CI. Variables with a p value of 0·2 or less in the univariable regression analysis were integrated into a multivariable model, and variables with a posterior p value of 0·05 or less were

retained in the final model. Missing responses, answers of "don't know", and refusals (<6%) were omitted from both risk factor analyses (ie, the current status analysis for seropositivity and regression analysis for viraemia).

Role of the funding source

The funder of the study was involved in study design, data collection, data analysis, data interpretation, and writing of the report.

Results

Between May 10 and June 14, 2023, 641 individuals from 641 households were included in the survey. Only 34 (5%) of 680 targeted households declined participation (figure 1). Baseline demographics of included participants are shown in table 1, with further information in the appendix (pp 1–3). The median age was 34 years (IQR 28–46) and 425 (66%) of survey participants were female; camp statistics report 54% of adults are female in the seven camps.[17]

Among the 641 participants, 191 tested positive for HCV antibodies, resulting in a survey-adjusted HCV seroprevalence estimate of 30·4% (95% CI 26·5–34·5). When adjusted to account for the difference in sex ratio of our survey compared with that in camp statistics, the estimated HCV seroprevalence was 29·5% (95% CI 24·6–34·9). HCV seroprevalence was higher for women than for men (34·8% [95% CI 29·8–40·0] *vs* 22·9% [17·5–29·4]); seroprevalence by age group is shown in table 2. HCV seroprevalence also varied by camp, with the lowest prevalence in camp 17 (table 2).

	HCV seropositive (N=641)	Active HCV infection (N=637)*	Viraemic ratio (N=187)*
Overall	30·4% (26·5–34·5)	19·8% (16·5–23·4)	66·2% (58·3–73·2)
Female	34·8% (29·8–40·0)	21·8% (17·6–26·6)	72·4% (56·8–84·0)
Male	22·9% (17·5–29·4)	16·4% (11·8–22·3)	63·7% (54·3–72·2)
Age group (years)			
18–24	12·6% (6·4–23·3)	9·5% (4·2–20·3)	81·8% (34·7–97·5)
25–34	30·5% (24·6–37·1)	20·9% (16·0–26·9)	70·8% (57·9–81·0)
35–44	38·3% (29·5–48·0)	21·3% (14·5–30·2)	55·6% (39·1–70·9)
45–54	33·5% (23·6–45·1)	20·6% (12·5–32·1)	61·6% (41·0–78·8)
≥55	32·0% (22·7–43·1)	23·0% (14·9–33·8)	73·1% (53·3–86·6)
Camp			
8W	21·3% (13·8–31·4)	13·4% (7·7–22·5)	63·0% (38·4–82·4)
12	47·5% (35·8–59·5)	25·5% (16·6–37·0)	53·7% (36·2–70·4)
13	26·7% (19·2–35·8)	17·2% (11·2–25·4)	69·3% (48·3–84·5)
16	39·7% (27·9–52·9)	31·4% (20·4–45·0)	79·0% (58·4–91·0)
17	10·6% (4·6–22·3)	8·9% (3·6–20·5)	84·6% (20·0–99·2)
18	30·8% (21·9–41·6)	21·2% (13·6–31·6)	70·3% (49·2–85·3)
19	33·5% (23·6–44·1)	21·0% (12·9–32·2)	62·5% (41·8–79·5)

Data are % (95% CI). HCV=hepatitis C virus. *Four HCV-seropositive individuals who did not have an HCV viral load test were excluded.

Table 2: **Survey-adjusted estimates of HCV seroprevalence, active infection, and viraemic ratio, by sex, age group, and camp**

Four of the 191 HCV-seropositive participants refused collection of venous blood to test for active infection. Among the 187 HCV-seropositive participants who were tested, 124 had a detectable HCV viral load. The survey-adjusted prevalence estimate of active HCV infection was 19·8% (95% CI 16·5–23·4; table 2). Prevalence of viraemia was lowest among the youngest group, highest among age group 55 years and older, and lowest in camp 17 (table 2).

The overall survey-adjusted viraemic ratio was 66·2% (95% CI 58·3–73·2). The viraemic ratio was highest among the youngest age group (18–24 years; table 2). The median viral load among participants with HCV viraemia was 638 000 IU/mL (IQR 192 500–1845 000); all had a viral load of 1000 IU/mL or greater and 122 (98·4%) had a viral load of 3000 IU/mL or greater.

