Original Article

Countering Pharmaceutical Fraud: Analyzing Pharmacist Competence and Policy Interventions in Falsified Medicines in Shymkent

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ABSTRACT

Background

Falsified medicines pose a severe threat to global healthcare, contributing to treatment failures, adverse health outcomes, and economic burdens.

Aims

This study aims to assess the awareness, detection capabilities, and reporting behaviors of pharmacists in Shymkent, Kazakhstan, regarding falsified medicines.

Method

A mixed-methods approach was used, incorporating a quantitative survey of 250 pharmacists and qualitative interviews with industry professionals. Data were analyzed using descriptive statistics, thematic analysis, and inferential statistical methods. The findings indicate that weight-loss medications are the most frequently falsified drugs in Shymkent, followed by erectile dysfunction drugs, weight-loss medications, and antibiotics. Most pharmacists relied on visual inspection to identify falsified medicines, but only 31% reported using formal reporting mechanisms, such as the Yellow Card Scheme. Notably, 72.8% of pharmacists actively reported cases of falsified medicines, yet many expressed uncertainty about detection techniques. A significant proportion of respondents lacked formal training in falsified medicine identification, and over half (51.6%) showed reluctance to participate in future training programs.

Results

This study highlights critical gaps in pharmacist training and regulatory enforcement, emphasizing the need for advanced detection technologies, enhanced regulatory cooperation, and pharmacist education initiatives. Strengthening the role of pharmacists in early detection and reporting, combined with the implementation of AI-driven verification systems and blockchain tracking, could significantly reduce the circulation of falsified medicines.

Conclusion

Future policies should focus on cross-border collaboration, stricter legal frameworks, and investment in pharmacist training to safeguard public health.

Keywords

Falsified Medicines; Pharmaceutical Counterfeiting; Drug Safety; Supply Chain Integrity; Pharmacists

INTRODUCTION

Counterfeit medicines are a serious global health threat, endangering patients, public health, and national economies[1]. These medicines are deliberately altered or mislabeled regarding their ingredients, identity, or origin. Unlike substandard drugs, which result from accidental manufacturing errors, counterfeit medicines are intentionally produced and sold with fraudulent motives[2]. Their spread is fueled by weak regulatory oversight, the globalization of pharmaceutical supply chains, and the rise of online drug sales [3,4]. According to the World Health Organization (WHO), around 10% of medicines in low- and middle-income countries are either falsified or substandard, with some regions experiencing rates as high as 30% [5].

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The prevalence of falsified medicines varies across different countries. In the United States, the Food and Drug Administration (FDA) reported that small percentage of the market of pharmaceuticals in legal supply chains could be falsified, while in developing countries, this rate is significantly higher[6,7]. Approximately, 10% of medical products circulating in low- and middle-income countries (LMICs) are either substandard or falsified. In certain regions, such as sub-Saharan Africa and parts of Asia, this percentage can rise significantly, with some studies reporting rates as high as 50% for specific types of medicines[7,8]. The issue is exacerbated by illicit online pharmacies, which account for approximately 95% of global illegal drug sales[9]. These figures highlight a critical challenge in ensuring the quality and safety of pharmaceuticals in areas with weaker regulatory systems and limited access to reliable healthcare infrastructure

The dangers associated with falsified medicines are substantial. Patients consuming falsified drugs may experience therapeutic failure, adverse reactions, or even death due to incorrect active ingredients, contaminants, or lack of efficacy[10]. The widespread availability of falsified medicines has contributed to antimicrobial resistance, leading to treatment failures and increased mortality rates, particularly in regions with limited healthcare access[11]. Additionally, falsified medicines undermine public trust in healthcare systems and create financial burdens for both patients and governments[12]. Reports indicate that the annual global economic cost of falsified medicines exceeds $200 billion[13].

In response to this crisis, various countermeasures have been implemented worldwide. The WHO has launched the Global Surveillance and Monitoring System (GSMS) to detect and report falsified medicines[14]. The European Union (EU) established the Falsified Medicines Directive (FMD), which mandates serialization and verification systems for pharmaceuticals [15, 16]. In the United States, the Drug Supply Chain Security Act (DSCSA) enforces traceability measures to prevent falsified drugs from entering the supply chain[17]. However, these countermeasures face challenges such as lack of enforcement, corruption, and technological barriers, particularly in low-income countries[18]. Despite efforts to strengthen regulations, criminals continuously adapt their strategies, making it difficult to completely eliminate falsified medicines from circulation[19].

