Original Article
Cent Asian J Med Sci. 2021 Dec;7(4):346-354. https://doi.org/10.24079/CAJMS.2021.12.006

Central Asian Journal of Medical Sciences
CAJMS

Prevalence of Blood-Borne Infection Among Healthcare Workers

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Submitted: September 16, 2021
Revised: September 22, 2021
Accepted: December 18, 2021

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Objectives: Needlestick and sharps injuries are a major cause of transmission of blood borne pathogens in health-care workers. The present study aims to examine the yearly incidence and causes of sharps injuries and assess the prevalence of blood-borne infection in provincial healthcare workers in Mongolia. **Methods:** A cross-sectional study enrolling 21 province hospitals across Mongolia was conducted from 2015 to 2019. Descriptive data presented as absolute numbers with percentage and a multivariate analysis was employed to identify the association between risk factors and occupational exposure to blood-borne factors. **Results:** Of the 20546 health care workers, 12.5% (n = 2566) employees were infected with hepatitis. Approximately 4.4% were infected with hepatitis B; 7.5% with hepatitis C; and 0.6% with hepatitis B, C or B, D. Among health care workers detected with hospital-acquired infection, most were women (n = 84.1%), aged between 41-55 years old (58.9%). Having sharp needlestick injuries, blood and body liquids splash, and a dental service was found to be associated with hospital-acquire infection in the study. **Conclusion:** Our study results demonstrated that 12 out of 100 health care workers were infected with HAI in Mongolia. This indicates that there be might serious occupational hazards. Public health authorities should consider increasing provision of public health programs such as vaccination, safety equipment and adjusted workload. Health care workers in Mongolia should be informed about the risks and consequences, as well as undertake preventive measures.

Keywords: Blood-Borne, Infection, Hepatitis, Prevalence, Healthcare Workers

Introduction

An infection that is acquired in a hospital or other health care facility is most commonly described as a hospital-acquired infection or a nosocomial infection [1]. To emphasize both hospital and nonhospital settings, it is sometimes instead called a healthcare associated infection [2]. Infection can be transmitted to the susceptible patient in the clinical setting by various means. Health care staff can also spread infection, in addition to contaminated equipment, bed linens, or air droplets. The infection

can originate from the outside environment, another infected patient, staff that may be infected, or in some cases, the source of the infection cannot be determined [3]. According to the World Health Organization (WHO), the prevalence of hospital-acquired infection is up to 20 times more in low- and middle-income countries when compared to developed nations [4]. Hospital acquired infection is mainly associated with non-compliant practice with infection control regime by health workers, it can lead to increased risk of deterioration, mortality, which in turn negatively can affect the work productivity, psychosocial well-being, disability, as well as increase in hospitalization rates and increase in the cost of health care system.

In 2011, the WHO reported findings from a study investigating the prevalence of hospital acquired infections and it involved 55 hospitals in 14 countries across four regions. The study results showed almost 9% of inpatients were diagnosed with hospital-acquired infection [5]. Eriksen et al. demonstrated that the total prevalence of the four recorded nosocomial infections varied between 5.1% and 5.4% in the 76 acute care hospitals in Norway. The most frequent infection was located in the urinary tract (34%), followed by the lower respiratory tract (29%), surgical sites (28%) and septicaemia (8%) (26). Another study in Slovenia showed 4.6% hospital-acquired infection among 6695 patients surveyed. The prevalence of urinary tract infections was highest (1.2%), followed by pneumonia (1.0%), surgical wound infection (0.7%), and bloodstream infection (0.3%) (27). Similar results also were reported in the study of Starakis et al, where urinary tract infections, bloodstream infections, surgical site infections, and gastrointestinal infections were found in 25.8%, 19.6%, 7.2% and 4.1% of patients, respectively (28). On the other hand, Ider et al reported that the prevalence of hospital-acquired infection ranged from 0.01% to 0.05% of all hospital admissions, with the highest prevalence (0.05%) reported by tertiary hospitals in Ulaanbaatar. In contrast, a 1-day prevalence study piloted at two tertiary hospitals showed that 5.4% of the 933 patients surveyed were diagnosed with HAI [6].

