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ORIGINAL RESEARCH ARTICLE

The Epidemic of Substandard and Falsified Medications in Iraq: Evaluating the Effectiveness of National Pharmacovigilance Alerts to Community Pharmacies

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Abstract

Background Assessing Iraqi experience with the impact of substandard and falsified (S/F) medicines can help other countries deal comprehensively with the underlying causes of this multifactorial problem. The tools used in this study to assess strategies to prevent the use of S/F medications can be used in other developing countries. This study investigated the problem of S/F medications at three levels: the Ministry of Health (MOH), pharmaceutical company representatives, and community pharmacists.

Objectives Study objectives were to evaluate the effectiveness of alerts about S/F medications issued by the national Iraqi Pharmacovigilance Center (IqPhvc) to community pharmacies and to explore the reasons and potential solutions for this problem from the perspective of both pharmaceutical companies and pharmacists.

Methods This was an exploratory mixed-method study. The qualitative phase comprised seven 1-h semi-structured interviews and one focus group conducted via Zoom. Thematic analysis was used to analyse the qualitative data. The findings of the qualitative phase were then used to develop the survey items. The quantitative phase included an electronic survey distributed among pharmacists via two professional Facebook groups between 23 April and 19 May 2020. The Kruskal–Wallis test was used to measure differences in pharmacists' knowledge of and ability to detect S/F medications according to their years of experience in the private sector.

Results Over the last 5 years (2016–2020), the IqPhvc received 183 reports about S/F medications from representatives of 25 international companies. Only 29 (15.8%) of the reports were about falsified medications; the majority were about substandard (parallel) medicines. We interviewed 12 pharmacists (11 male, 1 female) representing ten large international pharmaceutical companies. We also received surveys from 590 pharmacists, of whom 475 (80.9%) were women. Although 72% of the participants had not received any training in the identification of S/F medications, 59.4% of them easily identified S/F medications. Likewise, approximately three-quarters of the participating pharmacists recognized genuine registered medications through three means: medication price sticker, cost, and packaging features. Although 61% of the pharmacists followed-up alerts about S/F medications, only 25.6% were willing to report S/F medications.

Conclusions Most reports to the IqPhvc were about substandard medications. Participants of the two study phases agreed on several reasons for the problem of S/F medications, including their low prices, the unavailability of registered medications, the lengthy medicine registration process, and inadequate awareness of S/F medications among healthcare providers and the public. They also agreed that national alerts and price stickers are helpful in the identification of S/F medications. Community pharmacists can increase their efforts to report S/F medicines, but they need training, awareness, and tools. The study highlighted the need for a track-and-trace system to detect S/F medicines in the supply chain. In brief, the problem of S/F medication is multifaceted. Reducing it will require effective collaboration among different entities, including health officials, border agencies, healthcare providers, and registered pharmaceutical companies.

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Key Points

National alerts about substandard and falsified (S/F) medications and price stickers are helpful in the identification of S/F medications.

S/F medications are prevalent in the private sector for several reasons, including the low prices and greater profitability of S/F medications, the unavailability of registered medications, the lengthy medicine registration process, and inadequate awareness of S/F medications among healthcare providers and the public.

A track-and-trace system is necessary for the detection of S/F medicines in the supply chain.

The problem of S/F medication in the private sector is multifaceted. Solving this problem will require effective collaboration between different entities, including health officials, border agencies, healthcare providers, and registered pharmaceutical companies.

The tools used in this study to assess the strategies implemented to prevent the use of S/F medications can be used in other developing countries.

1 Introduction

In 2015, the Organisation for Economic Co-operation and Development estimated the value of the global counterfeit pharmaceutical industry to be about US $200 billion annually [1]. All regions of the world are affected by the problem of substandard/falsified (S/F) medicines but to different extents. The problem is more pronounced in low- to middle-income countries, where it is estimated that 10% of medical products are S/F [2]. A recent survey of 200 physicians in Sweden found that one-third of their patients may have taken S/F medicines [3]. According to a recent report from the Iraqi Ministry of Health (MOH), 60–70% of medications in the private sector are S/F [4, 5]. This problem poses a real threat to patient medication safety, decreases trust in medicines, jeopardizes the trust between patients and healthcare providers (HCPs), and has socioeconomic consequences [2].

The World Health Organization (WHO) defines substandard medicines as "authorized medical products that fail to meet either their quality standards or specifications, or both" [2]. Substandard medicines usually enter a country through unofficial avenues and may be exposed to substandard storage and shipping conditions [2, 6]. In other words, illegal diversion (parallel importing) occurs when a medicine is produced for sale in one country but illegally enters and is sold in another. The regulators in the second country refuse to use these parallel medications because they can harm patients [7]. According to the WHO, falsified medicines "deliberately/fraudulently misrepresent their identity, composition or source" [2]. Falsified medications are manufactured under substandard conditions and then packaged to look like authentic medications. They either do not contain active ingredient(s) or contain more/less than the stated dose [8].

The pivotal goal of pharmacovigilance is to monitor the benefit–risk balance of any medical intervention and/or product, with a positive value indicating a favourable safety profile. On the other hand, unclear benefit would indicate an unsafe intervention. As such, the definition of pharmacovigilance can be expanded to include monitoring of S/F medical products since they shift the balance towards risk [9].

The Iraqi pharmaceutical sector mainly relies on imported medicines; the market share of domestic medicines was < 25% of the total pharmaceutical volume in 2020 [5]. Medicines in Iraq are regulated by the MOH. The Directorate of Technical Affairs is responsible for this mission and conducts four essential regulatory activities: registration, pharmacovigilance, good manufacturing practice certification, and quality and safety control [5]. The medicine, its manufacturing site, the marketing authorization holder, and the medicine price must be registered with the Registration Department to be officially available in Iraq in both public and private sectors [5]. The public sector is under governmental control, and medicines are securely made available to all health institutions across the country through the State Company for Marketing Drug and Medical Appliances (KIMADIA), the MOH body responsible for procurement and distribution of medical products [10]. The private sector is partly regulated by the MOH and partly by the Syndicate of Iraqi Pharmacists (SIP) [5]. The pathway of medicines availability in the private sector involves different players: The scientific bureau(s) that represent the marketing authorization holder(s) provides the wholesalers with the medicines, and they in turn provide the medicines to the community pharmacies [10].

Evaluations of national pharmacovigilance alerts about S/F medications and pharmacists' abilities to detect and report S/F medications are relatively scarce. To the best of our knowledge, no previous Iraqi study has aimed to identify the causes of and practical solutions for this large-scale challenge, which began after 2003 when the importation of medicines to the private sector became decentralised.

Our study investigated the problem at three levels: the MOH, pharmaceutical company representatives, and community pharmacists. Additionally, we used a unique comprehensive method (exploratory mixed method) to answer our study questions about the effectiveness of the Iraqi

Pharmacovigilance Center (IqPhvc) alerts, price stickers, and other current strategies to minimize the distribution and use of S/F medications in the private sector. This evaluation of the experience in Iraq can help other countries to deal comprehensively with the underlying issues and to engage the stakeholders who can influence this multifactorial problem. The study objectives were to evaluate the effectiveness of the IqPhvc alerts about S/F medications sent to community pharmacies and to explore the reasons and potential solutions for this problem from the perspective of pharmaceutical companies and pharmacists.

2 Methods

This study triangulated three sources of data: IqPhvc reports, interviews with and/or a focus group involving pharmaceutical company representatives, and a survey of pharmacists. The study employed an exploratory mixed method (qualitative phase followed by quantitative phase) because the authors required real-world information about the problem of S/F medicines and its causes before developing the survey items. The qualitative phase helped the researchers assess the effectiveness of pharmacovigilance alerts from the pharmaceutical companies' point of view, and the interviewee comments were very helpful in understanding the whole complicated picture of this multifactorial problem.

The study proposal was approved by the ethical committees at the University of Baghdad College of Pharmacy and Iraqi MoH. No incentive was offered to participants. The survey was voluntary and anonymous, and the researchers de-identified the interview and focus group participants.

