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Work experience, profession type, and perception of medication waste disposal among healthcare workers: A study in the Eastern Province, Saudi Arabia



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ABSTRACT

Background: Improper disposal of medication waste is a global concern. Several published articles reported perceptions and barriers of the community or pharmacists towards proper medications waste disposal, but least are discussing the overall health workers' perception, particularly those in the Eastern Province in Saudi Arabia. **Aim and objectives:** The current research aimed to identify the healthcare worker's perception, explore limitations and barriers, and proposed solutions towards proper medication waste disposal. The second aim is to investigate difference in the response among healthcare worker based on their profession type and years of work experience. **Method:** This cross-sectional, descriptive study is based on an internet-based survey questionnaire. Questionnaires were adapted from previous study and were validated before distribution to participants. Respondents were classified based on their healthcare profession and based on the year of their work experience. Descriptive statistics analysis was carried out to assess difference in perception among respondents based on their profession or years of work experience. The Statistical Package for the Social Sciences (SPSS, version 26) package was used for conducting statistical analysis.

Results: 321 participants responded to the online survey. 60 % of the respondents were from clinical practice settings and 26 % had work experience between 0–2 years. 77 % of them had encountered medication waste issues, whereas 129 respondents reported that these issues raised from the workplace and 92 respondents reported that they raised personal source. Interestingly, respondents with limited work experience reported the lower perception and knowledge toward medication waste compared to those with more work experience. 31 % agreed that logistic issues (availability of collection bins) and 28 % reported that the unavailable policies/guidelines that govern this proper medication waste disposal are barriers which limit proper practice. 211 participants strongly agreed on that policies from governmental bodies are very important to limit this issue, whereas training and the availability of logistics were the most recommended solutions from respondents to increase healthcare awareness towards proper medication waste disposal.

Conclusion: Proper perception about medication waste disposal is still an ongoing issue among healthcare workers, particularly those who recently joined their work. Training and enforcing policies and guidelines by governmental bodies could be one approach to ensure proper medication waste disposal.

1. Introduction

Globally, improper disposal of medications waste is a growing concern because it is associated with a financial burden and has negative impacts on the safety of the environment (Wajid et al., 2020). Environmental contamination, in return, puts the health of living beings

(humans, animals, and plants) in danger. Adverse effects associated with inappropriate disposal of medications waste are not only affecting the involved persons, but they can also impact negatively on patients, healthcare workers, and employees who are responsible to manage the disposable materials (Paut Kusturica et al., 2016).

Every year, there is an increase in the production and consumption of

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pharmaceuticals because of the increasing prevalence of diseases. Medications remained a top priority for the government bodies at both national and international levels, contributing to a significant rise in the overall healthcare cost (Lucca et al., 2019, Alghadeer and Al-Arifi, 2021). Unused medications, such as contaminated, spilled, or expired medication, vaccines, or other equipment and supplies are a public safety issue, leading to potential accidental poisoning, misuse, and overdoses (Hassan et al., 2022). Previous studies recommended four main approaches to reduce medicines waste (Jesson et al., 2005; Lucca et al., 2019). Patient education, improving prescribing practices, patients' engagements with their healthcare to ensure their medication adherence, and establishing a nation-wide return and medication disposal program in the community are the four proposed approaches to overcome medication waste issue. (Alqurshi, 2020, Alghadeer and Al-Arifi, 2021).

Therefore, many developed countries, such as the United States, the United Kingdom and Australia have published several guidelines and regulations for proper disposal practices of medication waste, such as take-back policies (Lucca et al., 2019). A take-back policy means that patients can return their un-used and un-wanted medications to drug stores or manufacturers. However, in Saudi Arabia, no standard policy or guideline was established to govern the proper disposal of medication waste (AlAzmi et al., 2017, Alqurshi, 2020).

Several studies were conducted investigating medication waste management in Saudi Arabia, but few of them address this issue in the Eastern Region. Alshareef and his colleagues conducted a cross-sectional survey involving 50 randomly selected pharmacists. They reported a low awareness among participants towards appropriate medication waste disposal (Al-Shareef et al., 2016). Alghadeer and his colleagues also conducted another cross-sectional survey involving 400 community pharmacists and 360 healthcare workers assessing their awareness of appropriate methods to dispose medication waste. They concluded that the awareness of best practice was low, and the majority reported concerns towards negative impact of medications waste on environment (Alghadeer and Al-Arifi, 2021).

With limited literature describing the magnitude of appropriate medication wastage disposal in Saudi Arabia, the current research aims to assess the healthcare workers perception towards appropriate medication waste disposal and to identify the difference between healthcare workers perception based on their healthcare profession type or the years of their work experience. This descriptive research will be the first conducted in the Eastern Region in Saudi Arabia and will help in collecting deeper views and suggestion to build, plan and introduce a well-designed initiative which aims to govern an appropriate disposal of medication waste program to help in minimizing the hazard risk associated with improper disposal of medication waste.

2. Methodology

2.1. Study design

A descriptive, cross-sectional online survey was conducted during June 2022 and October 2022 throughout the Eastern Region in Saudi Arabia.

2.2. Study population and sample size

The study population consisted of healthcare worker, Arabic or English-speaking individuals and living in the Eastern Region in Saudi Arabia. A convenience sampling method (simple question, short time to answer) was used in this survey to attract respondents from a large geographical area and facilitate the recruitment of a large sample.

Participant were selected to be from the Eastern Region in Saudi Arabia, as this region is known for its robust healthcare infrastructure comprising hospitals, clinics, and pharmacies. The diverse practice settings in this area range from large tertiary care hospitals to smaller

community clinics, catering to various healthcare needs. These settings may vary in ownership, size, and specialties offered, and each may have its own policies and resources for medication waste disposal. Understanding the context of practice settings in this area provides valuable insight into the unique healthcare landscape and helps interpret the study findings within this specific context.

The inclusion criteria for our study were as follows: individuals who were healthcare workers, aged 21 years or older, and located in the Eastern Region of Saudi Arabia. Conversely, the exclusion criteria aimed to identify individuals who did not meet the specified criteria for our target population, such as individuals who were not healthcare workers, aged below 21 years, or located outside the Eastern Region. By excluding these individuals, we aimed to ensure the homogeneity of our study sample and maintain the relevance of the findings to the specific context under investigation.

Determining the exact number of healthcare workers in the Eastern Region was a challenging task due to potential variations over time and the lack of a centralized and comprehensive database specifically focused on healthcare workers either in governmental or private sectors. While we do not have access to the precise number, sampling measures were considered to ensure the selection of a representative sample that captures the diversity of healthcare providers within the Eastern Region. The sample size was calculated using the Raosoft formula to estimate the prevalence with 95 % confidence interval and 5 % margin of error. The final adjusted sample size was $(280 / (1-0.10)) = 280 / 0.90 = 311$, allowing for a nonresponse rate of 10 %.