There are limited data assessed the prevalence of hospital-acquired infection in health care workers. Yasin et al showed that 58.5% (165) and 42.2% (119) of the study participants had been exposed to blood and body fluids and needlestick injury in their lifetime, respectively [7]. Another study by Lee et al demonstrated that, among 10,452 health care workers, 1076 occupational blood exposure were reported (8.5% of doctors and 6.2% of nurses). Of these, 133 case was associated with HBV, 126 case was with HCV and 25 cases with HIV, however, neither HBV nor HIV infection occurred (29). On the other hand, the prevalence of HBV surface antigen (HBsAg) in the surgeons was found to be 25.7% in Nigerian study (9).

There are a few studies assessing the prevalence of hospital-acquired infection among health professionals in Mongolia. Kakizaki et al. reported that the incidence of needlestick and sharps injuries (NSSIs) during the previous 3 months was 38.4%. Health care workers were more likely to report NSSIs if they worked longer than 35 hours per week (odds ratio, OR: 2.47; 95% confidence interval, CI: 1.31- 4.66) and administered more than 10 injections per day (OR: 4.76; 95% CI: 1.97- 11.49). The likelihood of self-reporting NSSIs significantly decreased if health care workers adhered to universal precautions [8]. However, in this study, two out of thirteen public tertiary hospitals in the capital city were selected (National Center for Communicable Diseases Hospital and P.N. Shastin Central Hospital) and the survey of 435 health-care workers was conducted within three months, which is significantly shorter than other studies. Therefore, in the present study, we aimed to evaluate the prevalence of blood-borne infection among healthcare workers recruiting province' hospitals of Mongolia across 21 provinces between 2015 and 2019.

Materials and Methods

Research design and subjects

An institution-based case-control study was conducted in the province' hospitals of Mongolia between 2015 and 2019. Data regarding the infection rates were obtained using a standardized questionnaire from each hospital. A total of 449 medical professionals, including medical doctors and nurses, were reported as infected by hepatitis B, C and D viruses.

Based on the questionnaire, we selected cases and control groups. Two hundred and thirty-five prevalence-cases with hepatitis B, C and D virus infection were identified. Controls were matched to cases by sex, and age groups.

Questionnaire design

The questionnaire consists of twenty-six questions. All the questions were close ended. In the questionnaire, we included the variables such as working experience, sharp needles injury,

surgery, beauty salon, dental service, trauma and vaccine as well as intravenous treatment experience. The questionnaires were checked and missing information was completed by telephone interview. Data from the questionnaires were double-entered.

Statistical analysis

Descriptive statistics, including frequency, percentages, mean and standard deviation (SD), were calculated to evaluate demographic data characteristics. One-way ANOVA tests with Tukey's multi-comparison test, unpaired t-test and chi-square tests were conducted to determine statistically significant differences. Multiple logistic regression analysis was performed to identify the potential risk factors and exposure to hospital-acquired infection. For hypothesis testing, the critical p-value was set at 0.05. The statistical analysis was performed using Sciences (SPSS) version 20 statistical software.

Ethical statement

Ethical approval was obtained from the research and ethics review committee of MNUMS (2016.01.15 (No.6/3/2016- 06). The hospital administration was informed about the purpose of the study and informed consent was obtained from the participating hospitals. All data provided by each hospital were identified and data were managed in accordance to the guidelines.

Results

Demographic information of participants

Of the 20546 healthcare workers employed in the 21 province hospitals, 12.5% (n = 2566) were infected with hepatitis. Most respondents were females and 15.9% (n = 408) were males. The age range of study subjects was from 18 to 65 years with the mean age of 38 years. Approximately 46% of the study participants had a working experience of more than 21 years. To a lesser proportion with 4.4% (n = 893) of the study participants had hepatitis B, 7.5% (n = 1534) had hepatitis C infection, 0.6% (n = 63) had both combined B, C and B, D virus respectively (Table 1).

