



Number and type of medical errors caused by medical university students during their mandatory internships – survey research

Liczba i rodzaj błędów medycznych popełnianych przez studentów uczelni medycznych podczas obowiązkowych praktyk – badanie ankietowe

Adrianna Kruczkowska^{1,A-B,D}, Bartosz Tomczyk^{1,B-C}, Zuzanna Janeczko^{1,B-D},
Wojciech Hajdusianek^{2,D}, Aleksandra Jaremków^{2,A,D-F}

¹ Faculty of Medicine, Medical University, Wrocław, Poland

² Department of Population Health, Division of Environmental Health and Occupational Medicine, Medical University, Wrocław, Poland

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■ Abstract

Introduction and Objective. In Poland, during their education at medical universities students are obligated to do internships in a hospital facility. Unfortunately, situations sometime occur when, during the contact with their patients, students commit an error. This may be caused by lack of appropriate knowledge, or due to following wrong patterns. The aim of the study was to present the number and types of medical errors most commonly committed by students.

Materials and method. 506 medical students participated in the study. An anonymous on-line survey was conducted and distributed among students of medical universities in Wrocław, Zabrze, Opole, Łódź, Warsaw, Szczecin, Katowice.

Results. 70.9% participants were women. Most of participants were during the 2nd and 3rd years of study (43.1% and 24.9%, respectively). At least half of responders admitted committing at least one error. Most of them were related to hygienic procedures. Errors concerning drug administration or infectious material exposition were less often reported. Many students did not report the error to their supervisors because of neglecting it or lack of knowledge, or a fear of criticism from the supervisor.

Conclusions. The error committed by the majority of students related to sanitary procedures; therefore, appropriate measures should be imposed, such as an increase in the education of hygiene. A significant number of students reported that they felt unprepared for their tasks, which is the reason why there should be more emphasis on practical exercises during studies.

■ Key words

hygiene, internship, medical errors, medical students, questionnaire, survey

■ Streszczenie

Wprowadzenie i cel pracy. W Polsce studenci uczelni medycznych są zobowiązani do odbywania praktyk w placówce szpitalnej. Niestety zdarza się, że podczas kontaktu z pacjentem dochodzi do popełnienia błędu. Może być on spowodowany brakiem posiadania odpowiedniej wiedzy, jak i powielaniem błędnych schematów. Celem pracy było przedstawienie liczby i rodzajów błędów medycznych najczęściej popełnianych przez studentów.

Materiał i metody. Do badania przystąpiło 506 studentów kierunku lekarskiego. Polegało ono na przeprowadzeniu anonimowej ankiety internetowej, którą rozpowszechniono wśród studentów uczelni medycznych we Wrocławiu, Zabrzu, Opolu, Łodzi, Warszawie, Szczecinie i Katowicach.

Wyniki. Wśród studentów biorących udział w badaniu przeważały kobiety (70,9%). Najwięcej osób zgłosiło się z II i III roku studiów (odpowiednio: 43,1% i 24,9%). Co najmniej jeden błąd zdarzył się u ponad połowy ankietowanych. Najczęściej zgłaszane były błędy związane z higieną. Rzadziej dochodziło do popełnienia błędu związanego z lekami i ekspozycją na materiał zakaźny. Wielu studentów nie zgłosiło popełnionych błędów, co wynikało głównie ze zbagatelizowania błędu, niewiedzy i obawy przed krytyką ze strony przełożonego.

Wnioski. Większość studentów popełniała błędy związane z higieną, zatem powinno się podjąć działania mające na celu poprawę edukacji w tym zakresie. Znaczna liczba respondentów podała, że nie czuła się przygotowana do zadań, jakie były im powierzane na praktykach, co prowadzi do wniosku, iż na zajęciach powinno się kłaść większy nacisk na ćwiczenia praktyczne.

