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RESEARCH ARTICLE

Medication dispensing errors in Palestinian community pharmacy practice: a formal consensus using the Delphi technique

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Abstract *Background* Medication dispensing errors (MDEs) are frequent in community pharmacy practice. A definition of MDEs and scenarios representing MDE situations in Palestinian community pharmacy practice were not previously approached using formal consensus techniques. *Objective* This study was conducted to achieve consensus on a definition of MDEs and a wide range of scenarios that should or should not be considered as MDEs in Palestinian community pharmacy practice by a panel of community pharmacists. Setting Community pharmacy practice in Palestine. *Method* This was a descriptive study using the Delphi technique. A panel of fifty community pharmacists was recruited from different geographical locations of the West Bank of Palestine. A three round Delphi technique was followed to achieve consensus on a proposed definition of MDEs and 83 different scenarios representing potential MDEs using a nine-point scale. Main outcome measure Agreement or disagreement of a panel of community pharmacists on a proposed definition of MDEs and a series of scenarios representing potential MDEs. *Results* In the first Delphi round, views of key contact community pharmacists on MDEs were explored and situations representing potential MDEs were collected. In the second Delphi round, consensus was achieved to accept the proposed definition and to include 49 (59 %) of the 83 proposed scenarios as MDEs. In the third Delphi round, consensus was achieved to include further 13 (15.7 %) scenarios as MDEs, exclude 9 (10.8 %) scenarios and the rest of 12 (14.5 %) scenarios were considered equivocal based on the opinions of the panelists. *Conclusion* Consensus on a definition of MDEs and scenarios representing MDE situations in Palestinian community pharmacy practice was achieved using a formal consensus technique. The use of consensual definitions and scenarios representing MDE situations in community pharmacy practice might minimize methodological variations and their significant effects on the number and rate of MDEs reported in different studies.

Keywords Consensus · Community pharmacy · Delphi technique · Definition of error · Medication dispensing errors · Medication errors

Impact of findings on practice

- Methodological variability in counting medication dispensing errors (MDEs) in community pharmacy practice might arise from situations for which there could be some debate as to whether or not they should be considered MDEs.
- The use of consensual definitions and scenarios representing MDEs might be the way to forward in minimizing methodological variations in analyzing for MDEs in community pharmacy practice.
- Consensual definitions and MDE situations permit direct comparisons between the numbers and rates of MDEs reported in different studies.

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Introduction

Since the publication of the report "To Err is Human: Building a Safer Health System" by the Institute of Medicine in 2000, medication errors have become a center of attention for research in medicine and pharmacy [1]. Consequently, improving the safety of healthcare services and reducing medication errors have become a global priority [2]. Medication errors may occur at any stage during medication prescription, transcription, dispensing, administration or monitoring [3–6]. While the vast majority of previous studies have focused on medication errors occurring at the prescription and administration stages, the medication dispensing stage can be a source of harmful errors as well [2, 5, 7–10].

In Palestine, community pharmacies are often individually owned in a privately funded healthcare system where patients have to pay out of their pockets to purchase medications. Community pharmacies are operated by registered pharmacists. In routine community pharmacy practice, patients or their caregivers bring prescriptions to community pharmacies where pharmacists fill prescriptions and dispense medications accordingly. Generic substitution is a common practice that is often performed by the community pharmacists without consulting the prescriber. Like in many community pharmacy practice settings around the world, once a prescription was filled and a medication was dispensed to the patient further verifications to ensure the dispensing of correct medication are not performed [2, 9, 11]. Therefore, it is highly probable that errors made in the dispensing stage would reach the patient [12].

In community pharmacy practice, the processes of medication dispensing and patient counselling are the responsibility of community pharmacists and; therefore, MDEs are often made by pharmacists [13–15]. Data on prescription and dispensing volumes in the Palestinian market are not available. However, Khdour et al. [16] prospectively estimated the number of defined daily doses of non-steroidal anti-inflammatory drugs (NSAIDs) consumed per 1000 inhabitants per day in Palestinian mid-territories over a period of 3 months in 2011. The study showed that consumption was 61.3 % of that in the European countries. Conflicting reports were published on the rate of MDEs in different community pharmacy settings. In the UK, MDEs rates were reported in the range of 0.04–0.08 % in community practice [2, 17]. Franklin and O'Grady [9] reported content errors in 1.7 % and labelling errors in 1.6 % of dispensed items. In the US, dispensing error rates of up to 24 % in community pharmacies were reported [18, 19]. Flynn et al. [19] observed trained pharmacists in fifty

pharmacies and reported an overall error rate of 1.7 % (range 0–12.8 %) in 4481 dispensed items. Regardless of the exact rate, even smaller figures are of extreme importance given that millions of medications are dispensed annually in community pharmacy practice and therefore presenting many opportunities for errors and harm to patients.

