

Incidence of work accidents involving exposure to biological materials among healthcare workers in Brazil, 2010-2016

Incidência de acidentes de trabalho com exposição a material biológico em profissionais de saúde no Brasil, 2010-2016

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ABSTRACT | Background: Work accidents involving exposure to biological materials (WAEMB) are frequent among healthcare workers (HCW) and might have consequences for their health. **Objective:** To describe the characteristics of WAEMB involving HCW and post-exposure measures in Brazil as a whole. **Methods:** Ecological study based on secondary data recorded by System of Information on Notifiable Diseases (SINAN) for the period from 2010 to 2016. We performed descriptive analysis and calculated incidence coefficients (IC) per 1,000 HCW/year using software Stata 14.0. **Results:** The highest IC corresponded to 2014 (16.84). On analysis per state, the highest IC corresponded to Goiás, Minas Gerais, São Paulo and Paraná. Most victims were women, nursing assistants or technicians (64.71%), workers aged 15-31 years old, and with ≥ 12 years of formal education. Most accidents involved blood (74.93%) and percutaneous exposure (75.33%); needles were the most frequent causative agent (57.59%). About 29.71% of victims did not wear gloves at the time of the accident, and 1.12% refused chemoprophylaxis. Data missed for several variables of interest. **Conclusion:** Our description points to the need for effective preventive measures mainly based on use of personal protective equipment, lifelong learning and continuing education for HCW and adequate WAEMB reporting.

Keywords | accidents, occupational; occupational accidents registry; biological material; health personnel.

RESUMO | Introdução: Os acidentes de trabalho com exposição a material biológico (ATEMB) entre os profissionais de saúde ainda são frequentes e podem acarretar consequências à saúde do trabalhador. **Objetivo:** Descrever as características e as condutas adotadas pós-exposição entre os profissionais de saúde vítimas de ATEMB no Brasil. **Métodos:** Estudo ecológico, com dados secundários registrados no Sistema de Informação de Agravos de Notificação (SINAN), no período de 2010 a 2016. Realizou-se uma análise descritiva, calcularam-se os coeficientes de incidência (CI) por 1.000/profissionais-ano. Utilizou-se o Stata 14.0 para análise dos dados. **Resultados:** O maior CI no país foi observado no ano de 2014 (16,84). Na análise por unidade federativa (UF), os maiores CI foram encontrados em Goiás, Minas Gerais, São Paulo e Paraná. Entre os casos notificados, prevaleceram a população feminina, na faixa etária entre 25-31 anos, com 12 anos ou mais de escolaridade, e auxiliares e técnicos de enfermagem (64,71%). O sangue foi o material biológico mais envolvido nos acidentes (74,93%) por meio da via percutânea (75,33%), com a agulha sendo o principal agente causador (57,59%), e 29,71% dos pesquisados não utilizavam luvas no momento do acidente. Nas condutas adotadas pós-exposição, 1,12% recusou a quimioprofilaxia indicada. Entre as variáveis relacionadas em estudo, existiam muitos dados registrados como ignorado ou em branco. **Conclusão:** A descrição levantada denota a necessidade de medidas de prevenção efetivas que estejam baseadas principalmente no uso do equipamento de proteção individual e na educação permanente e continuada dos profissionais, assim como no preenchimento adequado das fichas de notificação.

Palavras-chave | acidentes de trabalho; notificação de acidentes de trabalho; material biológico; profissionais de saúde.

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INTRODUCTION

Work accidents involving exposure to biological materials (WAEBM) still are a public health problem with impacts for both organizations and workers^{1,2}. WAEBM are characterized as injuries derived from direct contact with blood or other body fluids in the workplace. They might occur through percutaneous inoculation involving sharps, or through direct contact with non-intact skin and/or mucous membranes^{3,4}. More than 90% of WAEBM occur in developing countries^{5,6}.

About 926,000 percutaneous accidents affecting health-care workers (HCW) are estimated to occur every year worldwide⁷. WAEBM led to an average of 145 (53–766) premature deaths from infection with the hepatitis C virus (HCV) and 736 premature deaths (129–3,578) from infection with the human immunodeficiency virus (HIV) among HCW in the period from 2000 to 2030 worldwide, variations due to geographical differences⁸.

In a study conducted in Cairo, Egypt⁹, HCV seroprevalence was 8% among 1,770 HCW, and the estimated incidence of HCV infection 7.3 per 1,000 person-years. Risk factors associated with HCV seropositivity were: age, history of blood transfusions and history of anti-schistosomiasis treatment.

