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Original article

Drug Administration Errors Between Anesthetists: The Burden in Libya

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ABSTRACT

Safe medication preparation and administration is a key part of anaesthesia practice. While anaesthesia practice has become safer, some medication errors can be inevitable leading to devastating complications. There is limited data and research on anaesthesia medication errors in developing economies. This study aims to identify the occurrence of medication errors and examines the associated factors, incident reporting, and preventive measures taken by anaesthetist practitioners in Libya. This was a multicentre; cross-sectional survey study conducted at three tertiary teaching hospitals in Libya from January 1, 2023 to June 30, 2023. An online questionnaire was sent to potential participants. Data was analysed using Statistical Package for Social Science (SPSS). The findings are expressed as absolute numbers and percentages. 185 completed surveys were returned for analysis (response rate = 84.09%). Anaesthesia technician (90.8%) commonly does medication preparation. 37.8% of respondents experienced one medication error and did not cause any harm to patients. Heavy workload/long hours (18.4%) were identified as the most common contributor to medication error in the operating room. Nearly all respondents 151 (81.6%) strongly agreed that double-checking the medication before administration was the most crucial preventive measure against medication errors. No effective reporting systems were identified. The study results are valuable to implementing and disseminating potential medication error risk mitigation or preventive strategies in developing economies. Enhancing medication administration safety in clinical practice should be a priority for policymakers at local and national levels across all healthcare contexts.

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INTRODUCTION

Medication errors, be it prescribing, preparation and dispensing, administration or monitoring are key patient safety concerns and a quality measure of healthcare medication process management [1]. Adverse drug events have led to patient morbidity and mortality - globally, medication errors are among the top 10 causes of death [2] and in the USA are among the 3 leading causes of death [3]. Further to human loss, these events impose a considerable financial burden to the healthcare system, induce various medical complications and prolong hospital stay. Yearly costs of medication errors are estimated at 20 billion in the USA [4] and above £98 million in the UK [5].

Medication Error Reporting and Prevention (NCC MERP, 2020) described medication errors as '*any preventable event that may cause or lead inappropriate medication use or patient harm while medication is in the control of healthcare professional, patient or consumer*', demonstrating that medication errors occur as a result of human mistakes or system flaws .[2, 3]. Global, adverse events rates among hospitalised patients is estimated to be between 18.7% to 56% and over 50% of these resulted from avoidable medication errors [4]. Current evidence also highlights that medication prescribing and administration error rates range from 3% to 37% and 72% to78% respectively [5, 6].

There is evidence showing that medication administration errors in anaesthesia settings are common as in other healthcare settings, however of greater severity compared to other clinical settings [7-10]. Individual anaesthetists give more than 250,000 medications through their career [11]. Their role requires prescribing, preparation and administration of high potent intravenous medication on their own, and sometimes while stressed or fatigued [8]. Various practice and environmental factors have been observed influencing anaesthetists making one or more errors or near miss over the duration of their career [12, 13]. Operating rooms environments can be full of distractions and stressful leading to potentially higher rates of medication errors. Depending on local practice and medication administration guidelines, sometimes medications are prepared and administered by one individual without review by second person or electronic machine. They rely on their situational awareness and vigilance to decrease the risk of medication errors. Nevertheless, human errors are an unavoidable outcome of poor human reliability; therefore, steps must be taken to minimise such events. A robust management of anaesthesia medication should be in place to enable the safe and effective use of medications by anaesthetists.

Several risk mitigation strategies to reduce drug errors in anaesthesia are available;(i) Using safety checks during drug preparation and administration, (ii) prefilled syringes that help reduce the risk of the wrong drug being drawn up, and (iii)a new colour-coded compartmentalised Rainbow drugs tray that storage on safe medication administration during anaesthesia [8,14,15]. Additionally, some healthcare organisations restrict anaesthetic room medication cupboard contents to only those medications that are regularly used or must be administered on an urgent basis.

There is limited data and research on anaesthesia medication errors in Middle Eastern countries [16] . One systematic review of medication errors in nine African Hospitals reported only fifty-one studies concentrated on medication errors and adverse events [17]. However, In Libya, such incidents are left unreported or are presented verbally as a case report. To our knowledge, no study has been done in Libya assessing anaesthesia medication errors. Therefore, this study aimed to study the occurrence of medication errors and examines the associated factors, incident reporting, and preventive measures taken by the anaesthetist.