Variability in the number of dispensing errors or rates could be attributed to the variable number or rate of errors observed in each study. Variability could also be attributed to differences in what constituted a MDE situation in each study. Such methodological variations were shown to affect the error rates reported in observational studies investigating medication administration errors [20]. Obviously, using a definition of MDEs is a prerequisite step in assessing the incidence and prevalence of MDEs in different community pharmacy settings [9]. Accordingly, the number or rate of errors to be reported would differ depending on the number and type of situations considered as MDEs in each analysis. Clearly, studies that would include a larger number of MDE situations would report a larger number or rate of errors and vice versa [9, 21, 22]. In their review, James et al. [12] showed that different studies used different definitions of MDEs. These definitions were either developed by researchers or were taken from previous studies.

Lately, formal consensus techniques were used to develop definitions of different types of medication errors like prescribing errors [22, 23] and medication administration errors [5]. Franklin and O'Grady [9] used a formal consensus technique to achieve consensus on a definition of MDEs and 26 situations representing potential MDEs by a panel composed of 16 healthcare professionals with backgrounds in primary care, community pharmacy and/or the study of dispensing errors in the UK. However, it is not known if a similar definition can be accepted to be applied in Palestinian community pharmacy practice by community pharmacists. Similarly, there is a need to explore a wider range of potential MDE situations than those included in the study by Franklin and O'Grady. Currently, it is not known what would be considered as MDEs in Palestinian community pharmacy practice. For example, some legislations permit generic substitutions while under other laws they are not permitted. It is also believed that using consensual scenarios representing MDEs would impart validity to the error numbers and rates to be reported in future epidemiology studies investigating the incidence and prevalence of MDEs in Palestinian community pharmacy practice. A thorough understanding of MDE situations might help in changing community pharmacists' behavior leading to errors.

Aim of the study

This study was conducted to achieve consensus on a definition of MDEs occurring in community pharmacy practice by a panel of community pharmacists using a formal consensus technique. The formal consensus technique was also used to achieve consensus on a wide range of situations representing potential MDEs in Palestinian community pharmacy practice.

Ethics approval

The protocol and ethics of this study were approved by the Institutional Review Board (IRB) Committee of An-Najah National University. All panelists invited to participate in this study gave verbal consent before taking part in the study. To protect the participants from any consequences, data were made anonymous before analyses. Views and opinions of each panelist were considered equally and each panelist remained anonymous to the remainder of the panelists during the Delphi rounds.

Methods

Panel of community pharmacists

We used purposive sampling to recruit panelists for this study. Personal contacts in the field were used to identify potential panelists from different geographical regions of the West Bank of Palestine. Nomination was based on qualifications and experience in the field of community pharmacy. Upon nomination, researchers approached the nominees and invited them to participate in the present study. Researchers explained the objectives and the design of the study to the nominees. The nomination criteria were as follows: (1) *possession of a basic or advanced degree in pharmacy*, (2) *licensed to practice pharmacy in Palestine*, (3) *at least 5 years of practicing experience in a community pharmacy setting* and as prior knowledge of the topic being investigated is highly recommended for panelists and (4) *knowledge of MDEs*. A total of fifty community pharmacists were invited to take part in this study. No financial incentives were offered to panelists during this study.

The Delphi technique

In this study, the Delphi technique was chosen as the most appropriate method to develop and achieve consensus on a proposed definition of MDEs and scenarios representing MDE situations [24, 25]. The Delphi technique has emerged as a valuable method of developing and achieving consensus on subjects with limited or inconclusive definitions [25]. This technique provides anonymity to the panelists, possibility to include panelists from different geographical locations, less costly and more practical than other commonly used methods like focus groups and ensures immunity against individual domination of the discussion [26, 27].

The Delphi technique is an iterative process which is executed in rounds. In the first round, views and opinions are generated [25]. These views and opinions are presented to a panel in subsequent rounds in which panelists indicate the extent of their agreement or disagreement with these views and opinions. To decrease the number of rounds needed to achieve consensus, panelists are provided with statistical summaries and comments generated in the previous round and asked to reconsider their prior agreements or disagreements in view of the opinions of other panelists [24].

Literature search

Prior to the first Delphi round, a literature search was performed to identify different definitions of MDEs used in previous studies. The majority of these definitions are summarized in a review by James et al. [12]. One of these definitions was developed by Franklin and O'Grady [9] using the Delphi technique. Consensus on this definition was achieved by a two round Delphi techniques using a panel of 16 panelists from the UK. In this study, we decided to use similar definition and explore if this definition would be accepted to be applied in Palestinian community pharmacy practice by a larger panel of community pharmacists from Palestine. In this definition a MDE was described as "any unintended deviation from an interpretable written prescription or medication order in terms of content and labelling in addition to any unintended deviation from professional or regulatory references, or guidelines affecting dispensing procedures" [9].

A comprehensive literature search was performed also to identify types of MDEs used in previous analyses [1, 2, 6–9, 12, 13, 17–19, 28–31]. All types of MDEs included or excluded in previous studies were identified. Other types of medication errors like prescribing and administration errors were also searched [5, 22, 23].

