

ANTINEOPLASTIC AGENTS AND THE USE OF PERSONAL PROTECTIVE EQUIPMENT: NURSING STAFF AWARENESS

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A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: Along with an increasing number of cancer patients, the need for cytostatic drugs is also increasing. Nursing staff are the largest professional group exposed to the potential dangers of these substances.

Aim of the study: Assess the awareness of nursing staff who have direct contact with cytostatic drugs in the use of personal protective equipment (PPE).

Material and methods: The research group consisted of 101 nurses routinely exposed to cytostatic drugs. A diagnostic survey and questionnaire technique were used along with the author's original questionnaire.

Results: Of the respondents, 58.42% (n=59) never used protective shoes while dealing with cytostatics, while 53.4% (n=54) never used long-sleeved, waterproof uniforms; 49.50% (n=50) did not apply half masks, and 34.65% (n=35) failed to protect their eyes with protective glasses. The most common cause of not using the protective equipment was identified as lack of time (72; 71.29%). Deficiency of training on protective measures while working with hazardous cytostatics was cited by 37.62% (n=38) as the reason for their behavior, while almost 22% of them claimed that their employer did not provide them with a sufficient amount of protective equipment for individual use. The older, more experienced and higher-educated the staff, the higher awareness among them about the need for using PPE.

Conclusions: Higher-educated and more experienced nursing staff should constitute the source of 'good practices' and educate younger undergraduate colleagues theoretically and practically. Employers and management staff should provide employees with more training on the correct application of protective measures and increase the intensity of control of the use of personal protective equipment.

KEYWORDS: antineoplastic agents, nursing, awareness

BACKGROUND

Despite continuous progress in diagnostics and therapies, the treatment of neoplastic diseases is one of the most challenging issues in medicine [1]. Cancer is a leading cause of death worldwide, accounting for an estimated 9.6 million deaths in 2018 [2]. In 2018, an estimated 1,735,350 new cases of cancer were diagnosed in the United States [3], and 185,630 new cases in Poland [4]. The most common cancers are breast, lung and bronchus, prostate, and colorectal cancer [3,4].

Along with an increasing number of cancer patients, the need for cytostatic drugs is also increasing. Cytostatics are substances used in chemotherapy to destroy

or damage the cells which are cancerously altered. One of the side effects is damaging healthy cells which are not cancerously affected [1,5]. Most of these drugs have been classified as dangerous to humans because of their mutagenic, clastogenic, and carcinogenic properties [6]. Nurses, doctors and pharmacists, as well as cleaning staff, are potentially exposed to negative effects of cytostatics' activity through their direct care of patients who receive the drugs, but also by being in the rooms where the drugs are stored [7].

Nurses belong to the group of professionals most frequently exposed to antineoplastic agents [8]. Tompa et al. (2016) showed that in nurses exposed to cyto-

statics, a significantly increased frequency of chromosome aberrations and sister chromatid exchanges were observed when compared with those in the controls. Genotoxicological and immunotoxicological changes, as well as iron deficiency, anemia and thyroid diseases increased among cytostatic exposed subjects [6]. Polovich showed that the incidence of leukemia among exposed nurses was 10 times higher, and the incidence of non-Hodgkin lymphoma among pharmacy technicians was 3.7 times higher, than in the control [9]. Cieślicka et al. (2016) found that staff working in cytostatic environments noted excessive lacrimation, dry eye, redness and itchy eyes, skin and mucous membrane irritation, increased eyebrow and eyelash prolapse, abnormalities of the heart rate, and nausea [10]. Exposure to cytostatics may also evoke allergies, hair loss, liver or kidney damage as well as respiratory diseases such as asthma, allergic rhinitis and nasal ulceration. Additionally, fertility issues, carrying pregnancy to term, severe fetal defects, non-neoplastic hematopoietic system diseases, leukemia and lymphomas may occur [10–13].