METHODS

Settings and study population

This was a multicentre; cross-sectional self-reporting survey study conducted at three a tertiary teaching hospital in Libya. The study was conducted from January 1, 2023 to June 30, 2023.

Ethics statement

This study has been ethically approved by the Libyan National Committee for Biosafety and Bioethics. It was also reviewed and approved by the Department of Anaesthesia and Critical Care, Tripoli University Hospital.

Participants

The inclusion criteria were anaesthetists who worked in the operating room and were involved in the medication preparation and administration process. The study excluded respondents with missing information.

Recruitment and sample size

The study used a snowball sampling approach in which participants recruited or referred other participants was used with 220 participants sample size target. Potential participants were invited to participate in this study via emails. All study information (participants' information sheet, and consent forms and content of the survey) were explained and sent electronically to them.

Data collection

Data was collected using a validated questionnaire designed and adopted from previous research [20-23]. Some of the questions were amended to be favourable with Libyan clinical practice. Due to quarantine, the researchers turned the version of the printed survey into an online form. It was divided into four sections, information related professional data and job characteristics, experience on drug errors and its related factors, the critical incident reported and its implication

and preventive measures with single or multiple-choice questions. Unipolar like scale was used to assess the questionnaire in terms of reliability and validity. The experts in epidemiology and biostatistics who were not involved in the study also assessed it.

Data analysis

The data collected in Microsoft® Excel and then analysed using Statistical Package for Social Science (SPSS) for Mac version 23 (IBM Corp, Armonk, NY). The findings were expressed as absolute numbers and percentages. In order to create charts, graph bad was used. Demographics and admission characteristics were reported for all participants.

RESULTS

The questionnaire was mailed to 220 Libyan anaesthetists. A total of 185 completed surveys were returned, response rate = 84.09%. The mean age of respondents was 39 (standard deviation, 10.8) years and 59.5% were female. Majority of respondents were practice anaesthetists 71 (38.4%), followed by anaesthesia technician 68 (36.8%), and postgraduate trainees 46 (24.9%). Fifty-nine (59, (31.9%)) of respondents had 5 to 9 years of experience, and 10 (5.7%) have had more than 20 years of experience. The findings also show that majority of participants 127 (68.6%) worked in one place which is governmental hospital, while the remaining 32 (17.3%) were worked in more than one place. The demographic characteristics of the study participants are depicted in table 1.

Table 1. Demographic characteristics of the study participants (N =185)

Characteristic	Participants, n (%)
Gender	
Male	75 (40.5%)
Female	110 (59.5%)
Degree	
Postgraduate trainee in anaesthesia	46 (24.9)
Practicing anaesthetist	71 (38.4)
Anaesthesia technician	68 (36.8)
Experience in years	
<5 years	50 (27.0)
5–9 years	59 (31.9)
10–14 years	35 (18.9)
15–19 years	31 (16.8)
20–25 years	10 (5.4)
Area of work	
Corporate hospital	4 (2.2)
Government medical college	7 (3.8)
Private medical college	5 (2.7)
Government hospital	127 (68.6)
Freelance practice	10 (5.4)
More than two places	32 (17.3)
Clinical area of practice	
No, only exclusively anaesthesia practice	70 (37.8)
Critical care	69 (37.3)
Chronic pain management	8 (4.3)
Teaching and academics	6 (3.2)
Administrative responsibilities	1 (0.5)
More than two area of practice	31 (16.8)

Medication preparation and administration

Medication preparation (drawing into syringe, loading syringe onto pumps and other forms of administration to patient) is reported commonly done by anaesthesia technician 168 (90.8%). Most respondents 126 (68.1%) always read the medication name on the syringe before administering it to the patient, 49 (26.5%) read the name of the medication most of the time, and only 9 (4.9 %) infrequently or never read the medication name. The practice of color-coded labels for medication syringes was not used by most of the respondents 137 (68.84%). **Table 2** presents the experience of anaesthetic medication errors.