■ Słowa kluczowe

higiena, praktyka, błędy medyczne, studenci medycyny, kwestionariusz, ankieta

INTRODUCTION

According to medical law, a medical error is considered to be a procedure that does not follow current medical knowledge [1]. A more precise definition is provided by Liszewska [2]: “error in medical art means physician’s (aware of undertaking medical activity) breach of occupational conduct rules, binding in particular case and developed within science and practice, towards legal goods in the form of human life and health which in terms of the law constitutes a basis for statement of violation of obligation of caution” (translation into English [3]). Such malpractice can be divided into diagnostic, therapeutic, technical, and organizational errors [4]. Recently, an increase in the number of Polish court hearings concerning medical errors has been reported (2018–5,739 cases) [5] which mainly concerned errors made by medical doctors and other post-graduate medical employees [6–8]. Overall, in healthcare, approximately 45,000 medical malpractice incidents are reported annually [8].

One of the main causes of medical errors among medical staff is multiple employment, which can lead to increased stress, exhaustion, decreased concentration and also delayed reactions. In the longer term – professional burnout, depressive symptoms, as well as a decline in the quality of life. [9]. One of the main reasons for multi-employment among physicians is material motivation – family maintenance [10].

Students can witness errors committed by their supervisors or contribute to one themselves [11]. As a result, they might learn wrong patterns and habits, and repeat them in their own future medical practice. What is more, witnessing or committing an error might be emotionally draining for students and young doctors who are still learning. In the study carried out by West et al. [12], they found that in addition to their possible impact on patients, perceived medical mistakes were found to have a significant impact on medics’ well-being. In the longer term they are associated with a reduction in their quality of life, an increase in burnout, empathy delines, and symptoms of depression.

In an ideal world, mistakes should be disclosed and the majority of doctors and students claim, hypothetically, that they would inform the patient about both t minor and the major errors. However, when an actual error occurred, not everyone informed the patient [13].

Students are not entitled to making diagnoses and implementg therapies, but they may commit a technical or organizational error due to being a part of the team that performs a particular medical procedure

Part of the educational process is completed by summer internships, the main goal of which is to improve competencies, gain experience, and prepare for entry into the labour market [14]. It is important to note that students’ knowledge is not tested before starting the internship.

There are no current scientific articles analyzing this problem among students during their internships, with the exception of a study by Martinez and Lo [11]. They aimed to investigate the experiences of medical students with medical errors they had witnessed or committed during their clinical clerkships by describing them anonymously in a questionnaire. Most of the participants had made or observed errors, many of which were not disclosed, and it seems that clinical staff also suggested that students should not admit their errors to patients, which caused some students felt bad about it. On the other hand, students who witnessed

senior doctors admitting medical errors to their patients, seemed to understand the value of ethics and claimed that they aspired to these norms. However, such articles are few, with the majoraty of the studies conducted among students being concerned mainly with their knowledge of hand hygiene in medical institutions, and some basic issues in the field of work safety [15, 16].

This study is one of the first to widely cover medical errors committed by students.

OBJECTIVE

The aim of the study was to present the number and types of medical errors most commonly committed by students. This study may contribute to adopting measures aimed at the reduction in medical errors, and provide information necessary for better planning of the students’ preclinical instruction.

MATERIALS AND METHOD

An anonymous questionnaire prepared composed of closed questions (single and multiple choice). Part of the survey asked about the general characteristics of the participant (age, gender, year of study, size of internship’s city, type of hospital and ward). The second part asked more specific questions about education: workplace health and safety training, familiarization with the HIV, HBV, and HCV virus exposure procedures (Tab. 1), level of stress measured by a Likert-type scale (Determine your stress level during the internship: 1 – no stress, 5 – extreme stress), and errors or medical procedures performer (see below: Student medical errors).