Cytostatics most frequently enter the human body through the respiratory system and the skin [14]. Exposure to the drugs may take place during such nursing procedures as assigning and administering cytostatics in the form of pills or tablets, opening ampoules, bleeding syringes, and applying and ceasing intravenous infusions. During these activities cytostatics diffuse into the air and enter the respiratory system. Exposure at work may also occur while cleaning surfaces used for preparing cytostatic drugs [15–17]. Touching patients who receive the drugs, contact with their bodily fluids, as well as every day bed linen change (which comes in contact with these fluids) can all be hazardous [12,18–20].

The negative exposure of nurses to cytostatic drugs may be minimized by following safety measures and work hygiene practices while preparing, administering, and storing them. These regulations must be applied to the process of equipping the rooms for preparation of cytostatics properly, controlling the equipment used while preparing and administering the drugs, disposable PPE use by all employees, prohibiting any food and drink consumption and smoking in the premises, and proper processing of contaminated areas, patients' underwear and their bed linen [20,21]. Previous studies showed that nurses, despite negative effects of these drugs on the human body, not always obey work safety regulations [22–25]. Taking into consideration the above, this study aims to assess the awareness of nursing staff, who come into direct contact with cytostatic drugs professionally, on the use of PPE.

The results collected in this study may have a positive impact on work safety conditions among nurses who have a direct contact with cytostatic drugs by identifying the areas requiring educational intervention. The results will also determine the degree of negligence and the reasons of insufficient usage of the PPE by staff.

AIM OF THE STUDY

The aim of the study was to evaluate the awareness of nursing staff in direct contact with cytostatic drugs on the use of personal protective equipment, in particular determining: (1) the measures undertaken by the employer to minimize the risk of exposure to cytostatic drugs, (2) the frequency of PPE use by staff, and possible reasons for not using them, (3) the frequency of applying alternative methods aimed at minimizing the negative effects of antineoplastic agents. The study also sought to determine whether or not a correlation exists between variables such as age, level of education, work experience, and applying safety measures while working with cytostatics.

MATERIAL AND METHODS

Study design

Observational research was carried out among the nursing staff who have direct contact with cytostatics at work.

Settings

The research was conducted between 2018–2019 in five hospitals throughout Poland which used cytostatics, including four hospitals in the Opolskie Region and one in the Greater Poland Region. Approval was granted by The Bioethics Committee at Opole Medical School (NR 114/PI/2018). The study was carried out in the spirit of the Declaration of Helsinki dated on 1975 and amended in 2013 as well as *Good Clinical Practice*.

Participants

The research surveyed 101 nurses who have direct contact with cytostatics at work and knowingly approved of taking part in the procedure; completing the questionnaire implied approval of participation.

Data sources/measurement

The research was conducted according to a diagnostic survey method with the use of the author's original questionnaire which consisted of 21 closed questions. Questions 1 to 7 concerned socio-demographic data, work experience, and form of employment. Questions 8 and 9 concerned the usage of cytostatic drugs at work and the frequency of their administration. Other questions dealt with professional training organized by the employer, supervision of the staff while at work, and providing staff with PPE (questions 11–15). To enter the data on the protection of nurses, the following questions were used: Do you properly protect yourself against the exposure to cytostatics? (q. 10), Do you or your colleagues eat or drink in the rooms where cytostatics are prepared or stored? (q. 16), How often do you use listed means of PPE while working with cytostatics? (q. 17). Question 17 included 10 different means of PPE and the respondent could choose between four levels indicating the frequency of their usage (always, often, sometimes, never).

Questions 16 and 20 examined the methods of minimizing the negative effects of cytostatics applied by the respondents. Question 19 probed the degree of awareness of the risks and possible complications while working with antineoplastic agents among the nursing staff. Responses to three statements were gathered using a 5-point Likert scale (I definitely agree, I rather agree, I don't have an opinion, I don't agree, I definitely disagree). Furthermore, the respondents were asked to list the activities during which, in their opinion, the exposure takes place (q. 21).