First Delphi round

In the first Delphi round, ten key contact community pharmacists were interviewed. The key contacts were asked to describe all situations they believed represented potential MDEs. Potential MDE situations found in the literature together with situations mentioned by the ten key contacts were formulated into a series of various scenarios. Some scenarios were based on other types of medication errors

like prescribing and administration errors. These scenarios were included into a questionnaire. The questionnaire was piloted with five pharmacists who were not included in the Delphi process. Based on the feedback from the pilot, some scenarios were modified to help understanding.

Second Delphi round

In the second Delphi round, the questionnaire was handed to the fifty panelists. The questionnaire was of three parts. In the first part, panelists were asked to provide their demographic details. The second part included the proposed definition of MDEs. Panelists were asked to indicate the extent to which they agree or disagree with the proposed definition on a nine-point scale, where a score of 1 indicated total disagreement with the definition and a score of 9 indicated total agreement with the definition. Finally, the third part included a series of 83 scenarios representing potential MDE situations and panelists were asked to indicate the extent to which they agree or disagree with each scenario to be considered or not considered a MDE on a nine-point scale. A score of 1 indicated total disagreement and the scenario should not be considered a MDE, while a score of 9 indicated total agreement and the scenario should be considered a MDE. Panelists were encouraged to include written comments to justify or qualify their scores.

Data analysis and definition of consensus

Descriptive statistics were calculated using Excel sheet (Microsoft Excel 2007). The first quartile (Q1), median (Q2), third quartile (Q3), and IQR of the scores were calculated for the definition and each scenario separately. The data were analyzed as previously described [5, 9]. Briefly, (1) when the median of scores fell within the range of 7–9 and the IQR was between 0 and 2, the definition or scenario was accepted; (2) when the median of scores fell within the range of 1–3 and the IQR was between 0 and 2, the definition or scenario was rejected; and (3) when the median of scores fell within the range 4–6 or the IQR was larger than 2, the definition or scenario was considered equivocal.

Third Delphi round

Scenarios that were considered equivocal in the second Delphi round were included in a revised questionnaire. The questionnaire was sent to panelists for a third Delphi round. Panelists were provided with median and IQR of the scores of each scenario considered equivocal in the second Delphi round. Additional comments made by panelists to justify or qualify their scores were also included. Inclusion of these

details was previously shown to reduce the number of rounds needed to achieve consensus on issues in healthcare [24].

Scores of the third Delphi round were analyzed as previously described for the second Delphi round.

Results

Participant characteristics and response rate

The panel included community pharmacists practicing in different geographical locations, of both genders, belonged to different age groups, and graduated from different universities and pharmacy schools. The demographic details of the panelists are shown in Table 1. Of the fifty panelists, 25 (50 %) were females and 25 (50 %) were males. The median age was 32.5 (IQR 13.5) years.

In the second Delphi round, questionnaires were returned by all panelists and therefore, the response rate was 100 %. However, in the third Delphi round, questionnaires were returned by 46 (92 %) of the panelists.

Table 1 Demographic details of the 50 panelists who participated in the study

	Number of participants	%
Gender		
Male	25	50
Female	25	50
Age (years)		
20–39	34	68
40 and above	16	32
Qualifications		
B.Sc. in Pharmacy	29	58
M.Sc. in Pharmacy	12	24
Ph.D. in Pharmacy	9	18
Employer		
Privately owned pharmacy	41	82
University/pharmacy school	9	18
Year of graduation/obtaining licensure		
1970–1989	3	6
1990–2009	34	68
2010 and after	13	26
Experience (years)		
5–9	28	56
10–19	14	28
20–29	6	12
30 and above	2	4

B.Sc. Bachelor of Science, *M.Sc.* Master of Science, *Ph.D.* Doctor of Philosophy

Definition of MDEs

When asked to indicate the extent of their agreement or disagreement with the proposed definition, consensus was achieved to accept the proposed definition which stated that a MDE was "any unintended deviation from an interpretable written prescription or medication order in terms of content and labelling in addition to any unintended deviation from professional or regulatory references, or guidelines affecting dispensing procedures". The median score was 7 and the IQR was 1.

Scenarios representing MDE situations

In the second Delphi round, consensus was achieved to consider 49 (59 %) of the 83 scenarios as MDEs. In the third Delphi round, consensus was achieved to consider further 13 (15.7 %) scenarios as MDEs. Scenarios considered as MDEs are shown in Table 2.

A total of 9 (10.8 %) scenarios were not considered as MDEs and the rest of 12 (14.5 %) scenarios were considered equivocal based on the opinions and comments of the panelists (Tables 3, 4). Considering the comments of the panelists following the third Delphi round, it was decided not to conduct further rounds as it would be unlikely to achieve consensus on the remaining scenarios. Equivocal scenarios might or might not be considered as MDEs depending on the individual situation.