2.1 Qualitative Phase

The qualitative phase was conducted first to help develop the survey items (exploratory mixed method). For example, the findings from the qualitative phase helped in the development of the survey items related to identifying potential reasons and suggested solutions for the problem of S/F medications. The interviewees were safety/regulatory agents from international pharmaceutical companies or scientific bureaus.

The interview was semi-structured with open-ended questions. The interview guide was made up of three sections and included 16 questions in total. The first section included participant characteristics (job title, experience years, profession), perceptions about the reasons for S/F, and participant/company experience with S/F medications. This section also asked about how community pharmacists identified S/F medications and the negative impact of S/F medications on registered medicine companies and patients. The second section included questions about participant perceptions of the effectiveness of the MOH, the IqPhvc, and the SIP in preventing S/F medications. Finally, section three included questions about what policy and decision makers can do to minimize the distribution and use of S/F medications.

Contact information for representatives of international pharmaceutical companies was obtained from the IqPhvc. Purposeful sampling was used to select participants from companies who had reported S/F medications to the IqPhvc within the last 4 years.

The researchers conducted interviews with a maximally diverse set of interviewees from stakeholders in areas of pharmaceutical regulations and S/F medications. Interviewees were invited via phone and provided verbal consent before the interviews were conducted and recorded. The seven interviews and the focus group were conducted via the Zoom meeting platform because of the coronavirus disease 2019 (COVID-19) pandemic. The interviews lasted for about 60 min each, whereas the focus group took 2 h. The interviews continued until saturation of the information was reached. The interviews were conducted in English by one researcher (AA, an expert in Social and Administrative Pharmacy), and a second researcher (MZ, a graduate student) acted as notetaker. The interviews were recorded and the recordings transcribed.

2.1.1 Thematic Analyses

The qualitative data were generated from the seven semi-structured interviews and one focus group. The interview records were transcribed and the transcriptions cross-checked by the research team. The names of the interviewees and their companies were deidentified to maintain participant confidentiality. During the qualitative analysis stage, the research team identified and developed themes from the participants' answers. The analysis followed the six phases of thematic analysis described by Braun and Clarke: familiarizing with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and displaying the findings [11].

Inductive analytic methodology (data driven) was used, and a constructivist paradigm was followed for the qualitative phase. This means we did not rely on a previous framework to generate themes but constructed the themes from the common trends emerging from the participants' responses. The data item was each sentence of the participants' answers. Finally, to enhance the credibility and trustworthiness of the findings, peer-checking/debriefing was performed twice to validate the qualitative analysis.

2.2 Quantitative Phase

The quantitative phase included an English-language electronic survey (Qualtrics) distributed among pharmacists and

the reports of S/F medications submitted to the IqPhvc. The target participants were pharmacists from across the country with experience in the private sector. The survey was distributed via two professional Facebook groups (members of the SIP and Al-Multaqa Al-Sadalany) between 23 April and 19 May 2020. These are well-known national professional Facebook groups that include around 20,000 members (any pharmacist with a Facebook account). The survey was reposted every other day.

The authors used the findings of the qualitative phase in addition to some items from previous studies that were customized to fit the Iraqi private sector [8, 12]. The authors also consulted current practising pharmacists before developing the survey to ensure the items were tailored to the domestic medicine market. Face validity of the new/modified survey items was checked by three experts in the field. Finally, a pilot study was conducted with ten community pharmacists to detect any unclear/inadequate questions, and the survey was revised accordingly.

The survey included five sections. Part 1 included six items about the responding pharmacist's characteristics. Part 2 included eight items related to the pharmacist's knowledge of and ability to detect S/F medications. Part 3 included seven items about the roles of the MOH, the IqPhvc, and the SIP in decreasing the distribution and use of S/F medications. Part 4 included eight items about the pharmacist's perceptions of S/F medications (such as reasons and potential solutions for the problem of S/F medications). Part 5 included six items about the roles of current community pharmacists in decreasing the distribution and use of S/F medications. An additional question concerned the pharmacist's awareness of ten IqPhvc alerts about S/F medications in 2019 and 2020.

Pharmacists without experience in the private sector were excluded from the questions identifying some S/F medications that were subject to alerts from the IqPhvc. Additionally, only community pharmacists could answer questions addressing the roles of community pharmacists in decreasing the distribution and use of S/F medications (using display logic question).

2.2.1 Statistical Analysis

The Statistical Package for Social Sciences program (SPSS) version 24 (IBM SPSS Statistics, Armonk, NY, USA) was used for data analysis. Continuous characteristics were expressed as mean, range, and standard deviation. Categorical variables were expressed as frequencies and percentages. The answers to preparedness questions used the 5-score Likert scale: strongly disagree, disagree, neutral, agree, and strongly agree. The Kruskal–Wallis test was used to measure the differences in pharmacists' knowledge of and ability to detect S/F medications according to years of experience in the private sector. P-values < 0.05 were considered statistically significant.

3 Results

3.1 Qualitative Findings

The qualitative phase included seven individual interviews and one focus group. The interviewees (P1–P7) represented nine large international pharmaceutical companies, and the five (P8.1–P8.5) focus group participants represented a tenth company. All interviewees were pharmacists (11 male; 1 female), with experience in pharmaceutical companies ranging from 2 to 13 years. They were employed as quality pharmacovigilance compliance agents, local safety representatives, sale managers, medical affairs managers, or distributor managers.

The qualitative findings are presented in five main sections: main reasons behind the availability of S/F medications, current strategies to minimize the distribution and use of S/F medications, the effectiveness of alerts from the IqPhvc in decreasing the distribution and use of S/F medications, the negative effects of S/F medications, and recommendations from representatives of pharmaceutical companies to decrease the distribution and use of S/F medications. The cited tables include the main themes and subthemes of and participants' quotes from within these sections.

3.1.1 Main Reasons Behind the Availability of Substandard/Falsified (S/F) Medications

According to the representatives of pharmaceutical companies and a scientific bureau, there are five main reasons (themes) behind the prevalence of S/F medications in the private sector: the current MOH regulations, unavailability of registered medications, lower prices of S/F medicines, inadequate awareness, and inadequate border control. Details and interviewees' quotes are shown Table 1.

3.1.2 Current Strategies to Minimize the Distribution and Use of S/F Medications

Four strategies to minimize the distribution and use of S/F medications are currently in place: detecting S/F medications in the private market, developing and distributing S/F alerts to drug stores and community pharmacies, increasing ways to identify S/F medications, and promoting awareness among HCPs (Table 2).

Representatives of pharmaceutical companies/scientific bureaus are the main detectors and reporters of S/F medications available in community pharmacies. They detect S/F medications and submit reports to the IqPhvc. When the

Table 1 Reasons behind the availability of substandard/falsified medications in the private sector

Theme	Subtheme	Quotes from pharmaceutical company representatives
Current MOH regulations	Delay in QC laboratory and price stickers (lengthy post-registration process)	P1: We need 5–6 months to bring medication legally. We have two timelines: One for production when we make order for new shipment, and this takes about 3 months to receive the shipment and we need 1–2 months to release drug to market (QC laboratory and price sticker). So, during this period, when there is a demand for a product, someone tries to bring it illegally P8.4: The process after drug registration takes about 2–3 months in QC laboratory and to give price sticker, so drug stores try to bring these drugs through parallel [unofficial] routes
	Lengthy MOH drug registration process	P6: Long process of drug registration and this waste of time will cause shortage in medicines in the market, so they seek to get the smuggled medicines p5: When introduce [medicine] file takes at least takes 2 weeks to get first feedback and sometimes takes 2–3 months in registration
Lower prices of S/F medicines	Lower prices in neighbouring countries (higher profitability)	P6: They brought these drugs because of their low prices P8.3: The product price is lower in neighbouring countries because it [is] marketed directly from source to pharmacy P1 There are differences in drug prices between Iraq and neighbouring countries. They [neighbouring countries] have insurance and co-payment, which reduce the prices P8.3: Turkey brings raw materials then packs the drugs that contribute to lower the price. So, Turkey is responsible for both substandard/falsified medication in Iraq P2: Some companies put Iraq in Gulf Cooperation Council area, so price will be high
	Supply chain (drug stores increase drug prices in the Iraqi private sector)	P2: The drug distribution system in Iraq increases the [drug] price. Scientific bureau [distributes] medicines to drug stores that increase the price by 8% before reaching pharmacies. This process does not exist in other countries P8.3: The product price is lower in neighbouring countries because it is marketed directly from source to pharmacy, but in Iraq there is drug stores, so that will increase the price of product P7: Drug stores: When, for example, the scientific bureau excuses to fund the drug stores because of their debt, so the drug stores try to bring them [medicines] by parallel way
Inadequate awareness	Inadequate healthcare provider awareness	P5: Inadequate level of awareness among pharmacists and doctors regarding the S/F medications
	Inadequate public awareness of differences between S/F and registered medications	P5: The original drugs have higher price than S/F drugs but have better efficacy. This is known for highly educated people but for low-income or low-educated people, the price is important. So, that reflects the role of community pharmacists in promoting awareness of all people to overcome this problem
Inadequate border control		P3: These [S/F] occur due to bad control on our borders P6: There are many reasons for parallel drugs: uncontrolled border and a lot of factories that are not registered give us low-quality products
Unavailability of registered medications	Unavailability of required medicines in the domestic market (stock rupture)	P1: We need 5–6 months to bring medications legally. So, during this period, when there is a demand for product someone tries to bring it illegally P5: Legal medications need long time. Sometimes, poor supply of the original drugs from company leads to stock rupture and that leads to provide the smuggled one by smugglers
	Unavailability of different drug strengths (other than registered)	P7: Our drug gives therapeutic effect at 60 mg and we do not have another one [strength], but we found 30 mg in a pharmacy

