



Contents lists available at ScienceDirect

European Journal of Oncology Nursing

journal homepage: www.elsevier.com/locate/ejon

Aspects of occupational safety: a survey among European cancer nurses

Lena Sharp^{a,b,f,*}, Per Fransson^b, Matthew Fowler^{c,f}, Helena Ullgren^{a,b,d,e,f}^a Regional Cancer Center, Stockholm-Gotland, Sweden^b Department of Nursing, Umeå University, Umeå, Sweden^c Department of Oncology, University Hospitals of Derby and Burton NHS Foundation Trust, UK^d Theme Cancer, ME Head and Neck, Lung and Skin Cancer, Karolinska Comprehensive Cancer Center, Stockholm, Sweden^e Karolinska Institute, Department of Oncology-Pathology, Stockholm, Sweden^f European Oncology Nursing Society (EONS), Advocacy Working Group, Belgium

ARTICLE INFO

Keywords:

Cancer
Nursing
Occupational safety
Hazardous drugs
Working conditions
Safety culture

ABSTRACT

Purpose: Nurses are particularly at risk for occupational exposure to hazardous cancer drugs, risking both acute and chronic health effects. Knowledge on the implemented safety precautions into minimizing these risks is limited.

Methods: The European Cancer Nursing Index (ECNI) was developed by the European Oncology Nursing Society (EONS) to illustrate the development and status of this profession. In this study, anonymous online survey data on occupational safety reported by European cancer nurses as part of the ECNI 2022, was analysed.

Results: A total of 630 cancer nurses from 29 countries responded to the survey. A majority reported that written guidelines ($n = 553$, 88%) on safe handling and administration of hazardous drugs, personal protection equipment (PPE) and cytotoxic spillage kits ($n = 514$, 82%) were available at their workplaces. 130 (21%) nurses reported that wipe testing to assess any residual hazardous drugs on workplace surfaces were conducted systematically at their workplaces. 185 (29%) nurses reported that nurses sometimes or always continued with their regular tasks (including handling hazardous cancer drugs) during pregnancy and breast feeding. 185 (29%) also reported that nurses at their workplaces did not receive an introductory education program before handling hazardous drugs. In total, 346 (55%) of the nurses reported that their workplace had a freedom to speak-up guardian or whistle blower policy for members of staff.

Conclusions: Even if most nurses report that there are safety routines in place at their workplaces, the results reveal several serious occupational risks for European nurses handling hazardous cancer drugs. Actions are needed to improve and optimize occupational safety for nursing staff.

1. Introduction

Nurses are the largest group of healthcare providers and key members of cancer care teams in most care settings (WHO, 2020). Cancer nurses have a unique role in optimising patients' safety as their tasks involve preparing, administrating, monitoring and following-up patients undergoing cancer treatments (Charalambous et al., 2018; Sharp et al., 2019; Kelly et al., 2020).

The rapid developments in cancer research offer new treatment options, involving more complex treatment regimens, resulting in better outcomes but also challenges related to new toxicity profiles and to both patient and occupational safety (Mohanty et al., 2019; Dede et al., 2023).

Research has shown that patient and occupational safety goes hand in hand. In a Swedish study among over 2000 hospital health care workers at over 150 work units, patient safety climate and occupational safety climate were strongly positively related at unit level. The authors conclude that patient safety and occupational safety therefore should be considered concomitantly (Pousette et al., 2017). Occupational safety and patient safety cultures have been shown to significantly be associated with the health care staffs' safety performance. Therefore, improving the occupational and/or patient safety climate can lead to improvements in the nurses' safety performance, resulting in fewer occupational incidents and also improving the quality of care (Aghaei et al., 2020).

With the increasing cancer incidence and prevalence across Europe

* Corresponding author. Regional Cancer Center, Stockholm-Gotland, Sweden.

E-mail address: lena.sharp@regionstockholm.se (L. Sharp).

<https://doi.org/10.1016/j.ejon.2024.102595>

Received 29 February 2024; Received in revised form 9 April 2024; Accepted 17 April 2024

Available online 18 April 2024

1462-3889/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

(De Angelis et al., 2024), the use of hazardous cancer drugs also increases, thus the occupational exposure for nurses and other professions also increases. Hazardous cancer drugs include cytotoxic therapies that have hazardous characteristics and are toxic to genes, reproductive organs and other body systems.

Unsafe handling of cancer drugs has been frequently reported and could have catastrophic consequences for healthcare workers (Nouri et al., 2021). Research shows that nurses in cancer care are particularly at risk for occupational exposure to hazardous drugs (Silva et al., 2017; Friese et al., 2020; Yu, 2020). There is clear evidence of both acute and chronic health effects from occupational exposure to these drugs, including allergic skin reactions but also more serious risks related to fertility (such as infertility, miscarriages, fetal abnormalities) and even cancer (Yu, 2020; Jiang et al., 2023, Hodson et al., 2023).

The World Health Organization (WHO) advocate that occupational health or occupational safety, involves all aspects of safety in the workplace and that more focus is needed on the prevention of hazards (World Health Organisation, 2024). Previous research has shown that safety culture in cancer care varies both between and within countries and is impacted by cancer nurses' education opportunities and level of recognition in the health care settings they work in (Young et al., 2020; Yari et al., 2019; Sharp et al., 2019; Kelly et al., 2020; Drury et al., 2023).

