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Knowledge and compliance as factors associated with needlestick injuries contaminated with biological material: Brazil and Colombia

Ehideé Isabel Gómez La-Rotta (https://orcid.org/0000-0003-1194-9898) [1]
Clerison Stelvio Garcia (https://orcid.org/0000-0003-0008-5481) [1]
Carlos Morales Pertuz (https://orcid.org/0000-0002-6453-3960) [2]
Isabella de Oliveira Campos Miquilin (https://orcid.org/0000-0003-4196-5901) [1]
Agnes Raquel Camisão (https://orcid.org/0000-0002-7069-6387) [3]
Danilo Donizetti Trevisan (https://orcid.org/0000-0002-6998-9166) [4]
Francisco Hideo Aoki (https://orcid.org/0000-0002-9003-8488) [1]
Heleno Rodrigues Correa-Filho (https://orcid.org/0000-0001-8056-8824) [5]

Abstract *This was a cross-sectional study to start a cohort in two University Hospitals of two countries – Brazil and Colombia – for assessing the prevalence of needlestick and sharps injuries (NSI), the level of compliance with standard precautions (SPs), and knowledge on blood borne pathogens and associated factors among health students and professionals, within the framework of the implementation of the NR-32 standard. We created compliance scales based on 12 and 10 questions, for assessing knowledge. We used the Multinomial Poisson-Tweedie Regression to evaluate the relationship between knowledge and compliance with SPs within NSI. We evaluated 965 individuals (348 students and 614 professionals). The mean score points for level of knowledge was 10.98, with a median of 11 (10; 12) and α-Cr of 0,625. Compliance with SP had a mean of 30.74 and median of 31 (28; 34), with a α-Cr coefficient of 0.745, associated with country, group (student) and risk perception. Among the factors associated with the report of NSI, we singled out knowledge and compliance, country of origin, and full vaccination scheme against the Hepatitis B virus. We concluded that the level of knowledge and compliance were adequate among participants, but better among Brazilian participants, and it was associated with NSI reporting.*

Key words *Knowledge, Guideline compliance, Occupational accident, Perception, Risk*

[1] Faculdade de Ciências Médicas, Universidade Estadual de Campinas. Cidade Universitária Zeferino Vaz, Barão Geraldo. 13083-970 Campinas SP Brasil. larottaehidee@gmail.com
[2] Clínica El Country. Bogotá Colombia.
[3] Curso de Enfermagem, Faculdade Evangélica de Goianésia. Goianésia GO Brasil.
[4] Universidade Federal de São João do Rei. Divinópolis MG Brasil.
[5] Departamento de Saúde Coletiva, Universidade de Brasília. Brasília DF Brasil.

Introduction

The global proportion of health workers in comparison with the general population is 0.6%, amount to 35.7 million workers; of these, 3 million are exposed to blood pathogens annually[1]. Worldwide, it is estimated that 37.6% of Hepatitis B, 39% of Hepatitis C, and 4.4% of HIV/AIDS in Health Workers are due to accidents with needles contaminated with biological material[1].

In Colombia, data from the Ministry of Labor inform that 7.51% of workers affiliated to the system have suffered some sort of work accident in 2015. Regarding work accidents with biological material (WA-BM), we have found studies conducted with the population affiliated to the Occupational Risk Administrators (ORAs) reporting that activities related to the health sector are the fifth most risky among other economic sectors, with an incidence coefficient of 6.61 per 100 workers[2] There are no consolidated data in Colombia about the number of work accidents with exposure to biological materials, nor a surveillance information system that allows the quantification and characterization of this kind of work accidents[3].

In Brazil, during 2015, the National Social Security Institute (INSS) registered 612,600 work accidents for all causes, a reduction of 13.99% in comparison with 2014[4]. In the distribution by economic activity, the subsectors with greater participation were 'Health and Social Services' and 'Trade and Repair of Motor Vehicles,' with 14.49% and 13.27% of the total, respectively[4].

The incidence coefficient of WA-BM in Brazil has increased. According to data from the INSS and the Inter-union Department of Statistics and Socioeconomic Studies – Dieese, the number of accidents/workers exposed*1000 went from 2.7 WA-BM in 2004 to 7.6 in 2014[4,5].