The prevalence of hepatitis and some risk factors

Hepatitis infection was more prevalent among specialized

Table 1. General characteristics of health care workers.

Variables	Needlestick Injuries			
	Case (n = 235)	Control (n = 207)	Total (n = 442)	
	Mean ± SD	Mean ± SD	Mean ± SD	p-value
Age, years	44.25 ± 8.99	42.05 ± 10.15	43.31 ± 9.59	0.000
Working experience, years	20.74 ± 9.45	16.72 ± 10.26	19.03 ± 10.08	0.000
	N (%)	N (%)	N (%)	
Gender				
Male	30 (12.8)	28 (13.5)	58 (12.9)	0.924
Female	205 (87.2)	179 (86.4)	390 (87.1)	
Organization				
Province hospitals	72 (30.6)	55 (26.6)	129 (28.8)	0.008
Regional hospitals	48 (20.4)	31 (14.9)	79 (17.6)	
Professional hospitals	65 (27.7)	89 (42.9)	155 (34.6)	
District hospitals	50 (21.3)	32 (15.5)	85 (18.9)	
Professions				
Medical doctors	42 (17.9)	50 (24.2)	93 (20.8)	0.000
Nurses / midwifes	125 (53.2)	61 (29.6)	188 (42.2)	
Specialized doctors	32 (13.6)	35 (16.9)	68 (15.2)	
Others	36 (15.3)	60 (29.1)	97 (21.7)	

Continued

Departments / units			
Genecology	26 (11.2)	9 (4.4)	35 (7.9)
Surgery	27 (11.6)	10 (4.9)	37 (8.3)
Internal medicine	18 (7.7)	21 (10.2)	40 (9.0)
Intensive care	18 (7.7)	13 (6.3)	31 (6.9)
Laboratory	16 (6.8)	4 (1.9)	21 (4.7)
Sterilization	14 (6.0)	7 (3.4)	21 (4.7)
Others	114 (48.9)	142 (68.9)	259 (58.3)

Table 2. Risk factors of hepatitis virus infection.

Variables	Case (n = 235) N (%)	Control (n = 207) N (%)	Total (n = 442) N (%)	p-value
Sharp needles injury				
Yes	146 (62.1)	25 (12.2)	171 (38.8)	0.000
No	89 (38.7)	180 (87.8)	270 (61.2)	
Surgery				
Yes	148 (63.2)	112 (54.6)	264 (59.3)	0.082
No	86 (36.8)	93 (45.4)	181 (40.7)	
Beauty salon				
Yes	98 (41.7)	69 (33.3)	170 (37.9)	0.086
No	137 (58.3)	138 (66.7)	278 (62.1)	
Dental service				
Yes	170 (72.3)	121 (58.5)	294 (65.6)	0.003
No	65 (27.7)	86 (41.5)	154 (34.4)	
Trauma				
Yes	54 (22.9)	34 (16.4)	89 (19.9)	0.109
No	181 (80.1)	173 (83.6)	359 (80.1)	
Tattoo				
Yes	29 (12.3)	17 (8.2)	48 (10.7)	0.207
No	206 (87.7)	190 (91.8)	400 (89.3)	
Virus test				
Yes	112 (47.7)	98 (48.3)	210 (47.5)	0.974
No	123 (52.3)	105 (51.7)	232 (52.5)	
Vaccine				
Yes	116 (50.2)	100 (49.0)	217 (49.5)	0.878
No	115 (49.8)	104 (51.0)	221 (50.5)	
B virus				
Yes	89 (42.8)	75 (39.5)	167 (41.5)	0.049
No	119 (56.7)	115 (60.5)	235 (58.5)	
C virus				
Yes	125 (58.7)	79 (39.9)	208 (50.0)	0.000
No	88 (41.3)	119 (60.1)	208 (50.0)	
Treatment				
Yes	98 (43.4)	60 (30.9)	161 (37.8)	0.012
No	128 (56.6)	134 (69.1)	265 (62.2)	

Table 3. Prevalence of hepatitis virus infection.