Occupational safety also includes factors related to working conditions, such as working times. Research has shown that long shifts and excessive overtime among nurses are associated with stress, resulting in lower perceived care quality and/or poorer patient safety as well as more care activities left undone (Griffiths et al., 2014; Cho et al., 2016). The EU working time directive (European Parliament, 2003) sets out minimum safety and health requirements including periods of daily (minimum rest period of 11 consecutive hours in every 24 h) and weekly rest (an uninterrupted 24-h rest period), annual leave, breaks and maximum weekly working time (maximum average working week of 48 h including overtime). The implementation of this directive in the health care sector have been questioned and discussed (Waurick et al., 2007; Datta and Davies, 2014) and the compliance has previously been reported as low (Goncalves-Henriques et al., 2022).

By promoting and fostering a safety culture, where members of staff feel safe to always report mistakes or near misses (Schwappach and Richard, 2018; Sharp et al., 2019), providing clear guidelines and routines for staff handling hazardous cancer drugs and making sure that the staff are well educated for their tasks (Friese et al., 2020; Aebersold et al., 2021), employers can minimize the occupational risks. Specific actions could reduce the risk for occupational exposure, such as providing adequate personal protection equipment (PPE) and spill kits at all times, using closed system transfer devices (CSTDs), and performing systematic wipe testing on work surfaces to assess for any residual hazardous drugs (Friese et al., 2020; Vyas et al., 2014).

In 2023, the European Commission published new guidelines (European Commission, 2023) for safe management of hazardous medicinal products at work. These guidelines include an overview of good practice advice, aiming at reducing workers' exposure to hazardous medicinal products. However, these guidelines are non-binding for the European Union (EU) member states.

The European Cancer Nursing Index (ECNI) was developed by the European Oncology Nursing Society (EONS) to illustrate the development and status of this profession across Europe (Sharp et al., 2020). The ECNI 2020, included profiles for each country's cancer nursing development, and were based on survey and interview data from cancer nurses as well as public workforce statistics (EONS, 2020). This tool was designed to display the development of cancer nursing in each country, as well as for Europe as a whole. The evaluation of the ECNI 2020, used for advocacy purposes to improve recognition of cancer nursing across Europe, also indicated some alarming results, mainly on occupational safety risks, but with a large variation both within and between countries.

The ECNI 2022, based solely on online survey data from cancer

nurses, focused more on the individual cancer nurses' workplaces, rather than the country they represented, to better highlight differences and also to follow up the reported safety concerns from 2020. Similar national profiles and compared data from 2020 to 2022 have been presented at EONS web page (EONS, 2022).

Despite the recent developments in cancer care and the latest decades' focus on safety aspects (including development of guidelines and regulations), little is known with regard to the occupational risks that clinical European cancer nurses are exposed to.

2. Aim

The aim of this study was to describe aspects of occupational safety reported by European cancer nurses.

3. Materials and methods

3.1. Design and context

The ECNI 2020 (with total scores from 0 to 100) included 22 items covering the following dimensions: 1. Education and Career Development (max score 23), 2. Patient and Occupational Safety (max score 36), 3. Recognition (max score 20), 4. Working Conditions (max score 20), Retention and Impact (max score 18) and 5. Workforce statistics (max score 3). The present cross-sectional study includes data from the ECNI 2022 (presented under Data collection below), reported by European cancer nurses. In addition to demographic data (age, gender, country of practice, experience in nursing and cancer care), the analysis in this current study included ECNI 2022 data from the ECNI dimensions: Patient and occupational safety (8 items), Working conditions, Retention and Impact (2 item) and Education and career developments (1 item).

3.2. Data collection

The ECNI 2022 update mainly focused on the respondents' individual workplaces, rather than for the status in their whole country, to better illustrate regional and local differences. The extended ECNI 2022 also included data on staffing levels and experiences from cancer care during the Covid-19 pandemic.

During May through December 2022, cancer nurses across Europe were invited via EONS active members and activities (meetings, newsletters, social media posts, e-mail) to anonymously respond to the online survey (created in Google forms) via a web link published on EONS web page.

National cancer nursing organizations across Europe were contacted and encouraged to share the invitation to participate among their members. An information letter (Supplement 1) was provided, including information on the ECNI, purpose and processes. Both the information letter and the survey were translated from English (by native speaking cancer nursing experts) into the following languages (Croatian, Czech, Dutch, Estonian, Finnish, French, German, Greek, Icelandic, Italian, Polish, Portuguese, Russian, Spanish, Swedish, and Turkish). Responding nurses could choose which language they preferred to respond in. The non-English responses were translated back to English, by the same experts, before data were analysed. The translations were not further validated. The survey was estimated to take 10–15 min to complete. No personal information, such as names, addresses or workplace information were collected in order to guarantee confidentiality and anonymity.

Responses from healthcare professionals working in countries outside of the WHO European Region, from other professions, as well as nurses working in other disciplines than cancer care, were excluded.

