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ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Knowledge and attitudes on medical waste management among Belgrade medical and dental students

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SUMMARY

Introduction/Objective Knowledge and practical skills in medical waste (MW) management are of equal importance for medical and dental doctors. The first comparative study on the knowledge and skills in the field of MW management among Belgrade students was conducted with the goal of examining whether students of medicine and dentistry are equally familiar with this extremely important field.

Methods A cross-sectional study included 558 students of the sixth year of studies (430 medical and 128 dental students) who completed an anonymous semi-structured questionnaire to determine attitudes and knowledge on MW management.

Results The majority of medical and dental students had no training in MW management (79.5% and 74.6%, respectively). Dental students use protective equipment more frequently than medical students (94.5% *vs.* 42%, $p < 0.001$). However, full vaccinal protection against hepatitis B is better among medical students compared to dental students (57.7% *vs.* 39.1%, $p < 0.001$). Complete knowledge on post-exposal prophylaxis is better among medical students compared to dental students (44.5% *vs.* 13.3%, $p < 0.001$). However, dental students are more disciplined in reporting injuries (63.1% *vs.* 52.4%, $p = 0.038$). The students' knowledge on primary separation of infectious waste (93% *vs.* 77.8%, $p < 0.001$) and used needles (80.3% *vs.* 70.4%, $p = 0.007$) is better among dental students compared to medical students' correct answers.

Conclusion Dental students show better knowledge on MW management and are more disciplined in using personal infection protection compared to medical students. The students support continued training on MW management and investigations on this topic.

Keywords: medical waste; safety; education; medical students; dental students

INTRODUCTION

The term medical waste (MW) refers to all the waste generated within health-care facilities, research centers and laboratories. It consists of materials ranging from used needles to body parts, diagnostic samples, blood, chemicals, pharmaceuticals, and radioactive materials. From 10% to 25% of all MW is hazardous and may cause a variety of environmental and health risks [1, 2].

A quarter of all MW in Serbia is hazardous, and infectious MW is the largest part of it [3, 4]. Annual production of infectious waste in Serbia is between 4,500 and 5,000 tons [5]. Since 2006, the national system for safe MW management has been put into place and all infectious MW has been sterilized. Serbia has reduced the amount of hazardous MW by 50% by introducing a waste separation process in healthcare facilities [6].

Recognizing the importance of familiarity with MW management for healthcare professionals, Serbian medical faculties have recently introduced MW topic into the curriculum in the final year of their studies. To assess the quality of undergraduate education on MW management, it is important to check the students' retention of knowledge. Further, although the knowledge in this field is of equal importance for medical and dental doctors, it is not clear whether medical and dental students adopt this necessary knowledge equally. For these reasons, we undertake this comparative study on knowledge and attitudes on MW management among Belgrade medical and dental students.

METHODS

We undertook a cross-sectional study between December 2017 and January 2018 at the Faculties of Medicine and Dentistry, University of Belgrade, Serbia. The study comprised 558 students of the sixth year of studies, 430 medical students (response rate 92.47%) and 128 dental students (response rate 81.01%). There were

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more female respondents in both samples, 62.8% among medical and 64.1% among dental students.

We used an original semi-structured questionnaire designed for this study to determine knowledge, attitude, and practice concerning MW management. Students were recruited during their classes and participation was voluntary and anonymous. The questionnaire consisted of four parts. Some questions were taken from the questionnaires from similar studies but were not standardized, which was the case with ours as well.

The first part of the questionnaire included questions concerning training for MW management, wearing personal protection (mask, gloves, protective glasses), knowledge about post-exposal prophylaxis, and the vaccinal status of students (10 questions). The second part of the questionnaire comprised questions on MW regulation, management (segregation, internal collection, packaging, storage, and final disposal) and injury reporting system (41 questions). The third part of the questionnaire referred to the knowledge about color coding system (four questions). The fourth part of the questionnaire was in the form of five graded Likert's scale statements (1= "I fully disagree"; 2 = "I mainly disagree"; 3 = "I cannot decide"; 4 = "I mainly agree"; 5 = "I fully agree") concerning MW management, continuing training, and investigations on this topic (seven questions).

Statistical analysis

We performed statistical analysis with IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). We set the significance level at 0.05. The distribution of categorical variables was investigated with χ^2 test. To test the significance of differences between the mean values of numeric and ordinal variables we used Student's t-test and Mann–Whitney U test, respectively.