At the end of the third Delphi round, the 83 scenarios were either considered as MDE situations, non-error situations or remained equivocal, i.e. to be considered as errors or not depending on the individual situation. In general, consensus was achieved to include scenarios representing MDE situations related to: (1) *when the community pharmacist dispensed another item instead of the prescribed item*, (2) *when the community pharmacist dispensed a different dose, dosage form or count of the dispensed item*, (3) *when the community pharmacist failed to deliver or delivered incorrect essential information pertaining to the dispensed item*, (4) *when the community pharmacist failed to correctly pack or label the dispensed item*, (5) *when the community pharmacist failed to document essential dispensing notes required by regulatory authorities*, (6) *when the community pharmacist failed to dispense appropriate tools for the administration of the dispensed item*, (7) *when the community pharmacist failed to verify the validity of the prescription*, (8) *when the community pharmacist failed to follow appropriate procedures in the preparation of the dispensed item*, and (9) *when the community pharmacist failed to dispense a medication or a dose of medication* (Table 2).

Discussion

In this study we sought consensus on a definition and scenarios representing MDE situations in Palestinian community pharmacy practice by a panel of community pharmacists. A definition of MDEs previously developed for community pharmacy practice in the UK and a total of 83 potential MDE situations were used. Situations representing MDEs were previously investigated individually or collectively, but a comprehensive list of potential MDE scenarios was not approached in one study [1, 2, 7–9, 12, 13, 17–19, 28–31]. To our knowledge, this study is the most comprehensive investigation of MDE situations using formal consensus techniques.

In the present study, purposive sampling was used to construct the panel of community pharmacists. Purposive sampling was long considered biased in conservative views [26]. However, other randomized sampling techniques are not suitable for this study. The sampling technique used in this study permitted the inclusion of panelists who were expert in the topic being investigated. In this study we decided to recruit a panel of expert community pharmacists. This decision was because dispensing medications and patient counseling in community pharmacy practice are the sole responsibility of community pharmacists. Therefore, MDEs in community pharmacy practice are committed by community pharmacists or occur under their responsibility. Pharmacists who commit MDEs may be subjected to blame, disciplinary action, litigation and/or job loss [32, 33]. Furthermore, to change the behavior leading to errors among community pharmacists, obviously, it would be better to use definitions that community pharmacists would agree with instead of using definitions that pharmacists would not agree with [5, 22, 23, 34, 35].

Many definitions were previously developed and used to investigate MDEs in previous studies [7, 9, 12, 18]. The definition used in this study was adopted from the study of Franklin and O'Grady [9]. The decision was made to adopt this definition because it was developed using the Delphi technique. In the study of Franklin and O'Grady, consensus on the definition was achieved using a panel composed of 16 panelists from the UK. Although the exact composition of the panel used was not provided in detail, amendments were made to the definition based on feedback from the panel adds to its validity. Amendments were made to include content and labeling errors. Inclusion of content and labeling errors was of particular importance as in previous studies a considerable portion of MDEs were content and labeling errors [9, 12].

Interestingly, all invited panelists accepted to participate, a strength which adds to the validity of the study. Panels used in the Delphi technique vary considerably in