4.3. Analysis

The survey data were summarized in an Excel spreadsheet, in the original languages and then translated back to English. Demographic

characteristics and the scores of the selected ECNI 2022 items were summarized, using descriptive statistics. Missing data were described for each item. All statistical analyses were performed using the software SPSS v. 29.0.1.0 (IBM, Armonk, NY, United States.).

4. Results

A total of 630 nurses from 29 countries responded to the online ECNI 2022 survey, with most nurses from Sweden ($n = 99$, 15.7%), Italy ($n = 98$, 15.6%) and Spain ($n = 95$, 15.1%). Most responders were female ($n = 562$, 89.2%) and had worked ≥ 21 years as a nurse ($n = 287$, 45.6%). The nurses' experience in cancer care varied and were fairly well distributed, with the most frequent response ≥ 21 years ($n = 152$, 24.1%)

Table 1
Characteristics for the responding nurses ($n = 630$).

Variable	N (%)
Age	
≤30	73 (11.6)
31–40	185 (29.4)
41–50	194 (30.8)
51–60	150 (23.8)
≥61	25 (4)
Missing	3 (0.5)
Gender	
Woman	562 (89.2)
Man	65 (10.3)
Non-binary	1 (0.2)
Prefer not to respond	2 (0.3)
Missing	0 (0)
Years as a nurse	
≤5	55 (8.9)
6–10	99 (15.7)
11–15	98 (15.6)
16–20	91 (14.4)
≥21	287 (45.6)
Missing	0 (0)
Years in cancer care	
≤5	129 (20.5)
6–10	138 (21.9)
11–15	130 (20.6)
16–20	79 (12.5)
≥21	152 (24.1)
Missing	2 (0.3)
Country	
Sweden	99 (15.7)
Italy	98 (15.6)
Spain	95 (15.1)
Greece	37 (5.9)
Portugal	31 (4.9)
Ireland	27 (4.3)
Belgium	26 (4.1)
The Netherlands	25 (4.0)
Germany	24 (3.8)
United Kingdom	22 (3.5)
Norway	16 (2.5)
Switzerland	16 (2.5)
Croatia	14 (2.2)
Georgia	13 (2.1)
Finland	13 (2.1)
Poland	12 (1.9)
Cyprus	9 (1.4)
Estonia	7 (1.1)
Iceland	5 (0.8)
Slovenia	5 (0.8)
Austria	5 (0.8)
Czech Republic	3 (0.5)
Denmark	2 (0.3)
Malta	2 (0.3)
Bosnia and Hercegovina	1 (0.2)
Lithuania	1 (0.2)
Romania	1 (0.2)
San Marino	1 (0.2)
Serbia	1 (0.2)
Country unknown	19 (3)

(Table 1).

4.1. Occupational safety

In total, 553 (87.8%) of the responders reported that written guidelines for health care professionals on safe handling and administration of hazardous drugs were available at their workplace. Most also reported always having access to both PPE and cytotoxic spillage kits when administering hazardous drugs ($n = 514$, 81.6%). Thirty-three nurses (5.2%) reported not (not at all) having access to either PPE or cytotoxic spillage kits. The extent of nurses preparing hazardous drugs at their workplaces, rather than by pharmacy staff in controlled labs, varied. Most responders ($n = 405$, 64.3%) reported that nurses never prepared hazardous cancer drugs at their workplaces, while 133 (21.1%) reported that it very rarely happened. Ten nurses (1.6%) reported it occurring every month, while 75 (11.9%) reported that cancer nurses prepared cancer drugs every week.

One hundred and thirty nurses (20.6%) reported that wipe testing to assess any residual hazardous drugs on workplace surfaces were conducted systematically at their workplaces (Table 2).

4.2. Occupational risks during pregnancy and breast feeding

A majority ($n = 393$, 62.4%) of the nurses responded that written guidelines for handling hazardous drugs during pregnancy and/or breast feeding were available at their workplace, while 115 (18.3%) stated that no guidelines were available, and 129 nurses (19%) were unsure (Table 2).

In total, 438 (69.5%) nurses reported that pregnant or breastfeeding nurses were assigned other tasks that without direct contact with hazardous drugs at their workplace, while 185 (29.3%) reported that nurses sometimes or always continued with their regular tasks, (including handling hazardous cancer drugs) during pregnancy and breast feeding (Table 2). A majority ($n = 391$, 62.1%) reported that, in their experience, there were no risk of negative consequences if a nurse planning or during pregnancy/breastfeeding asked for alternative duties to avoid occupational exposure to hazardous drugs, while 226 (35.9%) reported that these risks existed (always or sometimes), Table 2.

4.3. Education

In total, 336 (53.3%) nurses responded that newly employed nurses received an introductory education program before they start to administer hazardous drugs at their workplace, while 185 (29.4%) responded that nurses at their workplaces did not receive such education. When viewing data by country, a large variation appears. While most nurses in some countries (such as Spain, Italy, Greece and Portugal), report no introductory education, most nurses in other countries (such as Sweden, Ireland, The Netherlands, UK, Finland, Poland and Georgia) reported introductory education programs being in place at their workplaces (Table 3).