Table 1. Questions about educational preparation for internships

Have you been familiarized with the HIV, HBV, and HCV virus exposure procedures?	Yes/No
Have you undergone workplace health and safe training?	Yes/No
Have you been familiarized with the topography of the hospital?	Yes/No
Was a tutor available and provided you with all the necessary information?	Yes/No
Did you feel prepared for the internships?	Yes/No
Were the internships conducted according to the plan?	Yes/No
Have you felt the patients reluctance / distrust?	Yes/No

Only closed groups of medical university students were used at the following universities: Wrocław, Warsaw, Łódź, Katowice (Medical University of Silesia), Opole, and Szczecin (Pomeranian Medical University). 506 students participated in the study.

In the survey, medical errors were divided into four categories: 1) hygiene-related, 2) drug-related, 3) infectious material-related, and 4) other. The 1st group included lack of hand hygiene, misuse of examination gloves, failure to maintain sterility of equipment or inappropriate disposal of medical waste. The 2nd group included misadministration of drugs, incorrect preparation of drugs, or wrong form of drug use. The 3rd group included sticking with a needle, contact with contagious material with unprotected skin, or splashes

on mucous membranes. Participants were allowed to add their own answers if none of those provided by the authors applied to them.

The study was approved by the Bioethics Committee of Wrocław Medical University (Approval No. KB339/2019).

Statistical analysis. The obtained data were statistically analyzed using Statistica 13 software for Windows. To demonstrate the relationships between the errors committed and influencing factors, the Chi-square test was used. Level of statistical significance – $p < 0.05$.

RESULTS

Table 2 shows the characteristics of the study group. Most of the respondents were women, and the majority of participants were students in their 2nd or 3rd years of study. The students' internships tended to take place in larger cities with over 500 thousand and 100–500 thousand inhabitants. The distribution of students in the internships was not related to the hospital reference level (primary, secondary, tertiary hospital, each about 30%), with the remaining students distributed among general practitioner's clinics and dentistry clinics.

Table 2. Characteristics of the study group - division of students according to specific parameters

Characteristics	
Gender	
Women	– 359 (70.9%)
Men	– 147 (29.1%)
Year of study	
I	– 218 (43.1%)
II	– 126 (24.9%)
III	– 71 (14.0%)
IV	– 61 (12.1%)
V	– 30 (5.9%)
Size of the city where the practice took place	
I. Above 500,000 inhabitants	– 146 (28.9%)
II. 100,000 – 500,000 inhabitants	– 145 (28.7%)
III. 50,000– 100,000 inhabitants	– 83 (16.4%)
IV. 10,000 – 50,000 inhabitants	– 112 (22.1%)
V. Below 10,000 inhabitants	– 20 (4.0%)
Hospital referentiality/other	
I	– 163 (32.2%)
II	– 187 (37.0%)
III	– 146 (28.9%)
General practitioner office	
	– 10 (2.0%)
Department	
I. Internal diseases	– 232 (45.8%)
II. Surgical	– 199 (39.3%)
III. Hospital emergency ward	– 198 (39.1%)
IV. anaesthesiology and intensive care unit	– 77 (15.2%)
V. Paediatric	– 70 (13.8%)
VI. Gynaecology and obstetrics	– 49 (9.7%)
VII. Other	– 90 (17.8%)
VIII. Not applicable	– 6 (1.2%)

Students' preparation level for internships and level of perceived stress. 22.9% of participants denied participation in workplace health and safety training before starting their internships. Furthermore, 33.0% of students were not

familiarized with the HIV, HBV, and HCV virus exposure procedures. However, those deficiencies in training were not found to be associated with the frequency of errors involving infectious material ($p > 0.05$) or hygiene ($p > 0.05$). 29.2% of participants reported their supervisor's inaccessibility and therefore lack of any instructions. 58.1% admitted feeling unprepared for their internships, regardless of gender or year of study.

The results concerning the perceived stress by students are presented in Figure 1. The majority of students felt a medium level of stress. Respondents tended to choose levels 2 and 3 on the stress scale, with level 5 chosen the least.