In this panorama, Brazil was the first country in Latin America and the Caribbean to create a guideline (NR-32 – Health and Safety at Work in Health Services) aimed at minimizing the risks and providing a healthier work environment for health workers[6], consequently reducing the occurrence of infectious diseases from the exposure to biological materials among these professionals through recommendations about the use, disposal, and implementation of safety devices for needlestick and sharps[7]. Colombia does not have a specific rule for health workers, though, as Brazil, it complies with the recommendations of the Center for Disease Control and Prevention (CDC) and the guidelines if the International Labor Organization (ILO).

The CDC recommendations (standard precautions – SPs) were created after the HIV/AIDS epidemic and published in 1985, with an update in 1987 to include a guide on the prevention of accidents with needlestick and sharps, focusing on cares during handling and disposal. These directions were aimed at health professionals and had the goal of reducing the risk of contamination by HIV, HBV, and HCV due to contact with blood and bodily secretions[8].

Compliance with such recommendations (SPs) demands from health professionals appropriate attitudes during long periods of time, requiring motivation and technical knowledge[9]. Internationally, this is regarded as an effective way to protect health professionals, patients, and public[9], in addition to reducing hospital infections[8]. Non-compliance can be notice in the high rates of incidence of WA-BM[10].

Among other factors associated with the incidence of WA-BM according to the literature, one may find knowledge[11] and risk perception[12]. The concept of perception, from the description given by Dela Coleta (1986) and adapted by Correa-Filho (1994) based on the designs of Breilh (1990) – who described perception as a counter value –, may be expressed in work environments as the registration in the memory and personal feelings of the relationship between living, health, and working conditions and of the counter-values linked to the cause or mediating conditions of accidents or health injuries within the working environment[13-15].

With such data, this study aims at evaluating the prevalence of WA-BM, the level of compliance with Standard Precautions, and the knowledge on blood-transmissible pathogens among health workers and students in two Brazil-Colombia University Hospitals, within the framework of the NR-32 guideline implementation. Furthermore, we discuss whether knowledge, compliance, and risk perception are predictors of accidents with biological materials.

The theme has an increased importance for the hospital since it is an academic institution, where health students and residents learn to work in the best conditions and acquire both knowledge and attitudes through the observation of professors, who shall be an example, providing high-level information and medical acts of excellence[16].

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Method

A cross-sectional study was conducted to evaluate the level of compliance and knowledge among health students (Medicine, Nursing, and Dentistry) and health workers (doctors and nurses) of two Brazil-Colombia University Hospitals from January 2014 to February 2015.

This article discusses the first contact held, in which the cohort of participants to be followed for a year to determine the incidence of accidents with biological materials was formed, aimed at comparing Brazil – which is implementing the NR-32 norm – and Colombia.

After estimating the proportions of knowledge and compliance with standard precautions at 35% [11,17], the maximum sampling error acceptable was set at 0.05 (5%) and the power of test (1-beta) at 80%. The binational sample was calculated as n=1252 participants, resulting from the sum of 313 for each group (students and professionals), totaling 626 in each country.

Sample selection was random, by a systematic stratified sampling following the list of students and professionals. Those who have met the following criteria were included in the study: being a health professional for more than three months in the Hospitals studied at the time of interview, being a student enrolled in one of the colleges included, who were part of the institutions responsible for the University Hospitals and/or who adopted these Hospitals as field of practice.

A structured (self filling) questionnaire was prepared for performing the study, including seven sections with questions on the modes of transmission of Hepatitis B and C and HIV viruses and on the compliance with SPs. Also, questions on sexual habits (number of sexual partners in the last year and use of protection) and occupational risk perception were included. The questionnaire was validated in a previous pilot study, in both countries, to evaluate and adjust the construct for both languages[18].

The knowledge scale contained 12 questions scored from 0 (no correct answers) to 12 (all answers correct). The compliance scale was composed of 11 questions scored from zero to 37 points.

The variable Sexual Habit was recoded, creating a new variable named risky sexual behavior. We assigned 0 for no risk and 1 for the presence of risk. Participants who had no sexual intercourse or only one sex partner and used barrier methods in the previous year were included in the category "no risk," whereas those who had one or more sex partners and used no protection were included in the category "at risk."