73 (38%) of 191 HCV-seropositive participants reported previous HCV diagnosis; 41 (56%) of these individuals had HCV viraemia. 20 (10%) of the 191 HCV-seropositive

See **Online** for appendix

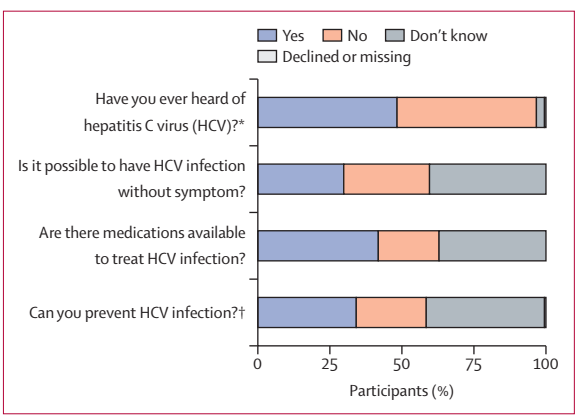

Figure 2: **General knowledge on HCV**
Proportion of participants who answered the questions regarding general knowledge on HCV (among all participants, N=641). HCV=hepatitis C virus. *One respondent declined to reply; two had missing information. †Three respondents had missing information.

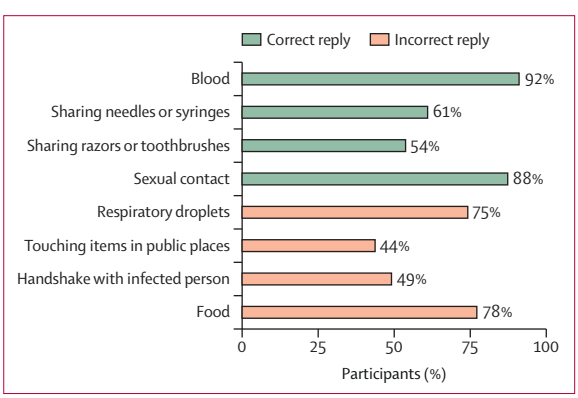

Figure 3: **Knowledge about hepatitis C infection**
Proportion of participants who answered the questions regarding how HCV can be transmitted ("How can HCV be transmitted?" Answers were probed). Assessed among 310 respondents who indicated having heard of HCV before; responses shown for 295 respondents (15 had missing data). HCV=hepatitis C virus.

participants reported previous HCV treatment and 20 (27%) of the 73 with a previous diagnosis reported previous HCV treatment. Among the 124 participants with HCV viraemia, 41 (33%) reported previous HCV diagnosis and five (4%) previous HCV treatment. Of all 641 participants, 33 participants reported previous treatment; of note, 13 (39%) of these participants were HCV seronegative.

328 (51%) of 641 participants had never heard of hepatitis C before, including 75 (39%) of the 191 individuals who tested HCV seropositive. 268 (42%) of 641 participants knew that HCV could be treated with medication and 198 (31%) knew that HCV infection could be asymptomatic (figure 2).

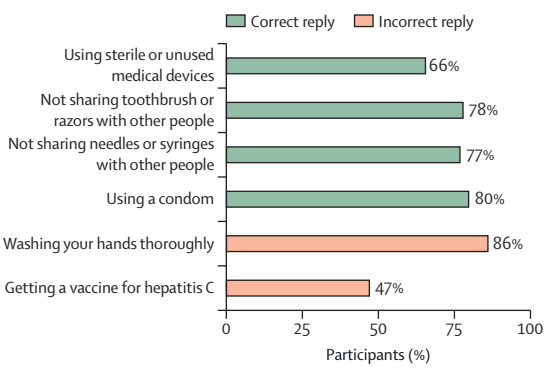

Figure 4: **Knowledge on HCV prevention**
Proportion of participants who answered the questions regarding how HCV infection can be prevented ("How can HCV infection be prevented?" Answers were probed). Assessed among 219 respondents who indicated having heard of HCV before and that HCV infection can be prevented; responses shown for 218 respondents (one respondent had missing data). HCV=hepatitis C virus.