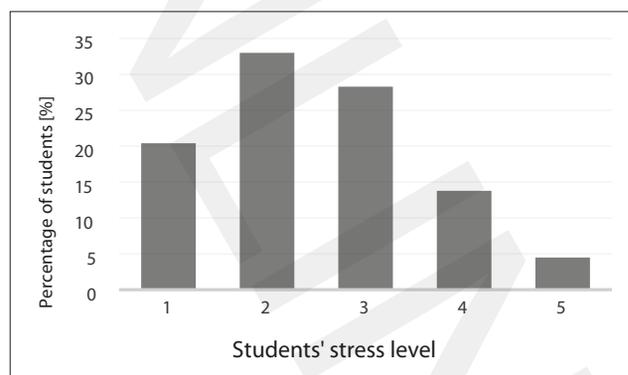


Figure 1. Stress level experienced by students during their mandatory internships

Student medical errors. More than half of the participants committed at least one error related to hygiene procedures. The most representative errors were lack of hand disinfection, medical glove misuse, using the same gloves a second time, and disposing of medical waste in an inappropriate container. On the other hand, most of the students did not commit any drug-related errors; however, some of them reported inappropriate drug preparation or administration of the wrong drug to the wrong patient. Some participants reported inappropriate stitching of wounds. At least one-third of the respondents suffered from exposure to infectious material. The most common incidents were sticking with a needle or splashing mucous membranes with infectious material. Some of the respondents admitted intentionally misinforming their patients, and some neglected to help a patient in need (Tab. 3).

Factors influencing drug administration errors. Results of the X^2 test indicate a statistically significant ($p < 0.05$) correlation between perceived stress and hygiene-related incidents ($X^2 = 13.02$), drug administration errors ($X^2 = 37.72$), and infectious material exposition errors ($X^2 = 15.65$). A high level of stress significantly increased the risk of such incidents (Fig. 2, 3, 4).

The frequency of drug administration incidents (DAIF) also depended on the hospital type, year of study, and gender (X^2 values = 13.39; 5.28; 5.11, respectively). DAIF depended on the medical facility chosen by the student. The largest number of errors were committed in hospitals with the highest and the lowest level of reference (38.8% and 35.5% of all incidents). The smallest, was in a 2nd reference level hospital with $p < 0.05$ (in Poland the highest hospital reference is 3). However, the level of the hospital had no influence in the case of infectious material exposure incidents ($p > 0.05$).

The year of study influenced the DAIF. The smallest number of incidents occurred with students during their