Ensuring the authenticity of medicines through rigorous inspections and verification at national and regional levels is crucial. Countries with stringent regulatory systems, such as Japan and Germany, have significantly lower incidences of falsified drugs due to advanced tracking technologies and regulatory oversight[20]. Meanwhile, nations with weaker pharmaceutical regulations, such as those in parts of Africa and Asia, remain vulnerable to falsified drug infiltration[21]. Regional cooperation and international partnerships are necessary to establish robust mechanisms for detecting and eliminating falsified medicines before they reach consumers.

This study aims to evaluate pharmacists in Shymkent, Kazakhstan, regarding their awareness, detection, and prevention of falsified medicines. Given the growing concerns over falsified pharmaceuticals in Central Asia, this research seeks to assess the prevalence of falsified medicines in Shymkent and analyze the effectiveness of existing countermeasures. By understanding pharmacists' knowledge and attitudes toward falsified medicines, the study provides insights into necessary interventions to enhance pharmaceutical safety and combat falsified drugs effectively. The findings will contribute to policy recommendations aimed at strengthening pharmaceutical regulations and reducing the circulation of falsified medicines in Kazakhstan.

METHODS AND MATERIALS

Study Design

This study employed a mixed-methods approach, integrating both quantitative cross-sectional and qualitative components to comprehensively explore the research objectives. The study was conducted in compliance with the principles of Good Clinical Practice (GCP) to ensure ethical integrity and scientific validity.

Quantitative Component

A structured Barrett R. questionnaire was used to evaluate the key variables of the study. The author's consent has been obtained. The questionnaire was administered to a representative sample of 250 individuals, calculated based on the population size of Shymkent city pharmacists using a validated electronic sample size calculator. The instrument was translated into Kazakh and underwent validation through a pilot study with 50 respondents. The reliability of the questionnaire was assessed using Cronbach's alpha.

To investigate the perspectives of pharmacy professionals, an additional survey was conducted among up to 10 employees of a pharmacy chain. Selection was based on the saturation method, ensuring that data collection continued until no new themes emerged.

Qualitative Component

The qualitative phase of the study involved semi-structured interviews to capture in-depth insights from participants. The interview guide was designed to allow flexibility while maintaining focus on key research themes. Interviews were conducted in a private setting, recorded with participant consent, and transcribed verbatim.

Data analysis followed a thematic approach, facilitated by MAXQDA 18.0.8 qualitative data analysis software. Codes and categories were developed both deductively, based on pre-defined research questions, and inductively, emerging from the data. A cyclical analytical process was applied, incorporating newly identified themes into subsequent rounds of data collection and analysis. Results were reviewed by an interdisciplinary working group at the Scientific Department of the Non-Commercial Joint Stock Company "Western-Kazakhstan Medical University named after Marat Ospanov," ensuring rigor and intersubjectivity.

Data Analysis

For the quantitative analysis, descriptive and inferential statistical methods were applied using SPSS software (IBM SPSS Statistics 30.0.0, USA, Chicago, IL). Figures and graphical representations of the data were generated using GraphPad Prism (v10.2.2, USA, California). to enhance visualization and interpretation. Statistical analyses were conducted with significance set at $p<0.05$. Thematic analysis was used for qualitative data, employing an iterative coding process to ensure validity and consistency in theme identification. Data from interviews and open-ended survey responses were integrated into the findings to provide a holistic interpretation of results.

Quality Assurance and Reliability

Measures were implemented to enhance the reliability and validity of the study. Data collection instruments underwent expert review and pilot testing. Interviews were independently coded by multiple researchers to ensure consistency in thematic analysis. Regular meetings with the research team facilitated discussions on emerging findings and methodological refinements.

By employing a rigorous methodological framework, this study ensures that findings are robust, ethically sound, and contribute meaningfully to the existing body of knowledge.

Ethical Clearence:

Prior to data collection, ethical approval was obtained from the relevant Bioethics Committee (Ethical Number: 1.7, date 24.01.2023). All participants provided informed consent before enrollment, ensuring their voluntary participation. Confidentiality was strictly maintained throughout the study, and personal identifiers were removed to protect participant anonymity. Research documentation will be securely stored for five years following study completion, in accordance with regulatory requirements.