QC quality control, *S/F* substandard and falsified

Table 2 Current strategies to minimize the distribution and use of substandard and falsified medications

Theme	Subtheme	Quotes from pharmaceutical company representatives
Detection of S/F medications in the private market (community pharmacies)	Representatives of pharmaceutical companies/scientific bureaus detect S/F medications in community pharmacies and provide a report to the MOH Pharmacovigilance Center	P5: The company, through their representative, does the report about the batch number that is not related to their company to the MOH IqPhvc, then IqPhvc does the alert and informs the SIP and then later distributed this alert through [their] Facebook page and reaches to community pharmacists P4: Our company has [an] internal role to notify MOH about any falsified or substandard products, and we commit to do this [with]in specific timeline
Developing and distributing S/F alerts to drug stores and community pharmacies	Developing S/F alerts through collaboration between the pharmaceutical company responsible for the registered medicine and the IqPhvc	P5: The company, through their representative, does the report about the batch number that is not related to their company to the MOH IqPhvc, then the IqPhvc does the alert and informs the SIP and then later distributed this alert through [their] Facebook page and reaches to community pharmacists P6: In their companies, they have medical representative seek for S/F medications and take pictures from pharmacy and try to inform the IqPhvc, that does the letter to inform the SIP, and the SIP announces to community pharmacists through its page on Facebook
	The SIP distributes alerts to community pharmacists	P1: We need 3–5 weeks to receive it [alert about S/F medicine] from the SIP P2: We do report to MOH that forwards it to the SIP that post it on the official Facebook page
	Pharmaceutical companies/scientific bureaus occasionally distribute S/F medication alerts related to their products to wholesalers and community pharmacies	P1: When we receive the letter, either from IqPhvc or the SIP, we try to distribute the letter to wholesalers and community pharmacies P7: Yes, our medical representatives try to notify the community pharmacists about the S/F medications' feedback
	SIP informs community pharmacists through distribution of alerts of reported S/F medicines	P1: They [SIP] focus on their inspection on pharmacies on who is the owner, and this issue [S/F] does not take the priority of their work. So, their role mainly is to inform pharmacists about these [S/F] medications through the Facebook page P5: The SIP tries to distribute the [S/F] letters on Facebook page and also they work on registration process to be fast
Increase ways of identifying S/F medications	SIP provides price stickers to registered medications	P3: It can be easily noticed by price sticker on the outer box of the product because every priced product is officially pass through all steps of importing and quality control testing before it takes the green light to be marketed P6: Three stickers on product can [help] community pharmacist[s] differentiate: scientific sticker, company sticker, and price sticker. Not all companies have stickers. Company sticker can be found on parallel drug from another country
	Packaging characteristics	P2: From price sticker and external characteristics of packaging P5: The company sometimes make packaging of drugs for certain countries or the Middle East. People who try to make falsified drugs and put starch instead of active ingredients, their work will be stop[ped] when the company change[s] the packing and when the patients know the new packet
	Physician feedback to the representative of the company responsible for the registered medications	P7: From characteristic[s] of original drug, like the sticker that contains the name of scientific bureau of international company and sticker of price of SIP and from the feedback of the drug by doctors when medical representatives visit them to check the feedback of drug
Promote awareness among healthcare providers	Pharmaceutical companies/scientific bureaus increase awareness among healthcare providers	P4: We try to train our medical representatives how to identify S/F drugs and inform the doctors through visiting and train them how to do report to local [company] safety representative then inform the IqPhvc P8.5: Yes, we try to communicate with all health institutions in Iraq and all branches of the SIP in the provinces of Iraq through doing awareness and send pictures of drugs entered through parallel routes P3: We promote the awareness of pharmacists and doctors about how they can differentiate between the original and S/F drugs

IqPhvc Iraqi Pharmacovigilance Center, *MOH* ministry of health, *S/F* substandard and falsified, *SIP* Syndicate of Iraqi pharmacists

IqPhvc receives an S/F report from a registered pharmaceutical company, an alert is developed and sent to the SIP to distribute to community pharmacists via their official and Facebook pages. In addition to the SIP, some pharmaceutical companies/scientific bureaus occasionally distribute S/F medication alerts related to their products to wholesalers and community pharmacies.

Increasing the number of ways in which S/F medications can be identified to help community pharmacists recognize them is essential. The main distinct sign is the SIP price sticker. These stickers are only provided for registered medications, so any imported medications without such a price sticker are probably S/F. Some companies change their packaging after a product has been falsified, which can also help distinguish between registered and falsified medications. The presence of a genuine company sticker can also help distinguish genuine from falsified medications but not parallel medications, which are genuine products that have entered the country through unofficial channels. Occasionally, physician feedback to the registered medication's company can also help identify S/F medications. Currently, it is primarily pharmaceutical companies/scientific bureaus that undertake to increase awareness among HCPs (physicians and pharmacists) working in the private sector, whereas the IqPhvc promotes awareness among pharmacists working in the public sector.

3.1.3 Effectiveness of Alerts from the Iraqi Pharmacovigilance Center (IqPhvc) in Decreasing the Distribution and Use of S/F Medications

Almost all interviewees were satisfied with the role of the IqPhvc in providing alerts about and promoting awareness of S/F medicines among hospital pharmacists. However, they requested more collaboration between the IqPhvc and other departments/entities since S/F medication is a multifactorial problem (Table 5). Examples of interviewee comments about the role of the IqPhvc and the effectiveness of their alerts are included in Table 3.

Table 3 Evaluating the effectiveness of alerts from the Iraqi Pharmacovigilance Center in minimizing the distribution and use of substandard and falsified products in the private sector: views of registered companies

Theme	Subtheme	Quotes from representatives of registered companies
Effectiveness of IqPhvc alerts to decrease the problem of S/F products in the private sector	Satisfied with role of IqPhvs in alerting about S/F medicines IqPhvs increases the level of awareness of hospital pharmacists about S/F medicines	P1: We appreciate their [IqPhvc] efforts, and they try to communicate with other entities to inform pharmacies about these [S/F] medications P2: They [IqPhvc] do their best efforts in announcing the letters to SIP and inspection department P4: Despite limited resources of MOH IqPhvc and [the difficult] work environment inside [the] MOH, IqPhvc is currently doing a great job. Their social media are followed by many community pharmacists and they started to upgrade their [pharmacists] awareness about these [S/F] drugs P5: We noticed that they [IqPhvc] developed their work by making workshops in neighbouring countries and bind Iraq to the Uppsala [Monitoring Centre] and [the] International Society of Pharmacovigilance, in the world. They [IqPhvc] increase level of awareness in governmental centres when patients that recumbent in hospital buy this drug from outside the hospital and if drug is falsified, pharmacists in hospital do report to MOH IqPhvc to inform them
	More effort and collaboration is needed	P5: IqPhvc members do their best efforts but need more cooperation with other departments of MOH P7: They [IqPhvc] do their efforts but need more work to control this problem P6: They [IqPhvc] do their best efforts, but need to do more, not just report to the SIP and to Inspection Directorate. There are a lot of drugs that come by parallel ways. When Inspection Directorate searched in [community] pharmacies in Iraq, they found many parallel drugs
Usefulness of IqPhvc alerts to companies/scientific drug bureaus	IqPhvc alerts are helpful	P3: They always stand with an official importer against unknown counterfeit goods that enter our country from unknown sources, which may have unknown consequences during their use on our patients P4: Yes, sure it [IqPhvc] is very helpful and triggers many further actions that done by local distributers of the companies. They give information to discontinue some products then forwarded to our company
	IqPhvc needs to collaborate with other departments	P6: IqPhvc must cooperate with other entities to solve this problem P8.3: Yes, the IqPhvc alerts are helpful but it [IqPhvc] alone cannot fight this problem