Statistical methods

For quantitative variables, normal distribution was obtained, whereas, for qualitative ones, numbers and percentages were calculated. The quantitative variables such as age, overall work experience and current work experience (the duration of cytostatic drug exposure) did not follow normal distribution, which was verified with the use of Shapiro – Wilk's test. For the variables which did not display normal distribution, median, maximum and minimum values were shown. The verification of the hypothesis was conducted with the use of Chi-squared test, Fisher's test, Spearman's rank correlation coefficient and adjusted contingency factor Pearson's chi-squared test.

Microsoft Excel 2010 and online calculators were used to calculate the data such as Rho-Spearman's correlation coefficient [26], Chi-squared test [27] and Shapiro – Wilk's test [28].

RESULTS

Descriptive data

The median age of the respondents' was 45 (min-max; 22–63), the vast majority of whom were female (98; 97.03%). Regarding educational qualifications, most respondents were university graduates (60; 59.40%), 41 (40.59%) had completed a 3-month professional course in oncology, 23 (22.77%) had done a fully-qualifying course, and 18 nurses completed a 2-year specialization in this field. A substantial majority of all the nurses (77; 66.33%) had worked in their profession for more than 16 years prior to examination. Most of them worked with cytostatic drugs from 6–15 years (34; 33.66%), with a significant majority of them using the drugs on an everyday basis, at each shift (64; 63.37%). They also added that drip infusion is the most common route of drug administration (98; 97.03%) for their patients (Tab. 1).

Employer's activities aimed at minimizing the risk associated with the exposure to cytostatic drugs

Most employees (63; 62.38%) claimed to be provided with a sufficient training on protective measures against the harmful effects of cytostatics; 37.62% of the respondents (n=38) noticed some shortages in this

Table 1. Characteristics of respondents n=101.

Variables	N	%	Me (min-max)	
Age, years	18–30	15	14.85	45 years (22–63)
	31–40	14	13.86	
	41–50	46	45.54	
	more than 50	26	25.74	
Gender	Woman	98	97.03	
	Men	3	2.97	
Education	secondary vocational	41	40.59	
	higher – undergraduate studies	38	37.62	
	higher education – master's degree	22	21.78	
	PhD degree	0	0.00	
Postgraduate education	specialist course in oncology	41	40.59	
	qualification course in the field of oncology	23	22.77	
	oncological specialization	18	17.82	
	no training	31	30.69	
Work experience in the profession	0–5 years	17	16.83	22 years (6 months – 42 years)
	6–15 years	17	16.83	
	16–25 years	31	30.69	
	more than 25 years	36	35.64	
Work experience in the current workplace	0–5 years	28	27.72	13 years (6 months – 40 years)
	6–15 years	34	33.66	
	16–25 years	23	22.77	
	more than 25 years	16	15.84	
Frequency of using cytostatics at work	at each duty	64	63.37	
	several times a month	29	28.71	
	twice a month	2	1.98	
	once a month	6	5.94	
The form of the most frequently administered cytostatics in the current workplace	drip infusion	98	97.03	
	Injection	22	21.78	
	drug for oral administration	29	28.71	
	Other	0	0.00	

Legend: Me – median, min – minimum, max – maximum

matter. Responses regarding supervision of staff on the use of protective measures at work appeared to be very much alike – 65.35% (n=66) confirmed that supervision in their workplaces worked well, but 34.65% (n=35) claimed it did not exist at all. The majority of respondents (79; 78.22%) believed that their employers provided them with a sufficient number of the PPE. However, 22 of them (21.78%) claimed quite the opposite (Tab. 2).