Ethical consideration

We performed the study with the permission from the Ethics Committee of the Faculty of Medicine, University of Belgrade.

RESULTS

The distribution of medical and dental students was similar concerning the training in MW management ($\chi^2 = 1.516$; $p > 0.05$). The majority of students had no training (74.6% at the Faculty of Medicine and 79.5% at the Faculty of Dental Medicine); a small number of them had partial training (18.5% *vs.* 15.6%); those who had full training were very few (6.9% *vs.* 4.9%).

Dental students use protective equipment more frequently than medical students (Table 1). Male students are more disciplined in this regard compared to their female colleagues (56.9% *vs.* 53%; $\chi^2 = 6.446$; $p = 0.04$). However, vaccinal protection against hepatitis B is better among medical students than in dental students (Table 1).

The knowledge on post-exposal prophylaxis is better among medical students compared to dental students (44.5% *vs.* 13.3%, $\chi^2 = 66.308$; $p < 0.001$); the availability of post-exposal prophylaxis is also better at the medical faculty compared to the dental one (36.4% *vs.* 14.8%, $\chi^2 = 31.783$; $p < 0.001$).

Around 80% of students of both faculties are aware of the significance of reporting injuries at work. However, dental students are more disciplined in reporting injuries compared to medical students (63.1% *vs.* 52.4%, $\chi^2 = 4.318$; $p = 0.038$). The responses of students are similar in relation to the treatment of injuries from sharp objects.

The majority of students are not familiar with the legal regulations regarding MW management, nor with the latest provisions from 2016, but most of them know who the responsible person is for managing MW at their faculty. Concerning waste separation at the faculty, there are more dental than medical students who believe that their faculty separates waste (Table 2).

Table 1. Infection protection among Belgrade medical and dental students

Infection protection	Answer	Faculty			
		Medicine n (%)	Dentistry n (%)	Total n (%)	p*
Personal protective devices	No	101 (24.4)	3 (2.3)	104 (19.2)	<
	Yes, fully	174 (42)	121 (94.5)	295 (54.4)	
	Yes, partially	139 (33.6)	4 (3.1)	143 (26.4)	
	Totally	414 (100)	128 (100)	542 (100)	
Vaccination against hepatitis B	No	159 (37.1)	76 (59.4)	535 (42.3)	<
	Yes, fully	247 (57.7)	50 (39.1)	297 (53.4)	
	Yes, partially	22 (5.1)	2 (1.6)	24 (4.3)	
	Totally	428 (100)	128 (100)	556 (100)	

*χ^2 test

Table 2. Knowledge and attitudes on medical waste management among Belgrade medical and dental students

Knowledge and attitudes on medical waste management	Answer	Faculty		p*
		Medicine n (%)	Dentistry n (%)	
Legal regulation	No	394 (91.8)	111 (86)	0.049
	Yes	35 (8.2)	18 (14)	
Responsible person at the faculty	No	365 (90.3)	119 (93.7)	> 0.05
	Yes	39 (9.7)	8 (6.3)	
Waste separation at the faculty	No	164 (41.2)	22 (17.2)	< 0.001
	Yes	234 (58.8)	106 (82.8)	
Containers for medical waste at the faculty	No	55 (13)	20 (15.5)	> 0.05
	Yes	367 (87)	109 (84.5)	

Concerning the primary separation of MW, the students' knowledge on infectious waste and used needles was satisfactory and better among dental students compared to medical ones. However, the majority of students of both faculties gave incorrect answers related to chemical and pathoanatomic waste, heavy metals, and cytotoxic drugs (Table 3).

Dental students showed more positive attitude towards MW management compared to medical students, particularly concerning the continuation of training and investigations on this topic (Cronbach's alpha = 0.778) (Table 4).