Three hundred and twelve (49.5%) nurses reported that a post-graduate university level training program in cancer nursing was available in their country, whilst 124 (19.7%) reported a non-university program being available and 193 (30.6%) reported no post-graduate training programs being available in their country.

4.4. Whistle blower policies and adherence to working time directive

In total, 346 (54.9%) of the nurses reported that their workplace had a freedom to speak-up or whistle blower policy for members of staff, while 92 (14.6%) reported not having and 190 (30.2%) not being sure if such a policy was in place (Table 4). Looking at the distribution between countries, the responses varied. While most nurses reported having a policy in place in some countries (such as the United Kingdom, Poland, Finland, Portugal, Sweden and Italy), most nurses in other countries

Table 2
Cancer nurses' responses on education and patient/occupational safety items in the European Cancer Nursing Index (ECNI) 2022.

ECNI Question (Q)	N (%)
Q1. Does your country have specialist (post-graduate) training in cancer nursing?	
Yes. A university-based cancer nursing program is recognised at a national level in my country	312 (49.5)
Yes. A non-university cancer nursing program is recognised at a national level in my country	124 (19.7)
No	193 (30.6)
Missing	1 (0.2)
Q 6. Are there written guidelines for health care professionals available on safe handling and administration of hazardous drugs in your workplace?	
Yes	553 (87.8)
No	74 (11.7)
Missing	3 (0.4)
Q 7. Do you have written guidelines on handling hazardous drugs during pregnancy and/or breast feeding at your workplace?	
Yes	393 (62.4)
No	115 (18.3)
I am not sure	129 (19.0)
Missing	2 (0.3)
Q 8. Are pregnant or breastfeeding nurses assigned other tasks that don't involve direct contact with hazardous drugs at your workplace?	
Yes	438 (69.5)
Sometimes	125 (19.8)
No	60 (9.5)
Missing	7 (1.1)
Q 9. Does your organisation/workplace undertake regular wipe testing to assess for any residual hazardous drugs on work surfaces?	
Yes, systematically	130 (20.6)
Yes, but rarely	167 (26.5)
No	321 (51)
Missing	12 (1.9)
Q 10. Do you have access to a cytotoxic spillage kit and Personal Protective Equipment (PPE) when administering hazardous drugs at your workplace?	
Always, we have both PPE and spillage kits	514 (81.6)
We have access to PPE but not spillage kits	29 (4.6)
We have access to spillage kits but not PPE	27 (4.3)
We sometimes have access to PPE and/or spillage kits	21 (4.3)
Not at all	33 (5.2)
Missing	6 (1)
Q 11. Do cancer nurses receive an introductory education program before they start to administer hazardous drugs at your workplace?	
Yes	336 (53.3)
Sometimes	104 (16.5)
No	185 (29.4)
Missing	5 (0.8)
Q 12. Do nurses prepare hazardous drugs at your workplace?	
It never happens	405 (64.3)
It happens very rarely	133 (21.1)
It happens every month	10 (1.6)
It happens every week	75 (11.9)
Missing	7 (1.1)
Q 13. Does your workplace have a speak-up or whistle blower policy for members of staff?	
Yes	346 (54.9)
No	92 (14.6)
I am not sure	190 (30.2)
Missing	2 (0.3)

Table 2 (continued)

ECNI Question (Q)	N (%)
Q 19. At your workplace do you experience that there is a risk of negative consequences if a nurse is planning pregnancy/are pregnant/breastfeeding and asks for alternative duties to avoid occupational exposure to hazardous drugs?	
Yes	94 (14.9)
Sometimes	132 (21)
No, never	391 (62.1)
Missing	13 (2.1)
Q 18. At your workplace, do you follow the European Work Time Directive?	
Yes, we always follow the directive for cancer nurses working hours at my workplace	280 (44.4)
Yes, most often but exceptions occur	236 (37.5)
No, we rarely follow the directive for cancer nurses working hours	40 (6.3)
No, we never follow the directive for cancer nurses working hours	37 (5.9)
I am not sure	34 (5.4)
Missing	3 (0.5)

Table 3

The respondents report on newly employed nurses receiving introductory education before they starting to administer hazardous drugs at their workplace (n = 630).

Country	N				Total
	Yes	Sometimes	No	Missing	
Sweden	80	10	6	3	
Italy	28	19	51	0	
Spain	21	23	50	1	
Greece	4	11	22	0	
Portugal	8	6	17	0	
Ireland	26	1	0	0	
Belgium	19	3	3	1	
The Netherlands	24	0	1	0	
Germany	13	7	4	0	
United Kingdom	20	2	0	0	
Norway	13	1	2	0	
Switzerland	9	4	3	0	
Croatia	3	3	8	0	
Georgia	11	0	2	0	
Finland	11	1	1	0	
Poland	8	1	3	0	
Cyprus	4	2	3	0	
Estonia	5	2	0	0	
Iceland	5	0	0	0	
Slovenia	2	0	3	0	
Austria	3	2	0	0	
Czech Republic	3	0	0	0	
Denmark	2	0	0	0	
Malta	2	0	0	0	
Bosnia and Hercegovina	1	0	0	0	
Lithuania	0	0	1	0	
Romania	0	0	1	0	
San Marino	0	1	0	0	
Serbia	0	0	1	0	
Unknown country	11	5	3	0	
	n (%)				
Total	336 (53.3)	104 (16.5)	185 (29.4)	5 (0.8)	630 (100)

reported not having (such as Greece) or not being sure (such as Spain, Ireland, The Netherlands, Croatia or Georgia) if a speak up/whistle blower policy being in place at their workplace (Table 4).