Application of PPE by nurses

The examinees (89; 88.12%), in general, agreed that being exposed to harmful cytostatics as a nurse constitutes a serious issue at work. They also confirmed that coming into contact with these drugs creates a real risk of health complications among nurses (85; 84.16%). According to the staff, the activities which endanger them the most are physical contact with patients' bodily fluids (69; 68.32%) as well as preparing and administering the drugs (62; 61.39%). The least dangerous activities were identified as transportation of drugs to the ward (9; 8.91%) and discarding contaminated clothing (19; 18.81%).

Table 2. Employer's activities aimed at minimizing the risk associated with exposure to cytostatic drugs.

	N	%	95% CI	
Provision of sufficient training by the employer for nursing staff on issues related to protection against the harmful effects of cytostatics				
Yes	63	62.38	52.93	71.82
No	38	37.62	28.18	47.07
Total	101	100.00		
Supervising nursing staff regarding their use of personal protective equipment				
Yes	66	65.35	56.07	74.63
No	35	34.65	25.37	43.93
Total	101	100.00		
Ensuring by the employer sufficient number of all types of personal protective equipment for nursing staff				
Yes	79	78.22	70.17	86.27
No	22	21.78	13.73	29.83
Total	101	100.00		
Encouraging nursing staff to use personal protective equipment during their work				
Yes	79	78.22	70.17	86.27
No	22	21.78	13.73	29.83
Total	101	100.00		

Legend: n – number, CI – confidence interval

Uniform was “always” used by 34.65% of respondents (35), waterproof apron with long sleeves – 15.84% (n=16), gloves – 89.11% (n=90), two pairs of gloves – 14.85% (n=15), thicker plastic gloves intended for work with cytostatics – 41.58% (n=42), cap – 29.70% (n=30), safety glasses – 23.76% (n=24), surgical mask – 31.68% (n=32), half-mask – 10.89% (n=11) and safety shoes – 25.74% (n=26). Safety shoes were “never” worn by 58.42% (n=59) of respondents while working with cytostatic drugs, long-sleeved waterproof uniforms – 53.47% (n=54), a half mask – 49.50 (n=50), safety glasses – 34.65% (35), two pairs of gloves – 33.66% (n=34), special thicker plastic gloves recommended at work with cytostatic drugs – 31.68% (n=35) and, finally, the same number of the examinees never used any head protection in the form of caps.

The most common reason for not using PPE was lack of time (72; 71.29%). Some other significant findings

appeared to be the discomfort using PPE (48; 47.52%), inaccessibility of PPE (39; 38.61%) and patients' anxiety while using PPE (37; 36.63%) (Fig. 1).

Alternative prophylactic activities aimed at minimizing the risk associated with exposure to cytostatics

Alternative procedures aimed at minimizing the risk associated with exposure to cytostatic drugs included frequent, regular airing of patients' rooms (72; 71.29%), avoiding any food and drink consumption in the areas where cytostatics are prepared and stored (64; 63.37%), and checking prepared cytostatic solution containers for any leakage or tightness (55; 54.46%). Respondents also noted the following, less frequent, activities: taking a shower after a shift (22; 21.78%), and consuming a significant volume of liquids during shifts (29; 28.71%) (Tab. 3).

Table 3. Alternative methods used by the staff in order to minimize the negative impact of antineoplastic agents on their bodies.

Alternative activities		n	%	95% CI	
1.	Frequent airing of the patients' rooms	72	71.29	62.46	80.11
2.	Avoiding any food and drink consumption in the area where cytostatic drugs are prepared and stored	64	63.37	53.97	72.76
3.	Checking prepared solution containers for any damage or leakage	55	54.46	44.74	64.17
4.	Checking infusive apparatuses used for cytostatic infusions for any damage or leakage	52	51.49	41.74	61.23
5.	Washing contaminated hospital clothing in the hospital laundry	50	49.50	39.75	59.26
6.	Frequent airing of cytostatics' preparation rooms	45	44.55	34.86	54.25
7.	Changing disposable gloves at least every 30 min. while working with cytostatics	37	36.63	27.24	46.03
8.	Daily change of hospital uniforms	35	34.65	25.37	43.93
9.	Drinking a lot of fluids during shifts	29	28.71	19.89	37.54
10.	Showering after shifts	22	21.78	13.73	29.83