Table 2. Experience of anaesthetic medication errors (N =125)

Item	Participants, n (%)
Number of Experienced of drug administration error	**N =125**
Postgraduate trainee in anaesthesia	30 (24)
Practicing anaesthetist	44 (35.2)
Anaesthesia technician	51 (40.8)
Approximate frequency of errors	
Few times a month	5 (2.7)
Once a month	1 (0.5)
Once every 3 months	9 (4.9)
Once a year	40 (21.6)
Only once till date	70 (37.8)
Time of experiencing drug errors	
Daytime working hours	18 (9.7)
Night duties	38 (20.5)
Not related time of work	69 (37.3)
Experience of associated drug error adverse event (cardiac arrest, permanent neurological damage, etc)	
Yes	21 (11.4)
No	80 (43.2)
Not willing to detect information	24 (13.0)

Of which, 70 (37.8%) had committed only one medication errors during their career of these errors 80 (43.2%) did not cause any harm to patients. For most of the respondents 69 (37.3%) reported that the errors were not related to specific times. On labelling process of syringes, more than half of respondents 101 (54.6%) preferred to label the syringe then withdraw the medication, while 84 (45.4%) reported preference to withdraw the drug then label the syringe.
Heavy work load/long hours of work 34 (18.4%), followed by fatigue and lack of sleep 17 (9.2%) were reported as common factors causing medication errors in the operation room. On the other hand, 77 (41.6%) of respondents reported more than one factors (Figure 1).

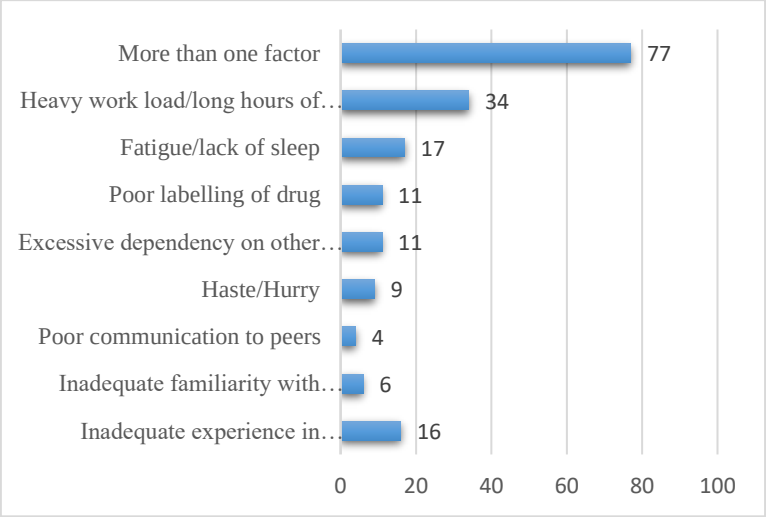

Figure 1. Factors that play major roles in causing errors in drug administration (n=185)

Regarding reporting medication errors, the majority of respondents 149, (74.87%) did not have an incident reporting system at their hospital, while 85 (25.13%) respondents reported errors to a senior anaesthetist in the hospital and 4 (2.01%) of them anonymously entry any critical incidents into a computer. When respondents were asked about the frequency of auditing medication errors, 28 (14.07%) respondents' errors were audited once in a year, 18 (9.05%) respondents monthly, 3 (1.51%) respondents once in 3 months, 1 (0.50%) respondent once in 6 months and all of them 185 (100%) supported having a national reporting system for anaesthesia medication. Common barriers deterring reporting medication errors, fear of medicolegal issues 87 (47%), followed by concerned person not sure whom or where to report the incident 56 (30.3%) (Figure 2).