A study performed in Nigeria found that the prevalence of sharps injuries among HCW in the previous 12 months was 51%. The authors observed that high prevalence rates indicate that HCW are at high risk of acquiring diseases spread through body fluids¹⁰.

The incidence of sharps injuries found in studies conducted in Ethiopia⁶ and in Ghana¹¹ was 19.1 and 37%, respectively. In both cases, the authors called the attention to the high prevalence of this type of accidents and to underreporting.

According to data available at System of Information on Notifiable Diseases (SINAN), the incidence of WAEBM is high in Brazil, and HCW are the most frequent victims¹². Indeed, this is leading occupational category in terms of number of accidents. A total of 203,709 WAEBM reports in the period from 2007 to 2013 recorded the victims' occupation: 76.86% (156,572) were HCW¹³.

According to a study conducted at a public hospital in Paraná, Brazil, in 2012¹⁴, 83.3% of 1,217 reported accidents corresponded to females, 59.6% to workers aged 20–34 years

old and 48.8% to nursing staff. Most cases involved percutaneous exposure (65.7%), followed by contact with intact skin (20.5%) and mucous membranes (12.6%), with blood as source (78.9%).

Also in a study performed with employees of a clinical analysis laboratory in Cajazeiras, Paraíba¹⁵, Brazil, victims were most frequently female (81.6%). Nursing technicians and biochemists were frequently exposed to biological materials. Most accidents involved the upper limbs (91%) and sources included blood (81.8%) and urine (45.5%).

A total of 1,919 WAEBM affecting HCW were reported in Maranhão¹⁶, Brazil, in the period from 2010 to 2015. Victims were mainly female (85.05%), nursing technicians (73.83%), workers aged 31–40 years old (37%), having attended 12 years of formal education (89.72%), with formal employment relationship (82.35%) and 1 to 5 years in the job (41.51%).

Several studies sought to characterize WAEBM among HCW in different hospital areas^{17,18} and health basic units¹⁹. However, these studies focused on one single occupational group, namely, nursing professionals^{20,21}, were restricted to municipalities or regions²² or sought to monitor risk factors at healthcare facilities²³, especially sharps handling and disposal^{24–26}. None of these studies provide an entire overview of the nationwide situation.

Guidelines for WAEBM victim care and follow-up were established in 1999. The Ministry of Health Administrative Ruling (AR) no. 777, from 2004²⁷, made reporting work accidents — including WAEBM — mandatory. As per AR no. 104/2011²⁸ reporting WAEBM to SINAN is mandatory, and AR no. 1,271/2014²⁹ establishes that public and private healthcare institutions should report WAEBM on a weekly basis, which requirement is reinstated in AR no. 204³⁰ and no. 205³¹, from 17 February 2016.

Incident descriptions — WAEBM among HCW in the present case — enable observations of their dynamics and a prognosis of future occurrences. Descriptive studies of WAEBM and involved HCW categories which consider all the Brazilian states are scarce¹². While the subject might seem saturated, this type of studies have several epidemiological applications, inasmuch as they seek to establish the distribution of diseases or other health-related conditions according to time, place and/or individual characteristics. Their goal, therefore, is to answer

the following question: who, when and where is affected by a given condition³²?

Given the strategic relevance of descriptive studies of work accidents and the current scenario of WAEMB in Brazil, the aim of the present study was to describe WAEMB involving HCW in Brazil in the period from 2010 to 2016.

METHODS

The present is an ecological, time series study of WAEMB involving HCW in Brazil reported to SINAN/Ministry of Health. The study population were all WAEMB records from all 26 Brazilian states and the Federal District reported from 1 January 2010 to 31 December 2016.

Data were collected from SINAN and entered into a reporting and investigation form entitled “Work accidents involving exposure to biological materials”.

We considered as WAEMB all “accidents involving blood or other body fluids suffered by healthcare workers during the performance their job, which exposes them to potentially contaminated biological materials”²⁸.

Access to SINAN WAEMB report database was granted by the Occupational Health General Coordination, Secretariat of Health Surveillance, Ministry of Health, through the Collaborative Center for Work Accident Surveillance, Institute of Collective Health, Federal University of Bahia (UFBA), which is available at www.ccvisat.ufba.br. The data were downloaded and entered into a single Excel 2013 spreadsheet twice to control for possible errors.

We analyzed 331,603 WAEMB reports issued within the preset period of time. Inclusion criteria were: victims aged 18 to 69 years old and HCW.

To identify repeated reports by a same or different healthcare facilities, we compared the records ID number, patient name, date and municipality of origin, alone and combined. Whenever duplicates were confirmed, we considered the earliest report alone for analysis, and when dates were the same, we considered the reports issued at the municipality where the patient resided. Exclusions were made by the investigator who entered the data in the form, according to preset criteria, as e.g. report completeness.