RESULTS

Participants: Their Demographic and Working Characteristics and Their Primary Opinion About the Falsified Medicines

This investigation encompassed 250 pharmacists (see Table 1 for detailed demographic information). The majority of participants were female (88%), with males constituting 12%. Private pharmacies employ 96 (38.4%) pharmacists and chain pharmacies employ 154 (61.6%) pharmacists. A substantial proportion of respondents reported 0–5 years of professional experience (44.4%) in pharmacy practice, and most worked an average of 35–44 hours per week (39.6%), equating to approximately 5.71 hours per day. Prior to administering the questionnaire, a detailed explanation was provided, and participants were queried regarding their readiness; a notable segment responded "very much" (n=87, 34.8%), followed by "somewhat" (n=84, 33.6%), while a small fraction indicated "not at all" (n=9, 3.6%). When questioned about the adequacy of their equipment such as fax machines, computers, and other software and hardware the majority again replied "very much" (n=105, 42%) or "somewhat" (n=71, 28.4%), with the remaining opinions distributed as "undecided" (n=42, 16.8%), "not really" (n=18, 7.2%), and "not at all" (n=14, 5.6%).

Impact on Workload, Profitability and Patient Safety

Subsequently, participants were asked to evaluate the impact of a specific directive on their workload and profitability (see Figures 1A and 1B). With

respect to workload, the predominant response was that the directive had "somewhat" affected it (n=86, 34.4%). Regarding profitability, most responses were "undecided" (n=111, 44.4%), with the next most frequent response being "very much profitable" (n=48, 19.2%).

Another focal point of this study was patient safety (Figure 1C). A significant proportion of pharmacists (42.4%, n=106) reported that the directive "very much improves patient safety," although a small minority (3.6%, n=9) contended that it "does not improve patients' safety at all."

Perceptions of Falsified Medicines in Shymkent

To gain insights into pharmacists' perceptions of falsified medicines in Shymkent, they were asked to estimate the prevalence of these drugs in the region (Figure 2A). The most frequently chosen response was 1-5% (n=91, 36.4%), followed by those who estimated the prevalence to be less than 1% (n=77, 30.8%).

Participants were then asked to estimate the proportion of falsified medicines that originated from online suppliers (Figure 2B). Their responses were distributed as follows:

- 0-20%: 44,4%
- 21-40%: 27.2%
- 41-60%: 19.6%
- 61-80%: 4%
- 81-100%: 4.8%

Sources of Falsified Medicines and Its Different Types in Shymkent

In addressing the origin of the falsified medicines, responses were varied: 91 participants (36.4%) identified internet pharmacies as the source, 39 (15.6%) indicated personal importation, 113 (45.2%) attributed them to professional falsifiers, one (0.4%) selected the option indicating all of the above, and 6 participants were uncertain about the source.

Pharmacists were also questioned about the types of falsified medicines encountered in Shymkent. The responses were as follows:

- Weight-loss drugs (n=139; 55,6%)
- Erectile dysfunction drugs (n= 33; 13,2%)
- Heart-related medications (n=21;8,4%)
- Cancer medications (n=13;5,2%)
- Antibiotics (n=13;5,2%)
- Anticholesterol drugs (n=8;3,2%)
- Cold medications (n=1;0,4%)
- Both cancer and Weight-loss drugs (n=1; 0,4%)

Additionally, two participants (0.8%) believed that falsified medicines were nonexistent, while one respondent (0.4%) mentioned other falsified drugs.

Factors Raising Suspicion of Falsified Medicines

Regarding the indicators that raise suspicions among pharmacy staff, a range of opinions was recorded. The majority (n=123, 49.2%) cited discrepancies in packaging relative to the original as the primary trigger for suspicion. Other factors included different labeling (n=27, 10.8%), variations in product composition (n=52, 20.8%), differences in the source (n=28, 11.2%), and altered distribution routes (n=18, 7.2%). One respondent (0.4%) admitted uncertainty regarding the specific cues for suspecting falsification, and another indicated that attributes such as the lack of effect of the drug raised their suspicions.

Reporting Falsified Medicines

At this stage, the study explored pharmacists' readiness to report falsified medicines. Among the participants, 182 (72.8%) reported that they directly communicated instances of falsified medicines to the Department of the Committee for Medical and Pharmaceutical Control of the Ministry of Health of the Republic of Kazakhstan in Shymkent city. Meanwhile, 40 (16%) opted to report to the Ministry of Healthcare of the Republic of Kazakhstan, 21 (8.4%) to the National Centre for Expertise of Medicines and Medical Devices, and 1 to their supervisor or company head. An additional, another 6 participants (2.4%) indicated that they did not know where to turn.

Awareness and Use of Detection Tools

Concerning their awareness of initiatives related to falsified medicines, pharmacists were asked about their participation in relevant campaigns (Figure 3). Only 23 pharmacists (9.2%) indicated active involvement in these campaigns, whereas 227 (90.8%) reported no involvement. Among those who participated, 59.09% deemed the campaigns effective, while 40.91% did not ($p = 0.003$, one-sample binomial test, test proportion=0.025).