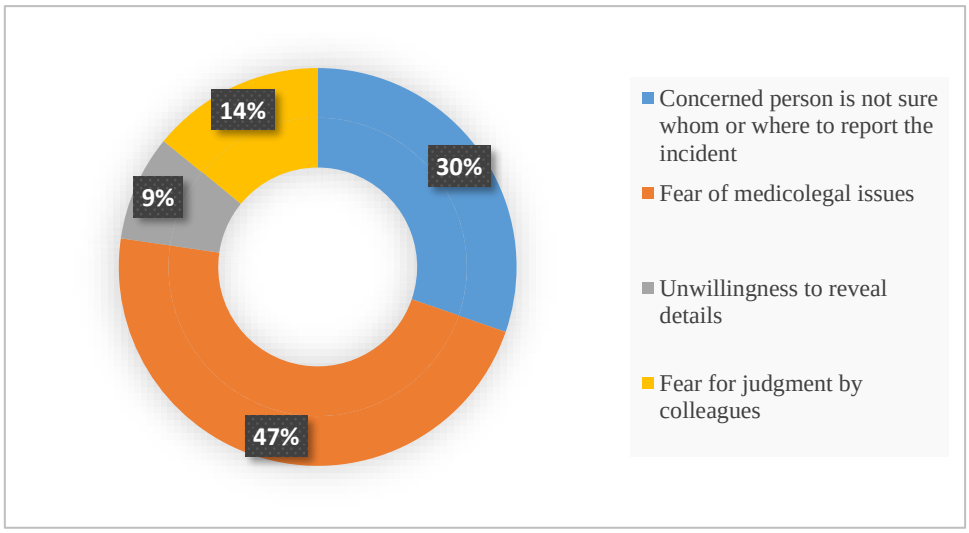

Figure 2. Barriers to reporting medication errors

Six questions were asked to the participants to give their opinions about the preventive measures of medication errors (Figure 3). Nearly all respondents 151 (81.6%) strongly agreed that double-checking the medication before administration was the most crucial preventive measures of medication errors and 113 (61.1%) of the participants agreed that loading and administering the medication by the concerned anaesthetists would decrease medication errors. Eight-nine (89 (48.1%) of respondents strongly agreed, that colour coding syringe would reduce errors and 45 (24.3%) of opinions agreed about the value of using prefilled syringes to decrease medication errors. Additionally, 65 (35.1%) of respondents agreed about reducing number of night shifts and 57 (30.8%) agreed reducing daytime working hours would reduce medication errors.

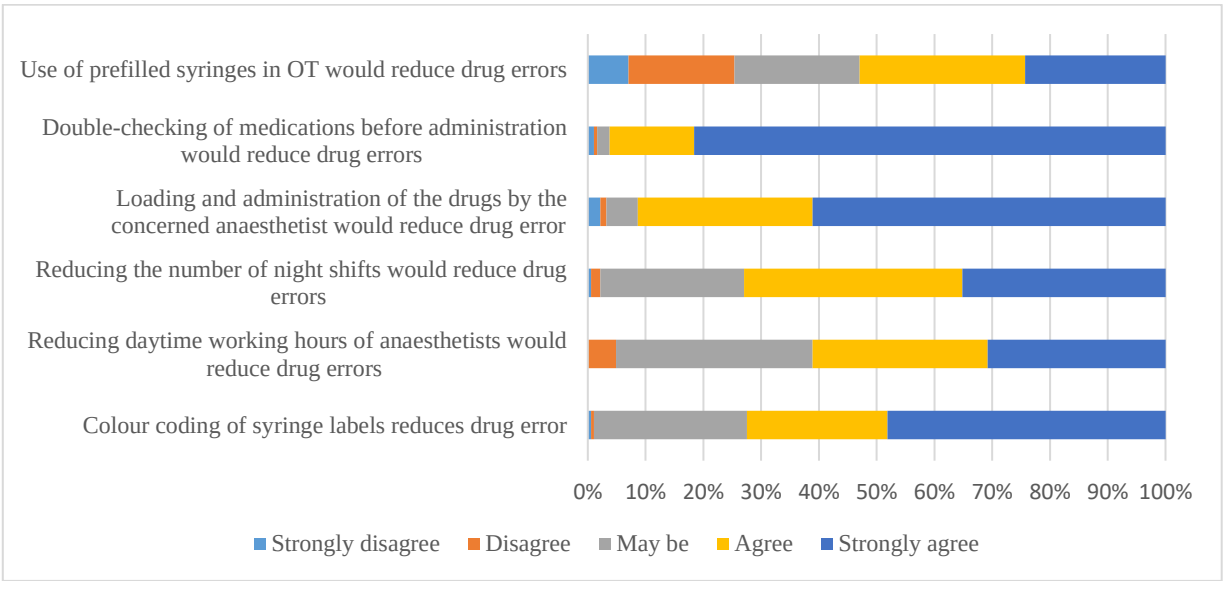

Figure 3. Preventive measures of medication errors (n=185)