IqPhvc Iraqi Pharmacovigilance Center, *MOH* Ministry of Health, *S/F* substandard/falsified

3.1.4 Negative Effects of S/F Medications

The negative consequences of S/F medications include the impact on the reputations of the original medicines, the profitability of the registered company, patient safety, and drug effectiveness. Some representative interviewee quotes are included in Table 4.

3.1.5 Recommendations from Representatives of Pharmaceutical Companies to Minimize the Distribution and Use of S/F Medications

Interviewee recommendations about how to minimize the distribution and use of S/F medications in the private sector include five main strategies: enhance public and HCP awareness of S/F medicines, conduct more frequent inspections of drug stores and community pharmacies and punish those who deal with S/F medications, enhance MOH regulations, adopt a tracking system, improve collaboration between the MOH and other ministries. Details and interviewee quotes are shown Table 5.

3.2 Quantitative Findings

3.2.1 Reports of S/F Medications to the IqPhvc

The IqPhvc received 183 reports about S/F medications from the representatives of 25 international companies (11 brands and 14 generics) over the last 5 years (2016–2020). Only 29 (15.8%) of the reports were about falsified medications, whereas the majority were about substandard (parallel) medicines. Collaborative investigations between the IqPhvc and the registered pharmaceutical company that reported the S/F medicine to the MOH identify whether the reported medicine is substandard or falsified. The highest number of reports (56) was in 2017, and the lowest (23) was in 2016; note that 2016 was the first year of receiving the reports. On the other hand, the number of reporting companies varied from five in 2016 to 11 in 2018. In 2017, only seven companies submitted 56 S/F medication reports to the IqPhvc. The most commonly reported S/F medications belonged to three anatomical therapeutic chemical classes: Alimentary tract and metabolism (29.0%), Cardiovascular system (21.0%), and Nervous system (10.4%) (Fig. 1).

Table 4 Negative effects of substandard and falsified medications on registered companies and patients' lives

Theme	Subtheme	The quotes of Pharmaceutical company representatives
The negative impacts of S/F medications	Negative impact on reputation of original medicines	P2 They [S/F] affect company reputation, especially life-saving drugs, also affect company profits P3: S/F medicines did not contain the import licence, also these drugs affect patient concern toward our company and affect reputation P4: These drugs did not have the import licence, also these [S/F] drugs increase patient concern toward our company and affect our reputation P7: During our visit to a doctor to see feedback about our product, he told us that our drug does not work and when we went to the pharmacy, we found that drug was not from our company and had another dose [strength]
	Impact on profitability of registered company	P8.5 Yes, we found that sales of S/F form of our drug approximately $2 million/year against the original one. They [S/F] affect the company reputation and profitability P7: Also, they [S/F] affect the sales and take the place of original drug in the market P6: Income of company will be affected when patient take the [S/F] drugs and do not act well like life-saving drugs, which must be given to patient
	Negative impact on drug effectiveness and patient safety	P6: Patient took a product and he told the company that their drug did not work well. When the company searched about the matter, it appeared this drug was not related to them and a patient was admitted to coronary care unit P1: Substandard drugs like insulin may be transported at bad conditions (high temperature), and that affects the safety of these drugs
	Impact of inappropriate storage conditions on substandard medicines	P2: We found important antidiabetes drug and another one for pregnancy are S/F P6: The company has cold chain drugs, and one time they found a counterfeit medicine from this cold chain product P1: The problem in the substandard drug is only storage condition because they are genuine like insulin or other peptides (cold chain)

S/F substandard and falsified

Table 5 Interviewees' recommendations to minimize the distribution and use of substandard and falsified medications in the Iraqi private sector

Theme	Subtheme	Quotes from pharmaceutical company representatives
Enhance awareness of S/F medicines among the HCPs and the public	Promote public awareness about S/F medicines	P1: [IqPhvc should] promote public awareness P4: Uneducated people need more efforts from MOH and Iraqi Pharmacists Syndicate P4: [The MOH needs to] promote the awareness of healthcare providers and then to people
	MOH, IPS and pharmaceutical companies need to promote the awareness of healthcare providers about S/F medicines	P4 MOH must do more to train pharmacists and physicians working in MOH about this topic because their direct contact with patients, and patients trust more and get feedback from their physicians so the physicians should be number one who report any [S/F] products P4: [SIP should] do workshop for training pharmacists about the differentiation between these drugs and original ones P4: [Pharmaceutical companies/scientific bureaus should] do more workshops to train HCPs about differentiation between S/F drugs and original ones. We can target many MOH audience
	Train healthcare providers to report S/F medications	P4: They [IqPhvc] should guide health workers to improve reporting ability workshop conferences, social media. They have to emphasis their role more and more because many physicians and pharmacists still have to guide more about these topics to be professional reporting, especially they can work on region where no licence of report P4: SIP needs to exert more efforts to train their audience pharmacists, because many pharmacists do not have enough education to follow these guidelines and unfortunately reporting guidance is not well identified by them [SIP]
More frequent inspections on drug stores and community pharmacies and punishment for people who deal with S/F medications	The MOH and Syndicate of Iraqi Pharmacists (SIP) need to inspect drug stores more frequently	P6: The SIP must increase the inspection visits to drug stores. They must punish people who bring these [S/F medications] P8.2: Increase SIP inspection to drug stores and take actions toward the people who deal with this matter P5: [MOH should] increase inspection to the drug store especially and punish the people who bring them P3: The process of inspections by the MOH should be more frequent to stop importing of parallel and counterfeit medicines
	Punish people who deal with S/F medicines	P8.4: MOH should destroy these S/F medications in drug stores, not just close these stores P2: The SIP must do inspection to drug stores and punish who deal with these drugs
	SIP needs to focus on S/F medicines in their inspections	P1: SIP must focus on the S/F medications on their inspection P3: I prefer they [SIP] do inspections on drug stores and pharmacies that deal with counterfeit products in order to stop their importing P5: Increase SIP inspection to pharmacies and punish the pharmacists who violates
Enhance MOH regulations	MOH needs to speed up registration process	P1: MOH needs to be much faster in registration and availability of drugs P6: The registration of drug is long process then [the registration department] needs to open work in evening period to accelerate the process of registration P8.4: MOH should reduce the routine process time and does actions toward these [S/F] drugs
	MOH needs to ask companies to have local safety representative	P5: Not all scientific bureaus have local safety representatives in Iraq that follow safety information about product and communicates with IqPhvc. Each company has different business modules than others. There is no restriction on companies that lack commitment
	MOH IqPhvc needs to accelerate the reporting and distributing the alerts of S/F medicines	P8.5: We want that reporting of S/F medications is done through the [IqPhvc] website [electronically] for faster process P3: Faster processes of announcing and issuing letters are needed P5: IqPhvc needs to increase the staff that work
Adopt tracking system	Scientific bureaus/companies should detect S/F medicines using track-and-trace system and notify IqPhvc	P1: We [scientific bureaus] can track each pack; this is called serialization. The S/F drugs come from Turkey and Iran. We cannot recognize who brings these medications or which pharmacies sell them. We can do barcode scanning in the community pharmacies depending on database from MOH
Better collaboration between the MOH and other ministries	MOH and SIP need to have more collaboration with other entities and ministries (e.g. interior ministry)	P8.4: MOH should work with other government circles to control the borders. Anyone can bring substandard drugs like dealers or pharmacists P7: MOH should talk to Ministry of Interior and border guards to contribute with them to solve this problem
	Secure borders	P3: Bad control on Iraqi borders is the key for parallel importing and need to stop entrance of smuggled products P2: Secure borders and do inspection on pharmacies and drug stores

HCP healthcare provider, *IqPhvc* Iraqi Pharmacovigilance Center, *MOH* Ministry of Health, *S/F* substandard/falsified

3.2.2 Pharmacist Characteristics

The authors received valid surveys from 590 pharmacists, 475 (80.9%) of whom were women (Table 7). The mean ± standard deviation age of participants was 32.6 ± 7.6 years (range 21–67). Almost all (96.4%) had experience in the private sector. The average experience of the participants was 8.5 ± 6.8 years. The 19 participants who did not have experience in the private sector were excluded from the statistical analyses. Approximately half of the participants (49.5%) worked at community pharmacies. The majority (40%) of the participants were employees, and 34% were private business owners (Table 6).