With respect to the detection of falsified medicines,

respondents were queried on their use of the Yellow Card Scheme (YCS). Only 31 pharmacists (31.4%) reported employing the YCS, in contrast to 219 (87.6%) who did not (p<0.001, one-sample binomial test, test proportion=0.025). Regardless of their use of the YCS, 135 pharmacists (54%) believed that the scheme could be beneficial in detecting falsified medicines, while 58 (23.2%) disagreed (p<0.001, one-sample binomial test, test proportion=0.025), with 57 (22.8%) providing no response.

Knowledge of Detection Technologies and Training, and Willingness to Learn It

The survey further assessed pharmacists' awareness of technologies that could aid in the detection of falsified medicines. Only 59 respondents (23.6%) affirmed familiarity with such technologies, while 191 (76.4%) did not (p<0.001, one-sample binomial test, test proportion=0.025). Among the technologies cited were packaging (n=13, 5.2%), QR codes (n=1, 0.4%), and the Naqty Onim app (n=6, 2.4%). Other responses included methods such as using a series of steps (n=1, 0.4%), visual inspection (n=2, 0.8%), and labeling (n=2, 0.8%); one respondent (0.4%) expressed uncertainty, and 224 (89.6%) did not provide any additional input. In terms of perceived effectiveness, 73 participants (29.2%) believed these technologies were effective in identifying falsified medicines, 33 (13.2%) disagreed, and 144 (57.6%) did not offer an opinion (p<0.001, one-sample binomial test, test proportion=0.025). Additionally, when asked about receiving training on the subject of falsified medicines, 94 respondents (37,6%) confirmed that they had received training, 156 (62,4%) stated they had not (p<0.001, one-sample binomial test, test proportion=0.025). When questioned about their willingness to participate in similar future training sessions, 129 (51.6%) indicated they would, whereas 95 pharmacists (38%) declined, and 26 (10.4%) were non-responsive (p<0.001, one-sample binomial test, test proportion=0.025).

Management Confidence in Combating Falsified Medicines

The study also examined pharmacists' confidence in managing falsified medicines through a series of questions (Questions 16–26), as depicted in Figure 4. These questions were initially piloted for validity with a sample of 50 participants in Shymkent, Kazakhstan. When evaluating any measurement instrument, the key considerations include both validity and reliability. Cronbach's alpha, a common metric for assessing internal consistency, is typically considered acceptable within the range of 0.70 to 0.95. In previous research, the set of questions 16–26 yielded a Cronbach's alpha of 0.728, indicating moderate reliability [22]. In the current study, with a larger cohort of 250 pharmacists and complete data, the Cronbach's alpha for the standardized items was recalculated to be 0.841, reflecting robust internal consistency and suggesting that the items are well-correlated and effectively capture the intended construct. Based on the results of these questions, it was shown that the pharmacists had sufficient confidence to manage falsified medicines.

Recommendations to Reduce Falsified Medicines

Finally, pharmacists were asked for their recommendations on how to minimize the distribution of falsified medicines to the general public. A total of twenty-one recommendations were collected, with the primary suggestions including: (1) enhancing healthcare education through proper prescribing practices, verification of medicine quality and certification, and instructing patients to report issues to the appropriate authorities; (2) improving public health education by encouraging the purchase of medicines from reputable, chain pharmacies or trustworthy distributors while discouraging the use of internet pharmacies; and (3) increasing government intervention through measures such as eradicating falsified medicines, tighten border controls, optimizing pharmacists' roles, and regulating online pharmaceutical sales.

Pharmacists' Role in Combating Falsified Medicines

The concluding query solicited opinions on the role of pharmacists in reducing the prevalence of falsified medicines. Major themes that emerged from the responses underscored the critical importance of pharmacists' involvement, including the necessity for specialized training to detect falsified products, the imperative for pharmacists to provide patient counseling and education, the need for proactive detection and reporting of suspected falsified medicines, the adherence to prescription-only dispensing, and the responsibility to notify the appropriate regulatory bodies upon identifying any falsified products.