When asked if the European Working Time Directive was followed at the workplace, 280 (44.4%) reported that the directive always or most often (n = 236, 37.5%) was followed (Table 2).

5. Discussion

In this study, a large sample of cancer nurses from various European countries reported on different aspects on occupational safety, mainly

Table 4

The cancer nurses report on having a speak up or whistle blower policy for members of staff at their workplace (n = 630).

Country	N				Total
	Yes	No	I am not sure	Missing	
Sweden	59	6	33	1	
Italy	65	17	16	0	
Spain	32	16	46	1	
Greece	13	15	9	0	
Portugal	27	2	2	0	
Ireland	10	6	11	0	
Belgium	14	2	10	0	
The Netherlands	10	2	13	0	
Germany	16	2	6	0	
United Kingdom	19	0	3	0	
Norway	8	3	5	0	
Switzerland	10	1	5	0	
Croatia	0	6	8	0	
Georgia	4	1	8	0	
Finland	11	2	0	0	
Poland	12	0	0	0	
Cyprus	6	2	1	0	
Estonia	6	0	1	0	
Iceland	5	0	0	0	
Slovenia	0	3	2	0	
Austria	4	0	1	0	
Czech Republic	3	0	0	0	
Denmark	1	0	1	0	
Malta	2	0	0	0	
Bosnia and Hercegovina	0	0	1	0	
Lithuania	0	1	0	0	
Romania	0	1	0	0	
San Marino	1	0	0	0	
Serbia	0	1	0	0	
Country unknown	8	3	8	0	
	n (%)				
Total	346 (54.9)	92 (14.6)	190 (30.2)	2 (0.3)	630 (100)

related to handling hazardous cancer drugs at their workplaces. The results reveal several occupational risks. The knowledge gained could be used by both health care managers and other decision-makers to implement actions to optimize occupational safety for nursing staff and in turn, patient safety (Aghaei et al., 2020).

An important and alarming finding in this study was that nearly a third of the responders reported that newly employed nurses failed to receive an introductory education program before starting to administer hazardous drugs. An additional proportion reported that nurses sometimes received an introductory education. It is likely that these newly employed nurses received a general clinical induction, but high-risk tasks such as handling potent hazardous drugs, requires specific and comprehensive training, rarely included in general clinical induction programs for nurses.

The European Commission's guidelines from 2023 (European Commission, 2023) state that it is the employer's responsibility to ensure that members of staff who handle hazardous drugs are adequately trained. These guidelines also point out that academic studies for professions with a high risk of exposure to hazardous medicinal products should include relevant education. However, one third of the nurses in this study reported that post-graduate training programs in cancer nursing were not available in their country. This is in line with previous research (Lahtinen et al., 2014), which concluded that within the European Higher Education Area, 27% of the 45 countries did not provide post-graduate nursing programs, even if some countries might have improved their education opportunities for some nursing specialties in recent years. Undergraduate and/or bachelor's degree nursing programs provide education at generalist level (Lahtinen et al., 2014) and rarely include specific education for handling hazardous cancer drugs. The association between nurses' education level and patient safety outcomes

in European hospitals are well-established (Aiken et al., 2014).

The rapid developments in cancer treatments with new drugs launched continuously, implies that ongoing education is needed to optimize both patient and occupational safety. Research has shown that practicing cancer nurses' knowledge, confidence and performance improved after undergoing education programs in safe handling of hazardous cancer drugs (Aebersold et al., 2021; Nouri et al., 2021). In the current study we did not collect data on recurrent or continued education. Neither does the ECNI include data on the responding nurses own academic education levels.

Other important findings raised concerns regarding the occupational risks for cancer nurses who are pregnant or breast feeding. The majority reported having specific routines in place, protecting pregnant or breast-feeding nurses from occupational exposure to hazardous cancer drugs. However, a substantial proportion of cancer nurses reported there being no specific guidelines available (n = 115, 18.3%). One out of five also reported that nurses sometimes or always continued handling hazardous cancer drugs during pregnancy and breast feeding. In addition, more than one third reported the risks of negative consequences if pregnant or breast-feeding nurses asked for alternative duties. Considering the well documented reproductive risks relating to occupational exposure to hazardous cancer drugs, this cannot be considered anything other than alarming and unacceptable (Jiang et al., 2023; Hodson et al., 2023). A recent study among Chinese nurses showed a nearly twofold increase in risk for premature birth among nurses handling hazardous cancer drugs (Jiang et al., 2023).