3.2.3 Pharmacist Knowledge of and Ability to Detect and Report S/F Medications

Although more than two-thirds (72%) of participants had not received any training in identifying S/F medications, 59.4% did easily identify S/F medications. In total, 61% of the pharmacists had followed-up the SIP alerts about S/F medications and 78% were aware of the IqPhvc, but only one-quarter (25.6%) of them were willing to report S/F medications to the IqPhvc (Table 7).

3.2.4 Entities and Means Helping Pharmacists Identify S/F Medications

Among the 28% of the pharmacists who had received training in identifying S/F medications, 60% had received the training from pharmaceutical companies (Table 8). The majority of participants (48.5%) indicated they usually became aware of the IqPhvc alerts through the SIP website and/or Facebook page. On the other hand, 19% of participating pharmacists were unaware of these alerts. Approximately three-quarters (73%) could identify genuine registered medications through three means: medication price sticker, cost, and package features (Table 8).

3.2.5 Pharmacist Perceptions of the Prevalence of, and Reasons and Suggested Solutions for, the Distribution and Use of S/F Medications

Approximately half (48%) of the participants indicated that they thought S/F medications represented ≥ 40% of the available medications in the private sector. Most of the participants (61%) thought that S/F medications were for brand medicines. According to the pharmacists, the most common reasons for the availability of S/F medications were the low price of S/F medications (75.2%), the unavailability of registered medicines in the market (52.1%), and—to a lesser extent—the lengthy drug registration process (41.7%) and attracting low-income

Table 6 Characteristics of survey participants (pharmacists)

Characteristic	Subcategory	Totals
Sex	Female	475 (80.9)
	Male	112 (19.2)
	Total	587 (100.0)
Current workplace in the private sector	Community pharmacy	292 (49.5)
	Currently not working in private sector	39 (6.6)
	Drug scientific bureau	102 (17.3)
	Drug store (wholesaler)	18 (3.1)
	International pharmaceutical company	112 (19.0)
	National pharmaceutical company	16 (2.7)
	Other	11 (1.9)
	Total	590 (100.0)
Do you have experience in the private sector? (such as community pharmacy, drug store, scientific bureau)	No	19 (3.2)
	Yes	566 (96.8)
	Total	585 (100.0)
Current position	Employee	234 (40)
	Manager/supervisor	156 (26)
	Owner	190 (34)
	Total	580 (100.0)

Data are presented as *N* (%)

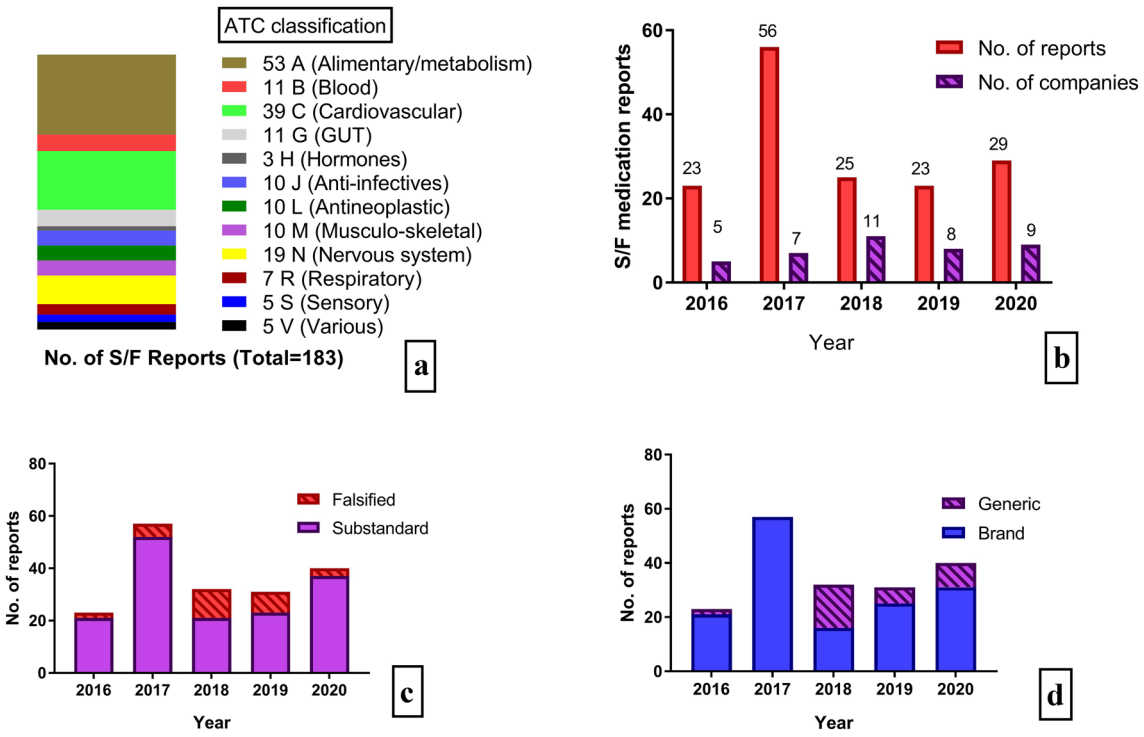

Fig. 1 The numbers of reported companies, the classes and the types of S/F medication reports to the IqPhvc over 5 years. **a** ATC classes of S/F medications. **b** Number of S/F medicine reports and reported companies. **c** Number of S/F medicines over the 5 years. **d** Number of generic and brand S/F medicines over the last 5 years. *ATC* anatomical therapeutic chemical, *GUT* genitourinary tract, *IqPhvc* Iraqi Pharmacovigilance Center, *S/F* substandard/falsified

patients (37%). Almost two-thirds (66.9%) of the pharmacists recommended a combination of four strategies to minimize the distribution and use of S/F medications: enhance border security, increase MOH inspections of the sources of S/F medications, and promote pharmacist and public awareness about S/F medications (Table 9).

3.2.6 Pharmacist Ability to Identify Recently Posted S/F Medication Alerts

When the participating pharmacists were asked to identify any of ten S/F medications reported by the IqPhvc in 2019–2020, only 16.7% could identify all ten medications. Additionally, more than half (59.6%) identified five or fewer of the ten S/F medications, and only 40.4% identified more than five. Plavix tablets (72.1%) and Depakin drops (64.7%) were the most commonly identified S/F medications, and Agiolax powder (40.1%) and Nebilet tablets (37.2%) were the least common.

3.2.7 Pharmacist Perceptions of the Impact of S/F Medications

The pharmacists disagreed with the misconception that "parallel medications can solve the problem of a shortage in registered medications," with an average score of 2.8 ± 1.4 out of five. In contrast, the majority agreed (68.6%) with the statement "parallel medications are negatively affected by improper storage/shipping conditions." On the other hand, three-quarters (75%) of the participants believed that S/F medications could harm patients. Finally, the participants were divided about "parallel and falsified medications impose comparable risk to patient safety," with 41.5% agreeing and 35% disagreeing with the statement (Table 10).