Variables selected for analysis were: state; occupation according to the Brazilian Classification of Occupations;

year, sex (male/female); age range (18–24, 25–31, 32–38, 39–45, 46–52, 53–59 and ≥ 60 years old, as per the Brazilian Institute of Geography and Statistics classification); educational level (<12 , ≥ 12 years of formal education); employment status (formal, informal, unknown/missing data); accident circumstances; causative agent; use of personal protective equipment (PPE); hepatitis B vaccination status; tests results (at the time of the accident–baseline); known source patient.

The number of HCW in each Brazilian state, necessary to calculate incidence coefficients, was obtained from the National Registry of Healthcare Facilities (Cadastro Nacional de Estabelecimentos de Saúde–CNES).

The selected variables were tabulated per year. We calculated absolute and relative frequencies with software Stata 14.0 (Stata Corp., College Station, Texas, USA) then incidence coefficients. As standard population we considered the estimated population of HCW in each analyzed year (2010 to 2016). The annual incidence coefficient was calculated by dividing the total number of WAEMB involving HCW by the total number of HCW in each Brazilian state and year, times 1,000. The results were expressed as incidence of cases per 1,000 HCW/year.

For analysis and comparison between regions and states, the incidence coefficients were standardized by means of the direct method, considering the Brazilian HCW population in 2010 as standard. Incidence coefficients were analyzed according to age range (≥ 18 , 20–39, 40–59, 60–64, ≥ 65 years old) and sex (male/female).

In compliance with the National Health Council Resolution no. 466/2012, the study was subjected to and approved by the research ethics committee of President Dutra University Hospital, Federal University of Maranhão (HU-UFMA), ruling no. 2,039,925/2017.

RESULTS

A total of 331,603 WAEMB were reported to SINAN in the period from 2010 to 2016, 243,621 of which (73.42%) involved HCW, corresponding to 34,803 reports/year and 95 reports/day, on average. The smallest number of reports corresponded to 2010, 28,858 (10.61%), and the largest to 2015, 40,119 (16.46%) (Table 1). The largest number of reports corresponded to São Paulo, 72,350 (29.69%),

followed by Minas Gerais, 29,608 (12.15) and Rio de Janeiro, 21,569 (8.85%). Acre was the state with the smallest number of reports, 243 (0.09%) (Table 1).

The highest incidence coefficient for the entire country corresponded to 2014 (16.84 accidents per 1,000 HCW/year) (Table 2) and the lowest to 2010 (14.01 per 1,000 HCW/year) (Table 2). The highest coefficient for 2016 corresponded to Paraná (24.70 per 1,000 HCW/year) and the lowest to Paraíba (3.65 per 1,000 HCW/year). Roraima was the Northern state with the highest incidence coefficient (16.99 per 1,000 HCW/year), Goiás in the Central-West (22.29 per 1,000 HCW/year) and Minas Gerais in the Southeast (16.20 per 1,000 HCW/year) regions.

Most accidents involved women, workers aged 25–31 years old and with ≥ 12 years of formal education. Most victims were nursing assistants or technicians, followed by physicians and nurses. About 10% of the incidents involved informal workers (Table 3).

Percutaneous and contact with intact skin were the exposure routes in 75.33% and 26.3% of incidents, respectively, with little variation along the analyzed period (Table 4). Most accidents involved contact with blood (74.93%), mainly consisting in needlestick injuries, 67.38% (Table 5).

Most victims wore gloves at the time of the incident (70.29%), but only 24.23% wore masks, 15.77% glasses, 39.57% lab coats, 12.99% boots and 6.49% face protectors (Table 4).

About 82.15% of the victims had received hepatitis B vaccination. Hepatitis B and HIV tests were performed in most cases. About 0.55% of the victims tested positive for hepatitis B and 0.53% for HIV, without variation along the analyzed period (Table 5).

Source patients were known in 67.58% of the incidents. Measures applied after exposure were those recommended by the Ministry of Health, but 1.12% of victims refused the prescribed chemoprophylaxis (Table 5).

DISCUSSION

The results reveal wide variation in the WAEMB incidence coefficients across Brazil along the analyzed period, frequency being higher for women, HCW aged 25–31 years old, with ≥ 12 years of formal education and nursing

assistants/technicians. Most accidents involved blood, occurred through percutaneous exposure and consisted in needlestick injuries. A considerable part of the victims did not wear basic PPE. In most cases data were missing relative to the serological status of source patients and victims and post-exposure measures.