2.3. Survey distribution and return

An internet-based survey questionnaire was developed and distributed to participants anonymously through an internet-based survey site (Google form). Informed consent was collected from each participant prior to participation. The consent form was a separate page, an introductory page to the online survey page. Prior accessing the survey, participants were presented with a clear and prominently displayed consent form on the online platform. The form outlined the purpose of the study, the data collection process, the rights of the participants, and any potential risks or benefits associated with their participation. To proceed with the survey, participants were required to actively indicate their consent by checking a box or clicking an "I agree" button on the consent form. Only after providing their informed consent were they able to access and complete the survey itself. Confidentiality of participants was maintained throughout the research, and participation was voluntary throughout the study.

2.4. Participant identification and recruitment

An invitation e-mail was sent by the researchers through their university e-mail network to potential participants. The e-mail contained an introductory statement about the study with a hyperlink to the web-based survey. The e-mail offered transformation of the URLs into direct links to the survey website.

WhatsApp® messages were also sent to professional healthcare worker colleagues working in different sectors across Eastern Province (i.e., administrative, clinical, or academic sectors), to increase the number of responses. Distribution of the survey link to as many colleagues and friends as possible was requested from other colleagues. The link was sent to different groups with different health care professions to ensure equal distribution among targeted professions.

2.5. Survey development

An anonymous research survey was prepared to assess and identify healthcare workers' perception, barriers, and their suggested solutions to implement an appropriate medication waste disposal program. A self-administered validated questionnaire was adapted from the previous

studies published in this regard (Abahussain et al., 2012, Wajid et al., 2020, Alghadeer and Al-Arifi, 2021). The study questionnaire included demographic details of the respondents like age, sex, educational level, and a question about their practice area. The participants will be asked questions about their perception and current attitude toward disposing of unwanted medications and healthcare workers' awareness about appropriate disposal of unwanted medications. We also asked the participants about current barriers in their workplace which limit their full engagement in appropriate disposal of unwanted medications. Finally, we asked the participants for their suggestions to ensure the full implementation of appropriate medication waste disposal program. The questionnaire contained 13 items with the options to fill in the blank and multiple-choice questions. As the study targeted Arabic speakers, an Arabic version of the questionnaire was also prepared.

2.6. Questionnaire validation

A pilot study was conducted before proceeding for the original study with a sample of ten randomly selected participants, who were healthcare workers with different professional background, pharmacists, physicians, nurses, etc. The pilot study ensured that the target population understood what each research question being asked, as well as what each response means. The research team reviewed and discussed the ideas in the pilot study to make the survey easier for the participants. According to the results of the pilot study, no modifications were implemented on the research questionnaires as the participants in the pilot study reported that the questions were clear and understandable. The reliability of the questionnaire was assessed with the Cronbach's alpha coefficient of 0.7. The Arabic version was validated by asking experts in English/Arabic language to re-check the translated questionnaire and their comments were addressed in the final Arabic version. Then, a sample of five randomly selected participants were asked to evaluate and ensure full understanding of the Arabic version.

2.7. Data management and analysis

Once the survey was closed, data was collected and extracted into Microsoft Excel to be coded for statistical analysis. The final Microsoft Excel sheet was entered into Statistical Package for the Social Sciences (SPSS, version 26) for statistical analysis. GraphPad Prism was used to prepare figures from produced results. The accuracy of the gathered data will be assessed by visual inspection. As part of the survey design, a mandatory response to all questions was required.

Demographic variables will be reported using mean and standard deviation for continuous parametric variables, median/interquartile range for continuous non-parametric variables and number/frequency for binary variables. Respondents were categorized based on the type of their healthcare profession into pharmacist, nurse, physician, and allied healthcare, or based the number of the years of experience they had into 0–2 years, 3–5 years, 6–10 years, 11–15 years, and over 15 years. These classifications were employed to determine the difference in perception or barrier among healthcare workers based on their profession or years of experience. To test the differences, Chi-square test was employed and a P -value < 0.05.

2.8. Ethical approval.

This study was approved by the Institutional Review Board (IRB) at Mohammed Al Mana College for Medical Science (Reference Number. SR-RP-86).

3. Results

3.1. Participants demographic data

The questionnaire was filled by 321 respondents, with a response

rate of 100 %, and the majority (56 %) were female participants. Most of the respondents ($n = 110$) were between age of 21–30 years, and most of them were recently joined their work (0–2 years, $n = 82$). 60 % of the respondents were bachelor graduates, most of them were working in clinical settings (70 %), and majority (72 %) were working in governmental sectors (Table 1).

3.2. Perception and knowledge

248 respondents reported that they were exposed to a medication waste issue during their work (Fig. 1). The majority of the respondents who exposed to medication waste issues were from governmental sectors ($n = 179$), female ($n = 145$) and from clinical practice settings ($n = 173$).

Fig. 2 showed the univariate analysis results for testing the differences between respondents who respond with "Yes" to the question "Have you ever been exposed to medication waste issues?". Fig. 1 (A) showed that there is no difference in response based on healthcare profession type, whereas Fig. 1 (B) showed that those responded with 'Yes' had more work experience compared to those respond with "No".

Fig. 3 presents the respondents response towards the source of medication waste issues they were exposed to in the previous question. 129 respondents reported that these issues were always raised from the workplace, followed by 113 respondents agreed that these issues were always raised from personal level and 115 agreed that they were always raised from patients' level.

Fig. 4 shows that 225 respondents reported that they had inquired about how to appropriately dispose of medication waste and 191 respondents reported that they had heard or read about medication waste disposal instructions.

After classifying the respondents based on their profession, no differences were detected for their response when they were asked "Have you ever thought/inquired as of how to appropriately dispose medication waste?" or "Have you ever read or heard about medication waste

Table 1
Respondents demographic data.

Variant	Frequency	Percentage (%)
<i>Age Groups</i>		
21–30 years	110	34
31–40 years	108	34
41–50 years	80	25
Above 50 years	23	7
<i>Gender</i>		
Male	143	45
Female	178	55
<i>Level of education</i>		
Diploma	49	15
Bachelor	191	59
Master	50	16
Residency	2	1
Doctorate	29	9
<i>Occupation type</i>		
Administrative	43	13
Clinical	223	70
Academic	55	17
<i>Occupation Name</i>		
Pharmacists	69	21
Nurses	71	22
Physicians	86	27
Allied health	95	30
<i>Work Experience</i>		
0–2 years	82	25
3–5 years	35	11
6–10 years	63	20
11–15 years	62	19
Above 15 years	79	25
<i>Work Sector</i>		
Governmental	231	72
Private	90	28