3.2.8 Pharmacist Perceptions of the Role of Health Officials in Decreasing the Distribution and Use of S/F Medications

Most participants agreed that both IqPhvc alerts (67.5%) and SIP price stickers (88.9%) help pharmacists recognize S/F medications. However, about half of the respondents (49.9%) believed that the IqPhvc alerts were not helpful in terms of decreasing the presence of S/F medications in the private sector (Table 11). The majority of participants (62%) believed that the current role of the MOH in drug registration was inadequate to prevent the presence of S/F medications. Additionally, 63.8% believed that the current MOH inspection of drug stores is inadequate to minimize the presence of S/F medications. On the other hand, 81 and 87.6% of the participants believed that IqPhvc should

Table 7 Pharmacist knowledge about and ability to detect and report substandard/falsified medications

Question	Yes		No		*P* value
	n (%)	Median	*n* (%)	Median	
Can you easily identify S/F medications?	350 (59.4)	7	240 (40.6)	7	0.855
Do you regularly follow-up the warning alerts of S/F medications on the Facebook page of SIP?	362 (61)	7	277 (39)	6	0.259
Do you know how to report S/F medications to the MOH IqPhvc?	148 (33.5)	9	391 (66.5)	6	0.000*
Are you willing to report S/F medicines to the MOH IqPhvc?	438 (74.4)	7	150 (25.6)	6	0.485
Are you aware of the IqPhvc and its duties?	458 (78)	7	123 (22)	5	0.000*
Have you received any kind of training to identify S/F medications?	162 (28)	7	423 (72)	6	0.031*

Data are presented as *N* (%) unless otherwise indicated

IqPhvc Iraqi Pharmacovigilance Center, *MOH* ministry of health, *S/F* substandard and falsified, *SIP* Syndicate of Iraqi pharmacists

*Statistically significant at < 0.05

promote awareness among the public and pharmacists about S/F medications, respectively (Table 11).

3.2.9 Current Community Pharmacy Roles Regarding S/F Medications

Participation in this section was restricted to the pharmacists who worked in community pharmacies. The participating community pharmacists indicated that their pharmacies performed five of the roles regarding S/F medications but neglected one essential practise: reporting suspicious medications to the IqPhvc (mean for answers 2.8 ± 1.4). The positive results included that the majority of community pharmacists educated co-workers and warned patients about S/F medications, with average results of about 4.0 ± 1.2, indicating agreement. On the other hand, only 54% indicated their community pharmacies were following-up with the SIP alerts about S/F medicines (Table 12). Small percentages of the participants stated that their community pharmacies were not buying medications from reliable sources (17.2%) or were examining every purchased medicine (14%) (Table 12).

Table 8 The entities and means helping pharmacists to identify substandard/falsified medications

Question	Subcategories	*N* (%)
From which entity did you receive training?	Pharmaceutical company	98 (60)
	Iraqi Pharmacovigilance center	14 (8.9)
	Iraqi Pharmacist Syndicate	7 (4.5)
	Personal effort	32 (19.8)
	Others	10 (6.7)
	Total	161 (100.0)
You usually become aware of the Iraqi Pharmacovigilance Center alerts about S/F medicines through:	I am unaware of these alerts	113 (19)
	Iraqi Pharmacists Syndicate website/Facebook page	283 (48.5)
	Pharmaceutical company representatives	69 (11.2)
	Scientific drug bureaus	78 (13.9)
	Other means, please specify	39 (6.7)
	Total	582 (100.0)
You identify the registered genuine medications through:	Price sticker	77 (13.8)
	Cost	16 (2.8)
	Package features	44 (7.7)
	All the above	419 (73)
	Other	13 (2.2)
	Total	569 (100.0)

Table 9 Pharmacists' perceptions of availability of and reasons and suggested solutions for the substandard/falsified medication problem

Question	Subcategory	*N* (%)
What is the percentage of S/F medications available in the private sector?	0–10	17 (2.9)
	10–20	55 (9.3)
	20–30	118 (20.4)
	30–40	114 (19.4)
	40–50	132 (22.5)
	> 50	150 (25.5)
	Total	586 (100.0)
Which medications are more likely to have S/F counterpart products?	Both brand and generic medicines	207 (35)
	Brand medicines	362 (61.6)
	Generic medicines	18 (3.4)
	Total	587 (100.0)
The most important reason behind the availability of S/F medications in the private sector	The lower price of S/F medication	436 (75.2)
	Unavailability of registered medicines in the market	301 (52.1)
	Lengthy MOH drug registration process	239 (41.7)
	Pharmacies can attract more low-income patients who are looking for cheaper medicines	217 (37.5)
	Higher profitability of drug store (wholesaler)	186 (32.2)
	Inadequate public awareness about the risks of S/F medications	184 (31.9)
	Pharmacist lack of awareness of the differences	71 (12.3)
Your suggestion to minimize S/F medications include	Enhance border security control over smuggled products to minimize entering S/F medications	113 (19.1)
	Increase MOH inspections on the sources of S/F medications	48 (8.1)
	Promote pharmacist awareness about S/F medications	14 (2.4)
	Promote public awareness about S/F medications	11 (1.9)
	All the above	396 (66.9)
Are you aware of the following Pharmacovigilance Center alerts about S/F medications during 2019/2020? (yes)	Plavix 75 mg tablet	396 (72.1)
	Depakene drop	356 (64.7)
	Betaserc 8 mg tablet	339 (61.8)
	Norgesic tablet	277 (50.4)
	Diamicron tablet	275 (50.2)
	Novonorm 2 mg tablet	270 (49.2)
	Coversyl 5 mg tablet	238 (43.4)
	Vastarel MR tablet	238 (43.4)
	Agiolax granules	220 (40.1)
	Nebilet 5 mg tablet	203 (37.2)

4 Discussion

This study investigated the problem of S/F medications at three levels: health officials (IqPhvc), pharmaceutical company representatives, and community pharmacists. Additionally, we used a unique comprehensive method (exploratory mixed method) to answer the study questions about the effectiveness of the national pharmacovigilance alerts, the reasons behind the prevalence of S/F medicines, and what else official entities can do to minimize the distribution and use of S/F medications in the private sector.

4.1 Ability of Pharmacists to Detect and Report S/F Medicines

Although more than two-thirds of participants had not received training in the identification of S/F medications, 59.4% could easily identify S/F medications. In contrast, an Iranian study evaluating pharmacists' knowledge in detecting falsified drugs found only 13.6% had adequate knowledge of S/F medications [13]. The interviewees in our study confirmed that pharmaceutical companies were the main sources of training in the detection of S/F medications for HCPs in the private sector, whereas the IqPhvc provides

Table 10 Pharmacist perceptions about the impact of substandard/falsified medications

Questions	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Agree	Strongly agree	Mean
Parallel medications can solve the problem of a shortage in registered medications	189 (32.5)	56 (9.6)	107 (18.4)	172 (29.6)	58 (10.0)	2.8 ± 1.4
Substandard (parallel) medications are negatively affected by improper storage/shipping conditions during the smuggling process	68 (11.6)	44 (7.5)	71 (12.2)	117 (20.0)	284 (48.6)	3.9 ± 1.4
Substandard/falsified medications can harm patient health	35 (6.0)	32 (5.5)	79 (13.5)	146 (25.0)	293 (50.1)	4.1 ± 1.2
Substandard (parallel) and falsified medications impose comparable risk to patient safety	73 (15)	97 (20)	114 (23.5)	129 (26.5)	73 (15)	3.4 ± 1.4

$N = 581–585$. Data are presented as N (%) or mean ± standard deviation unless otherwise indicated

training to pharmacists working in the public sector. The Iraqi MOH is a member of the WHO Global Surveillance and Monitoring System and regularly receives WHO global alerts about S/F medicines and distributes them to public healthcare settings [5].