Table 3. Knowledge on primary separation of medical waste among Belgrade medical and dental students

Primary separation of medical waste	Faculty				p*
	Medicine		Dentistry		
	Answer n (%)		Answer n (%)		
	Correct	Incorrect	Correct	Incorrect	
Infectious waste – yellow	330 (77.8)	94 (22.2)	120 (93)	9 (7)	< 0.001
Chemical waste – purple	146 (35.4)	266 (64.6)	43 (35.5)	78 (64.5)	> 0.05
Pathoanatomic waste – brown	179 (46.3)	208 (53.7)	50 (43.5)	65 (56.5)	> 0.05
Used needle – yellow	280 (70.4)	118 (29.6)	98 (80.3)	24 (19.7)	0.007
Thermometer with mercury – violet	26 (6.5)	372 (93.5)	12 (9.8)	110 (90.2)	0.012
Syringe / cytotoxic drugs – red	127 (32.7)	261 (67.3)	31 (26.5)	86 (73.5)	> 0.05

*χ^2 test

Table 4. Attitudes towards medical waste management among Belgrade medical and dental students (5-graded scale of agreement; mean ± standard deviation)

Attitude	Medical students	Dental students	p*
Inadequate medical waste management affects human health and environment	4.72 ± 0.69	4.71 ± 0.79	0.646
Medical waste management should be a mandatory part of practical and theoretical training of medical and dental students	4.01 ± 1.06	4.37 ± 0.92	< 0.001
Training on medical waste management should be performed at least once a year	3.71 ± 1.10	3.96 ± 1.08	0.020
In my opinion, medical waste is a topic that deserves more attention in the future	4.27 ± 0.89	4.49 ± 0.79	0.004
More investigations on medical waste management are needed	3.95 ± 1.12	4.24 ± 1.03	0.005

*Mann–Whitney U test

DISCUSSION

The majority of students of both faculties finish their studies with no training in the management of MW. Similar results were obtained in a study among health professional students in India, with only 19% of them trained in MW management [7]. Similarly, only about 40% of doctors employed in healthcare centers in Nigeria received adequate training on MW [8]. Another study conducted in Jahor showed that 37% of health workers did not pass adequate training in handling and disposal of sharp objects, with a significantly lower incidence of stabbing on sharp objects among those who were trained in MW compared to those who were not [9].

Dentistry students are disciplined in using protective equipment at work (94.5%); however, the majority of them have not been vaccinated against hepatitis B (59.4%). A minor part of dentistry students is familiar with post-exposal prophylaxis (13.3%), and half of them claim that it is not available. Unlike dental students, medical students are more aware of the significance of vaccination against hepatitis B; but, they use protective equipment in lesser degree (42%), and only a third are familiar with post-exposal prophylaxis. Still, the situation in Serbia in this regard is better than in Nigeria [8] and in Tanzania [10] where post-exposal prophylaxis is familiar to a lesser degree both to dental and medical students (30% and 22.5%, respectively). The relevant results are much better in Batu Pahat, Johor, Malaysia, where 87% of medical practitioners confirmed the use of personal protective equipment in handling clinical waste [9].

The vaccinal protection of health workers in Serbia is significantly better than in Nigeria, where only 18.5% of health workers are adequately vaccinated against hepatitis B [8]. Medical students are more aware of the significance of vaccination against HBV and are more frequently vaccinated compared to dental students (57.7% *vs.* 39.1%, respectively). Immunization against HBV is of utmost importance for all health workers [11]. There are countries that fully recognize this fact and have much better vaccination results. For instance, Saudi Arabia has 80% of dental students vaccinated against hepatitis B [12].

Undergraduate healthcare students undergo professional practice that exposes them to biological material. A study conducted in São Paulo, Brazil, registered that 48.8% of students' accidents with biological material occurred among dentistry students, 40.6% among medical students, and 6.5% among nursing students [13]. The practice of reporting injuries resulting from improper waste disposal is very poor in Serbia, in spite of the awareness of reporting significance, confirmed in our study among approximately 80% of students. In the present study we show that only one half of medical students and 63% of dentistry students report injuries from MW; still this is better than in India, where the practice of reporting injuries from MW is between 39.2% and 45.6% [8]. The practice of reporting work-related injuries caused by improper MW disposal is very poor across all groups of health professionals in India [14]. In developing countries, medical workers do not report about 40–75% of injuries from sharp objects; this is a major problem especially in case of HIV infection, where post-exposal prophylaxis is effective in 80% of the cases [15]. Even in developed countries like Poland, injury reporting in hospitals is low; the implementation of regulations in this field did not help [16].

According to the data of the Public Health Institute of Serbia, stab injuries from MW are poorly reported in Serbia; training of health workers may be an effective strategy for improving the practice and behavior towards hospital MW management [17]. In Serbia, 172 seminars were held 2008–2014; 3,278 employees in health care were trained

at three levels – technician, supervisor, and manager of waste management [6]. However, there was no adequate training of students.