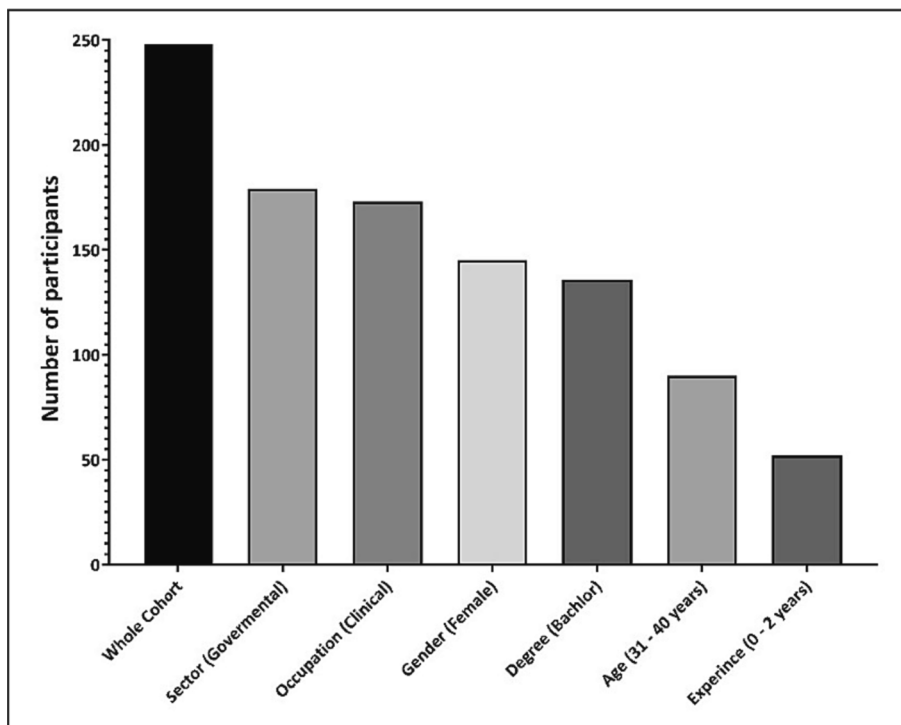


Fig. 1. Participants response to the following question ‘Have you ever been exposed to medication waste issues?’. Data were presented as total cohort, then the highest response with “Yes” among each variant collected.

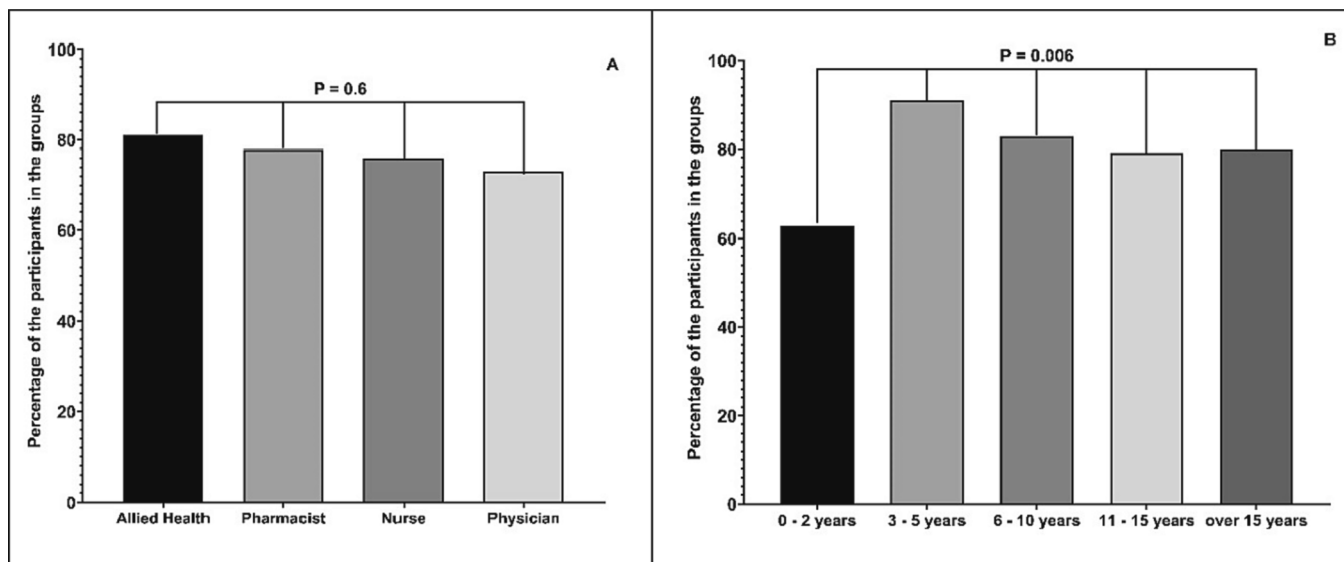


Fig. 2. Difference in response with ‘Yes’ to the question “have you ever been exposed to medication waste issues?” between respondents based on; A = their healthcare profession, B = years of experience. Data presented as percentage value from the participants in the referenced group.

disposal instructions?”. However, respondents with minimal years of experience where the lowest respondents with “Yes” to both questions compared to those with more work experience years (Fig. 5).

Table 2 shows that 189 respondents strongly agreed that inappropriate disposal of medication waste could result in harm for the environment and the living being, whereas 183 participants strongly agreed that medication waste should be an issue for each person handling medications.

Fig. 6 shows that there is no significant difference between respondents with “Strongly agree” to all the questions raised in Table 2 when the respondents were categorized based on their profession type,

expect for the question “Physicians over-prescribing could be a reason for medication waste” where pharmacists were the highest respondents with “strongly agree”. However, when categorizing the respondents based on their years of experience, Fig. 6 demonstrates a clear difference between the comparison group to each question being asked.

Fig. 7 represents that 42 % of the participants reported that they always dispose medication waste into the rubbish bin, whereas 23 % and 23 % reported that they always dispose of them into specialized container for medication waste or into the yellow containers respectively.

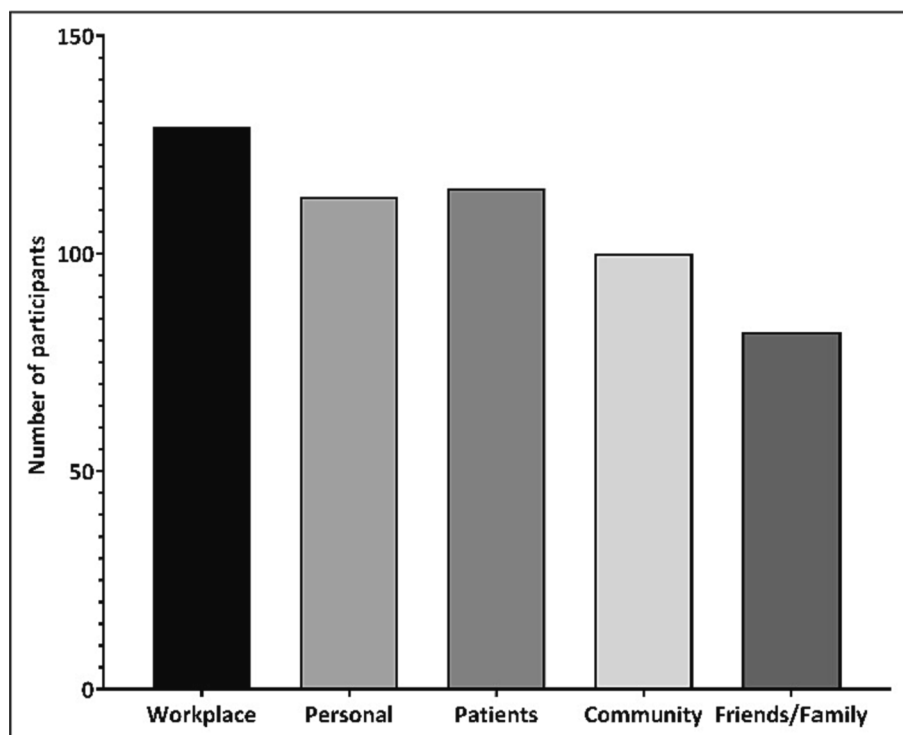


Fig. 3. Participants response to the following question ‘What is the type/source of these issues/situations?’. Presented results referred to those responded with “Always” among all participants within the referenced group.