The frequency of WAEMB reports increased along the study period. The total number of reports is higher than that found in a study that analyzed the period from 2007 to 2014 (284,887)¹², as well as that reported in the 2011 UFBA Epidemiological Bulletin, 15,735 WAEMB in 2007 and 32,734 in 2010³³. Then, the data reported in those two studies correspond to all categories of workers in Brazil, instead of HCW alone as in the present study.

Some of the factors which might have contributed to increase the number of WAEMB reports include improvements in reporting practice and also in the criteria for identification of causal links between accidents and work, especially from 2007 onward³⁰.

The largest and smallest number of WAMEB reports corresponded to São Paulo and Acre, respectively. The number of reports was also low in other states in the North region, such as Amazonas and Pará, covered by the Amazon rainforest. The highest incidence coefficients in 2016 corresponded to Paraná (South region), Minas Gerais (Southeast) and Goiás (Central-West) and the lowest to the North and Northeast regions. The absolute number of reports and incidence coefficients were highest for the Central-West, Southwest and South regions. Reasons might be the corresponding number of HCW and the procyclic dynamics of accidents³⁴.

According to the study entitled 2018 Medical Demography in Brazil³⁵, the North region exhibits the lowest physicians per population ratio (1.16 per 1,000) and the Southeast the highest (2.81 per 1,000). Also the rate of hospital beds is lowest in the North region (1.81 per 1,000 vs. 2.56 per 1,000 in the South), which was one of the Brazilian regions with the lowest number of WAMEB reports. The Northeast region exhibits the second lowest physicians per population ratio, 1.41 per 1,000.

Some regional factors might account for our findings, such as HCW density and concentration of healthcare facilities. The number of HCW and healthcare facilities is lowest in the Amazonian region³⁵. In turn, the states with the largest numbers of WAEMB reports are located in regions with

Table 1. Frequency of reported work accidents involving exposure to biological materials among healthcare workers in Brazil, 2010-2016 (n=243,621).

State	2010		2011		2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
RO	73	0.28	93	0.31	108	0.32	126	0.34	153	0.38	189	0.47	188	0.50
AC	15	0.06	10	0.03	16	0.05	18	0.05	38	0.10	53	0.13	93	0.25
AM	73	0.28	102	0.34	474	1.41	698	1.91	883	2.21	940	2.34	712	1.90
RR	102	0.39	108	0.36	129	0.38	156	0.43	154	0.39	143	0.36	137	0.37
PA	181	0.7	242	0.81	256	0.76	249	0.68	372	0.93	343	0.85	376	1.00
AP	52	0.2	49	0.16	62	0.18	113	0.31	108	0.27	91	0.23	148	0.39
TO	297	1.15	374	1.26	407	1.21	389	1.06	458	1.15	373	0.93	370	0.99
MA	242	0.94	326	1.1	278	0.83	262	0.72	304	0.76	322	0.80	367	0.98
PI	71	0.27	148	0.5	226	0.67	194	0.53	247	0.62	345	0.86	184	0.49
CE	516	2	614	2.06	756	2.24	978	2.67	1060	2.65	1012	2.52	707	1.89
RN	465	1.8	585	1.97	577	1.71	626	1.71	680	1.70	800	1.99	729	1.95
PB	154	0.6	231	0.78	302	0.9	456	1.25	377	0.94	490	1.22	177	0.47
PE	229	0.89	411	1.38	720	2.14	1179	3.22	1534	3.84	1567	3.91	1487	3.97
AL	557	2.15	581	1.95	634	1.88	541	1.48	623	1.56	571	1.42	664	1.77
SE	339	1.31	311	1.05	361	1.07	311	0.85	371	0.93	321	0.80	351	0.94
BA	905	3.5	1314	4.42	1320	3.92	1595	4.36	1859	4.65	1889	4.71	1706	4.55
MG	2734	10.57	3616	12.15	4368	12.96	4330	11.82	4676	11.70	5190	12.94	4694	12.53
ES	350	1.35	437	1.47	458	1.36	505	1.38	774	1.94	743	1.85	673	1.80
RJ	2493	9.64	3197	10.75	3406	10.11	3387	9.25	3535	8.84	2739	6.83	2812	7.50
SP	10167	39.32	10173	34.19	10176	30.20	10517	28.72	10874	27.20	10717	26.71	9726	25.95
PR	2300	8.89	2453	8.24	3309	9.82	3451	9.42	3409	8.53	3107	7.74	3466	9.25
SC	1016	3.93	1234	4.15	1563	4.64	2085	5.69	2405	6.02	2256	5.62	2046	5.46
RS	533	2.06	879	2.95	1156	3.43	1519	4.15	2153	5.39	2684	6.69	2535	6.76
MS	321	1.24	479	1.61	477	1.42	502	1.37	598	1.50	688	1.71	609	1.63
MT	341	1.32	409	1.37	509	1.51	471	1.29	455	1.14	533	1.33	429	1.14
GO	1029	3.98	972	3.27	1286	3.82	1614	4.41	1437	3.60	1607	4.01	1665	4.44
DF	303	1.17	405	1.36	361	1.07	348	0.95	434	1.09	406	1.01	424	1.13
Total	25.858	100.0	29.753	100.0	33.695	100.0	36.620	100.0	39.971	100.0	40.119	100.0	37.475	100.0