Occupational risk perception (perception of susceptibility to perform work f or study functions) was codified, scoring (1) to never and (5) to always.

The WA-BM analyzed in this study referred to those reported by the participants (professionals and students) and that occurred in the immediately preceding year, involving the exposure to potentially contaminated blood or bodily fluids during the development of work or study[19].

The questionnaire was individually applied by a previously trained multidisciplinary team (researchers, medicine students, and psychologist). Interviews were carried out at the time and place most suitable for the participant.

If unable to perform the interview in person, the participant had the option of filling the questionnaire on the internet, in a paid app of the "World Wide Web" to maintain privacy.

The database was typed using the Encuestafacil.com platform, which generated a standard 'Excel' file that was later downloaded and analyzed in the SPSS program version 18.0. Percentages were obtained for categorical variables, and for numerical ones we calculated mean ± standard deviation (SD), minimum and maximum values, and percentiles 25%, 50% (median), and 75%.

The comparison between groups of categorical variables was performed with the chi-square test (χ^2). Means were compared with the *Student*'s t test and medians, with the Kruskal Wallis (KW) test.

Knowledge and Compliance scales were recoded to create new variables, later performing Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) tests to determine their type of distribution. If the scale had a normal distribution, the comparison of mean was made using the ANOVA test for independent samples (Brazil-Colombia); otherwise the Kruskal-Wallis test was used for comparing medians.

Poisson-Tweedie Regression[20] was carried out to assess the relationship of the scales of knowledge and compliance to SPs with independent variables. We started from the complete model to build the multivariate ones, using all independent variables selected for analysis and removing them in succession when they did not reach statistical significance ($p > 0.05$). Only the statistically significant variables, with 95% confidence interval a p-value < 0.05, remained in the model.

The incidence rates were calculated for the 12 months of follow-up in each country, based on the retrospective sums of months/person until the date of the study, estimating incidence coefficients for each country and group so to compare them with the literature.

This study followed the ethical standards and was approved in Brazil by protocol no. 257,820 of 03.18.2013 and in Colombia by opinion 18,129 of 06.17.2014. All participants signed the Informed Consent Form.

Results

Demographic characteristics

965 individuals were evaluated, of which 348 were students (214 in Brazil and 134 in Colombia) and 617 professionals (310 in Brazil and 307 in Colombia), with mean (SD) age of 33.04 ± 10.81 years, ranging from 19 to 72 years; 73.3% were female; 71.3% were white; 58.7% single; 65.6% without children; 42.1% with household income between 6 and 20 monthly minimum wages (MMW) in 2014 (Table 1).

When comparing the two groups (students and professionals), we found differences in variables: age, self-reported skin color, marital status, children, and monthly household income (MHI).

Scales of Knowledge, Compliance, and Perception of Risk

Knowledge

Mean (SD) knowledge in both countries was 10.98 (± 1.34) points (Minimum of 0 and Maximum of 12 points), median 11 points (10, 12) compared to the expected minimum average of 9 points. The α-Cr was 0.625 and did not provide normal distribution (*Tweedie*) (K-S Test $p < 0.001$).

When 9 points or more are considered as cut-off points for having a good knowledge[21], 95.1% (915) participants fall into this category (Table 1).

Compliance with Standard Precautions (SPs)

Compliance with standard precautions had a mean (SD) of 30.74 (± 4.51) points (Minimum = 0 and Maximum = 36; Expected minimum = 27.75) an median of 31 points (25 percentile = 28 and 75 percentile = 34). The α-Cr coefficient of the scale was 0.745 when we eliminated the questions about needlestick recapping and vaccination against Hepatitis B. The scale has shown *Tweedie* distribution (K-S test $p > 0.001$).

We evaluated that 83.1% of the participants had a good compliance (≥ 27.75 points). When the guidelines are separately assessed, we found that 56.3% always washed their hands before and after examining the patient, 51.0% before and after wearing gloves, and 94.6% after contact with bodily fluids. Regarding the use of Personal Protection Elements (PPEs), we verified that 86.0% always wear gloves, 36.9% wear glasses, 56.0% wear masks, and 58.7% wear scrubs or surgical clothing.