Table 3. Types of errors made and their percentage

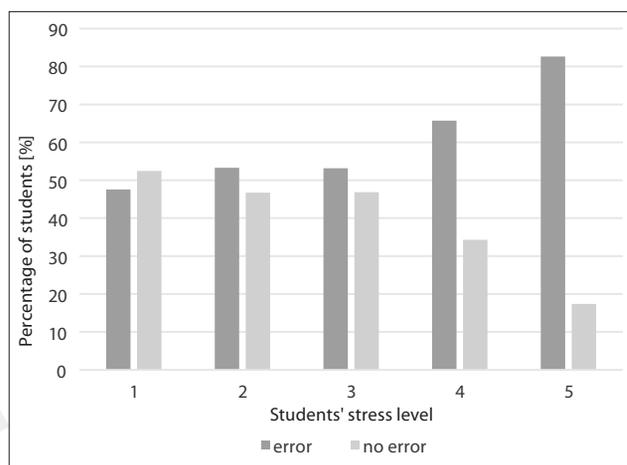
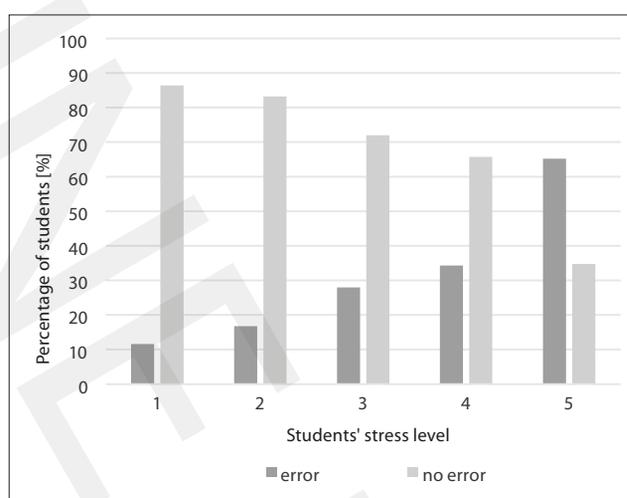
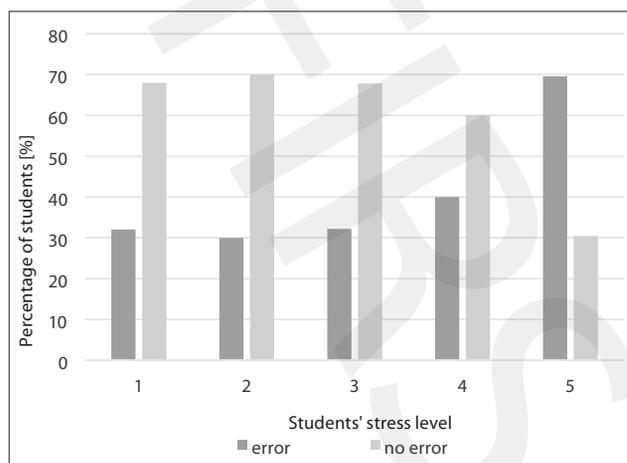
Types of errors	
What were your hygiene-related errors? Hygiene errors – 275 (54.3%)	
I. No hands' disinfection – 117 (23.1%)	
II. Not wearing gloves/using the same gloves several times – 127 (25.1%)	
III. Throwing medical waste into the wrong bins – 136 (26.9%)	
IV. Equipment sterility not maintained – 49 (8.0%)	
V. Use of the same needle / syringe for another patient – 4 (0.8%)	
VI. Other – 20 (3.2%)	
What were your medication errors? Medication/Medical procedures related errors – 118 (23.3%)	
I. Wrong preparation of the drug for the patient – 45 (8.9%)	
II. Incorrect application of a dressing or sutures – 41 (8.1%)	
III. Giving the patient the wrong drug – 19 (3.8%)	
IV. Incorrectly performer injection – 14 (2.8%)	
V. Other – 83 (13.5%)	
What were your errors related to exposure to infectious material? Exposure to infectious material – 171 (33.8%)	
I. Stabbing with a needle:	
a. Before the injection – 7 (1.4%)	
b. After the injection – 37 (7.3%)	
c. Other than during injection (cleaning, preparing medications) – 63 (12.5%)	
II. Body fluid splashes of mucous membranes – 27 (5.3%)	
III. Contact with infectious material through an unprotected wound – 19 (3.8%)	
IV. Other – 85 (13.8%)	
What were your other errors? Other errors – 102 (19.6%)	
I. Providing the patient with untrue medical information due to lack of knowledge – 70 (13.8%)	
II. Not informing superiors about the patients disturbing behaviour (e.g. threatening to kill someone) – 7 (1.4%)	
III. Deliberate action to the detriment of the patient – 5 (1.0%)	
IV. Failure to help the patient – 19 (3.8%)	
V. Other – 46 (7.5%)	

fifth year of studies (20.0% of all errors) and the highest number after the fourth year (32.39% of all errors).

DAIF were gender-dependent. Women more frequently committed errors than men ($p < 0.05$). Such differences were not observed with other types of errors.

