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Original article

Categorizing and understanding medication errors in hospital pharmacy in relation to human factors

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ABSTRACT

Background: Medication errors (MEs) in hospital settings are attributed to various factors including the human factors. Human factors researches are aiming to implement the knowledge regarding human nature and their interaction with surrounding equipment and environment to design efficient and safe systems. Human Factors Frameworks (HFF) developed awareness regarding main system's components that influence healthcare system and patients' safety. An in-depth evaluation of human factors contributing to medication errors in the hospital pharmacy is crucial to prevent such errors.
Objective: This study, therefore, aims to identify and categorize the human factors of MEs in hospital pharmacy using the Human Factors Framework (HFF).
Method: A qualitative study conducted in King Saud Medical City, Riyadh, Kingdom of Saudi Arabia. Data collection was carried out in two stages; the first stage was the semi-structured interview with the pharmacist or technician involved in the medication error. Then, occupational burnout and personal fatigue scores of participants were assessed. Data analysis was done using thematic analysis.
Results: A total of 19 interviews were done with pharmacists and technicians. Themes were categorized using HFF into five categories; individual, organization and management, task, work, and team factors. Examples of these themes are poor staff competency, insufficient staff support, Lack of standardization, workload, and prescriber behaviour respectively. Scores of fatigue, work disengagement, and emotional exhaustion are correlating with medium fatigue, high work disengagement, and high emotional exhaustion, respectively.
Conclusions: The study provided a unique insight into the contributing factors to MEs in the hospital pharmacy. Emotional stress, lack of motivation, high workload, poor communication, and missed patient information on the information system, are examples of the human factors contributing to medication errors. Our study found that among those factors, organizational factors had a major contribution to medication safety and staff wellbeing.

1. Introduction

A Medication error (ME) is defined as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labelling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use" (NCC MERP, 2015). MEs are global concern in healthcare settings and pose a threat for the patients, with prevalence ranging from 1.5% to 56% in the Kingdom of Saudi Arabia (KSA) (Al-Jeraisy et al., 2011; Ali et al., 2017). Healthcare systems are very complex systems, consisting of various factors from different levels (organizational, management, team, tasks and patients) interacting with each other and contributing to human error and patient harm (Kannampallil et al., 2011).

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The current theoretical perspective on human errors is shifting towards the system approach that considers errors as consequences of the system failure rather than blaming people (Reason, 2000). Therefore, analyzing all levels of the healthcare system is crucial to understand the interaction between different system components including organization, tasks, and humans... etc. (Salmon et al., 2010). Human factors reseaches are aiming to implement the knowledge regarding human nature and their interaction with surrounding equipment and environment to design efficient and safe systems (Henriksen et al., 2008).

Human Factors Frameworks (HFF) are employed to analyze social and technical elements in the healthcare system and their interactions in a systematic manner, they developed awareness regarding main system's components that influence healthcare system and patients' safety (Henriksen et al., 2008; Holden et al., 2011; Holden et al., 2013). A review of 32 studies applying human factors as a framework to understand patient safety in the pharmacy practice, identified several contributing factors to MEs. The factors were varying from internal environment factors such as level of staff knowledge, the implemented technologies, and poor communication to external factors such as patient factors and lack of regulation and guidelines (Weir et al., 2019).

A number of human factors have been found to cause MEs such as fatigue (Patterson et al., 2012), stress (Peterson et al., 2008), interruption (Bannan et al., 2018), workload (Holden et al., 2011), lack of organizational supervision (Mitchell et al., 2015), the perceived superiority of physicians and males (Alharbi et al., 2019), lack of task standardization (Heather et al., 2005) and communication (Mitchell et al., 2015).

There are a number of studies in KSA that identified the incidence and causes of MEs (Al-Jeraisy et al., 2011; Ayani et al., 2016; Ali et al., 2017), but there is limited number of studies that analysed the causes qualitatively to look into the social and technical causes of these errors. This study, therefore, aims to identify and categorize the human factors of MEs in hospital pharmacy using the HHF.

2. Method

2.1. Study design

A qualitative study comprised a series of face-to-face interviews with the pharmacy staff (clinical pharmacists, pharmacists, or pharmacy technicians) that have been involved in the occurrence of medication error.