The disposal of sharps is always performed in collectors by 72.2% of the participants and 2.4% never recap needlesticks, however, 93.5% still always do it, which is more prevalent among professionals (60.0%), in particular for nurses when compared to the students (33.5%).

Of the 957 participants who responded to the question, 835 (87.27%) reported having taken at least one dose of the vaccine against the Hepatitis B virus and, among them, 184 (22.03%) reported having taken three doses, 63 (7.54%) took a reinforcement, and 33 (3.95%) repeated the three doses of vaccine. There was no vaccine difference among the groups. Health professionals had a prevalence of 89.3% compared to 68.7% of the students.

Confirmation of immunity (AntiHBs) by serological examination was mentioned by 665 (69.6%) participants, and 499 (75.3%) indicated knowing they were immunized. We found difference ($p < 0.001$) among the groups (professionals and students). A higher percentage of professionals has made the serological test (74.0% > 26.0%), and those who reported accidents also tested the immunity (AntiHBs) in a greater proportion (92.3% > 80.4%).

Risk perception

We found a mean of 3.15 (± 1.10) points (Minimum 1 and Maximum of 5), median of 3 points, to the minimum mean expected of 3.75 points. The scale showed normal distribution (K-S test $p > 0.428$). We found no difference among countries, whereas among groups ($p < 0.002$) the professionals had a higher risk perception (3.25 ± 1.13) than students (2.97 ± 1.04).

Factors associated with knowledge and compliance with SPs

Among the factors associated with the level of knowledge, after the adjustment of models, were

Table 1. Characteristics of sociodemographic and behavioral characteristics among participants, Brazil – Colombia, 2015.

Variables	N	Brazil n = 524 (%)	Colombia n = 441 (%)	p
Gender				0.671
Female	707	381 (53.9)	326 (46.1)	
Male	258	143 (55.4)	115 (44.6)	
Age				0.354*
Median (25.75 percentiles)		30 (23.39)	30 (25.41)	
Mean ± SD	965	32.75 ± 10.81	33.39 ± 10.81	
Minimum		20	19	
Maximum		64	72	
Skin color				0.001
White	688	417 (60.6)	271 (39.4)	
Black – Brown	118	76 (64.4)	42 (35.6)	
Yellow (Asian)	25	23 (92.0)	2 (8.0)	
Indian – Mixed Ethnicity	92	1 (1.1)	91 (98.9)	
Does not know	42	7 (16.7)	35 (83.3)	
Marital status – Risk				0.001
Single/Widowed/Divorced	650	328 (50.5)	322 (49.5)	
Married/Stable Relationship	315	196 (62.2)	119 (37.8)	
Number of children				0.004
Without children	631	364 (57.7)	267 (42.3)	
With children	333	160 (48.0)	173 (52.0)	
Household income (MMW monthly minimum wage)				0.001
< 1 MMW	24	2 (8.3)	22 (91.7)	
1 to 5 MMW	399	135 (33.8)	264 (66.2)	
6 to 20 MMW	403	295 (73.2)	108 (26.8)	
21 or more MMW	90	65 (72.2)	25 (27.8)	
Does not know	49	27 (55.1)	22 (44.9)	
Risky sexual behavior				0.561
Yes	515	285 (55.3)	230 (44.7)	
No	445	237 (53.3)	208 (46.7)	
Knowledge				0.001
Good	918	513 (55.9)	405 (44.1)	
Bad	47	11 (23.4)	36 (76.6)	
Compliance with SPs				0.001
Good	745	439 (58.9)	306 (41.1)	
Bad	197	73 (37.1)	124 (62.9)	
Risk perception				0.986
High	249	135 (54.2)	114 (45.8)	
Low	689	374 (54.3)	315 (45.7)	
Training				0.486
Yes	133	76 (57.1)	57 (42.9)	
No	809	436 (53.9)	373 (46.1)	
Accident				0.686
Yes	103	54 (52.4)	49 (47.6)	
No	862	471 (54.6)	392 (45.4)	

Note: p (Squared X2 and Fisher's Exact Tests for categorical variables; *ANOVA for the comparison of means in independent samples).

regarded as important the country of origin, profession, a full vaccination scheme against VHV, AntiHBs realization, having suffered a prior accident, and having children (Table 2).