310 of the participants who had heard of hepatitis C before were asked about HCV transmission modes; responses were available for 295 individuals (figure 3). Blood was correctly identified as a mode of transmission by 270 (92%) of 295 individuals, sharing needle or syringes by 181 (61%), sexual contact by 259 (88%), and sharing razors or toothbrushes by 160 (54%). However, incorrect transmission modes such as food (229 [78%]), respiratory droplets (220 [75%]), hand shaking (146 [49%]), and touching items in public spaces (130 [44%]) were also frequently selected. The 219 respondents who acknowledged that HCV could be prevented were presented with a list of prevention options to choose from; responses were available for 218 individuals (figure 4). Many selected the correct prevention measures, such as using sterile or unused medical devices (143 [66%] of 218 respondents), while nearly half (103 [47%]) believed a vaccine was available, and most (188 [86%]) chose hand washing as a prevention measure.

451 (71%) of 633 participants reported having received medical injections (five did not know and three had missing information; appendix p 1), with no difference between male and female participants (data not shown). Among 450 of 451 individuals with available information (one with missing information), 440 (98%) reported receiving injections in the camps, 296 (66%) in Myanmar,

	n/N	HCV-seropositive estimate, % (95%CI)*	Univariable analysis crude OR (95% CI)	p value	Multivariable analysis adjusted OR (95% CI)†‡	p value
All participants	168/585	29·2% (25·3–33·4)	..	..	..	..
Sex	..	..	2·3 (1·5–3·4)	<0·001	2·1 (1·3–3·2)	0·0009
Male	41/200	20·1% (14·9–26·6)	..	..	..	..
Female	127/385	34·6% (29·4–40·2)	..	..	..	..
Injection(s) for medical reasons			1·7 (1·1–2·6)	0·015	1·8 (1·2–2·8)	0·007
No	38/177	20·3% (14·7–27·5)	..	..	..	..
Yes	130/408	32·6% (27·8–37·9)	..	..	..	..
Surgical intervention(s)	..	..	2·5 (0·9–6·8)	0·074	5·9 (1·9–18·4)	0·002
No	160/569	28·6% (24·7–32·9)	..	..	..	..
Yes	8/16	51·5% (27·8–77·4)	..	..	..	..
Dental or gum treatment(s)	..	..	1·1 (0·5–2·4)	0·887	..	..
No	159/556	29·0% (25·1–33·4)	..	..	..	..
Yes	9/29	32·3% (15·0–56·2)	..	..	..	..
Blood transfusion	..	..	2·4 (0·3–18·1)	0·393	..	..
No	166/581	28·9% (25·0–33·2)	..	..	..	..
Yes	2/4	60·0% (3·7–98·3)	..	..	..	..
Reuse of someone else's needle	..	..	1·3 (0·6–2·7)	0·572	..	..
No	157/552	28·9% (24·9–33·2)	..	..	..	..
Yes	11/33	33·7% (18·0–54·2)	..	..	..	..

HCV=hepatitis C virus. *Survey-adjusted estimates. †Model adjusted for camp (camp 8W, 12, 13, 16, 17, 18, 19). ‡OR reflect statistical associations rather than causal effects, as exposure timing relative to seroconversion is unknown.

Table 3: **Current status analysis on factors associated with HCV seropositivity (responses "don't know/refused", or missing information omitted) (N=585)**

and 34 (8%) in Cox's Bazar City. 447 individuals provided data for the location at which they had received injections; 406 (91%) individuals reported receiving an injection in a hospital, 299 (67%) by traditional healers, 101 (23%) in a pharmacy, and 38 (9%) through traditional birth attendants. HCV seropositivity did not differ by location or by provider of the injection (data not shown). 553 (86%) of 641 individuals reported sharing at least one personal item (toothbrush, nail clipping scissors, or razors), 190 (30%) reported piercings, while no individuals reported tattoos (appendix p 1). Only 21 (3%) of 623 individuals reported previous surgical interventions (three did not know, one declined to reply, 14 had missing data). Of these, 18 (90%) of 20 individuals had reported having previous surgical interventions in a hospital, seven (35%) in camps, eight (40%) in Cox's Bazar City, and seven (35%) in Myanmar (some participants reported surgery at more than one site; one of the 21 individuals who reported having surgery had information missing for location). Only eight participants reported blood transfusions (appendix p 1; four transfusions occurred in the camps, four in Cox's Bazar City, one in both locations, and one in Myanmar); notably, six (75%) of these participants tested HCV seropositive. Seven (1%) of 615 participants with available data reported having experienced sexual violence (four in the camps and two in Myanmar, one with missing information). 33 (5%) reported having re-used someone else's needle. Only five (<1%) reported injection drug use. Overall, among those with available information, 386 (91%) of 424 female participants reported a previous pregnancy, including 53 (82%) of the 65 women in the youngest age group (18–24 years); among those who had been pregnant, 378 (98%) reported having given birth. 206 (96%) of 215 male participants reported being circumcised (appendix pp 2, 3).