Actions taken against errors. 30.0% of respondents concealed their incidents from their supervisors. Analyzing the remaining reported errors, in 75% of incidents at least some action was taken. In this case, in the remaining 25%, the action was discontinued either due to the low significance of the error, or because the supervisor disregarded it. Clearly, 96.7% of participants did not suffer any consequences resulting from making a mistake, and the remaining 3.3% received various penalties starting from oral reprimand, additional personal instruction, up to expulsion from the internship.

Analyzing the reason behind the concealment of incidents, 41.4% of participants declared that: 'it can happen to anyone, so there is no need to report it', 27.0% incorrectly assessed the severity of the error, 16.4% were too afraid of their supervisor, and ceased the report due to their fear. Among other responses were: fear of consequences, lack of interest from the supervisors, acquiring bad habits from staff, and the excuse that other members of staff also made the same mistakes. As for the exposure to infectious material, approximately two-thirds followed the post-exposure protocols. It should also be noted that 44.3% of participants perceived their internship programme as not being adjusted to their knowledge and skills.

**Figure 2.** Stress level experienced by students during their mandatory internships, and the frequency of making errors related to hygiene**Figure 3.** Stress level experienced by students during their mandatory internships, and the frequency of making medication errors**Figure 4.** Stress level experienced by students during their mandatory internships, and the frequency of making errors related to exposure to infectious material

DISCUSSION

In comparison with another study, the responders in the current study committed more errors which, however, were

not as serious as those made by students who participated in the study by Martinez and Lo [11]. The responders described committing an error in 18% of their responses, 76% had witnessed an error, whilst in 6% of cases, the role of the student could not be determined. The most common mistakes among these mentioned by students were procedural errors (23%) (e.g. while attempting to insert a femoral central line, the peritoneal cavity was ruptured), medication errors (14%) (e.g. 5-day-old newborn suffering from opiate withdrawal was released on an opium tincture that was 100 times the prescribed strength), and errors in medical decision-making (13%) (e.g. despite deteriorating renal function, a surgical patient was placed on a potassium regimen and became critically hyperkalaemic). Differences in study programmes in Poland and the United States, and the fact that errors committed by doctors were also taken into account, may explain the disparities, as Polish students are not allowed to take part in such advanced procedures as those mentioned above.

The current study shows that hygiene errors are committed by over half of the students, the most common being lack of hand disinfection, medical glove misuse, and disposal of medical waste in inappropriate containers. However, these are not correlated with a lack of occupational safety and health (OSH) training. A lack of OSH training was also not correlated with the frequency of infectious material exposure or knowledge about post-exposure protocols. This may indicate an inappropriate method of OHS teaching, which is probably more theoretically focused than based on real practical skills [17]. The other reason may be the fact that not every student has satisfactory OSH knowledge after university classes, and short, intensive OSH training just before internships is insufficient to cover the lack of knowledge. The obtained results are similar to those by Kaspeczyk J. et al. [18] in which 73% of medical students were aware of the fact that the greatest source of cross-infection on medical wards are the hands of the staff. Surprisingly despite having a wide knowledge about hand-transmitted bacteria, only one out of three medical students paid attention to hand decontamination before contact with a patient. Subsequently, this may indicate the lack of ability to use theoretical knowledge in practice.

First-year students committed many more errors than the rest. As Heinen et al. [19] reported in their article, 1st-year med students experience higher levels of stress, depression, and anxiety compared to the reference group, which may explain why they are more susceptible to committing more errors than their older colleagues. Also, the fact that for most of the 1st-year students it was their first contact with the patient in their life, could make it even more stressful and thus prone to making mistakes. The results clearly indicate the lack of students' preparation for their internship. Unfortunately, subjects taught during the first year of study are theoretical and have little relationship to hospital situations.