	Hepatitis B (n = 143)	Hepatitis C (n = 184)	Hepatitis B and C (n = 24)	Total (n = 351)	p-value
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Age, years [a]	41.14 ± 8.95	45.96 ± 8.68	46.87 ± 8.68	43.31 ± 9.59	0.000
Working experience, years [b]	15.89 ± 9.75	21.20 ± 9.58	21.0 ± 11.47	19.02 ± 10.07	0.000
	N (%)	N (%)	N (%)	N (%)	
Gender					
Male	27 (20.3)	20 (11.9)	5 (4.2)	58 (12.9)	0.924
Female	114 (79.7)	162 (88.0)	23 (95.8)	390 (87.1)	
Organization					
Province hospitals	42 (29.4)	65 (35.3)	12 (50.0)	129 (28.8)	0.209
Regional hospitals	39 (27.3)	31 (16.8)	4 (16.7)	79 (17.6)	
Professional hospitals	34 (23.8)	49 (26.6)	4 (16.7)	155 (34.6)	
District hospitals	28 (19.6)	39 (21.2)	4 (16.7)	85 (18.9)	
Professions					
Medical doctors	36 (25.4)	39 (21.9)	5 (16.7)	93 (20.9)	0.638
Nurses / midwifes	58 (40.8)	82 (44.8)	8 (33.3)	188 (42.2)	
Specialized doctors	18 (12.7)	24 (13.1)	6 (25.0)	68 (15.2)	
Others	30 (21.1)	37 (20.2)	6 (25.0)	97 (21.7)	
Departments / units					
Genecology	14 (9.8)	13 (7.2)	2 (8.3)	35 (7.9)	
Surgery	11 (7.7)	16 (8.8)	5 (20.8)	37 (8.3)	
Internal medicine	12 (8.5)	15 (8.3)	2 (8.3)	40 (9.0)	
Intensive care	11 (7.7)	12 (6.6)	3 (12.5)	31 (6.9)	
Laboratory	7 (4.9)	11 (6.1)	2 (8.3)	21 (4.7)	
Sterilization	8 (5.6)	7 (3.9)	-	21 (4.7)	
Others	79 (55.6)	107 (59.1)	10 (41.7)	259 (58.3)	

One-way ANOVA, multiple comparison: [a]Hepatitis B vs. Hepatitis C, p = 0.001; [b]Hepatitis C vs. Hepatitis B and C, p = 0.000.

professionals 16.9% (n = 590), where it was 10.7% (n = 414) and 14.6% (n = 781) among doctors, nurses, and midwives respectively (Table 2). Most of study participants (64.3%), were exposed to sharp needlestick injuries in the last 21- 25 years, 49.2% were exposed to blood and body liquid splash in the period of more than 26 years (p < .001). The presence of macrosurgery over their lifetime were reported as 70.2% of the study participants. The majority (73.4%) of the study participants had dental services previously (Table 3).

Multivariate analysis of some risk factors

The univariate analysis showed a significant association between hospital-acquired infection and the risk factors were age, profession, sharp needlestick injuries, the presence of blood and body fluids splash, having macrosurgery, or dental service (p < 0.05) (Table 3).

In the multivariate analysis, having sharp needlestick injuries (Adjusted Odds Ratio (OR) 1. 1 (1.02- 7.2), and blood and body liquids splash (AOR = 2.15, 95% CI 1.2- 4.3), or having a dental service (AOR = 2.1, 95% CI 1.09- 5.5) were found to be risk factors associated with blood-borne infection among health care workers (Table 4).

Table 4. Multivariate logistic regression analysis of risk factors associated with hospital-acquired infection and risk factors.