Source: MS/CGSAT/SINAN (2017)³³.

Table 2. Distribution of incidence coefficients for reported work accidents involving exposure to biological materials among healthcare workers in Brazil, 2010-2016 (n=243,621).

Brazil States	2010	2011	2012	2013	2014	2015	2016
	IC/1,000 HCW	IC/1,000 HCW	IC/1,000 HCW	IC/1,000 HCW	IC/1,000 HCW	IC/1,000 HCW	IC/1,000 HCW
	14,01	15,32	16,25	16,56	16,84	16,24	14,52
RO	5.5	6.02	7.0	7.15	7.99	9.37	8.65
AC	1.9	1.21	1.81	1.92	3.63	4.90	8.37
AM	2.07	2.84	12.66	17.57	20.23	20.50	15.11
RR	17.66	17.13	17.24	20.03	17.17	17.69	16.99
PA	3.73	4.76	4.67	4.23	5.8	5.04	5.21
AP	8.42	7.81	8.82	15.05	12.07	9.79	14.99
TO	19.21	22.57	23.71	20.78	22.38	16.73	15.48
MA	4.39	5.69	4.60	4.13	4.6	4.68	5.16
PI	2.74	5.46	5.83	6.19	7.39	9.67	4.91
CE	8.35	9.75	11.43	13.77	13.79	12.12	8.26
RN	14.69	17.53	16.63	16.85	17.21	19.57	17.14
PB	4.51	6.30	7.67	10.77	8.37	10.46	3.65
PE	3.15	5.35	8.76	13.41	16.48	16.07	14.51
AL	21.37	21.42	22.38	17.99	19.49	16.71	18.60
SE	17.80	15.01	16.43	12.95	14.32	11.95	12.81
BA	7.73	10.71	10.22	11.57	12.63	12.39	10.83
MG	12.99	16.42	18.68	17.45	17.68	18.75	16.20
ES	9.77	11.56	10.77	11.24	15.92	14.87	12.88
RJ	15.09	18.22	17.79	16.72	16.38	12.44	12.31
SP	22.25	21.12	19.92	19.34	18.66	17.80	15.55
PR	23.45	23.37	28.83	28.66	26.58	23.21	24.70
SC	15.49	18.18	21.50	27.21	29.25	25.99	22.60
RS	5.56	8.80	10.57	12.74	16.02	19.00	17.14
MT	11.24	12.93	15.21	13.14	18.57	19.85	16.67
MS	13.58	18.71	17.16	16.64	11.98	13.34	10.27
GO	19.67	17.54	22.05	25.49	21.07	22.84	22.29
DF	8.40	10.52	9.15	8.30	9.97	9.24	8.26

IC: incidence coefficient; HCW: healthcare workers.
Source: MS/CGSAT/SINAN (2017)³³.

Table 3. Characterization of healthcare workers involved in work accidents involving exposure to biological materials according to demographic and occupational variables, 2010-2016 (n=243,621).