Approximately three-quarters of the participating pharmacists could recognize genuine registered medications through three means: medication price sticker, cost, and package features. Likewise, a recent Lebanese survey of pharmacists indicated that all participating pharmacists could identify the S/F medicines [14]. The interviews in our study also showed the benefit of the price stickers in the identification of registered medicines. The SIP medicine price stickers are unique and include the price and the SIP name and logo. They help pharmacists differentiate between registered imported medicines and S/F products. The absence of an electronic management system in community pharmacies makes it more difficult for pharmacists to detect S/F medications. One interviewee mentioned that drug stores could send S/F medicines to pharmacies alongside registered medicines. For example, if a retail pharmacy orders ten packs of medicine X, a drug store may send five registered and five substandard packs without informing the pharmacy. However, the pharmacy can return any unwanted medicines (except cold chain ones) within 2 weeks. On the other hand, in developed countries, the main source of S/F medications is online purchasing. A previous study examined the efficacy of an adaptive learning algorithm called recursive trust labelling, which can help in the detection of fake medical websites selling S/F medications [15].

4.2 Pharmacist Perceptions of the Reasons and Suggested Solutions for the Problem of S/F Medications

According to three-quarters of the surveyed pharmacists and the majority of interviewees, the most common reason behind the availability of S/F medications was their low

Table 11 The perceptions of pharmacists about the role of MOH and IqPhvc in minimizing substandard/falsified medications

Question	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Mean
The current MOH regulations of the drug registration are adequate to prevent S/F medicines	243 (44.4)	97 (17.6)	83 (15.0)	74 (13.4)	53 (9.6)	2.3 ± 1.4
The current MOH inspections to drug stores are adequate to prevent S/F medicines	246 (44.6)	106 (19.2)	96 (17.4)	70 (12.7)	33 (6.0)	2.2 ± 1.3
The IqPhvc should promote public awareness about S/F medications	34 (6.2)	18 (3.3)	53 (9.6)	103 (18.7)	343 (62.3)	4.3 ± 1.2
The IqPhvc should promote pharmacists' awareness about S/F medications	17 (3.1)	8 (1.5)	43 (7.8)	112 (20.3)	371 (67.3)	4.5 ± 0.9

$N = 551$. Data are presented as N (%) or mean ± standard deviation unless otherwise indicated

IqPhvc Iraqi Pharmacovigilance Center, *MOH* Ministry of Health, *S/F* substandard/falsified

Table 12 The current community pharmacy roles concerning substandard/falsified medications

Community pharmacy roles	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Mean
Our community pharmacy purchases medications from known and reliable sources	14 (5.8)	30 (11.4)	49 (18.5)	65 (24.9)	103 (39.4)	3.8 ± 1.2
In our community pharmacy, we examine every purchased medicine	9 (3.4)	24 (10.6)	46 (17.7)	77 (29.7)	100 (38.6)	3.9 ± 1.1
Our community pharmacy follows-up with the alerts of Iraqi Pharmacists Syndicate about S/F medicines	25 (9.8)	33 (12.6)	60 (22.6)	71 (27.2)	72 (27.5)	3.5 ± 1.3
In our community pharmacy, we educate co-workers about S/F medicines	17 (6.5)	19 (7.5)	36 (13.7)	73 (29.9)	116 (44.4)	4.0 ± 1.2
In our community pharmacy, we report suspicious medicines to the IqPhvc	62 (23.3)	37 (14.8)	85 (32.7)	34 (13)	42 (16.1)	2.8 ± 1.4
In our community pharmacy, we warn patients about the risks of S/F medicines	16 (6.4)	12 (4.5)	38 (14.5)	73 (27.9)	122 (46.7)	4.1 ± 1.2

$N = 261$. Data are presented as N (%) or mean ± standard deviation unless otherwise indicated

IqPhvc Iraqi Pharmacovigilance Center, *S/F* substandard/falsified

price. Low prices of substandard (parallel) medicines are probably due to lower prices in neighbouring countries and the multiple layers of the drug supply chain in the private sector. The survey also showed that some community pharmacies may find themselves under pressure from low-income customers to sell cheaper substandard (parallel) medicines. Similarly, a study of falsified antimalarial drugs in Cambodia found that "fake medicines were frequently preferred by patients and village health providers because of the lower price" [16]. However, the problem of poor-quality medicines may go beyond affordability and can be linked to the poor management of complex pharmaceutical supply chains and distribution networks [17].

Additionally, participants of the two study phases agreed that illegal filtration of medicines across borders can be due to non-restrictive border governance. Similarly, a recent Iraqi study about the national pharmaceutical industry showed deficiencies in border control strategies to prevent S/F medicines from entering [18]. The other reported causes of S/F medicines included a shortage of registered medicines in the market (52.1%) and—to a lesser extent—the lengthy drug registration process (41.7%). Since 2003, the private sector has been experiencing chaotic changes and unsustainable supply, which encourages smugglers to bring in cheaper S/F medicines [19].

4.3 Role of Health Officials in Minimizing the Distribution and Use of S/F Medications

Most participants (62%) believed that the current role of the MOH in drug registration is inadequate to prevent the distribution and use of S/F medications. Similarly, the qualitative findings indicated that current MOH regulations were one of the five main reasons (themes) behind the availability of S/F medications in the private sector.

Since 2003, KIMADIA (MOH) has been responsible for procuring and distributing medicines to public healthcare settings. Thus, there is a minimal chance of S/F medicines entering this secure path [5]. On the other hand, in the private healthcare sector, the Inspection Directorate and the SIP are responsible for inspecting retail pharmacies, drug stores, and scientific drug bureaus [5]. However, a large number of private scientific drug bureaus (> 540) import medicines, and hundreds of drug stores (> 400) distribute medications [10, 20]. The private sector is more vulnerable to the presence of S/F medicines for several reasons: multiple importers/distributers, uncontrolled borders, unstable medicine prices, and delays in the approval and registration of medicines.

In Africa, Nigeria's National Agency for Food and Drug Administration (NAFDAC) implemented a series of measures to prevent the distribution and use of S/F medications, which represented 68% of the total medications in the country in 2001, and reduced that percentage by 80% within 3 years (2001–2004) [21]. Similarly, a Lebanese mixed-methods study in 2018 recommended imposing strict controls on medicines, enhancing law enforcement, promoting quality control testing, developing an S/F medicine reporting system, and providing continuing education to pharmacists [22]. However, some of the reported reasons for S/F medications entering the private sector may be beyond MOH control, including border inspections. Illicit trade across borders with neighbouring countries can further complicate the problem.

4.4 Negative Impacts of S/F Medications

Findings from both the qualitative and the quantitative phases indicated that the negative impacts of S/F medications include endangering patient safety, undermining the effectiveness of the medicine, damaging the original medicine's reputation, and decreasing the profitability of the registered company. Falsified medicine formulations may contain insufficient active pharmaceutical ingredients, which can lead to a lack of clinical response and possibly death. For example, an interviewee stated that a patient was admitted to an intensive care unit after receiving a substandard anticoagulant post-heart catherization. A previous study reported incidences in which "vaccines" contained only water. For example, in a notorious case in Niger, over 50,000 people received a falsified meningitis vaccine during a meningitis epidemic in 1995, which resulted in the deaths of 2500 people and the permanent disability of many others [23]. Moreover, a recent Iraqi study showed that S/F medicines negatively affect the national pharmaceutical industry as national medicines cannot compete with their cheap prices [18].

4.5 Strategies to Minimize the Distribution and Use of S/F Medications and Increase their Detection

Our findings showed that the current strategies involve developing and distributing S/F alerts to drug stores and community pharmacies, enhancing ways of identifying S/F medications using price stickers, and promoting awareness among HCPs. However, all these strategies appear to be ineffective at preventing the epidemic of S/F medicines in the private sector. The private sector does not have a track-and-trace system to record the source of S/F medicines and relies heavily on reporting by pharmaceutical company representatives. A Lebanese study measuring pharmacist awareness of and views about S/F medicines reported that all participating pharmacists could define S/F medicines. The majority of participants identified the S/F medicines by their effect (67.7%), followed by cost (66.8%). Additionally, the participants reported that they believed that pharmacists who dealt with S/F medicines did it for the "easy money" (87.9%) and large profit (86.5%). The study highlighted the need for additional campaigns to raise awareness of S/F medicines, with an emphasis on enhancing patient medication safety.