Research shows that occupational risks are often overlooked and/or not identified (Connor et al., 2016; Friese et al., 2020). Despite this, only one out of five of the cancer nurses in our study reported that wipe testing/sampling to assess any residual hazardous drugs on workplace surfaces were conducted systematically at their workplace. The non-binding European Commission's guidelines (European Commission, 2023) recommend wipe testing be conducted to determine contamination at least annually for relevant drugs, since dermal absorption has been suggested as the most likely route of occupational exposure to hazardous cancer drugs in cancer care settings (Connor et al., 2016). Furthermore, the guidelines state that the quality of the cleaning, as well as adherence to PPE use and other safety routines should be checked systematically. Comprehensive safety guidelines for handling hazardous cancer drugs should include wipe sampling, as a screening tool to evaluate environmental contamination as a potential exposure source and strive to reduce contamination levels as much as possible. However, research indicates that if wipe sampling is not performed correctly or if too few samples are collected, the amount of drug detected may be low (Connor et al., 2016). This raises the question as to the validity of mandating annual wipe testing.

Positive results from this study were that most nurses reported always having access to PPE and cytotoxic spillages kits and also that the EU Working Time Directive was most often followed. However, a small proportion of nurses reported not having access to PPE and rarely or never following the Working Time Directive. Further work is required to explore these outliers in clinical practice to explore what needs to be done to empower the nursing workforce as well as advocate for them at an organizational/country level.

The US National Institute for Occupational Safety and Health (NIOSH) describes "The hierarchy of controls", as a way of controlling exposure to hazards in the workplace. This includes the following five levels (in preferred order) of actions to reduce or remove hazards; Elimination, Substitution, Engineering controls, Administrative controls and PPE. Using this hierarchy lowers worker exposure and reduces risk of illness or injury (NIOSH, 2024) and could also be used for European healthcare organizations, in their efforts to improve occupational safety systematically. A working environment that encourages all members of staff to speak up when errors or near misses occur fosters a safety culture (Schwappach and Richard, 2018). To implement a freedom to speak up guardian or whistle blower policy is a way for health care organizations

to encourage their staff to speak up as well as informing them what will happen when they do. These policies need to be well known to all members of staff, in order for it to serve its purpose. In the current study, just over half of the cancer nurses reported that their workplace had a speak-up or whistle blower policy for members of staff at their workplace. The fact that one third of the nurses reported that they were unsure if such a policy was in place or not, indicates that if such a policy existed, it was not fully implemented. In a recent systematic review, (Kane et al. (2023) concluded that speaking up policies are important for patient safety, but the lack of agreed definition of the concept might be an explanation to the differences in how successful these policies are. The authors (Kane et al., 2023) define speaking up as; “a healthcare professional identifying a concern that might impact patient safety and using his or her voice to raise the concern to someone with the power to address it”.

As previously discussed, more than a third of the nurses in our study reported risks for negative consequences if pregnant or breast-feeding nurses asked for alternative duties at their workplaces. This is a serious sign of poor safety culture and lack of effective speaking up policy.

One of the strengths in this study is the large sample; reporting from clinical cancer nurses in many countries and various workplaces. The fact that the survey was anonymous and could be completed in various languages, contributes to the quality of the data. Limitations are that the study does not include data on the responders' education level, type of workplace and that no validated data collection instrument was used, making comparisons with other studies difficult. The fact that the ECNI tool is not validated, entails no independent verification of the questions and responses, making it difficult to determine the full credibility of the results. The questions used and analysed in ECNI have, however, been developed by leading cancer nursing experts. After evaluating the ECNI 2020 results, a group of experts (cancer nursing researchers and clinicians) from different countries, revised and adapted the questions for the ECNI 2022, to improve rigor. However, the proportion of missing data is low ($\leq 3\%$) for all the items, indicating that the questions were relevant and understandable for the responding nurses. Further use of ECNI in scientific publications should, however include strategies for additional validation.

There is a risk of selection bias as the survey was disseminated by active EONS members (typically experienced and well educated), which is reflected in the data. On the other hand, these experienced cancer nurses undoubtedly have a good insight in working conditions and occupational safety matters at their workplaces, which may have contributed to more reliable data.

Another limitation is the great variation in the number of responses from the different countries, making comparisons inadequate. However, the purpose of this study was not to compare occupational safety in cancer nursing between European countries. Larger samples from each of the included countries would have enabled other possibilities, but they would also have required more resources for disseminating the study invitation. Few countries have cancer nursing registers that could have been used for dissemination. However, to compare occupational safety in cancer nursing between the European countries was not the purpose of this study. The aim was rather to present an overview of perceived occupational risks and the variation between workplaces.

6. Conclusions

Even if many health care providers actively focus on providing a safe working environment for cancer nurses, there are several occupational risks that could potentially be minimized with comprehensive safeguarding programs that were followed up systematically. As well as patients should be protected from avoidable medical errors, cancer nurses and other members of staff need to be better protected from serious workplace related medical risks. Occupational exposure to hazardous cancer should be minimized at all costs. More research is needed to improve the awareness and knowledge of occupational safety among

cancer nurses. Preferably, it will be designed as large-scale intervention studies with robust long-term evaluation and implementation strategies.

CRedit authorship contribution statement

Lena Sharp: Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Per Fransson:** Writing – review & editing, Validation, Formal analysis. **Matthew Fowler:** Writing – review & editing, Validation, Project administration, Methodology, Formal analysis, Conceptualization. **Helena Ullgren:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

None of the authors report any conflict of interest to report.