Table 3 presents results of the Poisson-Tweedie Regression performed to evaluate factors associated with compliance with SPs. The best adjusted model associated country, group (stu-

dents), subgroup (Brazilian students), marital status (risk), accident, and risk perception to SPs.

Factors associated with the level of compliance among health professionals were: age ($p < 0.031$: IC 95% 0.000-0.003), type of area ($p < 0.023$: IC 95% 0.004-0.053), Country ($p < 0.001$: IC 95% 0.033-0.084), vaccine against HBV ($p < 0.001$: IC 95% 0.027-0.115), accident ($p < 0.018$: IC 95% -0.093 to -0.021), training ($p < 0.033$: IC 95% 0.015-0.074), and risk perception ($p < 0.032$: IC 95% 0.001-0.023).

Work accidents

Among the participants evaluated, 103 (10.7%) mentioned having suffered accidents with biological materials in the immediately preceding 12 months, with no differences between countries (Table 4). The incidence rate of accidents was 6.05 per 100 people/year in both countries; in Brazil, it was 7.5 cases per person/year and, in Colombia, 3.5 cases per person/year.

When evaluating factors associated with suffering WA-BM, we found that Risky Sexual Behavior ($p < 0.050$), occupational risk perception ($p < 0.023$), AntiHBs realization ($p < 0.002$), knowledge ($p < 0.018$), and compliance with the SPs ($p < 0.039$) are related to the event. When analyzing health professionals (doctors and nurses) separately from students, the WA-BM were associated with working hours ($p < 0.009$), spe-

Table 2. Poisson-Tweedie Regression Model to determine factors associated with the level of knowledge among health professionals and students, Brazil – Colombia, 2015.

Variables	Simple Analysis			Multivariate Analysis		
	ß	95%CI	p-value	ßajud *	95%CI	p-value
Age in years	0.001	-0.001 - 0.001	0.538			
Gender		-0.007 to	0.091			
Female	0	-0.002				
Male	0.013					
Marital status – Risk		0.004 - 0.004	0.004			
Single/Widowed/Divorced	0					
Married/Stable Relationship	0.019					
Children		0.007 - 0.060	0.012	0.029	0.006-0.05	0.013
Yes	0					
No	0.031					
Country		0,07 a 0,05	0.001	0.069	0.05 a 0.08	0.001
Brazil	0.064					
Colombia	0					
Group		-0.004 - 0.029	0.139			
Professionals	0					
Students	0.012					
Sexual Risk		-0.016 - 0.016	0.985			
Yes	0					
No	0.001					
Hepatitis B vaccine		-0.073 - 0.015	0.003	-0.042	-0.067 to	0.001
Yes	0				-0.018	
No	-0.044					
AntiHBs Realization		-0.045 - 0.006	0.010	-0.027	-0.046 to	0.004
Yes	0				-0.009	
No	-0.025					
Accidents with BM		-0.042 to	0.014	-0.022	-0.040 to	0.017
Yes	0	-0.005			-0.004	
No	-0.023					
Training		-0.004 to 0.026	0.167			
Yes	0					
No	0.011					
Scale of compliance	0.001	-0.002 to 0.002	0.758			
Risk Perception Scale	0.003	0.0042 to 0.009	0.127			

CI = 95% confidence interval. * Adjusted for Age and gender.

Table 3. Poisson-Tweedie Regression Model to determine factors associated with the level of compliance with SPs among health professionals and students, Brazil – Colombia, 2015.