DISCUSSION

This finding showed that during their time in practice most of the anesthetists experienced at least one or more medication errors. However, no patient's morbidity or mortality was readily reported. Although, labelling is a key element of medication safety, there was a lack of using pre-printed labels. Heavy workload and fatigue were reported as common factors of medication errors. Medication error incident reporting or regular audits of similar nature are not common practice, the main reasons were being fear of medicolegal issues, and concerned person not sure whom or where to report the incident. No standardized reporting system is available. In anesthesia practice, several studies have reported the rate of medication errors and results vary extensively [13, 18-22]. This is perhaps due to the differences in

study methodology and scope. In self-reporting studies the incident rates is relatively low ranging from 0.008 to 0.03 [22, 23]. On the other hand, trials data collected by an observer reported higher incidents rates of0.96% per anaesthetic case and 11.6% per perioperative medication administration [24]. In this study, 68% of the respondents have admitted to experience one medication error during their carrier. This result was similar to other studies that reported the rate of medication errors in anaesthesia environment [10, 20].

In this study, the majority of the adverse events were minor consequence and no patient morbidity/morbidity was reported from medication errors. This is consistent with other studies [12, 20, 25, 26]. However, some researchers reported that medication errors have led to major morbidity/mortality. Oster etal [27] stated that 15 medication errors caused major morbidity and 4 deaths were reported and Annie and team [12] in their study also demonstrated that 7.7% of their participants faced major morbidity/mortality. These findings build on existing evidence reporting that 12,606 cases in National Patient Safety Reporting System (NPSRS) had errors, of which 2842 had minimal harm, whereas 269 had moderate to high morbidity/mortality [28]. This can cause emotional stress to the anaesthetist or technician involved. The field of anaesthesia has provided guidance in the development of patient safety and examining human factors that contributing to these errors. Majority of the respondents in this research identified heavy workload followed by fatigue/ lack of sleep as a factor that played major role in medication errors. In general, anaesthetists work in multitasking environment and may influence on safety through active failure and conflict [29]. This result is similar to previous results [30].

Other factors reported as reasons for medication errors among participants were stress, burnout and fatigue. Fatigue reported as a second most common factor to cause medication errors in this study. Almghairbi et al [31], suggested the importance of assessment of mental workload in anaesthesia as its supporting safety of patients and anaesthetists.

This is supported by a study by Annie, et al [12] that observed that maximum errors were due to hast/hurry (23.4%) and excessive dependency on other personnel/junior (15.6%) while heavy workload accounted for 14% of medication errors during anaesthesia.

Inadequate experience (9%) was reported as the third common factor led to medication errors. This observation is consistent with published data on medication errors in the USA and Saudi Arabia [10, 32]. However, Llewellyn et al. [33] reported that higher rate of errors was observed with experienced anaesthesia practitioners. From study results and literature evidence, this suggests a potential association between experience and medication administration errors.

Almghairbi et al [8] found that there were no clear standards of practice for medication preparation and administration across participating sites, although this is acknowledged to be a basic component for safe anaesthesia practice. Several studies have described medication preparation as possible high-risk clinical activity [34, 35]. Annie et al [12], recommended that anyone preparing the medication for anaesthesia should have sufficient information about each medication, its action and possible complications.

Merry et al [15], stated that having a standard way of labelling syringes is an important factor of medication safety. Published literature shows varying views about the labelling process, some suggest labelling before withdraw medication and others withdraw medication first then label the syringe [36].

National patient safety agency recommends filling out the syringes first, then label the syringe one medication at time [37, 38]. In this study, syringes labelling is different among the respondents as was lack of standard labelling in anaesthetic medication.

Reason et al [39] outlined that for appropriate management of errors and preventing them in the future, every hospital should have a dedicated system to identify, quantify/analyse the reasons, and create protocols for alterations. Although the requirement of critical incidents reporting system is clearly outlined for each hospital or institute, the majority of the respondents in this study did not have and were not aware of any formal reporting system in their hospitals. The lack of such system found to be well-known barriers to reporting errors.