Legend: n – number, CI – confidence interval

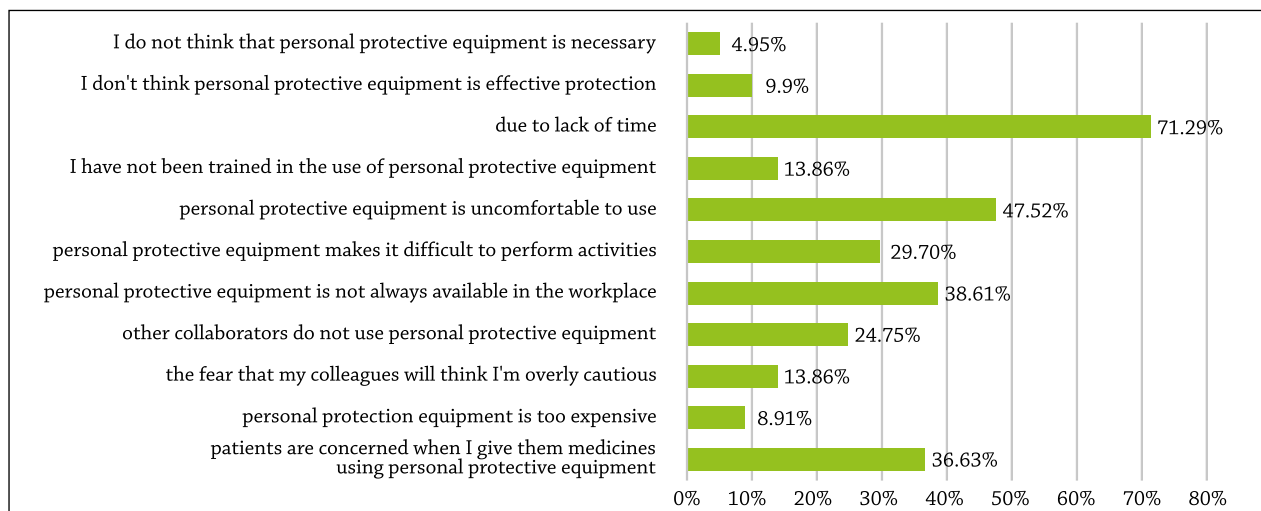


Figure 1. Reasons for not using PPE by nursing staff while working with cytostatics.

Undertaking protective measures while working with cytostatics vs. age, level of education and work experience of the staff

As age of respondents increased:

- self-assessment of the correct use of PPE during exposure to cytostatics increased ($C=0.60$, $p<0.001$)

- the frequency of eating meals in rooms with cytostatics decreased ($C=0.43$, $p=0.013$)
- the frequency of using PPE during exposure to cytostatics increased ($r_s=0.27$, $p=0.032$) (Tab. 4).

As the level of education increased, self-assessment on the proper use of PPE during exposure to cytostatics decreased ($C=0.38$, $p<0.001$) (Tab. 4).

As the number of years of work in nursing increased:

Table 4. Selected variables versus nursing staff activities related to occupational exposure to cytostatics.