Acknowledgements

We would like to thank the EONS Board and Team for support and encouragement. Specifically, we thank the cancer nursing experts who translated the survey and information letters as well as the EONS Past President Johan de Munter and Dr Gianluca Catania for important contributions during the study design and data collection process. We also thank the responding cancer nurses, who so generously shared their experiences with us.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejon.2024.102595>.

References

- Aebbersold, M.L., Kraft, S., Farris, K.B., Scherdt, M., Olsen, M., Polovich, M., Shelton, B.K., Montgomery, G.H., Friese, C.R., 2021. Evaluation of an interprofessional training program to improve cancer drug therapy safety. *JCO Oncol. Pract.* 17, e1551–e1558.
- Aghaei, H., Sadat Asadi, Z., Mirzaei Aliabadi, M., Ahmadiania, H., 2020. The relationships among occupational safety climate, patient safety climate, and safety performance based on structural equation modeling. *J. Prev. Med. Public Health* 53, 447–454.
- Aiken, L.H., Sloane, D.M., Bruyneel, L., Van Den Heede, K., Griffiths, P., Busse, R., Diomidous, M., Kinnunen, J., Kózka, M., Lesaffre, E., Mchugh, M.D., Moreno-Casbas, M.T., Rafferty, A.M., Schwendimann, R., Scott, P.A., Tishelman, C., Van Achterberg, T., Sermeus, W., 2014. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet* 383, 1824–1830.
- Charalambous, A., Wells, M., Campbell, P., Torrens, C., Ostlund, U., Oldenmenger, W., Patiraki, E., Sharp, L., Nohavova, I., Domenech-Climent, N., Eicher, M., Farrell, C., Larsson, M., Olsson, C., Simpson, M., Wiseman, T., Kelly, D., 2018. A scoping review of trials of interventions led or delivered by cancer nurses. *Int. J. Nurs. Stud.* 86, 36–43.
- Cho, E., Lee, N.J., Kim, E.Y., Kim, S., Lee, K., Park, K.O., Sung, Y.H., 2016. Nurse staffing level and overtime associated with patient safety, quality of care, and care left undone in hospitals: a cross-sectional study. *Int. J. Nurs. Stud.* 60, 263–271.
- Connor, T.H., Zock, M.D., Snow, A.H., 2016. Surface wipe sampling for antineoplastic (chemotherapy) and other hazardous drug residue in healthcare settings: Methodology and recommendations. *J. Occup. Environ. Hyg.* 13, 658–667.
- Datta, S.T., Davies, S.J., 2014. Training for the future NHS: training junior doctors in the United Kingdom within the 48-hour European working time directive. *BMC Med. Educ.* 14 (Suppl. 1), S12.
- De Angelis, R., Demuru, E., Bailj, P., Troussard, X., Katalinic, A., Chirlaque Lopez, M.D., Innos, K., Santaquilani, M., Blum, M., Ventura, L., Paapsi, K., Galasso, R., Guevara, M., Randi, G., Bettio, M., Botta, L., Guzzunati, S., Dal Maso, L., Rossi, S., 2024. Complete cancer prevalence in Europe in 2020 by disease duration and country (EUROCare-6): a population-based study. *Lancet Oncol.* 25 (3), 293–307.
- Dede, Z., Tumer, K., Kan, T., Yucel, B., 2023. Current advances and future prospects in cancer immunotherapeutics. *Medeni. Med. J.* 38, 88–94.
- Drury, A., Sulosaari, V., Sharp, L., Ullgren, H., De Munter, J., Oldenmenger, W., 2023. The future of cancer nursing in Europe: addressing professional issues in education, research, policy and practice. *Eur. J. Oncol. Nurs.* 63, 102271.
- European Commission, 2023. Guidance for the safe management of hazardous medicinal products at work. In: Irectorate-General For Employment. Publications Office of the European Union, Luxembourg.