Variables	2010		2011		2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Sex														
Female	20279	78.42	23111	77.68	26231	77.85	28752	78.51	31365	78.47	31390	78.24	28982	77.34
Male	5575	21.58	6642	22.32	7463	22.15	7868	21.49	8607	21.53	8729	21.75	8493	22.66
Age range														
18-24	4822	18.65	5424	18.23	5796	17.60	5983	16.34	6507	16.28	6215	15.49	6009	16.03
25-31	8184	31.69	9469	31.83	10760	31.93	11743	32.07	12175	30.46	11687	29.13	10731	28.64
32-38	5404	20.90	6281	21.11	7407	21.98	8309	22.69	9480	23.72	10111	25.20	9434	25.17
39-45	3773	14.59	4146	13.93	4732	14.04	5335	14.57	5916	14.80	5886	14.67	5688	15.18
46-52	2299	8.89	2764	9.29	3041	9.03	3279	8.95	3527	8.82	3806	9.48	3347	8.93
53-59	1060	4.10	1332	4.48	1563	4.64	1530	4.18	1821	4.56	1814	4.52	1694	4.52
>60	306	1.18	337	1.13	396	1.18	441	1.20	546	1.37	603	1.50	572	1.53
Formal education														
≤12 years	2710	10.48	3114	10.46	3208	9.51	3406	9.30	3657	9.14	3616	9.01	3013	72.09
> 12 years	17919	69.29	20684	69.51	23580	69.98	25686	70.14	28564	71.46	28580	71.25	27017	8.04
Unknown	5229	20.23	5955	20.03	6912	20.51	7538	20.56	7750	19.38	7923	19.74	7448	19.87
Occupation														
Physicians	2676	10.35	3120	10.49	3498	10.38	3647	9.96	3996	10.0	4184	10.43	4180	11.18
Dentists	950	3.67	1087	3.65	1257	3.73	1321	3.61	1653	4.4	1720	4.29	1632	4.35
Pharmacists	175	0.68	229	0.77	303	0.90	323	0.88	357	0.89	405	1.00	419	1.12
Nurses	2.262	8.75	2.902	9.75	3.445	10.22	4.099	11.19	4.592	11.49	4.762	11.87	4.385	11.70
Physical therapists	191	0.74	243	0.82	286	0.85	304	0.83	353	0.90	359	0.89	320	0.85
Nutritionists	6	0.02	7	0.02	13	0.04	17	0.05	17	0.04	21	0.05	16	0.04
Psychologists	2	0.01	2	0.01	5	0.01	7	0.01	5	0.01	4	0.01	6	0.01
Nursing asst./tech.	17974	69.51	20227	67.98	22808	67.70	24670	67.39	26552	66.43	26050	64.94	24245	64.70
Oral health asst./tech.	692	2.67	780	2.62	883	2.62	970	2.65	1061	2.65	1163	2.90	1095	2.92
Lab asst./tech.	697	2.70	878	2.95	909	2.69	977	2.67	1099	2.75	1101	2.74	891	2.38
Health asst./agent	233	0.90	280	0.94	288	0.85	285	0.78	287	0.72	350	0.87	277	0.74
Employment status														
Formal	18.233	70.51	21.377	71.84	24.227	71.90	26038	71.10	28.777	72.01	28.552	71.16	27011	72.07
Informal	2.014	7.78	2.616	8.79	2.728	8.09	2.986	8.15	3.437	8.59	3.226	9.22	3.218	8.58
Unknown/not informed	5.611	21.71	5.760	19.35	6.685	19.83	7.596	20.74	7.757	19.40	7.873	19.62	7.246	19.35

Asst.: assistant Tech.: technician.
Source: MS/CGSAT/SINAN (2017)³³.

higher number of HCW and better healthcare infrastructure (Central-West, Southeast and South).

This distribution is associated with the procyclic dynamics of accidents in Brazil. While one would expect a decrease in the number of accidents in parallel to economic expansion, as a consequence of technological development, in fact, the absolute number of health problems increases together with the growth of production, and their incidence remains stable or even rises among the working population³⁶. As a result, the number of accidents is higher in the Brazilian regions with better infrastructure in terms of human resources and healthcare facilities.

Still in regard to São Paulo and Acre, WAEMB reports respectively decreased and increased in 2015 and 2016. The decrease in São Paulo might be due to underreporting. In Acre, the number of reported WAEBM and registered HCW increased progressively. However, according to the results of the present study, this increase in the number of HCW did not arise from improvements in the working

conditions, which might have contributed to the trend to increase of the number of work accident reports.

Upon considering the differences between years and states, it is worth noticing they were not only due to individual aspects of HCW, but also to the formulation and organization of workers' health protection policies and their various dimensions — technical, economic, social, cultural and political³⁷.

While reports increased in absolute numbers along the analyzed period, underreporting is still relevant. Partial information about WAEMB among HCW in epidemiological estimates hinders the attempts at achieving an accurate understanding of the occupational health situation, especially since a considerable proportion of workers is not represented in the statistical data³⁸.

We did not detect relevant changes in the proportions of WAEMB according to sociodemographic and occupational variables in the analyzed period. Such variables nonetheless

Table 4. Frequency of reported work accidents involving biological materials among healthcare workers according to source of exposure and use of personal protective equipment (PPE), 2010–2016 (n=243,621).