Variables	Univariate Analysis			Multivariate Analysis		
	ß	95%CI	p-value	ßajud *	95%CI	p-value
Age in years	0.00	-0.01-0.01	0.783			
Gender						
Female						
Male	0.008	-0.015-0.031	0.483			
Marital status – Risk						
Single/Widowed/Divorced	-0.021	-0.004-0.002	0.077	-0.031	-0.058 to	0.027
Married/Stable Relationship	0				-0.003	
Children						
Yes	0					
No	-0.003	-0.024-0.018	0.819			
Country						
Brazil	0.57	0.029 to 0.086	0.001	0.067	0.048-0.086	0.001
Colombia	0			0		
Group						
Professionals	0			0		
Students	0.037	0.019-0.056	0.001	0.058	0.048-0.086	0.001
Subgroup						
Brazilian Professionals	0			0		
Colombian Professionals	-0.064	-0.09 to -0.038	0.001	0		
Brazilian Students	0.033	0.011-0.054	0.003	0.057	0.027-0.086	0.001
Colombian Students	-0.041	-0.07 to -0.026	0.001	0.038	0.055-0.072	0.025
Sexual Risk						
Yes	0					
No	-0.007	-0.025-0.014	0.504			
Hepatitis B vaccine						
Yes	0.064	0.033-0.095	0.045			
No	0					
AntiHBs Realization						
Yes	0					
No	-0.015	-0,033-0,095	0.168			
Accidents with BM						
Yes	-0.063	-0,099 a -0,026	0.001	-0.057	-0.093 to	0.001
No	0			0	-0.021	
Training						
Yes	0					
No	0.019	-0.009 to 0.048	0.183			
Knowledge Scale	0.009	-0.001 to 0.018	0.070			
Risk Perception Scale	0.008	-0.002 to 0.019	0.215	0.012	0.001-0.023	0.036

CI = 95% confidence interval. * Adjusted for Age and gender.

cialization (Surgery and Clinic) ($p < 0.005$), and compliance with the SPs ($p < 0.001$).

Risky sexual behavior

We found that 75.5% of respondents presented risky sexual behavior, with no difference between countries (Table 1), which was associated with marital status (married/stable relationship vs single/widowed/divorced) RP = 1.67 (95%CI 1.34-2.07) and accident with biological materials RP = 1.63 (95%CI 1.03-2.85).

The number of sexual partners in the previous year was on average 1.29 (± 1.04), ranging from 0 to 6, with differences according to group and gender. 62.7% did not use protection during sexual intercourse and, of the 37.6% who claimed having protected themselves, 35% used preservatives, with no differences between countries.

Table 4. Characteristics of accidents with biological material among health students and professionals, Brazil – Colombia, 2015.

Variables	Previous Year (965)
Accident	
Yes	103 (10.7)
No	862 (89.3)
Schedule	
Daytime	43 (41.7)
Afternoon	26 (25.2)
Nighttime	18 (17.5)
Does' t Know/Remember	16 (15.5)
Day of the week	
Monday	2 (1.9)
Tuesday	4 (3.9)
Wednesday	2 (1.9)
Thursday	8 (7.8)
Friday	9 (8.8)
Saturday or Sunday	8 (7.8)
Does' t Know/Remember	70 (67.9)
Day of the week	
Monday to Friday	25 (24.3)
Saturday or Sunday	8 (7.8)
Does' t Know/Remember	70 (67.9)
Object caused the Accident	
Needle	67 (65.0)
Catheter, Gelco and others	12 (11.7)
Scalpel	6 (5.8)
Wire and others	7 (6.8)
Blood and Fluids	11 (10.7)
Part of Body Affected	
Fingers	70 (68.0)
Hand	23 (22.3)
Face	7 (6.8)
Arms	3 (2.9)
Reported the accident	
Yes	76 (73,8)
No	27 (26,2)
Use of IPPs	
Yes	72 (69.9)
No	31 (30.1)
Needlestick and sharps with safety device	
Yes	11 (13.9)
No	68 (86.1)

Note: IPPs Personal Protection Individual.

Training

One should note that 34.9% of the participants mentioned the lack of proper training, with a difference between countries ($p < 0.003$), as this fact is mentioned more often in Brazil (21.4%) (Table 1).

Regarding frequency, 38.9% (369) reported irregular training and 28.3% (269) did not know when it was done. We have found differences between countries ($p < 0.001$) since in Brazil the lack of knowledge is greater.

Aspects that easy or difficult the compliance with SPs

The compliance with SPs improves with qualification, continuous and regular training, and information, especially in the form of posters and notices. Among the aspects that difficult such compliance, we found: lack of material availability (51.4%), work overload (18.3%), the hurry (16.8%), and the difficult access to PPEs (13.5%).

Discussion

Demographic characteristics of gender and age among students are similar to studies in Canada[22] and the United States[23]; and among professionals, to those found in Colombia[24] and Iran[25].

The highest number of women in this study (73.3% is due to the predominance of female nursing professionals (nurses and technicians – nursing assistants) and to the women:men ratio (2:1) among all professionals.