A small percentage of Belgrade medical and dental students, 8.2% and 14%, respectively, are well informed about the regulations related to MW management. Dental students in India are better informed about MW management; 55.5% of them had good training and 31% of them even know the year when this law was established [18, 19]; in a study conducted in 2016, this number increased to 64.3% [20]. Similarly to our results, the majority of health workers in Brazil are not familiar with regulations related to MW [21].

Regardless of poor knowledge on regulations, 90% of the investigated students know the person responsible for MW; this is better than in Jahor, Malaysia, where 83% of the respondents know the answer [9]. A recent study showed that the presence of waste managers can effectively minimize the risk of infection [22].

Most of our respondents, especially among dentistry students, know how to dispose of infectious waste and sharp objects; this is similar to the results of a study among the medical staff in the Babol City Hospital, Iran; 97% of them knew MW color coding [23]. However, the majority of students in our study did not know the proper way of managing chemical (90%) or cytotoxic waste (70%). These results are in contrast to a study among dental students from India, where 67% of the participants demonstrated good knowledge about disposing pharmaceuticals [24]. Similar results were found in a study conducted in Cairo, in which 60.9% of doctors answered correctly regarding the disposal of chemical waste [25]. Better knowledge on the management of infectious waste compared to other hazardous MW is probably related to the dominance of this type of MW in hospitals.

A recent review of literature has indicated that in many developing countries regulations and laws relating to waste management in hospitals have been adopted recently. However, the knowledge and awareness of adequate MW management remain poor due to the lack of appropriate training for both doctors and hospital staff, although this is a necessity today [26, 27]. A study conducted among Brazilian dental students proved that theoretical knowledge on waste managements can be improved, but this may not amend waste segregation and adequate disposal in dental practice [28]. In our study, students show a very positive attitude towards continuing training on MW management and investigations on this topic.

CONCLUSION

In this very first study on the knowledge and awareness of MW among Belgrade medical and dental students, we show that their training in MW management and vaccinal protection against hepatitis B are unsatisfactory. Dental students show better knowledge on MW and are more disciplined in personal protection compared to medical students. The students support better training on MW management at their faculties and more investigations on this topic.

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Conflict of interest: None declared.

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Знање и ставови београдских студената медицине и стоматологије о управљању медицинским отпадом

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САЖЕТАК

Увод/Циљ Знање и практичне вештине управљања медицинским отпадом су од посебног значаја за докторе медицине и стоматологије. Компаративна студија о знању и вештинама из области управљања медицинским отпадом спроведена је међу београдским студентима први пут, у циљу испитивања да ли овом изузетно важном облашћу студенти медицине и стоматологије владају подједнако добро.

Методе Ова студија пресека обухватила је 558 студената шесте године студија на Београдском универзитету (430 студената медицине и 128 студената стоматологије), који су попунили анонимни упитник о знању и ставовима о управљању медицинским отпадом.

Резултати Већина студената стоматологије и медицине нису имали никакву посебну обуку из управљања медицинским отпадом (79,5% и 74,6%). Студенти стоматологије су чешће користили заштитну опрему (94,5% према 42%, $p < 0,001$). Вакцинална заштита од хепатитиса Б је комплетнија међу студентима медицине у односу на студенте стоматологије (57,7% према 39,1%, $p < 0,001$). Знање о профилакси после изложености боља је међу студентима медицине (44,5% према 13,3%, $p < 0,001$). Међутим, студенти стоматологије су ажурнији у погледу пријављивања повреда на радном месту (63,1% према 52,4%, $p = 0,038$). Знање студената о примарној сепарацији инфективног отпада и коришћених игала је боље међу будућим стоматолозима (тачни одговори 93% насупрот 77,8%; $p < 0,001$ и 80,3% према 70,4%; $p = 0,007$).

Закључак Студенти стоматологије имају боље знање о управљању медицинским отпадом и дисциплинованији су у погледу коришћења заштитне опреме на раду у односу на студенте медицине. Студенти подржавају континуирану едукацију о управљању медицинским отпадом и даља истраживања о овој теми.

Кључне речи: медицински отпад; сигурност; едукација; студенти медицине; студенти стоматологије