DISCUSSION

Falsified Medicines: A Unique and Essential Care Imperative

The rise of falsified medicines is an increasing concern in global healthcare, and it's important to distinguish them from counterfeit drugs. According to the WHO, falsified medicines are intentionally misrepresented in terms of their identity, ingredients, or origin, making them a deliberate act of fraud. On the other hand, the FDA defines counterfeit medicines as those that violate trademark laws without authorization, meaning they may not always be intentionally falsified but still pose risks. Understanding this distinction is crucial, as falsified medicines are specifically designed to deceive both patients and healthcare providers, potentially leading to ineffective treatments and serious health complications. Research shows that these fraudulent medicines are particularly prevalent in low- and middle-income countries due to weaker regulatory oversight. However, even high-income nations are not immune, as falsified drugs can sometimes make their way into legitimate supply chains. The increasingly globalized pharmaceutical industry has made detecting and preventing these dangerous products even more challenging. The above discussion suggests that distinguishing falsified medicines from counterfeit drugs is vital for developing targeted regulatory strategies. Addressing the problem requires global cooperation, particularly in strengthening supply chain oversight and technological verification measures.

Importance of This Study on Falsified Medicines

This study provides critical insights into pharmacists' awareness, knowledge, and response to falsified medicines in Shymkent, Kazakhstan. Given that pharmacists are the frontline defenders against falsified medicines, understanding their level of preparedness is crucial [8, 26]. The findings from this study align with previous research indicating that pharmacists' training and access to regulatory tools significantly influence their ability to identify and combat falsified medicines [15, 26].

While some studies have reported high levels of pharmacist awareness regarding falsified medicines, others suggest that knowledge gaps persist, particularly in developing regions [19, 27]. A recent global survey found that up to 40% of pharmacists in some regions lacked confidence in their ability to distinguish between genuine and falsified products [22]. The current study's findings reinforce the need for continuous education and stricter regulatory interventions to enhance pharmacists' effectiveness in combating this issue.

The results underscore the necessity of equipping pharmacists with the necessary knowledge and tools to detect falsified medicines, emphasizing the role of policy reforms and training programs in improving pharmaceutical safety.

Impact of Falsified Medicines on Human Health and Different Diseases

The consumption of falsified medicines has severe implications for human health, ranging from treatment failure to life-threatening conditions. One of the most alarming consequences is the contribution of falsified antibiotics to antimicrobial resistance [11, 28]. The use of subtherapeutic doses in falsified medicines accelerates the development of drug-resistant pathogens, rendering standard treatments ineffective [16, 28, 29].

Another important result of the current study was that pharmacists in Shymkent identified weight-loss medications as the most commonly falsified drug category, followed by erectile dysfunction drugs, cardiovascular medications and antibiotics. These drugs can be some of the most frequently adulterated medicines, often resulting in severe health consequences [20]. The high prevalence of falsified weight-loss medications is particularly concerning, given their life-saving nature and the potential for severe adverse effects and causes possibly death. [11].

Additionally, the study found that pharmacists suspected falsification primarily based on discrepancies in packaging, labeling, and product composition. Previous studies have confirmed that visual inspection remains a primary detection method, though it is often unreliable without advanced analytical techniques [4, 30]. The study also revealed that pharmacists were concerned about patient safety, with many acknowledging that falsified medicines could lead to therapeutic failure and adverse reactions. This aligns with previous research showing that falsified medicines contribute to antimicrobial resistance and treatment inefficacy, particularly in low-resource settings [10]. These results confirm the significant health risks posed by falsified medicines, particularly weight-loss medications, cardiovascular drugs and antibiotics, reinforcing the urgent need for better detection and reporting mechanisms.

Strategies to Combat Falsified Medicines

The study found that while most pharmacists in Shymkent were aware of falsified medicines, a significant portion lacked access to effective detection tools. Only 31 pharmacists reported using the YCS for reporting falsified medicines, despite its recognized effectiveness in pharmacovigilance. This finding aligns with previous studies indicating that underreporting remains a critical issue in detecting falsified drugs [9, 31].

Additionally, the study highlighted the need for advanced technologies in falsified medicine detection, with only 23.6% of pharmacists reporting familiarity with modern verification methods such as QR codes and digital serialization. Previous research has emphasized the importance of blockchain-based tracking and serialization technologies in ensuring pharmaceutical integrity [18]. However, the study also found that most pharmacists had not received formal training on falsified medicines, but 51.6% expressed willingness to participate in future training. This reluctance presents a challenge, as research has consistently shown that training programs significantly improve pharmacists' ability to identify falsified drugs [15, 32]. In summary, the study underscores the urgent need for pharmacist education, enhanced regulatory reporting, and the adoption of digital verification technologies to combat falsified medicines effectively.

Opinions on Policy and Pharmacists' Role in Combating Falsified Medicines

The study revealed that 72.8% of pharmacists reported falsified medicines to regulatory authorities, with most preferring direct communication with the Department of Medical and Pharmaceutical Control. While this suggests a proactive approach, it also indicates that a significant minority of pharmacists do not engage in reporting. This finding is consistent with global studies that highlight the need for stronger regulatory enforcement and pharmacist engagement in surveillance systems [16, 33].