Considering the results of this study, one can say that Work Accidents with Biological Materials (WA-BM) are still a worldwide problem in Public and Collective Health, despite the many interventions conducted throughout the time: from the recommendations on hand-washing by Dr. Semmelweis to the CDC guidelines[9] and the Occupational Safety and Health Administration (OSHA) standards, strengthened in the Legislative Act of 2000[26]; continuing in Brazil in 2005 with the publication of the Regulatory Standard NR-32 until, more recently, in the European Union with the Agreement-Framework 2010/32/EU[27], which focus on the implementation of safety devices in needlestick and sharps.

We have found incidence coefficients or proportions of 10.3% in the ear preceding the establishment of the cohort, and of 5.5% in the following year in Brazil. This may be compared to national data from the period after the publication of NR-32 (2005), which report 185,910 WA-BM from 2007 to 2013, with incidence coefficients from 1.47% in 2007 to 3.70% in 2013. Such number may express both the increased reporting as the reduced underreporting, as well as the tendency to a real increase of incidence

proportions in Health working environments in Brazil during this period[28].

Coefficients of *Prevalence of Reports of WA-BM Incidents in the year preceding the study* (5.5 WA-BM/100 people/year in the binational study) were higher than those reported in international[29,30] and national[31] studies.

Results on the accident characteristics are similar to observations in studies in Brazil[32], Colombia[33], and other countries[34]. When factors associated with WA-BM are assessed, one can find similar data to those reported both in Brazil as in other countries. Among the most relevant factors found, we highlight working area (surgical and clinical)[33,35], profession (doctor)[35,36], working hours per week (> 42 hours)[35,37], knowledge[38], compliance with standard precautions[36], and risk perception[29].

The level of knowledge among study participants was high when compared to a study that used the same scale (2.7 and 5.7 points), held in Pakistan[38], finding better knowledge among Brazilians, doctors, and those who have children.

Moreover, those who suffered BM accidents had higher knowledge levels, which might be explained by the fact that, after an accident, one questions oneself on these themes and looks for information.

We have also noticed that participants with higher levels of knowledge prevalently perform the AntiHBs tests and complete the vaccination scheme against the Hepatitis B virus, being both a reflection of accidental exposure as of the search for information.

In this study, the mean compliance with SPs was 30.74 ± 4.51 points to an expected value of 27.75, which led us to conclude that the compliance level was good. When separately evaluating each of the guidelines, however, we have noticed that compliance with the use of glasses (2.6 points) and the non-recap of sharps (2.44 points) was still low, similar to a study conducted with doctors within a University Hospital[35], being an attitude that exposes the professional or students to the risk of acquiring diseases from contact with bodily fluids.

We know that compliance with protective measures can be understood as a set of response categories whose common characteristic is the following of guidelines provided or recommended by others[39], depending on many factors but especially on risk perception, as mentioned in this study, which is equivalent to the cited research that used a similar scale[38].

Among other factors associated with low compliance, we highlight the marital status. This data draws attention because being single, widowed or divorced is a risk factor for risky sexual behaviors as for occupational risk attitudes. These findings are similar to those found among doctors of a university hospital in Belo Horizonte[35].

We point out that individuals who do not have family responsibilities decrease their levels of protection against any kind of risk. Studies performed in Latin America inform that single people expose themselves more to both sexual[40] and occupational risks[41], including behavioral risks, such as driving at high speeds without seat belts.

Among other factors associated with the low compliance with precautions (SPs) we found, as described in a study conducted at Pakistan[36], that the occurrence of a WA-BM is related to a good compliance with SPs and leads to a lower prevalence of accidents (RP 0.94).

Conversely to what was expected, those who suffered WA-BM perceived more the risk of acquiring diseases at work, possibly as a response to the exposure. Our data seem to confirm that since the participants with higher prevalence of accidents were professionals (63.7%) and also have higher levels of risk perception. This is in accordance with Corrêa-Filho[14] and Cordeiro[12] (2003), who claim that workers who suffer injury at work have a different perception regarding immediate risk factors in the history of their accidents.

The prevalence of complete vaccination schemes against Hepatitis B was 81.9%, similar to results of Brazilian studies (73.5% and 97.7%)[35].