2.2. Ethical approval

This study was completed as part of the first author' (RA) master's project, she received education and training regarding conducting qualitative researches before and during this research process. This study was initiated after the approval from the Institutional Review Board of KSMC (Reference number: H1RE-24-Jul19-01) Participants' confidentiality was protected by coding the interviews. All participants were given enough time for reading and signing an informed consent document.

2.3. Study setting

The study took place in King Saud Medical City (KSMC), Riyadh, KSA. KSMC is the largest tertiary care Ministry of Health Hospital in the KSA, with 1,500 beds capacity. Sixty pharmacists and forty-nine pharmacy technicians are currently working at the Pharmaceutical Care Services in KSMC. In our study setting, MEs reporting is an anonymous process that is intended for use by healthcare providers who voluntarily report MEs to the medication safety unit.

2.4. Data collection

First, to collect ME reports, RA extracted ME reports done by pharmacy staff using the hospital's ME reporting system. Data was collected on a weekly basis from October 2019 to January 2020. The validity of ME reports was checked using patient records, medical references, and counselling notes of clinical pharmacists. Then, identification of the person involved in the ME was done using the hospital's information system. Participants were recruited using consecutive methods during the study period.

After that, semi-structured interviews were done with clinical pharmacists, pharmacist, or pharmacy technician involved in the ME individually to discuss the error and different personal and work aspects from the participants' perspective. We conducted an online interview for those participants who weren't able to attend interviews at the hospital; these participants electronically signed their informed consents.

2.5. Occupational burnout and fatigue measurements

At the end of each interview, participants were asked to answer a survey containing question related to occupational burnout and fatigue. We used the Oldenburg Burnout Inventory (OLBI) to assess occupational burnout. OLBI is a valid tool to measure emotional exhaustion and work disengagement of adults in any occupational setting, exhaustion score $\geq$ 2.25 were considered as having high exhaustion, while disengagement scores $\geq$ 2.1 were considered high (Peterson et al., 2008; Oldenburg burnout inventory, 2019). Fatigue was assessed using a Pilbara Ports Authority personal fatigue assessment tool (See the Appendix).

2.6. Data analysis

Quantitative data were descriptively analyzed using the Excel program. For qualitative data, interviews were audio-recorded and transcribed by a professional office, then translated from Arabic to English. A professional translator checked the accuracy of the translation. Thematic analysis was conducted using deductive HFF and inductive codes; codes were identified independently from the data by two researchers (RA, LJ) (Harding, 2013). The codes were then categorized using the HFF and a coding index was generated. The coding was checked for accuracy by a second researcher (LJ). Dedoose.com was used to manage the data. Finally, a comparative analysis was conducted to derive themes from the codes, themes were categorized using HFF. Burnout and fatigue scores were used to compare the scores with themes that emerged from interviews rather than establishing relationships between these factors and MEs. This study was conducted and reported in accordance with COnsolidated Criteria for Reporting Qualitative Studies (COREQ) (Tong et al., 2007).

3. Results

A total of 80 ME reports were identified during the follow-up period. We eliminated 11 duplicate reports, and the remaining 69 reports were screened to determine their relevance for inclusion. Of those, only 24 were found to be eligible. Subsequently, 5 reports were excluded owing to unavailability of the participants. Finally, a total of 19 participants were included in this study (Fig. 1). Demographics of the participants and Occupational burnout and fatigue scores are presented in Table 1 and Table 2, respectively.

Themes were categorized based on HFF into five categories; individual, organization and management, task, work, and team factors. Emerged themes are presented in Table 3.

Scores of fatigue, work disengagement, and emotional exhaustion are correlating with medium fatigue, high work disengagement, and high emotional exhaustion, respectively.