Reported history of medical injections, surgical interventions, dental or gum treatments, re-use of someone else's needle, blood transfusions, and female sex were included in multivariable regression analysis based on associations with HCV seropositivity in univariable analysis. Current status regression analysis, adjusting for camp of residence, identified significantly higher odds of HCV seropositivity in people reporting medical injections or surgical interventions, as well as in women than in men (table 3).

Among 187 HCV-seropositive participants with a viral load test, never having received HCV treatment (probed, self-reported) was associated with higher odds of current viraemic infection (adjusted OR 6·1 [95% CI 1·8–20·3]), while sex or age were not significantly associated with increased odds of viraemia (appendix p 4).

All 124 participants diagnosed with active HCV infection received their viral load test results and were offered treatment during post-survey follow-up; 122 started and completed the treatment, two refused it.

Discussion

The survey revealed a high burden of hepatitis C infection among Rohingya refugees residing in camps in Cox's Bazar, Bangladesh. Approximately one in three adults were exposed to HCV infection, and about one in five lived with active HCV infection, constituting a generalised epidemic of unprecedented extent. Only a few studies previously reported HCV seroprevalences close to the one found in our study, and these were in high-burden countries such as Pakistan and Egypt.[18–20] Adults of all age groups were exposed to HCV, and women were significantly more affected than men. Self-reported medical injections and surgical interventions were associated with HCV exposure, which has informed prevention strategies in the camps.

Before this study, little data existed on active HCV infection in the camps. A small pilot survey carried out in 2019 in one camp reported a concerning 13·2% HCV RNA positivity (active infection) among 53 tested blood samples.[13] The present survey provides for the first time a representative estimate of active HCV infection in the camps, with a prevalence of 19·8% (95% CI 16·5–23·4), far exceeding available national population estimates from Bangladesh (0·6% chronic HCV infection, 2020 data)[21] and Myanmar (1·4%).[22] About a third of people with HCV infection clear the infection spontaneously without treatment.[23] The survey-estimated viraemic rate (active infections among those who tested HCV seropositive) was 66·2%, confirming that the HCV-exposed population is largely untreated. In this study, only 20 (10%) of 191 seropositive participants reported previous HCV treatment, further highlighting a significant treatment coverage gap. A cross-sectional survey carried out in 2022 by MSF in slum settlements in Karachi, Pakistan, also reported high HCV seroprevalence (13·4%, 95% CI 11·1–15·8), with a notably lower viraemic rate (32%, 24·3–40·5), and with 44% of exposed participants reporting previous HCV treatment, which was attributed to nearly 10 years of accessible diagnosis and treatment in this setting.[24]

Exposure to unsafe medical procedures (iatrogenic transmission) involving re-use of contaminated needles or instruments, injection drug use with needle sharing, or personal care and beauty treatments with non-sterilised equipment are well established high HCV transmission risk factors.[2] Our analysis found a lower proportion of seropositivity in the youngest age group, consistent with higher cumulative exposure risk and life-long HCV antibody persistence with age, as seen in surveys from Cambodia and Pakistan.[24,25] Assuming a constant hazard rate, this pattern reflects longer durations of risk exposure in older individuals, rather than an increased risk with age. Notably, the odds of HCV exposure were nearly twice as high for women than for men, as observed in earlier serological assessments in the camp.[11] This difference might be due to differences in health seeking behaviour and health-care-related exposure risks,

although the origin of potential differences in male versus female HCV prevalence is not well understood.[26] A study that assessed HCV seroprevalence in women across nine countries (in Europe, Asia, and Africa) between 2004 and 2009 reported an association with age and exposure to childbirth-related medical interventions.[27] Surveys conducted among the general population in Karachi, Pakistan, and Battambang, Cambodia, did not identify higher exposure for women than for men,[24,25] and, in contrast, they showed a higher prevalence among men than women in Battambang. A study conducted in Egypt, a country with historically high HCV exposure, also did not find a difference in HCV seroprevalence between men and women.[26] In the survey, almost 90% of female participants reported having given birth (no information were collected on caesarean intervention), and more than 95% of men reported being circumcised, which did not allow for inference of related risk. The survey did not aim to investigate HCV prevalence specific to individual camps, since sociodemographic characteristics and health-care access across Cox's Bazar camps are considered very similar. Nevertheless, some variability in HCV seroprevalence between camps was observed, with the lowest estimate in Camp 17. However, 95% CI were wide and mostly overlapped. Data to explain a potential trend are lacking.