The age of respondents and self-assessment of the proper use of personal protective equipment during occupational exposure to cytostatics								
Age	Yes		No		Sum (n)	Chi ²	P value	*Adjusted contingency factor Pearson's C. /**Spearman's rho correlation coefficient
	N	%	n	%				
18–30 years	6	40	9	60	15	22.98	<0.001	0.60*
31–40 years	10	71	4	29	14			
41–50 years	43	93	3	7	46			
>50 years	23	88	3	12	26			
Sum (n)	82		19		101			
Age of respondents and eating in rooms with cytostatics								
Age	Yes		No		Sum(n)			
	N	%	n	%				
18–30 years	5	33	10	67	15	10.79	0.013	0.43*
31–40 years	4	29	10	71	14			
41–50 years	6	13	40	87	46			
>50 years	0	0	26	100	26			
Sum (n)	15		86		101			
Age of respondents and frequency of using PPE during work exposure to cytostatics								
Age	Never	sometimes	often	always	Sum (n)			
	n (%)	n (%)	n (%)	n (%)				
18–30 years	8 (53)	5 (33)	1 (7)	1 (7)	15	18.25	0.032	0.27**
31–40 years	3 (21)	9 (64)	2 (14)	0 (0)	14			
41–50 years	6 (13)	18 (39)	18 (39)	4 (9)	46			
>50 years	4 (15)	11 (42)	8 (31)	3 (12)	26			
Sum (n)	21	43	29	8	101			
The level of education and self-assessment of the proper use of personal protective equipment during occupational exposure to cytostatics								
Level of education	Yes		No		Sum(n)			
	N	%	n	%				
secondary education	37	90	4	10	41	9.46	<0.001	0.38*
bachelor degree	32	84	6	16	38			
master degree	13	59	9	41	22			
Sum (n)	82		19		101			
Educational level and eating meals in rooms with cytostatics								
Level of education	Yes		No		Sum(n)			
	N	%	n	%				
secondary education	2	5	39	95	41	5.46	0.065	0.29*
bachelor degree	8	21	30	79	38			
master degree	5	23	17	77	22			
Sum (n)	15		86		101			
Work experience and self-assessment of proper protection against the negative effects of cytostatics								
Work experience	Yes		No		Sum(n)			
	n	%	n	%				
0–5 years	7	41	10	59	17	21.46	<0.001	0.532*
6–15 years	15	88	2	12	17			
16–25 years	28	90	3	10	31			
more than 25 years	32	89	4	11	36			
Sum (n)	82		19		101			
Work experience and the frequency of eating meals and drinks at the place of preparation and administration of cytostatics								
Work experience	Yes		No		Sum (n)			
	n	%	n	%				
0–5 years	6	35	11	65	17	9.75	0.02	0.377*
6–15 years	4	24	13	76	17			
16–25 years	3	10	28	90	31			
more than 25 years	2	6	34	94	36			
Sum (n)	15		86		101			

Legend: * Corrected Pearson C contingency coefficient, ** Spearman rho correlation coefficient.

- staff self-assessment in terms of proper protection against the negative effects of cytostatics increased ($C=0.532$, $p<0.001$)
- the frequency of eating meals and drinks at the place of preparation and administration of cytostatics decreased ($C=0.377$, $p=0.002$) (Tab. 4).

DISCUSSION

Key results

This study shows that the older, more educated, and more experienced the nursing staff, the more frequently they use all the protective measures while working with cytostatics and, consequently, the higher their awareness of using PPE. Staff did not use PPE mainly because of lack of time for such procedures during their shifts, some discomfort resulting from using PPE or, finally, because of not being provided with sufficient PPE by their employer. Although staff were highly self-aware of proper self-protection against exposure to cytostatics, it was observed that usage of PPE was incomplete or improper e.g. staff used interlining uniforms or surgical masks.

Interpretation

It is employers' responsibility to inform their employees about sources of exposure to agents which have cancerous or mutagenic properties, familiarizing them with potential health consequences, hygiene requirements critical to minimizing exposure to dangerous substances, informing them about the necessity of using PPE, as well as providing them with appropriate PPE in order to minimize the risk of the exposure to these agents [19,29]. However, this study demonstrated that approximately 38% of respondents noticed some shortages in training on protective measures while working with harmful substances, and almost 22% claimed that their employers does not provide them with sufficient PPE. Kyprianou et al. (2010) found that only 33% nurses reported having received specialized training [23]. Boiano et al. (2014) indicated that the main reasons for not using PPE while administering antineoplastic drugs included not being provided with a sufficient amount of specialized gloves (31%), lack of waterproof uniforms (13%) and lack of masks protecting the airways (15%) [25]. Coupled with this, education on the usage of cytostatics is essential; this was highlighted by Rai et al. (2015) who applied two tests (pre and post training of nurses) to illustrate the importance of education. The mean participant score on the safe handling of cytotoxic drugs was 35.3 in the pre-test, significantly increasing to 83.7 in the post-test after an educational intervention ($p<0.001$) [30].