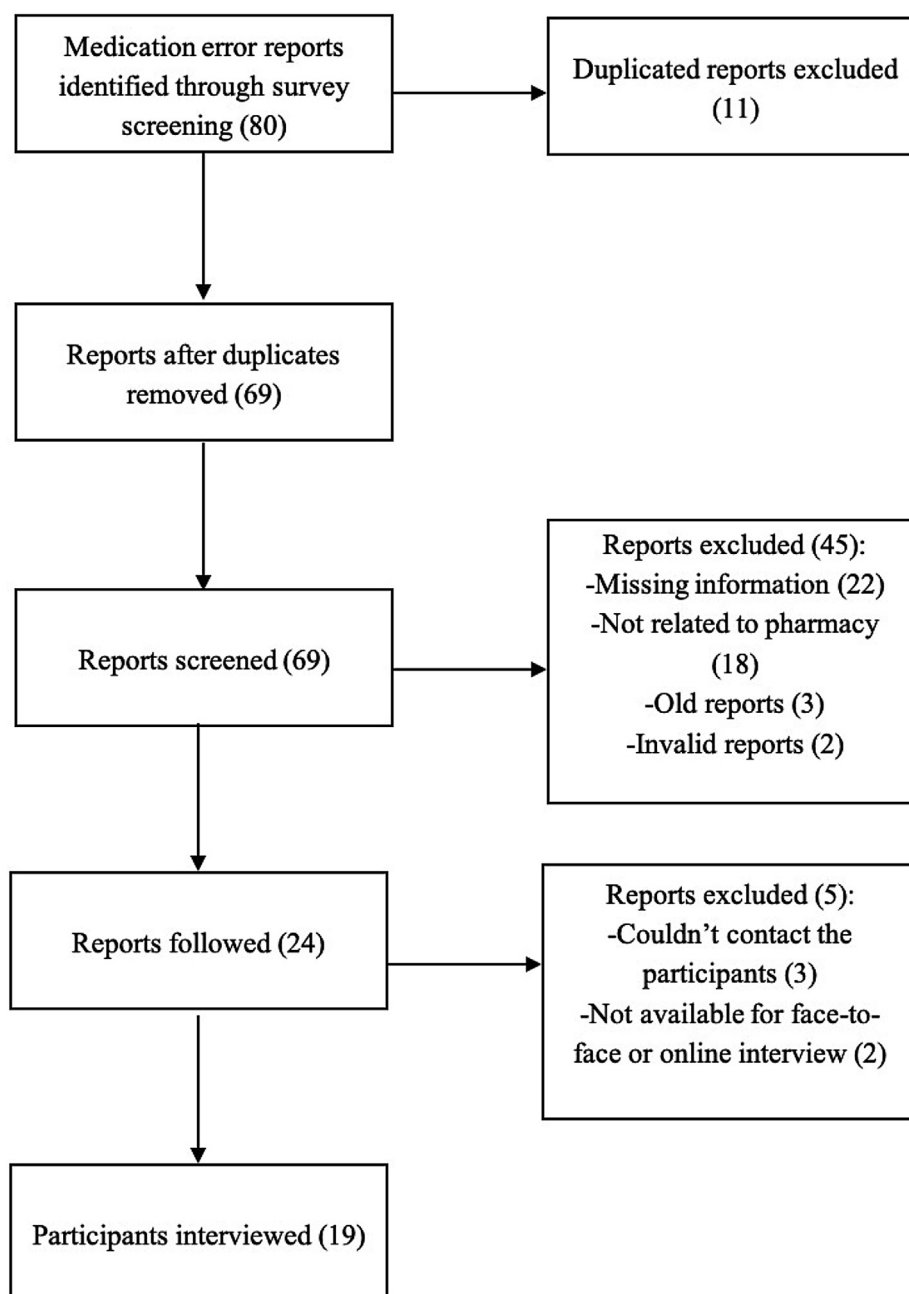### 3.1. Individual factors

3.1.1. Staff competency

Several participants mentioned that they detected many MEs during their duty, they stated that those errors were due to writing prescriptions by Junior prescribers. Participants reported that it was more common during evening, night, and weekend shifts because they aren't covered by consultants nor specialists.

Table 1
Participants demographics.

Parameters	Participants
Participants' No. (males)	19 (12)
Mean age ± SD	30.8 ± 5.7 years
Job (No.)	Clinical pharmacist (1)
	Senior pharmacist (2)
	Pharmacist (14)
	Technician (1)
	Resident (1)
Social status (No.)	Married (10)
	Engaged (2)
	Single (7)
Years of experience mean ± SD [a]	6.8 ± 5.5 years
Training months mean ± SD	3.15 ± 0.6 months

[a] Training months stand for on-job training.

Fig. 1. Process of participants inclusion.

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Table 2
Occupational burnout and fatigue measurements.

Parameters	Score
Disengagement score mean ± SD	2.27 ± 0.48
Exhaustion score mean ± SD	2.30 ± 0.47
Personal fatigue score mean ± SD	3.44 ± 2.22

Occupational burnout was measured using emotional exhaustion and work disengagement scores.

Table 3
Emerged themes based on HFF.