Table 2 Situations that should be included as MDEs

#	Scenario	Round 2 Median (IQR)	Round 3 Median (IQR)
	When the community pharmacist dispensed another item instead of the prescribed item		
1	A community pharmacist misread a prescription and dispensed a medication that was completely different from the medication prescribed. For example, a community pharmacist dispensed *ciprofloxacin* when *amoxicillin* was prescribed	9 (1)	NA
2	A community pharmacist misread a prescription and dispensed a medication that looked like the medication prescribed. For example, a community pharmacist dispensed *Motilium* [*domperidone*] when *Movalis* [*meloxicam*] was prescribed	9 (1.75)	NA
3	A community pharmacist misread a prescription and dispensed a medication that sounded like the medication prescribed. For example, a community pharmacist dispensed *Sintrom* [*acenocoumarol*] when *Centrum* [*multivitamins*] was prescribed	9 (1.75)	NA
4	A community pharmacist substituted an alternative formulation of a medication that contained sugar and dispensed it to a diabetic patient instead of a sugar free formulation of the medication when the sugar free formulation was available	9 (1)	NA
	When the community pharmacist dispensed a different dose, dosage form or count of the dispensed item		
5	A community pharmacist misread a prescription and dispensed a formulation containing larger amount of the medication than was prescribed. For example, a community pharmacist dispensed *amoxicillin* 500 mg dose units when 250 mg dose units were prescribed	8 (2)	NA
6	A community pharmacist misread a prescription and dispensed a formulation containing smaller amount of the medication than was prescribed. For example, a community pharmacist dispensed *amoxicillin* 250 mg dose units when 500 mg dose units were prescribed	7 (2)	NA
7	A community pharmacist misread a prescription and dispensed a smaller number of dose units than prescribed or needed by the patient. For example, a community pharmacist misread a prescription and dispensed 10 tablets when 12 tablets were prescribed	6 (3)	7 (1)
8	A community pharmacist misread a prescription and dispensed a larger number of dose units than prescribed or needed by the patient. For example, a community pharmacist miscounted a prescription and dispensed 12 tablets when 10 tablets were prescribed	7 (2.75)	7 (2)
9	A community pharmacist failed to dispense the prescribed dosage form of a medication. For example, a community pharmacist dispensed a modified release formulation when the conventional formulation was prescribed	7 (2)	NA
10	A community pharmacist misread the prescription and dispensed a medication in a dose calculated in "milligrams" when "micrograms" were intended or in "x mL" when "0.x mL" were intended	9 (0.75)	NA
	When the community pharmacist failed to deliver or delivered incorrect essential information pertaining to the dispensed item		
11	A community pharmacist failed to inform the patient the number of dose units that should be taken at each administration time. For example, a community pharmacist dispensed a medication and did not inform the patient that he/she should take one or two tablets at each administration time	8 (2)	NA
12	A community pharmacist failed to inform the patient the frequency at which the drug should be taken. For example, a community pharmacist dispensed a medication that was prescribed to be taken 3 times a day but the community pharmacist did not inform the patient how many time he should take the drug	8 (2)	NA
13	A community pharmacist instructed a patient to take a medication at a lower frequency than prescribed. For example, a medication was ordered to be administered 3 times a day but was instructed to be administered 2 times a day	7 (3.75)	8 (0.5)
14	A community pharmacist instructed a patient to take a medication at a higher frequency than prescribed. For example, a medication was ordered to be administered 2 times a day but was instructed to be administered 4 times a day	8 (2)	NA
15	A community pharmacist dispensed a medication that should be administered at specific times in relation to meals but did not instruct the patient when to take it. For example, a community pharmacist did not instruct the patient when to take the medication before or after the meal when meals affected drug absorption	8 (2)	NA
16	A community pharmacist dispensed a medication without instructing the patient how to use it. For example, a community pharmacist dispensed *salbutamol* inhaler without instructing the patient the proper way to use it	8 (2)	NA
17	A community pharmacist dispensed a medication that was prescribed to be taken when needed but the community pharmacist did not inform the patient when it should be used	7 (3)	7 (1)
18	A community pharmacist dispensed a medication without providing the patient with sufficient warnings and precautions of a potential clinically significant adverse effect associated with the use of the medication. For example a community pharmacist dispensed *warfarin* for a patient without informing the patient that this drug might increase the risk of bleeding	7.5 (2)	NA

Table 2 continued

#	Scenario	Round 2 Median (IQR)	Round 3 Median (IQR)
19	A community pharmacist dispensed a medication without providing the patient with sufficient warnings and precautions of a potential congenital anomaly or birth defect associated with the use of the medication. For example a community pharmacist dispensed *isotretinoin* for a patient without informing her that this drug might increase risk of congenital anomaly	9 (1)	NA
20	A community pharmacist dispensed a medication without assessing a potential drug-drug interaction. For example a community pharmacist dispensed *ciprofloxacin* to a patient treated with *warfarin*	8 (2)	NA
21	A community pharmacist dispensed a medication without assessing a potential drug-food interaction. For example, a community pharmacist dispensed *doxycycline* to a patient without informing him to avoid milk products	8 (2)	NA
22	A community pharmacist failed to check (inquire) if the patient had allergy to any of the constituents of a medication and dispensed a medication to which the patient had allergy	8 (2)	NA
23	A community pharmacist failed to instruct the patient with the correctly devised route of administration and instructed the patient to administer the medication using a different route of administration than prescribed. For example, a community pharmacist instructed a patient to administer the medication via the nasogastric route instead of ocular route or vice versa	8.5 (2)	NA
24	A community pharmacist failed to instruct the patient with the correctly site of administration and instructed the patient to administer the medication using a different site of administration than prescribed. For example, a community pharmacist instructed a patient to instill a medication in the right eye instead of the left eye or vice versa	9 (1.75)	NA
25	A community pharmacist instructed a patient to crush a modified (delayed or extended) release formulation to be administered in parts or as a whole either because the correct strength of the tablet was not available on the pharmacy or to facilitate swallowing the dose without clear permission from the prescriber	8 (2)	NA
26	A community pharmacist instructed the patient to take a medication every morning while the medication was prescribed to be administered every evening or vice versa	7.5 (2)	NA
27	A community pharmacist dispensed a medication to be taken when required and which can be administered more than once, but failed to instruct the patient with the maximum number of times that the drug can be taken	7 (1)	NA
28	A community pharmacist misspelled a name of medication on the label but the misspelling was major and the medication can be recognized with some confusion	8 (2)	NA
29	A community pharmacist failed to adhere to general policies and did not instruct the patient to disinfect vials before using them	7 (2)	NA
30	A community pharmacist failed to adhere to general policies and did not instruct the patient to shake a suspension bottle before withdrawing a dose of the medication	7 (1)	NA
When the community pharmacist failed to correctly pack or label the dispensed item			
31	A community pharmacist dispensed a medication whose expiry date exceeded. For example, a community pharmacist dispensed a medication whose expiry date was 09/14 during the month of December of the year 2014	9 (2)	NA
32	A community pharmacist dispensed a medication whose primary packaging was damaged. For example, a community pharmacist dispensed a medication whose aluminum seal was torn away	9 (2)	NA
33	A community pharmacist dispensed a medication whose color has changed. For example, a community pharmacist dispensed a cough syrup whose color has changed	9 (1)	NA
34	A community pharmacist dispensed a medication whose clarity has changed. For example, a community pharmacist dispensed a vial with turbidity which should not be normally present	9 (1)	NA
35	A community pharmacist dispensed a medication with a wrong name on the label. For example, a community pharmacist dispensed *ciprofloxacin* in a container bearing the label for *amoxicillin*	9 (1)	NA
36	A community pharmacist dispensed a medication with a wrong dose strength on the label. For example, a community pharmacist dispensed *ciprofloxacin* 250 mg in a container bearing the label for *ciprofloxacin* 500 mg	9 (2)	NA
37	A community pharmacist dispensed a medication with a wrong dosage form on the label. For example, a community pharmacist dispensed *ciprofloxacin* suppositories in a container bearing the label for capsules	9 (2)	NA
38	A community pharmacist dispensed a medication with a wrong number of dose units on the label. For example, a community pharmacist dispensed 5 capsules of *ciprofloxacin* in a container bearing the label for 10 capsules	7 (4)	7 (0.8)