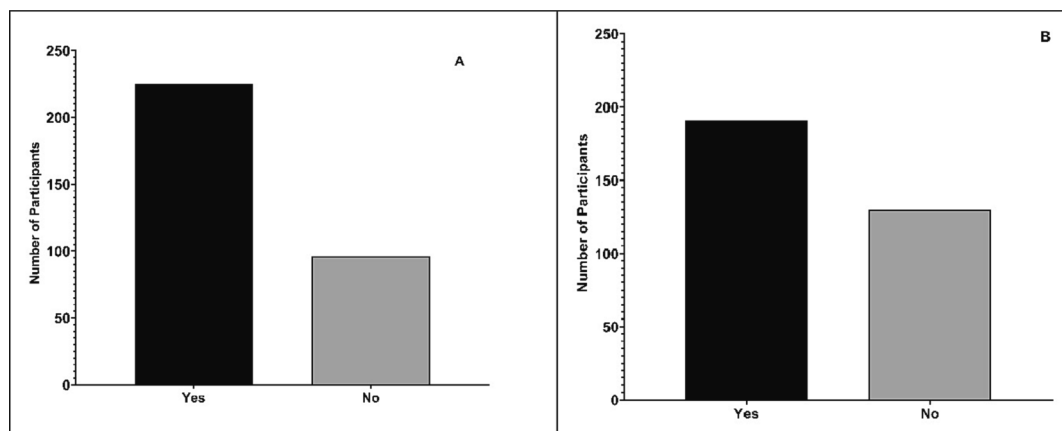


Fig. 4. Participants response to A: “Have you ever thought/inquired as of how to appropriately dispose medication waste?”, B: “Have you ever read or heard about medication waste disposal instructions?”. Presented results referred to those responded with “Yes”.

3.3. Barriers

95 % of the respondents showed a willingness to practice a safe disposal of medication waste approaches. Table 3 shows that time/workload (23 % of the participants) and administrative support (20 %) were the least voted by respondent as normal practice supporting appropriate medication waste disposal. Interestingly, 45 % of the respondents reported that they did not think that safe disposal of medication waste in an issue to consider, whereas 28 % of them responded that they were always adhering to policies and guidelines related to medication waste disposal.

Fig. 8 shows that there were no differences between the respondents’ response with “Always” to the questions raised in Table 3 based on their profession types. However, in respect to years of work experience, responses vary among respondents’ groups. Those with limited years of

experience were the highest respondents with “Always” to question “How often bins/containers for medication waste are available in your workplace?” and “How often time/workload could stop you from practicing safe disposal of medication waste?” but least to the question “How often do you think that safe disposal of medication waste is an issue to consider?” compared to others with more years of experience.

3.4. Solutions

Fig. 9 demonstrates respondents’ response when they were asked about their opinion on who is responsible for medication waste disposal. 204 respondents reported that they strongly agreed that appropriate medication waste is the responsibility of the higher administration and 193 of the respondents strongly agreed that it is the pharmaceutical companies’ responsibility.