Category	Sub-theme
Individual factors	Staff competency
	Fatigue
	Emotional stress
	Poor policies compliance
Organization and management factors	Insufficient staff supporting system
	High job security
	Difficulties in work regulation
	Low salary
Task factors	Lack of task clarification
	Lack of standardization
	Lack of decision supporting information system
Work factors	Distraction related to noise
	Workload
	Physical layout
	Medication safety measures
Team factors	Poor communication
	Lack of teamwork and unity
	Prescriber behavior

Participant 3: *"Often in the evening shift, residents are writing the prescriptions, not the specialists, they have less information and knowledge. Even when we were discussing the doses, they would ask me (Is it a mistake? [physician] I don't know)"*

However, several errors occurred due to pharmacists' lack of knowledge also

Participant 2: *"It was late, and I didn't have the time to double-check the dose. It was new information for me that the maximum IV dose of ciprofloxacin is 400 mg per dose."*

All participants received 3 months of initial training and orientation. However, some participants saw sometimes it wasn't enough

Participant 7: *"Training in some areas wasn't enough... in the matter of medication safety, it was only a day or two, it should have been a week or a full rotation."*

As a solution, participants came with some suggestions

Participant 11: *"To prevent such errors, there should be an education for all parties, especially prescribers, because they are writing prescriptions, so if they write it correctly, there would be no time wastage of nurses and pharmacists."*

3.1.2. Fatigue

Several participants mentioned that fatigue would affect their functionality and could lead to MEs, they identified multiple factors causing fatigue including lack of sleep

Participant 6: *"When I don't have enough sleep, I cannot focus the day after, so a minimum of 6 h is required to keep me performing well."*

Participant 4: *"The days at which I am really tired and feeling very sleepy, I tend to drink coffee. My caffeine consumption is really high to keep me awake and focused. I drink coffee in the morning, then at the break, I take another one. Sometimes after 4o'clock, I get one more cup."*

While others talked about their health conditions and medications as a source of fatigue.

Participant 3: *"I've had iron and vitamin D deficiency for a long time. The last months were bad, I was tired... I don't know if this could be considered as a justification for the incident, but it's actually a realistic cause plus other influencing factor... I used Tetracycline at the time of the incident for acne. I took Roaccutane before, but it didn't affect me like Tetracycline. I was trying to concentrate, but in recent months I couldn't."*

A participant was working and studying at the same time; thus, he was feeling exhausted.

Participant 8: *"After finishing my work, I feel tired already, I arrive home almost at 4p.m., I have to go to the university in the evening. So, I go home and sit with my mother. Then I go to the university..."*

The workload was stated by almost all the participants, as they were serving a big medical city with 1500 beds rather than the outpatient services. Workload made them feel fatigued easily and could increase errors as they mentioned.

Participant 10: *"Our working hours are 8 h; the workload depends on one's luck. Almost, when the weather changed when the first drop of rain landed in Riyadh, all people were on Ventolin or prednisolone, I was at the night shift at that time, people were coming at 11o'clock with insomnia and apnea, it was annoying, I was working since the minute I came till the end of the shift without any break."*

Several participants –especially mothers- talked about family responsibilities and childcare as factors for fatigue.

Participant 14: *"I've detected several MEs to write in the medication error form, but I don't have time to do so, I don't take my work home because I have children to take care of, my children are in elementary school, they need extensive follow-up. After finishing their homework, I feel already exhausted."*

Another participant talked about having insufficient sleeping hours just to balance his work/home life which made him feel fatigued.

Participant 13: *"The truth is that my sleep isn't enough... after the pressure of work, when I come home, I have a social life... I have people to give them my attention... I mean for my father and my mother I must give them their rights by setting with them for a period of time, because of that I may stay up to 11p.m."*

3.1.3. Emotional stress

Sources of the emotional stress varied among participants, as one of the participants shared his experience of living away from his family and how he adapted that

Participant 5: *"I spend my time between work and home, I'm living alone now. I rarely go out... I'm a social person but I'm new at the*

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place and I don't know anyone… Even for eating, my situation has been messy since I came to Riyadh. I may eat one meal a day."

Family responsibilities could contribute to emotional stress as one pharmacist expressed

Participant 5: "I am now in a situation where my wife isn't here with me, she is studying abroad, and I'm living here alone. Sometimes I think, does she need anything? Is she facing any problem? I keep thinking this way. Sometimes I feel absent-minded, I become afraid regarding doing a medication error or dispensing the wrong medication."