Table 2 continued

#	Scenario	Round 2 Median (IQR)	Round 3 Median (IQR)
39	A community pharmacist dispensed a medication with a wrong name of the patient on the label. For example, a community pharmacist dispensed a medication prescribed for Mr. X with a label bearing the name of Mr. Y	8 (2.75)	7 (1)
40	A community pharmacist dispensed a medication with wrong directions on the label. For example, a community pharmacist dispensed a medication to be taken after meal in a container labelled for before meal	8 (2)	NA
41	A community pharmacist dispensed a medication that requires a prescription without a prescription	8 (2)	NA
42	A community pharmacist dispensed a medication with a wrong date of expiry (advanced) on the label. For example, a community pharmacist dispensed a medication that expires on 11/15 in a container bearing the expiry date of 10/15	7 (2)	NA
43	A community pharmacist dispensed a medication and failed to provide the patient with the appropriate storage conditions for the medication dispensed. For example, a community pharmacist dispensed *Augmentin* [*amoxicillin/clavulanate*] suspension without informing the patient to store it in the refrigerator	8 (1.75)	NA
44	A community pharmacist dispensed a medication in an inappropriate bag. For example, a community pharmacist dispensed *insulin* in unrefrigerated (without ice) bag	8 (2)	NA
45	A community pharmacist dispensed a deteriorated medication. For example, a community pharmacist dispensed a medication required to be stored in refrigerator which was originally stored outside a refrigerator	9 (1)	NA
When the community pharmacist failed to document essential dispensing notes required by regulatory authorities			
46	A community pharmacist dispensed a controlled medication that should be entered in the controlled drug registry (record) and failed to enter the dispensing information	7.5 (3)	7 (0.5)
47	A community pharmacist dispensed a controlled medication that should be entered in the controlled drug registry (record) and failed to enter the correct drug name	8 (3)	8 (0.5)
48	A community pharmacist dispensed a controlled medication that should be entered in the controlled drug registry (record) and failed to enter the correct drug strength	8 (2.75)	8 (2)
49	A community pharmacist dispensed a controlled medication that should be entered in the controlled drug registry (record) and failed to enter the correct drug amount	7 (3)	7 (0.8)
When the community pharmacist failed to dispense appropriate tools for the administration of the dispensed item			
50	A community pharmacist dispensed a medication that requires a measuring tool without dispensing the tool with the medication. For example, a community pharmacist dispensed a vial containing powdered drug and water for injection without a syringe	7 (4)	7 (0.5)
51	A community pharmacist dispensed an inappropriate measuring tool. For example, a community pharmacist dispensed a vial containing an injectable medication with accompanying unscaled syringe	7 (3.5)	8 (0.5)
When the community pharmacist failed to verify the validity of the prescription			
52	A community pharmacist failed to check the validity of a prescription and dispensed a medication on the basis of an expired prescription	7 (3.75)	7 (0.8)
53	A community pharmacist failed to check the validity of a prescription and dispensed a medication on the basis of a cancelled prescription	8 (2)	NA
When the community pharmacist failed to follow appropriate procedures in the preparation of the dispensed medication			
54	A community pharmacist failed to follow the appropriate procedures or technique in the preparation of a medication and used inappropriate diluents	8 (2)	NA
55	A community pharmacist failed to follow the appropriate procedures or technique in the preparation of a medication and used inappropriate solvents	8.5 (2)	NA
56	A community pharmacist failed to follow the appropriate procedures or technique in the preparation of a medication and mixed physically incompatible ingredients	9 (1)	NA
57	A community pharmacist failed to follow the appropriate procedures or technique in the preparation of a medication and mixed chemically incompatible ingredients	9 (1)	NA
58	A community pharmacist failed to follow the appropriate procedures or technique in the preparation of a medication and did not keep light labile constituents protected from light	9 (2)	NA
59	A community pharmacist failed to follow the appropriate procedures or technique in the preparation of a medication and did not keep heat labile constituents protected from heat	8 (2)	NA
60	A community pharmacist failed to follow the appropriate aseptic techniques and did not prepared an intravenous dose of medication aseptically	9 (1)	NA
61	A community pharmacist failed to adhere to general policies and did not wash his/her hands before preparing the medication to be dispensed to the patient	8 (2)	NA