In this study, despite high awareness surrounding the use of proper protection against exposure to cytostatic drugs, many respondents appeared to have used PPE in an incomplete or inappropriate way. Most of them (90; 89.11%) used gloves most frequently. Although an

interlining uniform does not provide proper protection, as it does not have liquid-proof properties, it was declared to have been used by 34.65% ($n=35$) of the nurses at any time. In contrast, only 15.84% ($n=16$) claimed to have always used a long-sleeved, waterproof uniform designed specifically to work with cytostatics while working in hazardous environments. Despite the fact that a surgical mask does not protect against gases, fumes and sprays, it was always used by 31.68% ($n=32$) of the surveyed. On the contrary, a half mask, recommended for such tasks, was worn by only 10.89% ($n=11$) of the respondents. Cieślicka et al (2016), in their research among nurses in hospitals in Lubelskie Province, found that during the administration of cytostatic drugs, staff used disposable gloves (83%; $n=66$), disposable interlining uniforms (64%; $n=51$), and face masks (61%; $n=49$). They less frequently used PPE such as protective glasses (36%; $n=29$), head caps (33%; $n=26$) and two pairs of disposable gloves (20%; $n=16$). Only 11% ($n=9$) declared to have used disposable uniforms [10]. Kim et al. (2019) found that only 24.1% of nurses showed high adherence to standard guidelines, while 58.3% and 17.7% reported moderate and low adherence, respectively. Nurses reported very low adherence to 'wearing protective eye gear' (6.7%) and 'wearing protective clothing' (13.3%). In this study, protective clothing was always worn by 116 (13.3%) of the nurses, hand protective equipment was used by 683 (78.3%) of the respondents, eye protection gear by 58 (6.7%) of them, and a group of 390 nurses (44.7%) declared to have always worn protective respiratory gear [31]. Research conducted in Cyprus showed that most participants reported high levels of compliance with the use of personal protective equipment such as gloves and protective gowns (95.4%, and 84.5%) during reconstitution of antineoplastic agents, respectively [23]. In contrast, Colvin et al. (2016) compared questionnaire responses to their own observations and observed that 75% of them used two pairs of gloves while applying chemotherapy to their patients. The researchers also noted that other indicators of protective behaviors were lower than declared during the survey [24]. The results clearly demonstrate the need for constant supervision of staff in order to increase safety during chemotherapy procedures. Our research shows that 34.65% ($n=35$) of respondents highlighted the existence of any supervision during cytostatic procedures. The study did not include questions on the form of monitoring. Therefore, further studies should likely concentrate on this aspect.

This research showed that, during the exposition to cytostatics, respondents never used protective footwear (59; 58.42%), long-sleeved, waterproof uniforms (54; 53.47%), half masks (50; 53.47%) or protective glasses (35; 34.65%); lack of time was identified as the main reason for not applying PPE. Krzemińska et al. (2016) found haste (36; 38%) and duty overload (45; 48%) as the most frequent reasons for it, while a group of 16 nurses (17%) indicated the disregard of

danger as the main cause [11]. Such factors as duty overload, shortages of staff, haste, exhaustion, and disregard of dangers were also found as the reasons for not using the PPE in Bilski's study [22]. Their research, along with ours, also mentioned patients' anxiety as the reason for not using the PPE. To conclude, patients need to be educated on the necessity of using such measures by nursing staff.