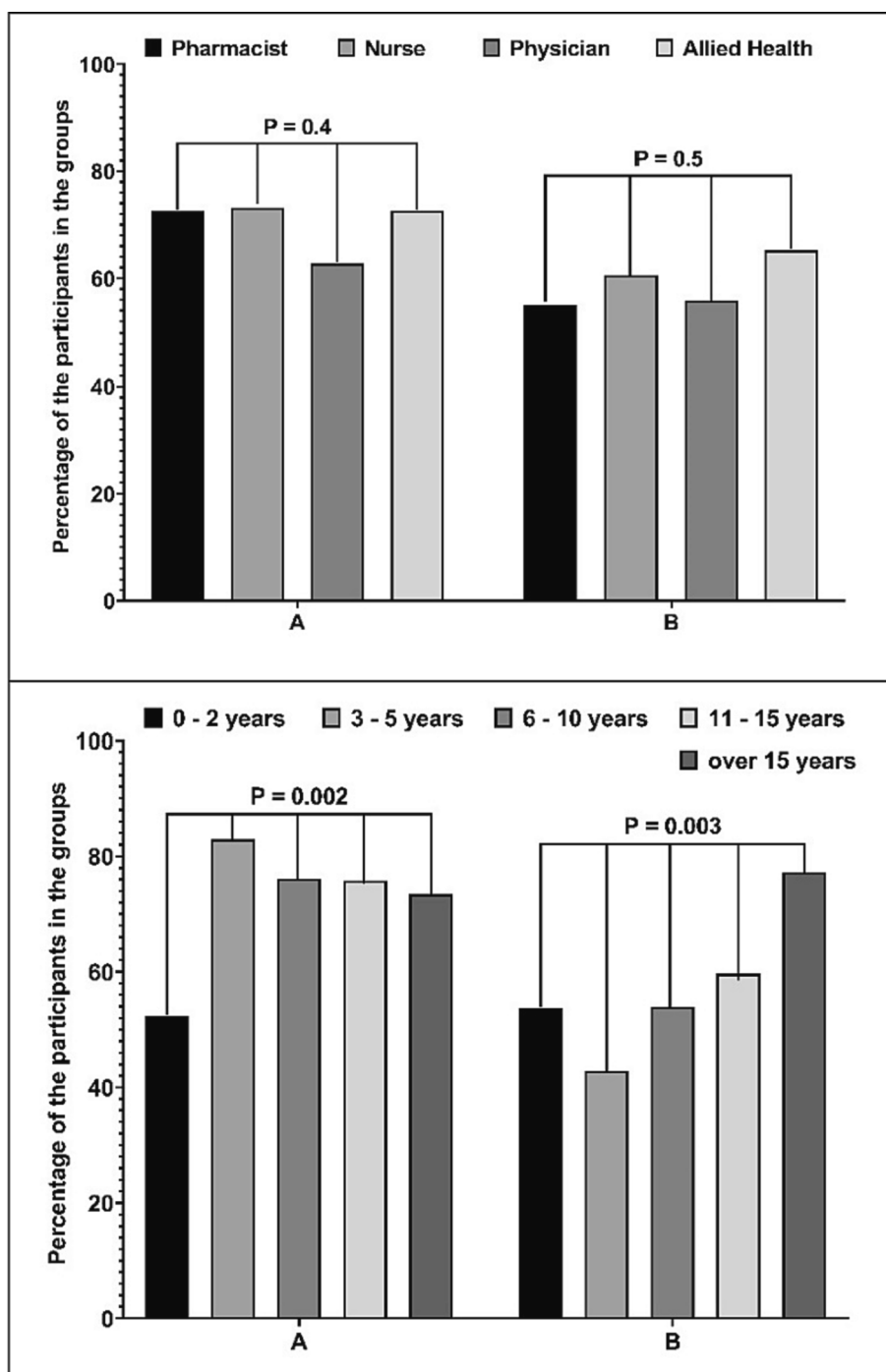


Fig. 5. Difference in response with ‘Yes’ to the questions A = “Have you ever thought/inquired as of how to appropriately dispose medication waste?” or B = “Have you ever read or heard about medication waste disposal instructions?”. Top: categorized based on profession type, Bottom: categorized based on years of experience. Data presented as percentage value from the participants in the referenced group.

Table 4 shows that 217 respondents reported that the availability of specific and appropriate logistics to encourage safe disposal of medication waste should be extremely helpful to promote appropriate disposal of medication waste followed by 215 reported that training and workshops to highlight the importance of safe disposal of medication waste would be beneficial to promote safe disposal of medication waste.

4. Discussion

The current study confirms that medication waste is still an important concern among healthcare workers in Saudi Arabia due to low level

of their awareness of the issue, particularly among those with limited years of work experience. The majority of the respondents had concern regarding how to dispose medication waste appropriately, which had them to seek or search for some advice during their work life. Lack of specific guidelines and overprescribing was the most reported cause contributing to medication waste, whereas limited perception/knowledge about the issues and the unavailability of logistics (bins) and guidelines were the most barriers limiting safe disposal of medication waste. Training and workshops and ensuring the availability of appropriate logistics were proposed solution from the respondents to ensure safe disposal of medication waste followed by the important role of

Table 2

Participants opinions toward the specific statements related to their perception of medication waste disposal.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<i>Medication waste is mainly an issue for patients receiving or using medications</i>				
124	69	37	41	50
<i>Medications waste should be an issue for each person handling medications</i>				
183	53	29	17	39
<i>Inappropriate disposal of medication waste could result in harm for the environment and the living being</i>				
189	65	23	13	31
<i>Safe medication waste disposal is mainly responsibility of pharmacy department staff</i>				
97	52	61	47	64
<i>Dispensing medications in large quantity is considered a reason for medication waste</i>				
144	73	41	26	37
<i>Physicians over-prescribing could be a reason for medication waste</i>				
141	75	43	26	36

higher administration or pharmaceutical companies.

This study showed that 77 % of the respondents reported that they had encountered medication waste issues during their life. This finding is consistent with a previous study conducted in Saudi Arabia which reported that medication waste is a national issue and requires intervention to limit the risk associated with improper disposal of medication waste (Wajid et al., 2020). However, the current study showed that respondents with long work experience were more likely exposed to medication waste issues compared to those with 0–2 years of work experience. This highlighted that those with limited years of work experience would be at risk to inappropriately dispose of medication waste. This claim is inconsistent with a previous study from Kuwait which reported that respondents showed a high level of awareness of the issue with no respect of their work experience. Such differences can be related to the nature of the respondents, where this study recruited different healthcare professional, the study from Kuwait recruited only pharmacists. Pharmacists are well aware of this issue because they were tough about medication waste during their pharmacy course (Abahussain et al., 2012).

Interestingly, 70 % of the respondents started to get concerns about how to appropriately dispose of medications waste and 60 % of the respondents had searched for advice to resolve their concerns. Such approach was collected more often among those with long work experience compared to those with limited work experience. This difference could be an important message to collect from this study, as healthcare workers are at risk of improper disposal of medication waste at their early carrier life, due to their limited information about the issue.

Importantly, this study reported that 45 % of the respondents reported that proper medication waste disposal is an issue to consider. Such response was higher among those with long work experience compared to those with limited work experience. Such result, supported by the respondent's perception, raise an alert to the limited knowledge and awareness among those who are recently joined the work and how important to introduce a sufficient training to increase their awareness toward the issue.

However, 59 % of the respondents were aware that improper medication waste disposal causes undesirable effects on the environment, whereas 57 % respondents strongly agreed that medication waste should be an issue for each person handling medications. This finding is consistent with previous study which reported that 80 % of the community pharmacists reported that improper disposal of medication waste could result in environmental (Alghadeer and Al-Arifi, 2021).

Interestingly, 44 % of the respondents agrees that overprescribing is one cause contributing to medication waste. Previous reports raised the issue of overprescribing and its contribution to medication waste (Abahussain et al., 2012, Makki et al., 2019, Alhomoud, 2020). This highlight the importance of the introduction of E-prescription system supported with the integrated national electronic care record in Saudi Arabia and their role to limited overprescribing and prescriber-cascade

(Alnuem et al., 2011, Al Aoolo et al., 2020).

In this study, 42 % of the respondents reported that they disposed medication waste into rubbish bin and 23 % disposed them into specialized containers. This finding is inconsistent with previous study where medication waste was disposed into the sink or toilet flush (Kadam et al., 2016, Hassan et al., 2022). These differences may be due to the type of the respondents recruited for this study and the nature of their clinical work, compared to community pharmacy practice. However, another study reported that 48 % of the respondents reported that they dispose of their medication waste into household garbage (Wajid et al., 2020). This is important to be addressed as risk of hazard to the environment is going to be higher and this could endanger living begins, either medication waste was disposed into rubbish bin or into toilet sink.

This study showed that 28 % of the respondents were less likely to adhere to policies and guidelines which control medication waste disposal. This finding was consistent with a finding from a previous study, in which the participants pharmacists' response that there was no clear census policy on how to appropriately dispose of medication waste (Lucca et al., 2019, Alqurshi, 2020). The Food and Drug Authority (FDA), in United States, had launched several guidelines for the safe disposal of unused and expired medicine which includes the take-back program (Hendaus et al., 2021). Such a program is not clearly defined and established in Saudi Arabia and no clear guidelines were established to govern the safe and proper disposal of medication waste (Alhomoud, 2020).

Our study showed that 31 % of the respondents reported that unavailability of specialized bins could limit their engagement to proper medication waste disposal and they 68 % believed that appropriate logistic (bins, containers, accessibility) is one strategy to promote proper medication waste disposal. In contrast, a recent study reported that when participants were asked what the best way is to dispose medications, more than 70 % said that the best way is returning them to a healthcare facility or healthcare providers (AlAzmi et al., 2017). It is potentially recommended to establish medication waste disposal system in the Saudi which is essential for the safety of the environment and for controlling medication waste by individuals.