Surprisingly when it comes to the DAIF (drug administration incidents) the 4th year students committed more mistakes than the rest, whereas the 5th year students had the lowest rate of errors. The results of the students of 4th year may be impacted by the type of internship. After the 4th year, at most of the universities it is required that the students choose paediatrics, surgery or intensive care. The drugs administered in the paediatric wards and intensive care units have to be precisely calculated and individualized

for specific patients, which may leave more opportunity for medical errors to be committed. However, it is not clear why exactly these students made more mistakes, and it should be further investigated in future studies.

The gender-dependent difference in the current study may be influenced by the fact that the majority of the participants were female, a difference that was observed only in drug administration incidents.

Perceived stress was also a great factor that made students susceptible to committing mistakes, especially the DAIF. Most of the students had a moderate level of stress during the internship, and those who felt high levels of stress committed more errors. This corresponds well with the outcomes of another study by Salam et al. in which the impact of work-related stress on medication errors was measured. The study took into consideration overall stress, 25 work-related stressors, and rate of medication error. What is interesting about the study is that it is the first to be based on incident reports rather than self-reports. The researchers stated that there is a close relationship between work-related stress and medical workers who made at least one medical error per month. The second conclusion by Salam et al. was that doctors who suffer overall stress are twice as likely to make medical errors [20].

Almost half of the respondents did not report their errors to their supervisors, most commonly because of neglecting them, or fear of their superiors. This result corresponds to research carried out by Lauris C. Kaldjiana et al. [21] in which, despite the assurance of reporting the error (97% in minor and 93% in major error), in a real situation only 41% admitted to committing an error, and 5% notified the patient or family. The reasons why such information would be concealed may be: the thought that the patient would not understand it anyway, the patient is not interested in finding out that the incident had happened, or the fear of a possible court case [22]. There are different approaches to this matter in different countries, e.g. students are trained in how to communicate errors in a small group, which helps them learn how to perceive the situation from various positions: doctor, patient, and patient's family. This practice was said to increase students' interpersonal communication skills [23]. Such role-playing training could also be a way to teach how to admit to committing an error to students, and could contribute to an increase in error detection and reporting. In research conducted in the United Kingdom [24] animation was used to describe an incident, after which the doctors discussed the issue with their students. This form of education was valued by students as a more engaging and effective form of teaching OSH.

In the current study, only three-fourths of incidents were analyzed with any action taken. In almost every situation the student suffered neither a penalty nor received additional instruction to prevent committing errors again in the near future. Only a few respondents had any consequences, varying from oral reprimand to expulsion from the internship. Such disproportion may result from little supervision engagement in the students' education, blurring the responsibility for errors or the minor importance of particular incidents. Although one-third of the respondents in the current study suffered from infectious material exposure, a special post-exposure procedure was followed by only two-thirds of them. The reason for this may be negligence of the issue. Similarly, in research by A. Trzcinska, approximately 40–80% of needle

stick injuries among medical staff remain unreported unless the patient is seropositive [25]. Participants in the current study reported more incidents than professional medical staff in a comparative study. Nevertheless, the rate of not following the procedure is large, therefore, it is valuable to keep informing students of the issue of medical mistakes, both before and during the internship.

CONCLUSIONS

In recent years, interest in medical errors issue among employees and institutions involved in healthcare has increased significantly. This is the consequence of the changes in conduct with errors. Although previously concealed, now due to the principle of transparency, errors are more often revealed to patients. The same conduct is expected from students. The current study shows that the most common errors were those related to hygiene. Because the students felt unprepared for internships, it is extremely important to impose appropriate measures to improve their education: better prepared in the OHS field before participating in an internship (more focus on practical skills rather than pure theory). The authors of his study consider that during students' university training there should be a part of role-playing activities in order to help students with interpersonal skills essential for sharing knowledge about errors. It would also be worth considering introducing animation-based activities to student teaching programmes in which senior doctors could discuss how to prevent incidents in the future. Understanding the causes and contributing factors to medical errors is the only way to act against them.

Despite the efforts of the authors, the subject of this study has not been fully resolved, and further research is necessary to broaden knowledge in this field.

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