Moreover, the study found that pharmacists believe policy reforms should focus on stricter import regulations, improved public awareness, and increased government oversight of online pharmacies. These findings align with WHO recommendations emphasizing that policy interventions should target supply chain vulnerabilities and enhance intergovernmental cooperation [1].

Study Limitations

Despite its valuable contributions, this study has several limitations. First, the reliance on self-reported data introduces potential bias, as participants may overestimate their knowledge or underestimate the prevalence of falsified medicines [12]. Additionally, the study's sample was limited to pharmacists in Shymkent, which may not fully represent national trends [22].

Future research should expand the sample size and incorporate objective methods, such as laboratory analysis of suspected falsified medicines, to enhance result reliability [34].

Future Prospects and Recommendations

Future efforts to combat falsified medicines should focus on technological advancements, regulatory strengthening, and pharmacist engagement. Artificial intelligence (AI)-driven verification systems, blockchain tracking, and digital serialization have shown promise in detecting falsified medicines more accurately and efficiently [10, 35]. These technologies can enhance supply chain transparency, reduce manual errors, and improve real-time detection of counterfeit drugs [18]. Additionally, strengthening cross-border regulatory collaborations will be crucial in preventing the international circulation of falsified medicines. Countries should work together through shared surveillance systems and harmonized policies, similar to the European Medicines Agency's FMD [16].

Pharmacists play a key role in the early detection and prevention of falsified medicines, yet many lack access to proper training and reporting tools. Future initiatives should integrate pharmacists into nationwide surveillance programs, providing them with real-time detection tools and encouraging active reporting [11, 36]. Additionally, public awareness campaigns should educate consumers on the risks of purchasing medicines from unverified sources and how to identify legitimate pharmacies [15]. Governments should also enforce stricter penalties for pharmaceutical fraud, ensuring that falsified medicine trafficking is treated as a serious criminal offense [21, 37].

Global funding and investment in anti-counterfeit research should also be a priority. International organizations like the WHO and the Global Fund should allocate resources for developing affordable field-testing kits and expanding pharmacist education programs [1]. By combining advanced technologies,

policy reforms, and pharmacist training, the fight against falsified medicines can become more effective, ensuring safer healthcare systems worldwide.

CONCLUSIONS

This study provides crucial insights into the prevalence, detection, and reporting of falsified medicines in Shymkent, Kazakhstan. The findings reveal that while pharmacists are aware of the dangers of falsified medicines, gaps in training, regulatory enforcement, and access to detection tools hinder their ability to combat this growing issue effectively. The low adoption of formal reporting mechanisms and reluctance to engage in additional training highlight the need for structured educational programs and improved technological interventions. The study underscores the importance of pharmacist involvement in national surveillance systems, the implementation of advanced verification technologies, and the necessity of cross-border regulatory collaboration. By addressing these challenges, policymakers can enhance medicine safety, reduce public health risks, and strengthen pharmaceutical regulation efforts on a broader scale.

DECLARATIONS

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Project administration, Gulsim N. Amirkhanova, and Nurgul Zholdassova;

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Disclosure Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethics and consent to participate

Not applicable.

Consent to publish

Not applicable.

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This research has received no fund.

Availability of data and materials

Not applicable.

Table 1. Demographic characteristics of populations involved in this study.

Respondent variables		Frequency (Percentage %, N=250)
Sex	Male	12
	Female	88
	Preferred not to say	0
Years of registration experience	0-5	44.4
	6-10	33.2
	11-15	14
	16-20	5.2
	>20	3.2
Working hours per week	16-24	16.4
	25-34	4.4
	35-44	39.6
	45-54	28.4
	>55	11.2