In our study, 64 % of the respondents reported that they were strongly agreed that appropriate medication disposal is the responsibility of the higher administration and 60 % strongly agreed that it is the pharmaceutical companies' responsibility. A previous study reported that 85.5 % of the respondents said that the government is responsible for creating awareness about the proper disposal of unused and expired medicines while 129 (38.3 %) of them agreed that it should be the pharmaceutical industries (Wajid et al., 2020).

Another solution raised from the respondents to promote proper medication waste disposal is training and workshops introduced regularly to healthcare workers (67 % of the respondents). This can be crucial particularly when considering that most of the respondents were recently joined their work (limited work experience), and most of them were not aware of the risk associated with improper disposal of medication waste on the environment.

One strength of this study is that it is the first study conducted among healthcare workers in the Eastern Region, Saudi Arabia. Another strength of this study is that it delivers a wider view on this issue from a large range of healthcare workers, rather than asking specific professions, such as nurses or pharmacists. As medications are commonly handled by all healthcare workers, this study presented a bigger view of the issues and could support higher administrative level to set guidelines and strategies to effectively manage this issue, compared to previous studies which were focusing on specific profession or community (AlAzmi et al., 2017, Alghadeer and Al-Arifi, 2021).

Another strength of the current study is that it highlights the difference in awareness toward medication waste in relation to the work experience the respondent has. Differences in experience levels and training among healthcare providers can impact their understanding and implementation of proper medication waste disposal more than

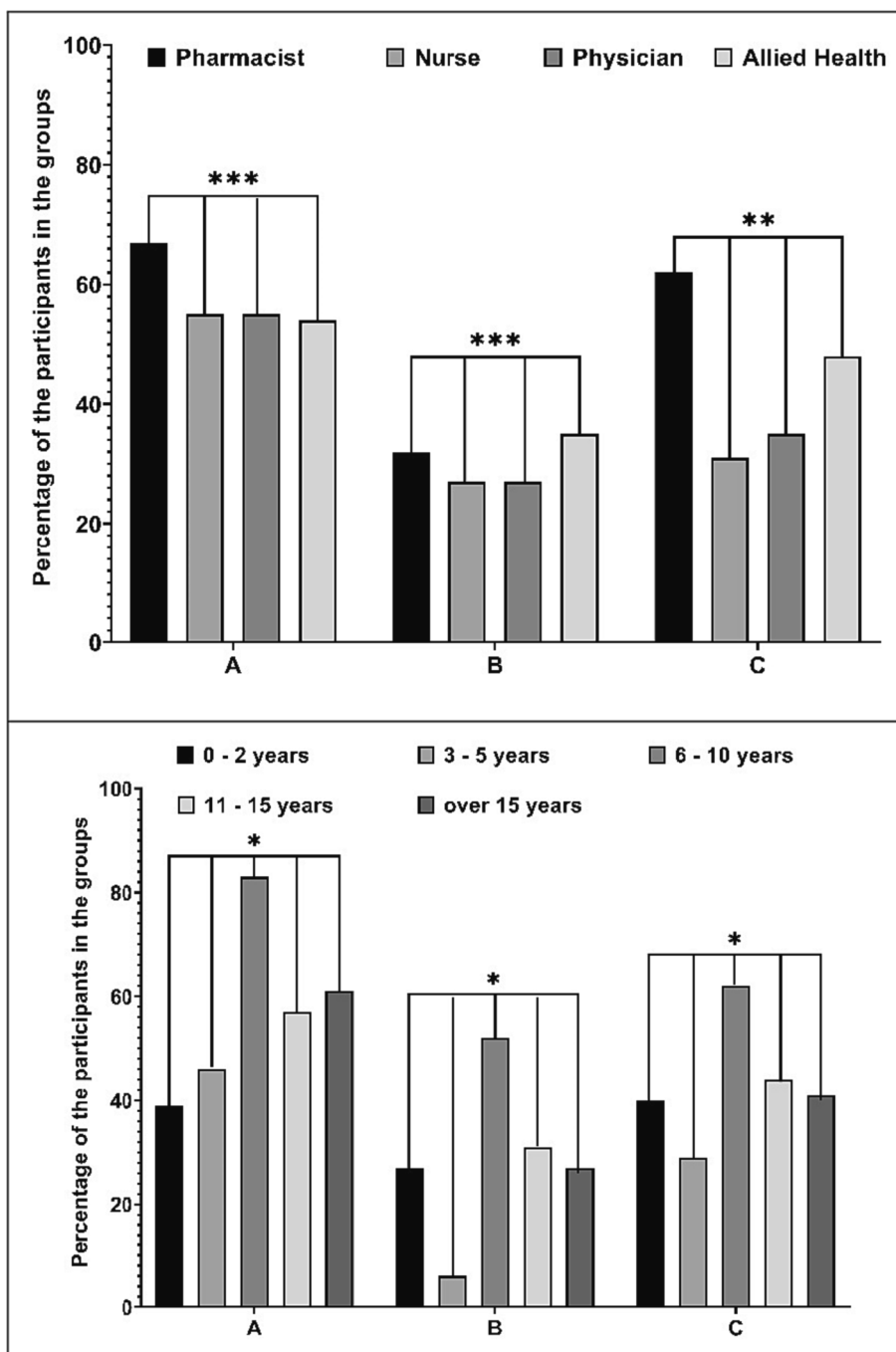


Fig. 6. Top: Difference in response with ‘Strongly agree’ to the questions A = “Medication waste should be an issue for each person handling medications”, B = “Safe medication waste disposal is mainly a responsibility of pharmacy department staff”, or C = “Physicians over-prescribing could be a reason for medication waste”. Top: categorized based on profession type, Bottom: categorized based on years of experience. Data presented as percentage value from the participants in the referenced group. * = P-value < 0.001, ** = P-value < 0.05, *** = P-value > 0.05.

types of healthcare workers profession. More experienced providers may have had more exposure to waste management practices and guidelines, while less experienced providers may require additional training or guidance in this area. This provides valuable insights into the complex factor influencing medication waste disposal practices. Understanding these variations can help inform targeted interventions, training programs, and policy development to address gaps and promote consistent and proper disposal practices among healthcare providers.

Some limitation for the current study should be acknowledged, such using a self-reported, online questionnaire that is completed based on the participants’ statements and stories might reduce the chance of

obtaining a true picture of events because the respondents may have an imperfect to recall or understanding of the questions.

Another limitation of this study is the lack of an exact count of healthcare workers in the Eastern Region of Saudi Arabia. Despite this limitation, the current study employed recognized sampling techniques and collaborated with professional associations to identify a diverse range of participants. Efforts were taken to enhance the representativeness of the study sample by including healthcare providers from various specialties and practice settings within the Eastern Region. Therefore, caution should be exercised when generalizing the findings to the broader population of healthcare workers in the Eastern Region.