Variables	OR	95% CI	p-value
Age groups			
18 - 27	1.00	Reference	
28 - 37	1.21	0.51 - 2.00	0.531
38 <	2.23	1.35 - 8.86	0.051
Professions			
Office workers	1.00	Reference	
Medical doctors	1.24	1.01 - 6.13	0.001
Specialized doctors	1.67	0.20 - 4.21	0.082
Nurses/midwifes	1.18	0.97 - 1.56	0.099
Sharp needlestick injuries			
No	1.00	Reference	
Yes	1.21	1.04-9.89	0.003
Had a surgery			
No	1.00	Reference	
Yes	1.94	0.87 - 3.39	0.091
Exposed to blood			
No	1.00	Reference	
Yes	2.33	1.61 - 8.54	0.001
Had a dental service			
No	1.00	Reference	
Yes	2.65	1.16 - 14.4	0.020
Gender			
Male	1.00	Reference	
Female	1.33	0.80 - 2.20	0.086
Tattoo			
No	1.00	Reference	
Yes	0.99	0.40 - 2.49	0.994
Beaty salon service			
No	1.00	Reference	
Yes	1.78	1.65 - 4.69	0.056
Trauma			
No	1.00	Reference	
Yes	1.15	0.69 - 1.91	0.586
Organization			
Professional hospitals	1.00	Reference	
Regional hospitals	1.19	0.80 - 12.20	0.109
Province hospitals	0.84	0.65 - 14.69	0.095
District hospitals	1.09	1.04 - 9.89	0.314

Discussion

Our study enrolled 21 province hospitals in Mongolia and examined the prevalence of hospital-acquired infection in health care workers. Our study results demonstrated that 12 of 100 Mongolian health care workers were infected with hospital-acquired hepatitis. No other infection types were detected in our study cohort. Our study findings are comparable to those reported from low-middle income countries. A 2011 review assessing the prevalence of hospital-acquired infection in low- and middle-income countries included 220 studies. The pooled estimated prevalence of hospital-acquired infection was

15.5 per 100 patients [95% CI 12·6–18·9] [9, 10]. A study by Butsashvili et al. was performed in a Georgian public hospital enrolling 1386 health care workers. Similar to our study, the nosocomial risk events were reported by the majority of health care workers, including accidental needlestick injury (45%), cuts with contaminated instruments (38%) and blood splashes (46%). The proportion of needlestick injuries was found to be the highest among physicians (22%) and nurses (39%), and was related to recapping of used needles. Prevalence of HCV infection was 5%, anti-HBc was present among 29% with 2% being HBsAg carriers [11].

Similar findings are reported from other studies. A study from Brazil enrolling 1077 health care workers reported the mean incidence rate of occupational BBF exposures was 11.9 per 100 full-time equivalent worker-years (95% confidence interval: 8.4– 15.3). The cumulative prevalence was 7% during the 12 months preceding the interview. University-level education, employment as a nurse assistant, dental assistant or dentist, higher workload score, inadequate working conditions, having sustained a previous occupational accident and current smoking were associated with BBF exposures ($p \leq 0.05$) [12].

A long term retrospective observational descriptive study identified the exposure to hospital-acquired infections for 17 years in Lebanon [13]. Overall, the rate of blood and bloody fluid exposures was 0.6 per 100 admissions per year. In 2001, the proportion of infection was 13% in house officers and 8% for attending physicians, followed by 5% for nurses. Commonly stated reasons included a procedural intervention (29%), improper disposal of sharps (18%), to recapping (11%) and to other causes (5%) [13].

Observational studies from other low-middle income settings reported the prevalence of hospital-acquired infection to be higher, in particular it was almost 60% in Northwest Ethiopia (58.5%), and more than 65% in other countries, including Serbia (66%) [14], Iran (74%) [15], India (73%) [16] and Bahir Dar (74%) [17]. However, these studies failed to report on the prevalence rates of hospital -acquired infection in health care workers.