As a strategy to mitigate medication errors risks, majority of the respondents in this study considered that drawing medication from ampule first before labelling and double-checking prior to administration of drug. Similar results were observed in previous studies [12, 40]. There was also considerable support for the use of colour coded label syringe. Grissing et al [41] stated that the use of colour coded syringe or drug trays would increase the speed and accuracy of medication administration. However, robust precautions are still a pre-requisite to avoid possibility of more errors as participants might depends on colour and ignored to read the labels [42]. The use of prefilled syringes has various human factor benefits including decreasing dependency on human performance to ensure medication safety. It can be useful for emergency situation [36, 43], reduce the steps of medication preparation and saving money and reducing wastage by decreasing routine drawing up of emergency anaesthetic drug and discarded at the end of the day if not been used. In this study, participants were not certain about using prefilled syringe.

This study looked at medication errors in a low-income country healthcare context, which could limit generalizability

of study findings to other healthcare systems. However, our findings are similar to those identified in broader literature making them generalizable.

The finding of this study broadly highlights the following fundamental aspects; in the health care contexts where incidents reporting systems are not available – instituting such key measures must be a priority both at administrative and clinical practice levels. Medication errors are complex and standardized risk mitigation strategies should be suitable and cost effective for the associated healthcare system.

CONCLUSION

This study outlined medication error issues in a developing country healthcare context. In order to enhance medication safety in anaesthesia practice, there is a need for effective reporting system at both institutional and national level. Key to address findings in this study is the development of a clinical practice environment that supports and facilitated care excellence encouraging anaesthetists to report, review and learn from errors. Further research to implement a systems approach to reduce medication errors in developing countries healthcare context is warranted.

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Conflicts of Interest

There are no conflicts of interest.

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أخطاء إعطاء الأدوية بين أطباء التخدير: العبء في ليبيا- دراسة استقصائية مبنية على الاستبيان

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المستخلص

يعد تحضير الأدوية وإدارتها بشكل آمن جزءًا أساسيًا من ممارسة التخدير. وفي حين أصبحت ممارسة التخدير أكثر أمانًا، إلا أن بعض أخطاء الأدوية يمكن أن تكون حتمية مما يؤدي إلى مضاعفات مدمرة. هناك بيانات وأبحاث محدودة حول أخطاء أدوية التخدير في الاقتصادات النامية. تهدف هذه الدراسة إلى تحديد حدوث أخطاء الأدوية وفحص العوامل المرتبطة بها والإبلاغ عن الحوادث والتدابير الوقائية التي يتخذها ممارسو التخدير في ليبيا. كانت هذه دراسة مسحية متعددة المراكز ومقطعية أجريت في ثلاثة مستشفيات تعليمية في ليبيا من 1 يناير 2023 إلى 30 يونيو 2023. تم إرسال استبيان عبر الإنترنت إلى المشاركين المحتملين. تم تحليل البيانات باستخدام الحزمة الإحصائية للعلوم الاجتماعية . يتم التعبير عن النتائج كأرقام مطلقة ونسب مئوية. تم إرجاع 185 استبيانًا مكتملًا للتحليل (معدل الاستجابة = 84.09٪). يقوم فني التخدير (90.8٪) عادةً بإعداد الأدوية. واجه 37.8٪ من المستجيبين خطأً واحدًا في الدواء ولم يتسببوا في أي ضرر للمرضى. تم تحديد عبء العمل الثقيل/ساعات العمل الطويلة (18.4%) باعتباره المساهم الأكثر شيوعًا في حدوث خطأ في تناول الأدوية في غرفة العمليات. وافق جميع المستجيبين تقريبًا 151 (81.6%) بشدة على أن إعادة فحص الدواء قبل الإعطاء كان الإجراء الوقائي الأكثر أهمية ضد أخطاء الأدوية. لم يتم تحديد أنظمة إعداد تقارير فعالة. نتائج الدراسة قيمة لتنفيذ ونشر التخفيف المحتمل لمخاطر أخطاء الأدوية أو الاستراتيجيات الوقائية في الاقتصادات النامية. يجب أن يكون تعزيز سلامة إعطاء الأدوية في الممارسة السريرية أولوية لصناع السياسات على المستويين المحلي والوطني في جميع سياقات الرعاية الصحية.

الكلمات الدالة. أطباء التخدير، إدارة الأدوية، تحضير الأدوية، أخطاء الأدوية، الإبلاغ عن أخطاء الأدوية.