Regarding the AntiHBs test realization, we have found similarities with a research conducted in Iran, in which 60% of the professionals have tested their immunity[42]. Among the participants who made the test, 69.1% reported to possess immunity, equal to the data obtained in a Basic Health Unit in Brazil[43].

It is important to note that, among those who suffered accidents, there is the highest prevalence both in vaccination schemes as in AntiHBs tests; a secondary fact to the entrance of this group in tracking protocols.

According to our description and results regarding the participants' country of origin, which confirmed the existence of higher levels of knowledge and compliance in Brazil in comparison with Colombia, one may conclude that standards such as the Brazilian one, published with the purpose of protecting health workers from specific accidents and diseases of the pro-

fession, increase the knowledge about the means of transmission of multiple microorganisms and compliance with standard precautions. However, these are not totally effective means to eliminate the occurrence of accidents with biological materials.

Changes in organizational aspects that were not included in the standard, especially regarding the workload and number of working hours per week, would contribute more effectively in this regard.

Finally, we remind that each of the guidelines on biological risk in the standard NR-32 is aimed at guaranteeing the best practices in the use and disposal of needlestick and sharps and, thus, reduce the incidence of accidents, especially with the implementation of safety devices. Studies conducted in the USA showed that the publication of the Legislative Act of 2000[26] contributed to a reduction of incidents with needlestick and sharps[44].

However, to achieve better protective attitudes that contribute to real behavior changes, and continuous training is additionally required, as described in the NR-32 standard. Thus, we propose strengthening the risk perception among health workers and students, through training and periodic evaluations, in all levels of training and on the job.

Among the main factors described by the participants as facilitators of compliance, we have found: training, access to information through posters and notices in workplaces, use of personal protective equipment (PPEs) and its availability. This is similar to what has been mentioned by the participants of other Brazilian studies[45].

A Brazilian study described, among the aspects that hinder the compliance with SPs: work overload; lack of specific training; difficulty in adapting the PPEs; lack of time, PPEs, incentives, and habits. These aspects were very similar those expressed by participants of this 5

Among other factors reported by professionals and students as difficulting the compliance with SPs, we found hurry and urgency, as corroborated by a previous study that believes that the heavy and debilitating work routine minimized the fear generated by the possibility of suffering accidents and severe consequences. However, this feeling of panic does not prevent the risk of an accident and subsequent contamination, making it necessary to create s of continuous training[46].

We should clarify that health systems in Brazil and Colombia at present are different[47]; however, the Central Military Hospital in Colombia where the study was developed still is a gap of the State presence in the system, demanding regimes called special, in which specific groups (military, public servers, and oil workers) have integral care and universal access. In Brazil, the principle of solidarity and the concept of citizenship remain, structuring models such as the Unified Health System (SUS), which ensures universal access[48], being similar to the gap found in the Colombian Hospital within this study. In addition, it is possible to compare participants from the countries included in the study by both the similarities in the health system working process as the biomedical learning model to which the participants are exposed.

Conclusions

The proportion or coefficient of previous incidence of WA-BM between health professionals and students was high, being higher in Brazil than in Colombia. Brazilian participants, students and, among professionals, doctors who work in the surgical fields or intensive care units and who work over 42 hours per week, had more WA-BM.

The level of knowledge was good, being better between Brazilian participants – possibly as a result of the NR-32 implementation, and was associated with the country of origin, having children (marital status: married), full vaccination scheme, AntiHBs realization, and suffering WA-BM. Also, it was not a good predictor of compliance with the SPs.

The level of compliance with the SPs was good, however, when the guidelines were separately assessed, the compliance with the use of glasses and the non-recap of needlestick and sharps. Factors such as country of origin (Brazil), groups (Brazilian student) marital status (married/stable relationship), no accidents suffered, and risk perception are associated with higher levels of compliance with the SPs.

Collaborations

EIG La-Rotta was the initiator of the project and designed the study with FH Aoki and HR Correa-Filho. CM Pertuz, DD Trevisan, AR Camisão and CS Garcia collected data. CM Pertuz, CS Garcia and IOC Miquilin assisted in data analysis and in writing the text in conjunction with EIG La-Rotta. EIG La-Rotta, HR Correa-Filho and FH Aoki wrote the manuscript. All authors read and approved the final manuscript.

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