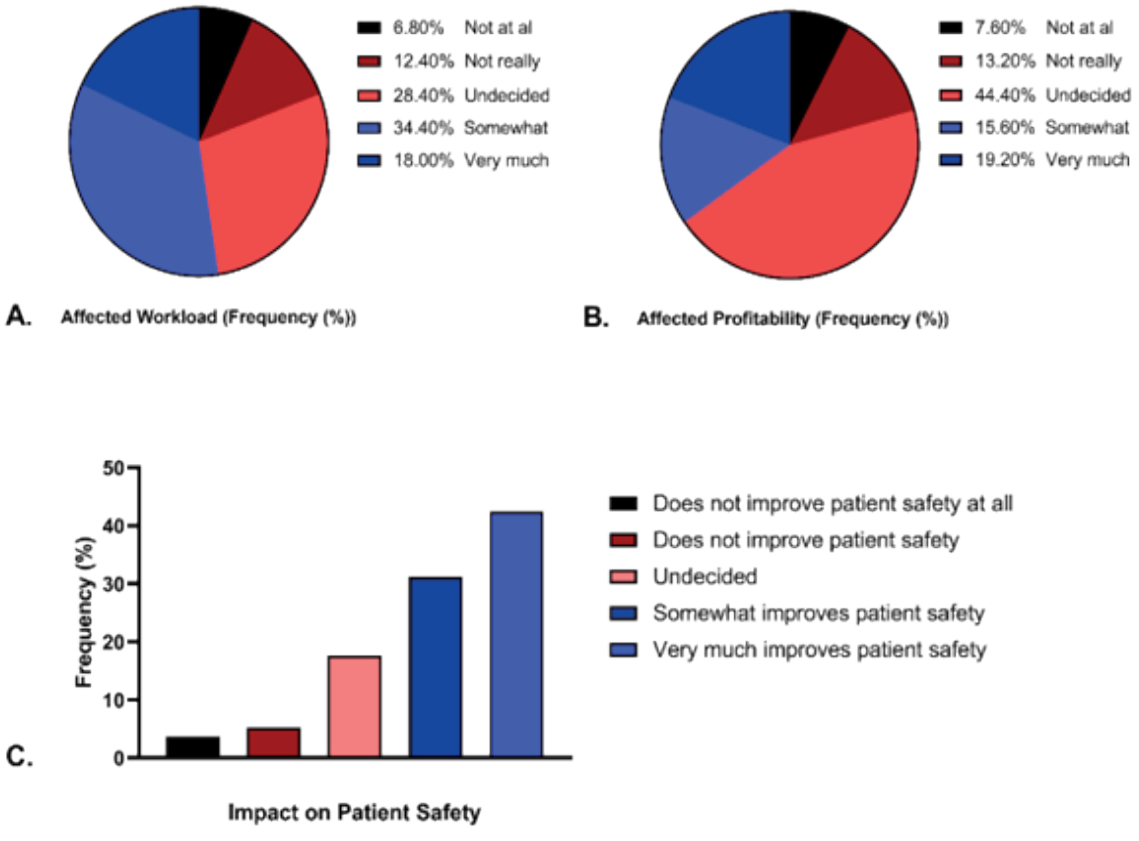

Figure 1. Affected workload (A), affected profitability (B) and impact of this directive on patients' safety (C) reported by participants.

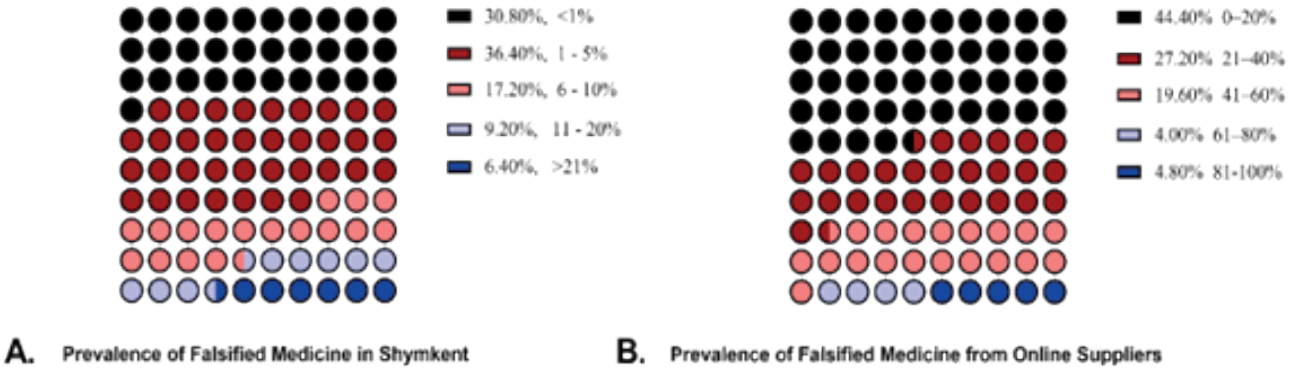

Figure 2. Prevalence of the falsified medicines in Shymkent (A) and prevalence of the falsified medicines from online suppliers (B) reported by participants.