Current status analysis showed a strong association between HCV seropositivity and reported history of surgery (adjusted OR 5·9 [95% CI 1·9–18·4]), and an association with reported medical injections (1·8 [1·2–2·8]). Of note, surgery was rarely reported (21 [3%] participants), while medical injections were frequently reported (451 [70%] participants). Blood transfusion, re-use of needles, or intravenous drug use were rarely reported. The re-use of needles and intravenous drug use are sensitive topics with potential for under-reporting, and exposure to re-use of needles during medical injections might not be recognisable for those receiving the injection. The survey conducted in Karachi, Pakistan, identified advancing age (OR 1·12 [95% CI 1·09–1·15]) and therapeutic injections (1·07 [1·0–1·13] for each additional injection in the past 12 months) to be associated with HCV exposure.[24] The prevalence survey in Battambang, Cambodia, reported lower socioeconomic status and past routine medical interventions (dental or gum treatment, medical injections and surgery, particularly those received before 1990 and 1980) to be associated with HCV seroprevalence in participants aged 45 years or older.[25]

The Rohingya population's knowledge about hepatitis C was limited. Only about half of survey participants had heard of HCV before, and of those, only two-fifths knew that HCV treatment was available. Nearly half of respondents incorrectly stated that a vaccine exists, and food and handshaking were cited among proposed transmission risk factors. Furthermore, among the few who stated having received HCV treatment before, almost 40% had tested seronegative. The contextual narrative (not assessed in the survey) also suggests that people struggle to differentiate HCV seropositivity and active infection, and different causes of liver infections, which might explain why some participants with seronegative test result reported previous HCV treatment. Large-scale health education campaigns are required to address awareness and knowledge gaps about hepatitis C in the population.

Our findings do not indicate when or where significant HCV exposure might have occurred. While living in Myanmar, marginalised and stateless Rohingya faced dire living conditions with no access to basic health care.[5,7] Historical data on HCV prevalence for the Rohingya population in Myanmar are lacking. Although not fully representative, seroprevalence assessments in the camps between 2017 and 2019[11,12] indicate that HCV prevalence was already considerably high shortly after most of the Rohingya had arrived in the camps in 2017.

Extrapolation of the survey estimates to the total adult population in the camps (464 324 adults residing in the camps as of September, 2023),[28] adjusted for the slightly higher proportion of women included in the survey, suggests that approximately 86 000 adults require HCV treatment. Scaling up access to diagnosis and treatment in the camps will be crucial to stop, or at least drastically decrease, likely ongoing transmission and prevent severe liver disease and associated mortality. A key challenge will be to scale up HCV screening into all camps, diagnose all people with chronic HCV infection, and ensure access to care, given current gaps in HCV diagnosis and treatment in the camps and resource-limited settings in general. HCV care is also not integrated into the general healthcare package of the camp community (treatments are not in the UNHCR essential drugs list and not available in the public sector in Bangladesh), and until recently, MSF was the only actor providing HCV diagnosis and treatment in the camps. In March, 2024, a task force comprised by some of the main health actors of the camps was created to brainstorm and prepare for a response. In April, 2024, WHO, in collaboration with the government and other partners (including the International Organization for Migration and Save the Children International), began HCV screening in the camps. Between April and May, 2024, 4486 people (83% women) were screened, with 37% testing seropositive (of whom 73·8% had viraemia). WHO provided 900 treatment courses[29] and plans to secure an additional 3000. MSF is currently preparing for a community-based mass test-and-treat campaign in nine MSF supported camps with a capacity to enrol 30 000 patients on treatment in 2025. As of February, 2025, other health actors have committed to scale-up HCV test-and-treat capacities. Securing long-term funding and commitment will be essential to achieving HCV elimination in the mega-camps.