Variable	Yes		No		Unknown/Not Informed	
	n	%**	n	%**	n	%**
Exposure source*						
Percutaneous	183.523	75.33	45.498	18.67	14.600	6.0
Intact skin	64.074	26.30	140.693	57.75	38.854	15.95
Non-intact skin	10.821	4.44	191.596	78.64	41.204	16.92
Mucous membranes	24.681	10.13	156.523	64.24	62.417	25.63
Other	2.709	1.12	176.852	72.59	64.060	26.29
PPE*						
Gloves	171.248	70.29	55.017	22.58	17.356	7.13
Lab coats	96.404	39.57	116.257	47.72	30.960	12.71
Masks	59.032	24.23	151.308	62.10	33.281	13.67
Face protectors	15.813	6.49	194.096	79.67	33.712	13.84
Boots	31.661	12.99	172.910	70.97	39.050	16.04
Glasses	38.420	15.77	172.077	70.63	31.634	13.60

*There was more than one answer for variables "exposure source" and "PPE" in each report; **relative frequencies were calculated per total number of WAEMB in the analyzed period (n=243,621).

Source: MS/CGSAT/SINAN (2017)³³.

deserve to be discussed to achieve a reliable profile of the workers involved in such accidents.

WAEMB involved more frequently women: 20,279 in 2010 and 29,982 in 2016 (increase of 43%). Men represented 5,575 cases in 2010 and 8,493 in 2016 (increase of 52.34%). These findings agree with those reported by Miranda et al.¹² — women accounted for 77.9% of victims — and other authors (81.3 to 85.05%)¹⁴⁻¹⁶. It should be observed that women represent the largest proportion of HCW, as e.g. of nursing professionals. In addition, double burden (paid job and domestic and child care work) might cause physical and mental exhaustion among women, thus contributing to the occurrence of work accidents¹².

The results relative to variable age — highest prevalence of incidents among workers aged 25–31 years old — are similar to those reported in studies conducted with HCW in Paraíba¹⁵ and Maranhão¹⁶, Brazil — 31-40 years old. Such higher frequency of accidents among young workers suggests a relationship with lack of experience and of technical skills, which might derive from the training received. Therefore, better orientation on accident prevention is needed during the training period, and more particularly a longer time for adjustment to work and routine procedures at health care facilities^{12,39}.

While the rate of accidents was higher among HCW with ≥ 12 years of formal education, the most affected

Table 5. Frequency of reported work accidents involving biological materials among healthcare workers according to accident circumstance, involved biological material, causative agent, vaccination status, source patient and serological status, 2010-2016 (n=243,621).

Variables	n	%	Variables	n	%
Accident circumstance			Hepatitis B vaccination status		
IV, IM, ID, SC medication administration	43.406	17.82	Yes	200.156	82.15
Venous/arterial puncture	23.376	9.60	No	18.873	7.75
Inadequate sharps disposal	72.889	29.91	Unknown	24.592	10.1
Surgical, dental and laboratory procedures	39.725	16.90	HIV test on accident day		
Other	55.088	22.62	Positive	1.307	0.53
Unknown	9.137	3.75	Negative	152.552	62.61
Involved biological material			Inconclusive	2.175	0.89
Blood	182.569	74.93	Not performed	24.383	10.03
Bloody fluid	9.825	4.03	Unknown	63.204	25.94
Plasma	1.348	0.55	Hepatitis B test on accident day		
Other	21.736	8.92	Positive	1.348	0.55
Unknown	28.143	11.57	Negative	129.920	53.35
Causative agent			Inconclusive	2.922	1.19
Needles	164.150	67.38	Not performed	38.602	15.84
Intracath	1.842	0.75	Unknown	70.829	29.07
Blades/lancets	16.859	6.92	Source patient		
Glass	2.252	0.92	Known	164.899	67.68
Other	45.544	18.69	Unknown	62.110	25.49
Unknown	12.974	5.34	Missing data	16.612	6.83
			Total	243.621	100.0

HIV: human immunodeficiency virus; IV: intravenous; IM: intramuscular; ID: intradermal; SC: subcutaneous. Source: MS/CGSAT/SINAN (2017)³³.

occupational group was that of nursing technicians and assistants, who as a rule attend up to secondary school only. The fact that this is the usual educational status of medium-level HCW might be related to the low educational level of the Brazilian population as a whole, as well as to economic reasons, for instance, hiring technicians is less expensive to employers^{12,38,39}. In addition, nursing professionals represent the highest proportion of HCW (1.8 millions, of whom 80% are nursing technicians or assistants and 20% are nurses) and are exposed to hazards inherent to patient care⁴⁰.

The circumstances under which accidents occurred were similar to those reported in previous studies, i.e. inadequate sharps disposal, as e.g. needle recapping^{10,24,25}, and neglect of PPE¹⁶. According to our results, inadequate sharps disposal accounted for 29.91% of WAEMB, and in 29.71% of cases victims were not even wearing gloves. Only 6.49% of victims wore face protectors, with consequent risk of contamination through the mouth, eyes and face.