Consistent with reports from other studies, predisposing factors to needlestick injuries were related with several factors, including the over-use of injections, unnecessary sharps, lack of personal protective equipment (PPE) supplies, failure to use sharps container immediately after use, poorly trained staff, needle recapping, no engineering control, such us safe needle devices, passing instruments from hand to hand in the operating room, and lack of hazard awareness [18]. This was in agreement with our findings in which 57.1% of staff had needlestick injuries and 40.4% were exposed to blood and body fluid splash.

Currently, HBV is the only one that has a vaccine, which can prevent the virus to progress to more severe infections, including the HBCV, HCV and HIV [18]. Health care workers who received hepatitis B vaccine are at almost no risk infection [19]. The overall prevalence of chronic HBV infection (HBsAg positive) among health care workers in a tertiary hospital in the northern part of Tanzania was 7.0 % [9], whereas in our study it was lower with 4.4% (893) of the participants having hepatitis B. This may be related to high vaccine coverage in the Mongolian population, with more than 90% in 2012 and 2013. However, the prevalence of hepatitis B was prevalent in 12% of the unvaccinated population [20]. In Mongolia, vaccination for hepatitis B is mandatory for health care workers, however no current evidence to demonstrate the coverage rates of vaccination in health care workers was found in our literature review. Further research needs to investigate the coverage rate, as well as identify risk factors and challenges to vaccination in health care workers.

Compared to our results in the Democratic Republic of Congo 13.7% of the samples were seropositive for HCV but only 3.7% were viremic [21]. Other studies from Nigeria and Angola showed rates of HCV seroprevalence (anti-HCV+) of 12.8% and 8 %. The risk of getting virus in age 30-49 was 33.6% of all study participants and 73% of all infected people [22, 23]. Mongolia is one of the countries with the high prevalence rates of hepatitis C worldwide, ranging from 10-12% of the total population [24, 25]. Again, our study was the first to inform about the prevalence of hepatitis C in health care workers in Mongolia.

As indicated by others, exposure to hospital-acquired infection may be associated with insufficient hand washing practices found in health workers, major reasons being lack of hot water supply, and inadequate handwashing basins, and soaps to provincial level health care workers. In addition, lack of hand sanitizers and high work overload at tertiary level hospitals was associated with malpractice regarding hand washing [26]. Showing the current picture of occupational exposure to hepatitis infection could be taken as the strength of this study.

Limitations of our study may include the retrospective

cross-sectional study design and our data extraction was from paper-based reports. This was time consuming and tedious work, however all entries were double checked and validated to assure the accuracy of data. In the present study, except hepatitis, no other types of hospital-acquired infection were identified in our study cohort. Given that, health care workers are more prone to hepatitis, in particular hepatitis B, [27-30]. We believe that our results are representable of the current practice on the national level. On the other hand, our study was based on hospital reports which may not completely cover the previous lifetime occupational exposure. This may affect the result by under reporting by health care workers. Thus, particular consideration should be directed towards whether the participants of this survey had needle stick injuries before the survey and need further investigation.

Conclusions

The prevalence of hospital acquired infection was 12.5 per 100 health care workers in Mongolia. The main infection was due to hepatitis, most being infected with hepatitis B (n = 893, 34.8%). Given that vaccination is available for HVB, considerable work must be undertaken to increase the immunisation rate among health care workers in Mongolia. Moreover, extended national guidelines should provide the risks associated with hospital=acquired infection while working in a hospital setting in Mongolia.

Conflict of Interest

The authors state no conflict of interest.

Acknowledgements

We would like to express appreciation to all participants of this survey and the 21 province's hospital staff for their kind effort and support.