Current HCV incidence in the camps is unknown, although the very high burden of active HCV infection

seen in this study suggests that ongoing transmission (even if at low level) is likely. Prevention measures to contain transmission are crucial. Given the generalised, high prevalence epidemic, it is plausible that a key factor is exposure to unsafe medical practices, which aligns with our results. Health education and prevention campaigns will be a critical component of the response, to reinforce safe medical practices and use of sharps and needles in all relevant services in the camps (eg, healthcare and personal hygiene and grooming services). The survey did not include children, yet the 2019 assessment in the camps reported 1% HCV seroprevalence among 1100 children aged 7 years and older.[11]

The WHO's 2016 Global Health Sector Strategy aims to eliminate viral hepatitis by 2030, with a WHO Southeast Asia region 2019 action plan targeting 90% diagnosis and 80% treatment of chronic HCV cases by then.[30,31] Achieving these targets requires expanded screening, diagnosis, and access to affordable pan-genotypic direct-acting antivirals.[32,33] A rapid, multi-actor test-and-treat campaign, drawing on key elements of Egypt's successful elimination strategy,[34] should be considered for the Cox's Bazar camps. Furthermore, scaling up of the MSF simplified model of care should facilitate uptake of HCV diagnosis and care by other actors in the camps. Locally produced direct-acting antivirals in Bangladesh are significantly more expensive than generics accessible in many other low-income and middle-income countries, a barrier that also needs to be addressed.

Study limitations include potential bias due to the preferential inclusion of people at home during the study time windows, which may explain why two-thirds of participants were female, compared to the 54% female adults reported by UNHCR in the surveyed camps.[17] Other limitations are the reliance on self-reported exposure to risk factors, which depends on memory and might also be biased for sensitive topics. Assessing knowledge of hepatitis C through a closed-ended questionnaire also has known limitations, including overestimations. The survey did not collect data on the number of pregnancies or the age at first pregnancy, or information on the mode of delivery, which might affect HCV exposure risk. The cross-sectional design limits causal inference between risk factors and HCV seropositivity, as we cannot determine if exposures (eg, medical injections) occurred before or after seroconversion, potentially leading to misclassification and bias. This limitation was partially addressed using a current status model, which estimates the probability of seroconversion over time but does not clarify the timing of exposure. For example, the high proportion of participants reporting medical injections in the camps suggests that some exposures might also have occurred after seroconversion. The adjusted ORs should thus not be interpreted as direct measures of risk but rather as statistical associations that provide insights into the health-seeking behaviour characteristics of individuals with a history of HCV exposure. Factors other than those included in this study might also have influenced disease risk and effect sizes. Longitudinal follow-up and more detailed exposure histories are needed to clarify the temporal relationships between these risk factors and HCV seroconversion. The absence of data on ongoing HCV transmission (incidence) limits the ability to assess the urgency and scale of interventions needed to curb transmission and prevent future severe disease. The survey focused on assessing HCV prevalence among adults, based on the available data suggesting high HCV exposure mainly among adults.[11] Children are generally at low risk of HCV infection, except in high-prevalence endemic areas. Furthermore, access to the required weight-based sofosbuvir–daclatasvir formulation for children below 26 kg is constrained due to high price and limited production. Targeted diagnosis for children at risk in the Cox's Bazar camps is important, as well as advocacy for access to paediatric formulations of direct-acting antivirals.

Our findings point to a high burden, generalised HCV epidemic, and suggest that approximately 86 000 adults are currently undiagnosed and untreated, requiring additional stakeholders to intervene and support rapid expansion of access to HCV diagnosis and treatment in the camps. A large-scale testing and treatment initiative will be crucial to prevent further transmission and severe liver disease in the population. A multi-partner HCV test-and-treat scale scale-up test is planned to be implemented in 2025, and continuous actor engagement will be critical. Ongoing monitoring of the HCV epidemic at community and health facility level is strongly recommended, including re-assessment of the infection prevalence at community level after an initial round of mass interventions. Ideally, prospective follow-up or phylodynamic analyses of circulating HCV could address pending information on extent and patterns of ongoing transmission in the camps.

Contributors

BS, MH, JBF, KAA, WF, MF, SB, and FH contributed to study conception and design, KAA and BS supervised field data collection and AR conducted laboratory analyses. BS, KAA, WF, JBF, FH, SB, PSG, ATRHB, AR, MD, and MH interpreted the data. BS, JBF, AA-R and KAA had full access to and verified the underlying data. KAA and AR had full access to and verified the HCV viral load data. BS, AA-R, and JBF conducted the statistical analysis. BS wrote the first draft; SB, KAA, WF, FH, JBF, MH, PSG, and ATRHB substantially reviewed and edited the manuscript. All authors critically reviewed the manuscript for important intellectual content and decided to publish the final version.

Declaration of competing interests

We declare no competing interests.