The authors of a study conducted in Maranhão found that the highest rates of WAEMB and the lowest rates of adherence to PPE corresponded to the period from 2011 to 2015. These findings indicate that PPE neglect might be associated with the reported increase in WAEMB rates¹⁶.

Blood was the biological material most frequently involved in accidents, as was previously reported^{12,16,40}. For this reason, notwithstanding their field of activity, all workers should keep their hepatitis B vaccination status up to date, and post-exposure care should be duly provided as part of a broadly encompassing preventive program against the main infections and other aspects relevant to workplace safety.

According to the Brazilian Ministry of Health recommendations, preventive, prophylactic and occupational safety measures should be implemented on the occasion of WAEMB. Although measures should be selected as a function of the particular accident type and the involved biological material, the serological status of source patients — when known — and victims, as well as the latter's vaccination status should be verified in all cases, independently from the accident circumstances⁴¹.

A study conducted in Florianópolis, Brazil, found that the measures most frequently implemented by dental staff were to wash the involved body site and to ask the source patients whether they were infected with HIV, hepatitis B

and C. In turn, chemoprophylaxis, reporting and lab tests were the least frequent measures⁴². In a study performed at a cancer hospital in São Paulo, 18.6% of HCW were found to have been involved in work accidents in the previous 12 months, however, 72.1% of them had not received any post-exposure care, the main reason being it was considered unnecessary⁴³.

The measures recommended by the Ministry of Health against hepatitis B depend on the serological status of the source patients and the anti-HBs level of victims. For this reason, a complete vaccination series, followed by serological testing to investigate immunity have paramount importance. Chemoprophylaxis against HIV should be started as soon as possible when the source patient is unknown or seropositive⁴¹. According to the results of the present study, the recommended measures against hepatitis B and HIV were effectively implemented, however, 1.12% of the victims refused chemoprophylaxis.

Even when hepatitis B seropositivity is higher after occupational exposure and vaccination is available within the public healthcare network, a considerable proportion of workers do not receive any or all the required doses¹². In a study performed in Goiania with nursing professionals, 77.6% of the participants had completed the hepatitis B vaccination series. Of these, 82 (4.1%) reported having been tested for anti-HBs, being 59/82 (72.0%) characterized as respondents and 23/82 (28.0%) as non-respondents to vaccination. Cases with incomplete vaccination (16.6%) were included in the non-vaccination group. Information lacked for 4.3% of the participants, and 1.5% ignored their vaccination status⁴⁴.

It is worth observing that data on serological status (victims and source patients) and implemented measures missed in 25.71, 43.57 and 24.45% of the reports, respectively. These findings agree with those in a study of the quality of SINAN-WAEMB data for the period from 2010 to 2015⁴⁵, a situation that hinders the attempts at providing reliable information relative to these variables.

The limitations of the present study derive from the resource to SINAN secondary data and the variable frequency of missing data in report forms. These shortcomings, however, did not interfere with analysis, since we did not seek to analyze risk factors, but to describe reported incidents.

The differences found between regions and states, mainly in regard to the number of active HCW, interfered with our attempts to provide a general overview of work accidents. Yet, the data relative to demographic and occupational variables and to the circumstances under which accidents occurred did not change along the analyzed period. These findings might indicate that the implemented safety measures were not effective, that underreporting still occurs and that the completeness of records should be reviewed. Therefore, prevention is crucial to reduce WAEMB, while monitoring report data is necessary to establish the actual context of accidents.

CONCLUSION

Our findings contribute to consolidate the relevance of biological hazards for HCW, since WAEBM are still a public health problem in Brazil. We found regional differences in the frequency of WAEMB reports, which

was higher for the Central-West, South and Southeast regions, i.e. the most developed, and lower for the North and Northeast regions. These differences notwithstanding, victims were most often women, workers aged 15–31 years, with ≥ 12 years of formal education and nursing technicians. Most accidents corresponded to sharps injuries and involved exposure to blood. The implemented post-exposure measures complied with the recommendations formulated by the Ministry of Health, however, the rate of HCW who refuse prophylaxis is still considerable. The frequency of missing data for variables “patient serological status” and “victim serological status” was high, which interfered with our attempts at obtaining a reliable overview of the actual situation.

Finally, our description points to the need for effective preventive measures mainly based on use of PPE and life-long learning and continuing education for HCW. We also call the attention to the need for nationwide improvements in the reporting of WAEMB to SINAN.

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