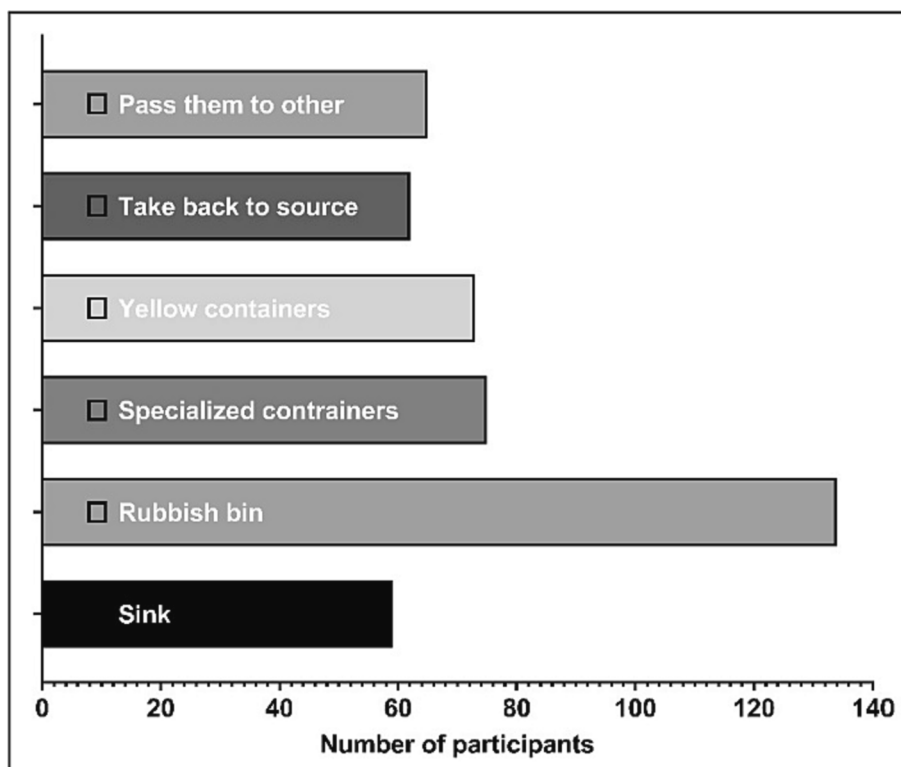


Fig. 7. Participants response to how they are disposing their medication waste. Presented results referred to all participants.

Table 3

Participants response to specific statements examining barrier or limitation for proper medication waste disposal.

	Always	Often	Sometimes	Rarely	Never
How often bins/containers for medication waste are available in your workplace?	101	51	63	56	50
How often do you adhere to the policies or guidelines that govern appropriate disposal of medication waste in your workplace?	90	93	67	41	30
How often time/workload could stop you from practicing safe disposal of medication waste?	73	82	79	40	47
How often do you think that safe disposal of medication waste is an issue to consider?	144	82	47	21	27
How often do you and your co-workers cooperate to ensure safe disposal of medication waste in your workplace?	80	94	77	37	33
How often the administrative team conduct meetings and discuss the importance of safe disposal of medication waste	62	68	67	76	48

In Saudi Arabia, a comprehensive medication waste management policies or guidelines are not available (Abou-Auda, 2003; Al-Shareef et al., 2016; Lucca et al., 2019). Under current regulations, Pharmacists are not expected to accept returned medications from their patients, nor the patients are expected to return their excess or expired medications (Abou-Auda, 2003; Al-Shareef et al., 2016; Lucca et al., 2019). Many patients are not even aware of the presence of such service (Al-Shareef et al., 2016; Lucca et al., 2019). Therefore, a nation-wide initiative would support the introduction appropriate policies which can ensure proper medication waste disposal.

The present study contributes to the understanding of healthcare workers' awareness towards medication waste and carries several significant implications for stakeholders involved in healthcare delivery. The lower awareness of medication waste among early work joiners is an important factor to consider. This finding is significant as it highlights potential challenges faced by newly employed healthcare workers in

recognizing and addressing medication waste. Another noteworthy finding of our study is the lack of significant differences in awareness between different healthcare professions. This finding emphasizes the importance of promoting interprofessional collaboration in the context of medication waste management. Healthcare professionals from diverse backgrounds and roles should work together to develop comprehensive strategies for waste reduction.

5. Implications and directions for future research

The implications of the current study extend beyond individual healthcare workers to healthcare organizations and policymakers. Medication waste has significant financial, environmental, and patient safety implications (Wajid et al., 2020, Hassan et al., 2022). The current study findings can guide the development of waste reduction strategies, such as implementing technology solutions, optimizing medication procurement and inventory management, and establishing waste reduction metrics. Furthermore, policymakers can utilize our findings to inform healthcare policies and regulations that promote waste reduction practices across healthcare settings. By implementing evidence-based interventions, healthcare organizations and policymakers can contribute to cost savings, environmental sustainability, and enhanced patient safety.

Training and workshops were one proposed solution to increase healthcare workers understanding of the current issue and how to effectively overcome it. This recommendation was consistent with previous studies findings, as training and increasing awareness was one options given by their participants (Alfian et al., 2021). In addition, the current study pointed the importance of applying such approach in early career to ensure new staff awareness of the issue and introducing available options to reduce its risk. Implementing an effective nation-wide program with defined policies and procedures that govern proper medication waste disposal would have a crucial role in better control of such concern. Additionally, Launching some country-wide programs, such as take-back program, with the help of medical stores