References

1. Abraham GM, Obley AJ, Humphrey LL, Qaseem A, Centor RM, Akl E, et al. World Health Organization guidelines on treatment of hepatitis C virus infection: best practice advice from the American college of physicians. Ann Intern Med 2021; 174: 98-100.
2. Stiller A, Schröder C, Gropmann A, Schwab F, Behnke M, Geffers C, et al. ICU ward design and nosocomial infection rates: a cross-sectional study in Germany. J Hosp Infect 2017; 95: 71-5.
3. Novosad SA, Fike L, Dudeck MA, Allen-Bridson K, Edwards JR, Edens C, et al. Pathogens causing central-line-associated bloodstream infections in acute-care hospitals-United States, 2011-2017. Infect Control Hosp Epidemiol 2020; 41: 313-9.
4. Sakr CJ, Alameddine R, Hoteit R, Carla D, Rita D, Khalil K, et al. Occupational exposure to blood-borne pathogens among healthcare workers in a tertiary care center in Lebanon. Ann Work Expo Health 2021; 65: 475-84.
5. Yang X, Li R, Hu X, Wang X, Zhang J, Yang L. Prevalence and associated factors of sharps injuries and other blood/body fluid exposures among healthcare workers: a multicenter study. Infect Control Hosp Epidemiol 2021; 9: 1-5.
6. Yasin J, Fisseha R, Mekonnen F. Occupational exposure to blood and body fluids and associated factors among health care workers at the University of Gondar Hospital, Northwest Ethiopia. Environ Health Prev Med 2019; 24: 18-23.
7. Ider BE, Clements A, Adams J, Whitby M, Muugolog T. Prevalence of hospital-acquired infections and antibiotic use in two tertiary Mongolian hospitals. J Hosp Infect 2010; 75: 214-9.
8. Kakizaki M, Ikeda N, Ali M, Enkhtuya B, Tsolmon M, Shibuya K, et al. Needlestick and sharps injuries among health care workers at public tertiary hospitals in an urban community in Mongolia. BMC Res Notes 2011; 4: 184-9.
9. Orji CJ, Chime OH, Ndibuagu EO. Vaccination status and prevalence of hepatitis B virus infection among health-care workers in a tertiary health institution, Enugu State, Nigeria. Proc Singapore Healthc 2020; 29: 119-25.
10. Lopez LBA, Moyado-Ocampo KL, Soto-Ramírez LE. Hospital-based hepatitis C screening in a tertiary care centre in Mexico: targeted at health care- associated transmission. Infect Dis (Lond) 2020; 52: 139-41.
11. Keles E, Hassan-Kadle MA, Osman MM, Eker HH, Abusoglu Z, Baydili KN, et al. Clinical characteristics of acute liver failure associated with hepatitis A infection in children in Mogadishu, Somalia: a hospital-based retrospective study.