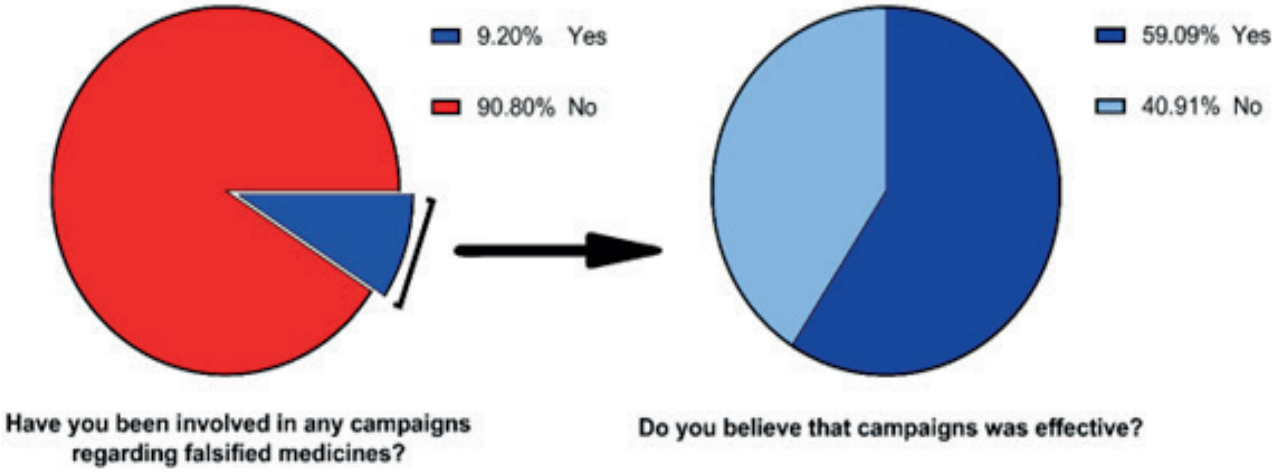

Figure 3. Involvement of the participants in the campaigns and their opinions about its effectiveness.

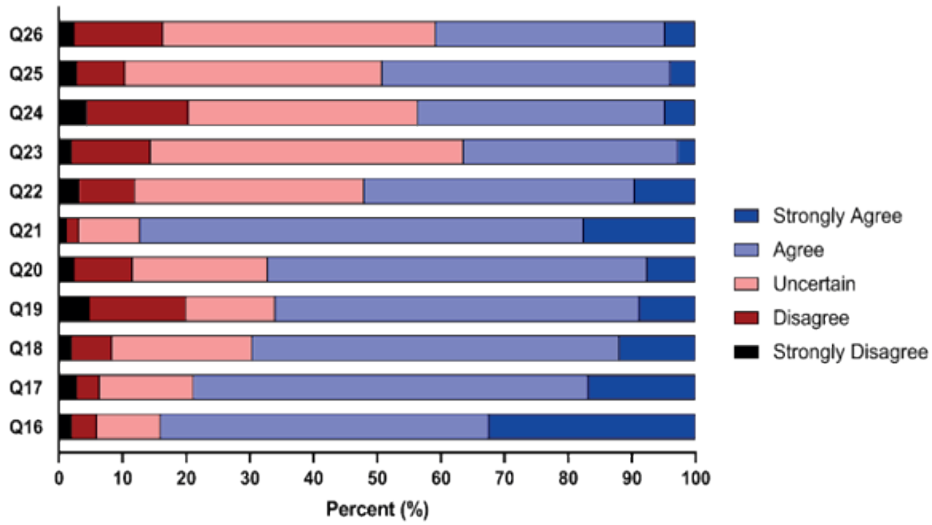

Figure 4. Questions about the participants' confidence in managing falsified medicines.

QUESTIONS

Q16-Do you agree that falsified medicines pose a significant problem to the pharmacy profession?

Q17-Do you agree that lack of knowledge is a barrier for detecting the presence of falsified medicines?

Q18-Do you agree that lack of resources is a barrier for detecting the presence of falsified medicines?

Q19-Do you agree that the dispensing pharmacist retains highest liability when falsified medicines reach patients?

Q20-Do you agree that a pharmacist's intervention can prevent or disrupt the supply of falsified medicines to patients?

Q21-Do you agree that training courses can improve pharmacists' knowledge regarding falsified medicines?

Q22-Do you agree that listening to patients could help identify falsified medicines?

Q23-Do you agree that the majority of my fellow pharmacists in Shymkent are confident regarding falsified medicines?

Q14-Do you agree that I'm confident and capable in identifying falsified medicines?

Q25-Do you agree that I'm constantly vigilant of encountering falsified medicines when checking prescriptions?

Q26-Do you agree that I have enough knowledge to identify falsified medicines?

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