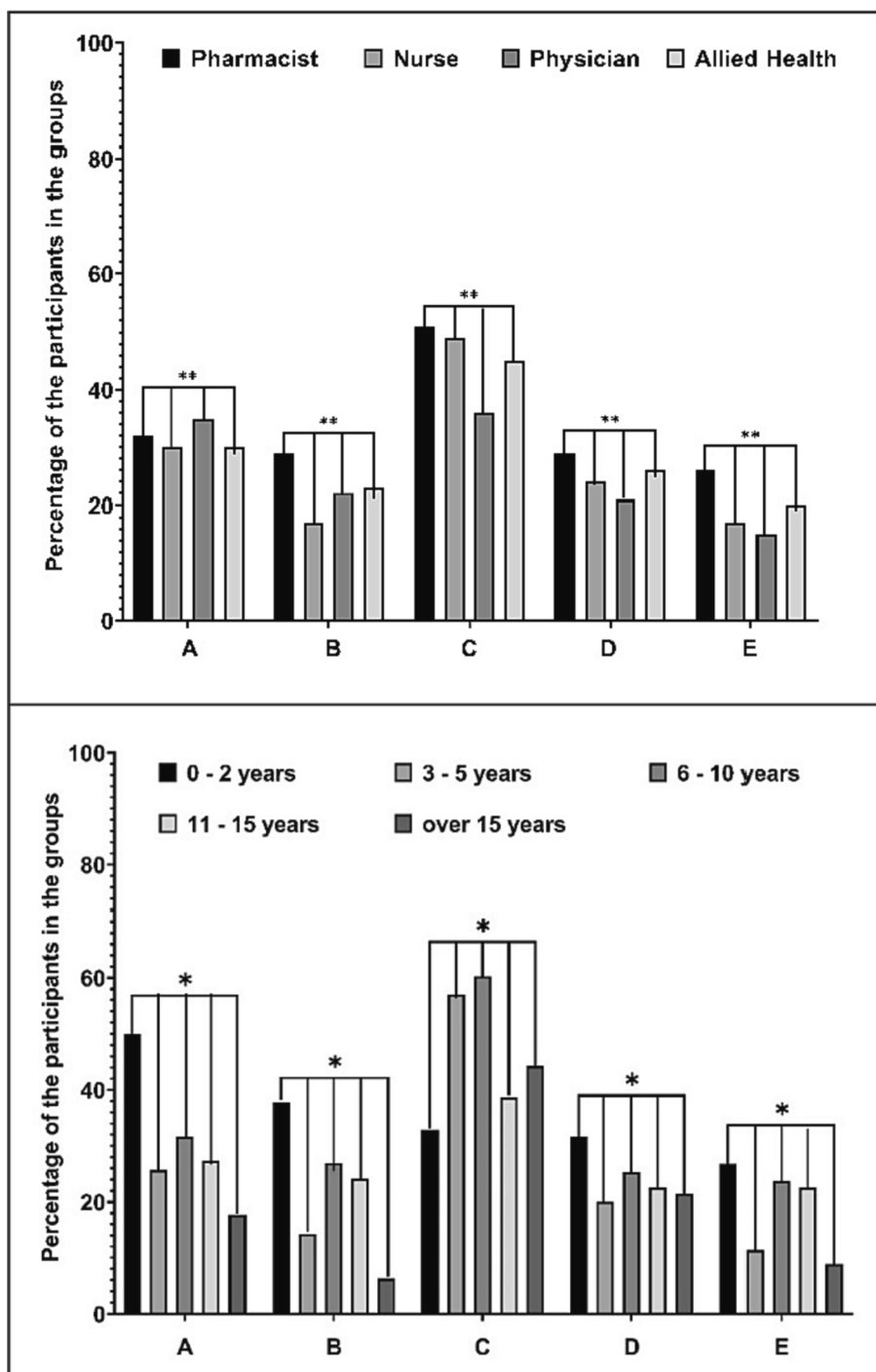


Fig. 8. Difference in response with ‘Always’ to the questions A = “How often bins/containers for medication waste are available in your workplace?”, B = “How often time/workload could stop you from practicing safe disposal of medication waste?”, C = “How often do you think that safe disposal of medication waste is an issue to consider?”, D = “How often do you and your co-workers cooperate to ensure safe disposal of medication waste in your workplace?”, and E = “How often the administrative team conduct meetings and discuss the importance of safe disposal of medication waste”. Top: categorized based on profession type, Bottom: categorized based on years of experience. Data presented as percentage value from the participants in the referenced group. * = P-value < 0.01, ** = P-value > 0.05.

and the pharmaceutical industry is proposed by the government (Abahussain et al., 2012).

In the current study, the primary focus was on healthcare workers’ awareness towards medication waste and their awareness of proper disposal practices. However, other confounding factors such as practice settings, including hospitals, clinics, and pharmacies, can play a significant role in shaping waste management practices due to variations in organizational policies, resources, and infrastructure. Additionally, the

specific tasks and responsibilities related to medication disposal may vary among different healthcare professionals. As these were not collected during the survey, future research could explore the influence of practice settings and the roles of different healthcare professionals in more detail. By considering these factors, a more comprehensive understanding of medication waste disposal practices can be achieved.

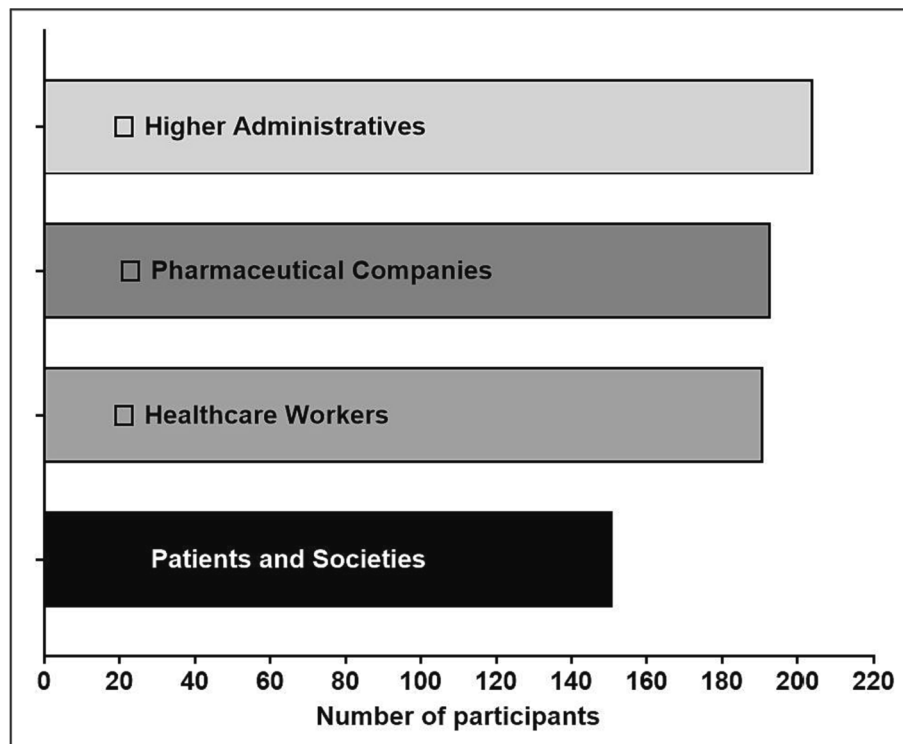


Fig. 9. Participants response when they were asked about their opinion on who is responsible for medication waste disposal.

Table 4

Participants response when they were asked for their opinion for the best option to promote appropriate disposal of medication waste?

	Extremely helpful	Helpful	Slightly helpful	Less helpful	Not helpful at all
<i>Training and workshop to highlight the importance of safe disposal of medication waste to health care workers</i>	215	58	24	6	18
<i>Community days and campaigns to highlight the importance of safe disposal of medication waste to patients and community</i>	178	95	20	11	17
<i>Appropriate logistics (bins/containers/accessibility) to encourage safe disposal of medication waste</i>	217	56	13	13	22
<i>Availability of policies and guidelines to govern safe disposal of medication waste</i>	211	52	29	4	25

6. Conclusion

This cross-sectional survey study explored the awareness of healthcare workers towards medication waste, focusing on awareness, limitations, and potential solutions for proper disposal. This study reported a low awareness about proper medication waste disposal, particularly among recently joined healthcare workers and overprescribing and that the absence of guidelines and policies as key limitations to proper disposal practices. The proposed recommendations, including targeted training, the establishment of guidelines, and interprofessional collaboration, offer practical solutions for improving waste management practices. By implementing these recommendations, healthcare systems can enhance waste management efforts, optimize resource utilization, and improve patient care outcomes.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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