Data sharing

Individual pseudonymised participant data that underlie the results reported in this Article will be made available to others upon submission of a proposal. Requests will be reviewed and sharing of the data will follow the conditions required by all applicable laws and the possible prior signature of any necessary agreement, in accordance with the legal framework set forth by Médecins Sans Frontières data sharing policy, which ensures that all security, legal, and ethical concerns are addressed. For data access and additional related documents such as the study

For the **Epicentre contact form** see https://epicentre.msf.org/en/contact

protocol readers can contact the corresponding author directly or through the Epicentre website.

Acknowledgments

The study was funded by Médecins Sans Frontières. The authors thank all study participants, study surveyors and community volunteers and laboratory technicians. We thank the Médecins Sans Frontières team in Cox's Bazar and Ukhia for supporting preparation and implementation of the survey, and Olaya Astudillo for providing editing assistance with this manuscript.

References

1 WHO. Global hepatitis report 2024: action for access in low- and middle-income countries. https://www.who.int/publications/i/item/9789240091672 (accessed Feb 17, 2025).
2 WHO. Hepatitis C - key facts. 2024. https://www.who.int/news-room/fact-sheets/detail/hepatitis-c (accessed Sept 20, 2024).
3 Gonzalez SA, Davis GL. Natural history of hepatitis C. In: Busuttil RW, Klintmalm GBG, eds. Transplantation of the Liver, 3rd edn. Elsevier, 2013; 120–30.
4 Saseetharran A, Hiebert L, Gupta N, Nyirahabihirwe F, Kamali I, Ward JW. Prevention, testing, and treatment interventions for hepatitis B and C in refugee populations: results of a scoping review. *BMC Infect Dis* 2023; **23:** 1–12.
5 MSF. The Rohingya: persecuted across time and place. https://www.msf.org/rohingya-refugee-crisis-depth?component=pull_quote-79221 (accessed Sept 12, 2024).
6 Joint Government of Bangladesh - UNHCR. Population factsheet as of June 2024 - Bangladesh - Cox's Bazar - Bhasan Char. 2024. https://data.unhcr.org/en/country/bgd (accessed Sept 8, 2024).
7 Mahmood SS, Wroe E, Fuller A LJ. The Rohingya people of Myanmar: health, human rights, and identity. *Lancet* 2017; **389:** 1841–50.
8 Bhatia A, Mahmud A, Fuller A, et al. The Rohingya in Cox's Bazar: when the stateless seek refuge. *Health Hum Rights* 2018; **20:** 105–22.
9 Zhang M, O'Keefe D, Iwamoto M, et al. High sustained viral response rate in patients with hepatitis C using generic sofosbuvir and daclatasvir in Phnom Penh, Cambodia. *J Viral Hepat* 2020; **27:** 886–95.
10 Firuz W, Ashakin KA, Schramm B, et al. Evaluation of a simplified model of care for chronic hepatitis C infection in Rohingya population in Ukhiya, Cox's Bazar, Bangladesh. https://scienceportal.msf.org/assets/8816 (accessed Feb 25, 2025).
11 Ali M, Rahman MA, Njuguna H, et al. High prevalence of hepatitis B and C virus infections among Rohingya refugees in Bangladesh: a growing concern for the refugees and the host communities. *Clin Liver Dis* 2022; **19:** 1–6.
12 Mazhar MKA, Finger F, Evers ES, et al. An outbreak of acute jaundice syndrome (AJS) among the Rohingya refugees in Cox's Bazar, Bangladesh: findings from enhanced epidemiological surveillance. *PLoS ONE* 2021; **16:** e0250505.
13 Mahtab M, Fazle Akbar SM, Takahashi K, et al. Alarming levels of hepatitis C virus prevalence among Rohingya refugees in Bangladesh: emergency national and international actions warranted. *Euroasian J Hepatogastroenterol* 2019; **9:** 55–56.
14 OCHA services. OCHA services-Camp boundary (Admin level-1) of Rohingya refugees in Cox's Bazar, Bangladesh. https://data.humdata.org/dataset/outline-of-camps-sites-of-rohingya-refugees-in-cox-s-bazar-bangladesh (accessed March 2, 2023).