Iraq may learn from the EU's success in combating S/F medicines. Since 2013, measures have consisted of four pillars. First, as of 9 February 2019, the EU requires two safety features: a unique identifier (a two-dimension barcode) and an anti-tampering device on the outer packaging. One or both of these features are available for medicines entering Iraq from Europe but they may not be available for all imported medicines. The second pillar involved securing the supply chain and good distribution practice at wholesaler and broker levels. To date, no such measures exist in Iraq. Third, imported active substances and excipients are only allowed to enter Europe if they are accompanied by a written confirmation from the regulatory authority of the exporting country; this regulation is also implemented in Iraq. Finally, for internet sales, the websites of legal online pharmacies and approved retailers in the EU must carry a specific logo [24]. In contrast, there is no internet sale of medicines in Iraq, except for supplements.

The study had some limitations. It included a convenience sample for the survey and may not represent all provinces in the country. The 590 surveyed pharmacists may not represent the entire population of 20,000 pharmacists working in Iraq at the time of the study. However, we did our best to reach out to all professional Facebook groups for pharmacists in Iraq. The interview participants represented ten large brand companies, and small (generic) companies were not represented. From our pharmacy practice experience and interviewee responses, it is clear that most S/F medications target mainly brand medicines more than generic medicines because they are more expensive and more often requested.

The study highlighted the need for a track-and-trace system to be implemented to detect S/F medicines in the supply chain. Health officials need to accelerate medicine registration and testing processes and collaborate with border security agencies to prevent S/F medications from entering the country. Furthermore, health officials need to increase the frequency with which community pharmacies and drug stores are inspected, focusing on S/F medications. Finally, more efforts are required to promote awareness among HCPs and the public about the risk of S/F medications and how to report them to health officials.

5 Conclusions

S/F medications have several negative clinical and economic impacts, including endangering patient safety, reducing drug effectiveness, ruining the reputation of original medicines, and reducing the profitability of registered companies. The vast majority of documented S/F medicine reports concerned substandard (parallel) medications. Survey participants (community pharmacists) and the interviewees (pharmaceutical company representatives) both agreed on several reasons for the prevalence of S/F medications in the private sector, including the lower prices and higher profitability of S/F medications, the unavailability of registered medications, the lengthy medicine registration process, and the inadequate awareness among HCPs and the public. Interviewees also added insecure borders as one of the main causes of the prevalence of S/F medications. The participants of the two phases also agreed that S/F medication alerts and price stickers are helpful for the identification of S/F medications. Although the majority of the included pharmacists could identify S/F medications, a low percentage were willing to report them to health officials.

The survey and interview questions from this study can be used in other developing countries to assess strategies implemented to prevent the distribution and use of S/F medications. Community pharmacists can increase their efforts to report S/F medicines, but they need training, awareness, and tools to do so. In brief, the problem of S/F medication in the private sector is multifaceted; decreasing it will require effective collaboration between entities, including health officials, border agencies, HCPs, and registered pharmaceutical companies.

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Declarations

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Conflicts of interest Ali Azeez Al-Jumaili, Manal Mohammed Younus, and Mena Ziad Saleh have no conflicts of interest that are directly relevant to the content of this article.

Ethics approval The study proposal was approved by the ethical committees at the University of Baghdad College of Pharmacy and Iraqi Ministry of Health.

Consent to participate Verbal consent was obtained from interviewees before conducting and recording the interviews.

Consent for publication Not Applicable.

Availability of data and material Available from the authors on reasonable request.

Code availability Not Applicable.

Author Contributions Ali Azeez Al-Jumaili designed and executed the study, analysed the data, and wrote and reviewed the manuscript. Manal Mohammed Younus provided the S/F reports, recruited the interviewees, and participated in study design and reviewing the manuscript. Mena Ziad Saleh participated in data collection, analysing the qualitative data, and writing the manuscript.

References

1. Kristina ML, Acri NL. Pharmaceutical Counterfeiting: Endangering Public Health, Society and the Economy, C. FRASER Institute, Editor. 2018, fraserinstitute.org: https://www.fraserinstitute.org/sites/default/files/pharmaceutical-counterfeiting-endangering-public-health-society-and-the-economy.pdf. Accessed 1 Oct 2020.
2. WHO, Substandard and falsified medical products. 2018, World Health Organization: https://www.who.int/en/news-room/fact-sheets/detail/substandard-and-falsified-medical-products. Accessed 1 Oct 2020.
3. Funestrand H, Liu R, Lundin S, et al., Substandard and falsified medical products are a global public health threat. A pilot survey of awareness among physicians in Sweden. J Public Health (Oxford, England). 2019;41(1):e95–e102.
4. Alaa AlAlwan M. Health Situation in Iraq: Challenges and Priorities for Action, M. Iraqi Ministry of Health, Editor. 2019, Ministry of Health: Baghdad.
5. Al-Jumaili AA. Iraq Pharmaceutical Country Profile 2020, M.o. Health, Editor. 2020, World Health Organization: https://moh.gov.iq/upload/upfile/ar/1375.pdf.
6. Binagwaho A, Bate R, Gasana M, et al. Combatting substandard and falsified medicines: a view from Rwanda. PLoS Med. 2013;10(7):e1001476.
7. Attaran A, Barry D, Basheer S, et al. How to achieve international action on falsified and substandard medicines. BMJ. 2012;345:
8. Fadlallah R, El-Jardali F, Annan F, et al. Strategies and systems-level interventions to combat or prevent drug counterfeiting: a systematic review of evidence beyond effectiveness. Pharm Med. 2016;30(5):263–76.
9. Preda, A. Pharmacovigilance in the new millennium: challenges, opportunities and new directions. J Pharmacovig. 2013;01.
10. Al-Jumaili AA, Hussain SA, Sorofman B. Pharmacy in Iraq: history, current status, and future directions. Am J Health Syst Pharm. 2013;70(4):368–72.
11. Creswell JW, Plano Clark VL. Designing and conducting mixed methods research. 2nd ed. CA: SAGE; 2011.
12. Hamilton WL, Doyle C, Halliwell-Ewen M, et al. Public health interventions to protect against falsified medicines: a systematic review of international, national and local policies. Health Policy Plan. 2016;31(10):1448–66.
13. Shahverdi S, Hajimiri M, Pourmalek F, et al. Iranian pharmacists' knowledge, attitude and practice regarding counterfeit drugs. IJPR. 2012;11(3):963–8.
14. Sholy L, Gard P, Williams S, et al. Pharmacist awareness and views towards counterfeit medicine in Lebanon. Int J Pharm Pract. 2018;26(3):273–80.
15. Abbasi A, Zahedi FM, Kaza S. Detecting fake medical web sites using recursive trust labeling. ACM Trans Inf Syst. 2012;30(4):22.
16. Rozendaal J. Fake antimalaria drugs in Cambodia. Lancet. 2001;357(9259):890.
17. Buowari O. Fake and counterfeit drug: a review. Afrimed J. 2012;3(2):1–4.
18. Ahmed KK, Al-Jumaili AA, Mutlak SH, et al. Determinants of national drug products acceptance across patients, pharmacists, and manufacturers: A mixed method study. J Gener Med. 2020. https://journals.sagepub.com/doi/abs/10.1177/1741134320926625. p. 1741134320926625.
19. Ahmed Al-Humadi CL. Challenges of Iraq pharmaceutical market post-2003. Pharm Drug Regula Affair J. 2019'2(2). https://medwinpublishers.com/PDRAJ/PDRAJ16000116.pdf.
20. Pharmacist, S.o.I., Iraqi Pharmacists Syndicate Official Website. 2020, IPS: http://www.iraqipharm.com/.
21. Abiodun Raufu I. Nigeria leads fight against "killer" counterfeit drugs, in Bulletin of the World Health Organization. 2006, World Health Organization: https://www.who.int/bulletin/volumes/84/9/06-020906/en/. pp. 685–764.
22. Sholy L, Saliba C. Public awareness, experiences and views about counterfeit medicines in Lebanon. J Pharm Health Serv Res. 2018;9(2):161–9.
23. Kelesidis T, Kelesidis I, Rafailidis PI, et al. Counterfeit or substandard antimicrobial drugs: a review of the scientific evidence. J Antimicrob Chemother. 2007;60(2):214–36.
24. European Medicines Agency. Falsified medicines: overview, in Human regulatory. 2019, EMA: https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/falsified-medicines-overview. Accessed 1 Oct 2020.w

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