The study also asked the respondents to identify other methods used to minimize the influence of cytostatic drugs on their bodies. They most often mentioned frequent airing of the patients' rooms (72; 72.29%). A group of 63.7% (n=64) of respondents followed the legal regulations regarding the prohibition of any food and drink consumption in the rooms where cytostatic drugs are prepared, administered or stored. In order to protect themselves, 51.49% (n=52) of them checked infusion apparatuses for their leakage properties. It is highly concerning that only 49.5% (50) of the nurses decided to wash their contaminated uniforms and clothing in the hospital laundry, which suggests that the rest of them took them to their homes. The research by Cieślicka et al. (2016) found that 86% of staff (n=83) frequently performed airing of the chemotherapy preparation and patients' rooms, while 82% (n=80) of them checked preparations for any leakage or damage. However, a much smaller group, in comparison to our study, declared washing contaminated clothing at home (12%) [10]. Boiano's study was similar to Cieślicka's in this aspect [10,25]; this suggests that this study yielded poorer results than those previously reported.

In our study, we asked the nurses to identify the activities, which in their opinions, are the most dangerous when the staff might be exposed to cytostatics. They most frequently indicate that contact with patients' bodily fluids (69; 68.32%), preparing and administering the drugs (62; 61.39%) and, finally, administering tablets (46; 45.54%). In the study performed by Krzemińska et al. (2016), only 6% of the respondents indicated the direct contact with patients' bodily fluids, whereas they named the most dangerous procedures as drug preparation (60%) and starting intravenous infusions (55%) [11]. In contrast, Jeong et al. (2015) found switching cytostatic infusions (92; 21.6%) and discarding cytostatic waste (88; 20.7%) as the most hazardous procedures [32].

Generalizability

The results obtained in this study suggest that not only lack of time can be blamed for not using PPE. Incomplete and improper usage of PPE among staff suggests some shortcomings in their knowledge on work safety measures and work hygiene while preparing, administering, and storing cytostatic drugs. These

knowledge deficits may result in discrepancies between suggested standards of proceeding, and methods of work used at work. As a result, the number of dangerous situations may be increasing. Incomplete knowledge of risky situations leads to disregard of issues like this. Therefore, there is a need for constant training of nursing staff and supervision of the employers in terms of providing PPE to their employees. It is, however, comforting that the number of nurses following safety measures while working with cytostatic drugs is increasing with age, work experience and the level of education. Highly educated and experienced staff set an example, and can be the source of valuable knowledge for younger and less educated colleagues.

Limitations of the study

The limitations of the study fall into a small research sample and a non-standard tool used to collect data. However, conducting research in five different hospitals and taking into consideration multiple aspects (employer's actions, frequency of using the PPE, reasons for not using the PPE, other prophylactic activities to minimize the risks of exposure to cytostatics) in the research tool are its great asset.

CONCLUSIONS

Despite the high level of self-assessment regarding adequate protection against exposure to cytostatic drugs, most nursing staff did not fully apply PPE. It was observed that respondents used PPE in an incomplete and improper way. The awareness of using PPE increased with age, work experience and the level of education. Higher educated and experienced nurses should constitute the source of 'good practices' and ought to provide their younger and less experienced and less educated colleagues with theoretical and practical knowledge. Accordingly, employers and management staff should provide employees with more training on the correct application of protective measures and increase the intensity of control of the use of personal protective equipment. The lack of time and the reduced comfort of tasks performed after the use of PPE were the most common reasons why nursing staff did not apply PPE. The response "lack of time for use PPE" may indicate that nurses are overloaded with the work, but this phenomenon requires further research. Nursing staff cannot identify all situations during which exposure to cytostatic drugs may occur. In addition, it omits the use of many important methods that ensure safety at work, such as avoiding washing contaminated clothing at home. The above information confirms the need to increase the intensification of training of nursing staff on the safe handling of cytostatic drugs.

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