15 Joint Government of Bangladesh - UNHCR. Population Factsheet - Block Level as of April 2023 -Bangladesh - Cox's Bazar Chittagong. 2023. https://reliefweb.int/report/bangladesh/joint-government-bangladesh-unhcr-population-factsheet-population-breakdown-april-2023 (accessed May 2, 2023).
16 Keiding N. Estimation from current-status data in continuous time. *Lifetime Data Anal* 1996; **129**: 119–29.
17 Joint Government of Bangladesh - UNHCR. UNHCR Population Factsheet as of May 2023 - Bangladesh Cox's Bazar - Bhasan Char Chittagong. 2023. https://data.unhcr.org/en/country/bgd/12112 (accessed July 6, 2023).
18 Salari N, Darvishi N, Hemmati M, et al. Global prevalence of hepatitis C in prisoners: a comprehensive systematic review and meta-analysis. *Arch Virol* 2022; **167:** 1025–39.
19 Ahsan A, Khan AZ, Javed H, Mirza S, Chaudhary SU, Shahzad-ul-Hussan S. Estimation of hepatitis C prevalence in the Punjab province of Pakistan: a retrospective study on general population. *PLoS ONE* 2019; **14:** e0214435.
20 Mohamoud YA, Mumtaz GR, Riome S, Miller DW, Abu-Raddad LJ. The epidemiology of hepatitis C virus in Egypt: a systematic review and data synthesis. *BMC Infect Dis* 2013; **13:** 288.
21 Coalition for Global Hepatitis Elimination. Country Data - Bangladesh. https://www.globalhep.org/data-profiles/countries/bangladesh (accessed July 15, 2024).
22 Phyo Z, Ko K, Ouoba S, Sugiyama A, et al. Intermediate hepatitis C virus (HCV) endemicity and its genotype distribution in Myanmar: a systematic review and metaanalysis. *PLoS ONE* 2024; **19:** e0307872.
23 Ayoub HH, Chemaitelly H, Omori R, Abu-Raddad LJ. Hepatitis C virus infection spontaneous clearance: has it been underestimated? *Int J Infect Dis* 2018; **75:** 60–66.
24 Mansoor M, de Glanville WA, Alam R, et al. Prevalence and risk factors for hepatitis C virus infection in an informal settlement in Karachi, Pakistan. *PLOS Global Public Health* 2023; **3:** e0002076.
25 Lynch E, Falq G, Sun C, et al. Hepatitis C viraemic and seroprevalence and risk factors for positivity in Northwest Cambodia: a household cross-sectional serosurvey. *BMC Infect Dis* 2021; **21:** 223.
26 Abdel-Gawad M, Nour M, El-Raey F, Nagdy H, Almansoury Y, El-Kassas M. Gender differences in prevalence of hepatitis C virus infection in Egypt: a systematic review and meta-analysis. *Sci Rep* 2023; **13:** 2499.
27 Clifford GM, Waterboer T, Dondog B, et al. Hepatitis C virus seroprevalence in the general female population of 9 countries in Europe, Asia and Africa. *Infect Agent Cancer* 2017; **12:** 9.
28 Joint Government of Bangladesh - UNHCR. Population Factsheet - Block Level as of September 2023 - Bangladesh - Cox's Bazar - Bhasan Char. 2023. https://data.unhcr.org/en/documents/details/103839 (accessed Feb 14, 2024).
29 WHO. Battling viral hepatitis in Rohingya camps amid mounting risk and resource crunch. https://www.who.int/southeastasia/news/detail/19-06-2024-battling-viral-hepatitis-in-rohingya-camps-amid-mounting-risk-and-resource-crunch (accessed July 17, 2024).
30 WHO. Global health sector strategy on viral hepatitis 2016-2021. Towards ending viral hepatitis. https://www.who.int/publications/i/item/WHO-HIV-2016.06 (accessed March 10, 2025).
31 WHO. Workshop on development of costed action plans for viral hepatitis in South-East Asia Region. 2019. https://www.who.int/southeastasia/news/events/detail/2019/08/19/default-calendar/workshop-on-development-of-costed-action-plans-for-viral-hepatitis-in-south-east-asia-region (accessed July 15, 2024).
32 Roudot-Thoraval F. Epidemiology of hepatitis C virus infection. *Clin Res Hepatol Gastroenterol* 2021; **45:** 101596.
33 Spearman CW, Dusheiko GM, Hellard M, Sonderup M. Hepatitis C. *Lancet* 2019; **394:** 1451–66.
34 Salomon I, Olivier S, Egide N. Advancing hepatitis C elimination in Africa: insights from Egypt. *Hepat Med* 2024; **16:** 37–44.