Table 2 continued

#	Scenario	Round 2 Median (IQR)	Round 3 Median (IQR)
	When the community pharmacist failed to dispense a medication or a dose of medication		
62	A community pharmacist failed to dispense a prescribed medication. For example, a community pharmacist filled a prescription and omitted one or more prescribed medications	8 (2)	NA

NA not available, *IQR* interquartile range; generic names in square brackets when brand names are cited

Table 3 Situations that should be excluded as MDEs

#	Scenario	Round 2 Median (IQR)	Round 3 Median (IQR)
1	A medication was prescribed by its generic name as opposed to the brand name or branded-generic name. The medication was available in more than one formulation with different prices, a community pharmacist did not take into considerations the economic status of the patient and dispensed the costly brand of the medication	5 (3.75)	1 (1.25)
2	A community pharmacist dispensed a generic version of a medication as opposed to its brand-name prescribed in the prescription without consulting the prescriber; e.g. a community pharmacist dispensed *Ogmin* [*amoxicillin/clavulanate*] when *Augmentin* [*amoxicillin/clavulanate*] was prescribed	2 (2.75)	1 (2)
3	A medication was prescribed in a specified dose unit, because the medication was not available in the specified dose units (strength), a community pharmacist dispensed one dose unit of a formulation containing double strength and instructed the patient to crush the dose unit in two halves and take one half. For example, a medication was prescribed in 250 mg dose units and the community pharmacist dispensed dose units of 500 mg each and instructed the patient to crush the dose units and take one half when the dose was due	5 (4)	2 (0.8)
4	A medication was prescribed in a specified dose unit, because the medication was not available in the specified dose units (strength), a community pharmacist dispensed two units of a formulation each containing half strength and instructed the patient to take the two units at a time. For example, a medication was prescribed in 500 mg dose units and the community pharmacist dispensed two dose units of 250 mg each and instructed the patient to take the two dose units at a time	3 (3)	2 (0.8)
5	A community pharmacist dispensed a pack of medication missing the patient information leaflet	4.5 (3)	2.5 (1)
6	A community pharmacist misspelled a name of medication on the label but the misspelling was minor and the medication can be recognized without confusion	3 (3.75)	2 (2)
7	A community pharmacist failed to dispense a dose of medication because the patient refused to take it	2.5 (2.75)	2 (0.5)
8	A community pharmacist failed to dispense a dose of medication based on professional judgment	3 (3)	2 (1)
9	A community pharmacist failed to document the medication dispensing in the medication dispensing record by him/herself	3 (4.75)	2 (1.5)

NA not available, *IQR* interquartile range; generic names in square brackets when brand names are cited

size and may range from 10 to over 1000 [26, 36]. However, the literature is inconclusive on the ideal size. Previous studies on other types of medication errors used fifty panelists or less [22–24]. The panel size used in this study was either comparable or larger than panel sizes used to achieve consensus on issues in healthcare [5, 9, 22–24]. Obviously, the panel used in this study was larger than the one used in the study of Franklin and O'Grady [9]. In this study, consensus on the definition was achieved with a larger panel of fifty community pharmacists with diverse geographical locations, gender, age group, experience and academic backgrounds (Table 1). Our results add to the

validity and suitability of the definition to be used in Palestinian community pharmacy practice. In the absence of gold standards, using formal consensus methods may reduce bias, promote transparency and validation of judgmental methods in the development of certain criteria [37]. Hence, definitions approached using formal consensus techniques might be more appealing than other definitions.

Using a three round Delphi technique, consensus was achieved to consider 62 scenarios as MDEs (Table 2). These results are consistent with some scenarios used in previous studies investigating MDEs [1, 7–9, 12, 18, 28]. However, consensus was achieved to consider 9 scenarios

Table 4 Situations that may be considered MDEs, depending on the individual clinical situation