- European Oncology Nursing Society, 2020. EONS Cancer Nursing index 2020 [Online]. Available: <https://cancernurse.eu/advocacy/eons-cancer-nursing-index-2020/>. (Accessed 27 February 2024).
- European Oncology Nursing Society, 2022. European Cancer nursing index, 2022 [Online]. Available: <https://cancernurse.eu/ecni2022/>. (Accessed 27 February 2024).
- European Parliament, 2003. EU's Working Time Directive (2003/88/EC). Directorate-General for Employment, Social Affairs and Inclusion.
- Friese, C.R., Wong, M., Fauer, A., Mendelsohn-Victor, K., Polovich, M., Mccullagh, M.C., 2020. Hazardous drug exposure: case report analysis from a prospective, multisite study of oncology nurses' exposure in ambulatory settings. *Clin. J. Oncol. Nurs.* 24, 249–255.
- Goncalves-Henriques, M., Horala, A., Topcu, E.G., Boekhorst, F., Khattak, H., 2022. The implementation of the European Working Time Directive in Europe and its impact on training in obstetrics and gynaecology: a ten year follow-up. *Eur. J. Obstet. Gynecol. Reprod. Biol.* 278, 1–5.
- Griffiths, P., Dall'ora, C., Simon, M., Ball, J., Lindqvist, R., Rafferty, A.M., Schoonhoven, L., Tishelman, C., Aiken, L.H., 2014. Nurses' shift length and overtime working in 12 European countries: the association with perceived quality of care and patient safety. *Med. Care* 52, 975–981.
- Hodson, L.O.J., Couch, J., Hirst, D., Lawson, C., Lentz, T.J., Mackenzie, B., Mead, K., Cincinnati, OH: U.S., 2023. NIOSH [2023]. Managing Hazardous Drug Exposures: Information for Healthcare Settings. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH).
- Jiang, Z., Chen, J., Feng, L., Jin, M., Liu, S., Wang, L., Wang, J., Yu, C., Zhou, J., Ye, Y., Mei, L., Yu, W., Zhang, X., Lou, J., 2023. Associations between maternal occupational exposures and pregnancy outcomes among Chinese nurses: a nationwide study. *Reprod. Health* 20, 161.
- Kane, J., Munn, L., Kane, S.F., Srulovici, E., 2023. Defining speaking up in the healthcare system: a systematic review. *J. Gen. Intern. Med.* 38, 3406–3413.
- Kelly, D., Lankshear, A., Wiseman, T., Jahn, P., Mall-Roosmae, H., Rannus, K., Oldenmenger, W., Sharp, L., 2020. The experiences of cancer nurses working in four European countries: a qualitative study. *Eur. J. Oncol. Nurs.* 49, 101844.
- Lahtinen, P., Leino-Kilpi, H., Salminen, L., 2014. Nursing education in the European higher education area - variations in implementation. *Nurse Educ. Today* 34, 1040–1047.
- Mohanty, R., Chowdhury, C.R., Arega, S., Sen, P., Ganguly, P., Ganguly, N., 2019. CAR T cell therapy: a new era for cancer treatment (review). *Oncol. Rep.* 42, 2183–2195.
- Nouri, A., Seyed Javadi, M., Iranijam, E., Aghamohammadi, M., 2021. Improving nurses' performance in the safe handling of antineoplastic agents: a quasi-experimental study. *BMC Nurs.* 20, 247.
- Pousette, A., Larsman, P., Eklof, M., Torner, M., 2017. The relationship between patient safety climate and occupational safety climate in healthcare - a multi-level investigation. *J. Saf. Res.* 61, 187–198.
- Schwappach, D., Richard, A., 2018. Speak up-related climate and its association with healthcare workers' speaking up and withholding voice behaviours: a cross-sectional survey in Switzerland. *BMJ Qual. Saf.* 27, 827–835.
- Sharp, L., Rannus, K., Olofsson, A., Kelly, D., Oldenmenger, W.H., 2019. Patient safety culture among European cancer nurses-An exploratory, cross-sectional survey comparing data from Estonia, Germany, Netherlands, and United Kingdom. *J. Adv. Nurs.* 75, 3535–3543.
- Sharp, L., Ullgren, H., Fowler, M.N., Protogiros, D., Van Klinken, M., Hálfðánardóttir, H., Theologia, T.A., Conceicao, F., Hanan, T., Khmaladze, A., 2020. CN9 the European Cancer Nursing Index 2020: a tool for mapping cancer nursing status across Europe. *Ann. Oncol.* 31, S1127.
- Silva, J., Arezes, P.M., Schierl, R., Costa, N., 2017. Risk of occupational exposure to cytotoxic drugs: the role of handling procedures of hospital workers. *Int. J. Med. Health Sci.* 11, 558–566.
- The National Institute for Occupational Safety and Health (NIOSH), 2024. Centers for disease control and prevention [Online]. Available: <https://www.cdc.gov/niosh/topics/hierarchy/>, 05/April 2024.
- Vyas, N., Yiannakis, D., Turner, A., Sewell, G.J., 2014. Occupational exposure to anti-cancer drugs: a review of effects of new technology. *J. Oncol. Pharm. Pract.* 20, 278–287.
- Waurick, R., Weber, T., Broking, K., Van Aken, H., 2007. The European Working Time Directive: effect on education and clinical care. *Curr. Opin. Anaesthesiol.* 20, 576–579.
- World Health Organisation (WHO). 2020 State of the World's Nursing 2020: Investing in Education, Jobs and Leadership. Geneva: Licence: CC BY-NC-SA 3.0 IGO.
- World Health Organisation (WHO), 2024. Occupational health [Online]. Available: <http://www.who.int/health-topics/occupational-health>. (Accessed 28 February 2024).
- Yari, S., Naseri, M.H., Akbari, H., Shahsavari, S., Akbari, H., 2019. Interaction of safety climate and safety culture: a model for cancer treatment centers. *Asian Pac. J. Cancer Prev.* 20, 961–969.
- Young, A.M., Charalambous, A., Owen, R.I., Njodzeka, B., Oldenmenger, W.H., Alqudimat, M.R., So, W.K.W., 2020. Essential oncology nursing care along the cancer continuum. *Lancet Oncol.* 21, e555–e563.
- Yu, E., 2020. Occupational exposure in health care personnel to antineoplastic drugs and initiation of safe handling in Hong Kong: a literature review. *J. Infusion Nurs.* 43, 121–133.