BMC Infect Dis 2021; 21: 890-6.
12. Silva KMD, Ferreira JRDS, Carvalho Neto APM, Gomes DCS, Cavalcanti MGDS. Epidemiological profile of viral hepatitis infection in the population treated at a reference hospital in Alagoas. Braz J Biol 2021; 82: e238431.
13. Brennan J, Mullins H, Tobey K, Jones C, Kainer MA, Fiscus M, et al. Nosocomial hepatitis A outbreak among healthcare workers and patients in a community hospital during an ongoing statewide outbreak. Infect Control Hosp Epidemiol 2021; 42: 139-41.
14. Shah SM, Rodin H, Pogemiller H, Magbagbeola O, Ssebambulidde K, Zewde A, et al. Hepatitis B awareness and vaccination patterns among healthcare workers in Africa. Am J Trop Med Hyg 2020; 103: 2460-8.
15. Dayyab FM, Iliyasu G, Ahmad BG, Bako AT, Ngamariju SS, Habib AG. Hepatitis B vaccine knowledge and self-reported vaccination status among healthcare workers in a conflict region in northeastern Nigeria. Ther Adv Vaccines Immunother 2020; 8: 25-7.
16. Akazong WE, Tume C, Njouom R, Ayong L, Fondoh V, Kuiate JR. Knowledge, attitude and prevalence of hepatitis B virus among healthcare workers: a cross- sectional, hospital-based study in Bamenda Health District, NWR, Cameroon. BMJ Open 2020; 10: e031075.
17. Botchway ET, Agyare E, Seyram L, Owusu KK, Mutocheluh M, Obiri-Yeboah D. Prevalence and attitude towards hepatitis B vaccination among healthcare workers in a tertiary hospital in Ghana. Pan Afr Med J 2020; 36: 244.
18. Kandi V, Katoch A, Miniskar H, Jaripiti S, Rv SS, Burugu HR, et al. Adequate knowledge and low vaccination rates of hepatitis B virus infection among students, medical, and paramedical persons in a tertiary care teaching hospital. Cureus 2020; 12: e9121.
19. Yuen MF, Agarwal K, Gane EJ, Schwabe C, Ahn SH, Kim DJ, et al. Safety, pharmacokinetics, and antiviral effects of ABI-H0731, a hepatitis B virus core inhibitor: a randomised, placebo-controlled phase 1 trial. Lancet Gastroenterol Hepatol 2020; 5: 152-66.
20. Grazzini M, Arcangeli G, Mucci N, Bonanni P, Bini C, Bechini A, et al. High chance to overcome the non-responder status to hepatitis B vaccine after a further full vaccination course: results from the extended study on healthcare students and workers in Florence, Italy. Hum Vaccin Immunother 2020; 16: 949-54.
21. Hiva S, Negar K, Mohammad-Reza P, Gholam-Reza G, Mohsen A, Ali-Asghar NG, et al. High level of vaccination and protection against hepatitis B with low rate of HCV infection markers among hospital health care personnel in north of Iran: a cross-sectional study. BMC Public Health 2020; 20: 920.
22. Ssekamatte T, Mukama T, Kibira SPS, Ndejjo R, Bukenya JN, Kimoga ZPA, et al. Hepatitis B screening and vaccination status of healthcare providers in Wakiso district, Uganda. PLoS One 2020; 15: e0235470.
23. Wong GL, Wen WH, Pan CQ. Hepatitis B-management of acute infection and active inflammation in pregnancy-a hepatologist's perspective. Best Pract Res Clin Obstet Gynaecol 2020; 68: 54-65.
24. Gebremeskel T, Beshah T, Tesfaye M, Beletew B, Mengesha A, Getie A. Assessment of knowledge and practice on hepatitis B infection prevention and associated factors among health science students in Woldia University, Northeast Ethiopia. Adv Prev Med 2020; 2020: 94-6.
25. Zhang L, Ai Y, Liu J, Yue N, Xuan J, Bal V, et al. Economic burden of needlestick injuries among healthcare workers in China. J Med Econ 2020; 23: 683-9.
26. Bhattarai S. Knowledge, attitude and practice of hepatitis B vaccination among health care workers at Manipal teaching hospital. Kathmandu Univ Med J (KUMJ) 2020; 18: 256-9.
27. Eriksen HM, Iversen BG, Aavitsland P. Prevalence of nosocomial infections in hospitals in Norway, 2002 and 2003. J Hosp Infect 2005; 60: 40-5.
28. Klavs I, Bufon Luznik T, Skerl M, Grgic-Vitek M, Lejko Zupanc T, Dolinsek M, et al. Slovenian hospital-acquired infections survey group. Prevalence of and risk factors for hospital-acquired infections in Slovenia-results of the first national survey, 2001. J Hosp Infect 2003; 54: 149-57.
29. Starakis I, Marangos M, Gikas A, Pediaditis I, Bassaris H. Repeated point prevalence survey of nosocomial infections in a Greek university hospital. J Chemother 2002; 14: 272-8.
30. Lee JH, Cho J, Kim YJ, Im SH, Jang ES, Kim JW, et al. Occupational blood exposures in health care workers: incidence, characteristics, and transmission of bloodborne pathogens in South Korea. BMC Public Health 2017; 17: 827-31.