#	Scenario	Round 2 Median (IQR)	Round 3 Median (IQR)
1	A community pharmacist dispensed a medication without providing the patient with sufficient warnings and precautions of a potential life-threatening adverse event associated with using the medication. For example the community pharmacist dispensed an antidepressant that potentially may increase risk of suicidal tendencies without informing the patient about this	7 (3.75)	7 (4)
2	A community pharmacist dispensed a medication without providing the patient with sufficient warnings and precautions of a potential inpatient hospitalization or prolongation of existing hospitalization associated with using the medication. For example the community pharmacist dispensed digoxin for an elderly patient and did not warn him/her that this drug potentially may increase risk of inpatient hospitalization or prolongation of existing hospitalization	6 (5.5)	6 (5)
3	A community pharmacist dispensed a medication without providing the patient with sufficient warnings and precautions of a potential clinically significant persistent or significant incapacity or substantial disruption of the ability to conduct normal life functions associated with the use of the medication. For example a community pharmacist dispensed a contraceptive for a patient without informing the patient that this drug might increase risk of significant loss of bone density with long-term use	6.5 (4)	6 (1)
4	A community pharmacist dispensed a medication without assessing the suitability of the prescribed medication to the patient concerned. For example a community pharmacist dispensed verapamil to heart failure patient without asking the patient if he/she had a history of heart failure	7 (3)	7 (3)
5	A community pharmacist dispensed a medication with a wrong name of prescriber on the label. For example, a community pharmacist dispensed a medication prescribed by Dr. X with a label bearing the name of Dr. Y as the prescriber	6 (3.75)	5 (2)
6	A community pharmacist dispensed a medication with a wrong name of the pharmacy on the label	5 (4)	3 (3)
7	A community pharmacist dispensed a medication with a wrong address of the pharmacy on the label	5 (3)	3 (3)
8	A community pharmacist dispensed a medication with a wrong name of the community pharmacist (dispenser) on the label	5 (4)	4 (3)
9	A community pharmacist dispensed a medication with a label bearing the wrong date on which the medication was dispensed	6 (4)	5.5 (1.5)
10	A community pharmacist dispensed a medication with a wrong date of expiry (late) on the label. For example, a community pharmacist dispensed a medication that expires on 10/15 in a container bearing the expiry date of 11/15	7 (3)	6 (1)
11	A community pharmacist dispensed a medication whose costs to be covered by a third party payer but filled the wrong paying center in the dispensing form	6 (4)	6 (3)
12	A community pharmacist dispensed a medication that was not prescribed for the patient by a physician just because the patient asked for it	6 (4)	6 (2)

NA not available, *IQR* interquartile range

as non-error situations (Table 3). These scenarios represented common practices in the community pharmacy settings. In general, panelists believed that some deviations made by community pharmacists in common practice are justified. Examples include generic substitutions, not dispensing a medication based on professional judgment or when the patient refuses to take the medication. In this study, generic substitutions were not considered as MDEs, even when the physician prescribed a brand-name medication or a branded generic version. Generic substitution continues to generate heated debates [38]. While evidence for similar safety and efficacy scientifically justifies substitution it is subjected to local legislations. Some legislations permit generic substitution without the prescriber's permission while other legislations require prescriber's authorization. In neighboring Jordan, for example, current

regulations do not permit the pharmacist to make any change or substitution to prescriptions, unless authorized by the physician [39]. However, the ministry of health encourages generic substitution and physicians in public sector are encouraged to prescribe generically [39]. In this study, panelists did not consider dispensing a pack of medication missing the patient information leaflet as a MDE. Similar consensus was previously achieved by a panel from the UK [9]. Panelists commented not to include misspelling a medication name as a MDE when the misspelling was minor and the medication can be recognized without confusion.

Some labeling errors were divisive among panelists and after the third Delphi round remained equivocal (Table 4). These scenarios would be considered as MDEs or not depending on the individual situation. We did not execute a

further Delphi round as based on the panelists' comments, it is unlikely that consensus would be achieved on these scenarios. Moreover, conducting further rounds would lead to panel fatigue which is a known limitation of the Delphi process [22].

Limitations

Results of this study can be interpreted considering the following limitations. First, our panel of experts included solely community pharmacists. Other healthcare professional were not included. It is important to note that other healthcare professionals like physicians and nurses might have different views and opinions. However, in this study we intentionally recruited community pharmacists because dispensing medications and patient counselling in community pharmacy practice are the responsibility of community pharmacists. Second, the developed scenarios represent situations that occur in community pharmacy practice. Despite that some scenarios might apply to hospital pharmacy settings, our results might not be generalized to hospital pharmacy settings. Lastly, our results might not be generalized to community pharmacy settings where legislations do not permit community pharmacists to perform some of the practices considered common practice in this study.

Conclusion

Consensus on a definition of MDEs and scenarios representing MDE situations in Palestinian community pharmacy practice was achieved using a formal consensus technique. In previous studies, researchers must have counted MDEs and calculated error rates based on different MDE scenarios. Some potential MDE situations were divisive among researchers. This should have affected the numbers or rates of the reported MDEs in their studies and therefore it is not possible to compare results from these different studies. The use of consensual definitions and scenarios representing MDE situations in community pharmacy practice might minimize methodological variations and their significant effects on the number and rate of MDEs reported in different studies. Furthermore, using consensual definitions and MDE situations can permit and promote direct comparison of different studies conducted in community pharmacy practice. A pilot study using the scenarios that were considered as MDEs by the community pharmacists might be needed to assess the applicability of the findings of this study.

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