Another example is dealing with aggressive patients

Participant 7: "When some medications aren't available, patients get a little nervous sometimes. There are days when my mood is ruined because of one or two patients."

3.1.4. Poor policies compliance

A participant talked about that despite the efforts for providing appropriate endorsement policy, there were some problems in following them and how it could be a factor for MEs.

Participant 4: "We must have an endorsement in order to have proper communication. For example, in the medical city, we have a policy regarding information endorsement, which is always occur between 3–3:30 p.m. and from 7–7:30 a.m. Although we have a good policy, but some staff aren't following it."

3.2. Organization and management factors

3.2.1. Insufficient staff supporting system

Participants agreed on the importance of encouraging and empowering them to create a positive work environment. They discussed different types of staff support such as receiving feedback and considering staff wellness.

Participant 16: "I remember that the medication safety unit was sending a monthly report regarding MEs as a way to reduce them… So, we knew exactly the reasons behind MEs, and it was helping us to learn and be alert regarding them. However, it's been a long time since we received those reports."

As a sign of employee support, a participant highlighted the importance of providing adequate protective actions against staff healthcare-related diseases.

Participant 17: "For employees who communicate with the public, for example pharmacists, laboratory technicians, nurses, they are at high risk for infections. We're missing a fixed program in which they reach us to check our immunity status."

3.2.2. High job-security

A participant revealed that having high job-security could affect staff commitment by leading to neglectfulness.

Participant 8: "There should be a kind of restriction, if one gives an order, it should be followed, but here I've never seen such a thing, there is no fear, the job security is high. Human nature is dominant, there must be a kind of pressure on people from a certain authority."

3.2.3. Difficulties in work regulation

Managing and regulating work and staff needs with a large number of staff was challenging as participants stated.

Participants 8: "Here, the possibilities are available, but they don't know how to manage them well. We have a high number of employees, but the staff distribution is bad. For example, for the new orders, there are 2 pharmacists and 2 technicians, we are talking about new orders in KSMC, we have approximately 1500 beds covered only by four people with two computers!!"

Participants were facing difficulties to take vacations.

Participants 10: "Vacations are a big problem because they are linked to the staff number, our administration is centralized… The supervisor is the one who is supposed to have this authority. However, the supervisor here can only regulate the workflow… When it is centralized, it's very annoying"

3.2.4. Low salary

When asking participants about their financial status, they responded that they have good finance. However, some participants stated that it covers basics only.

Participant 8: "For me, I don't have financial pressures. I think my salary is very little. Basically, if I relied on only my salary, I wouldn't expect it to cover my needs, maybe what it covers is around 50% or 60% of my needs."

Another participant was feeling underpaid compared to other colleagues.

Participant 10: "I would compare my salary with the physicians. Unfortunately, I don't have a housing allowance while physicians have. Foreign pharmacists here are taking housing allowance. I feel that I'm restricted because I'm a citizen. We're following a restricted career ladder, unlike the foreign contractors, during renewing their contracts, their salary may increase, but I am restricted to the path of the citizen, and this, in my opinion, is injustice."

3.2.5. Lack of task clarification

A participant talked about the ambiguity regarding some tasks appointed to the staff, as a consequence of the ineffective communication between the organization and staff.

Participant 10: "One of the things that stress me out is the lack of clarity with employees, they obligate employees with tasks just because they have a goal behind. There was an antibiotic they told us to print double labels for, and write the number of its prescriptions. The load increased and if I refuse to do it, it will affect my evaluation… At the end of the year, we will receive an email that someone did research on the antibiotic we spent our time on printing and writing information about, without any appreciation."

3.3. Task factors

3.3.1. Lack of standardization

Participants identified issues with task standardization in several aspects such as using different measurement units. An incident of delayed dispensing occurred when a medication prescribed in a different unit from that used by the pharmacy. The pharmacist justified the delay by the time consumed in contacting prescriber and correct the prescription again.

Participant 6: "The physician has no knowledge of unit conversions, which it's understandable, this is our job. When physicians prescribe calcium gluconate in millimole, they may not know how much grams in it? So, we should standardize everything. In that incident I had to call the prescriber and wait for the nurse to come again."

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Unstandardized medication references are also highlighted as a factor for MEs and task delay.

Participant 17: *"Our reference is Lexicomp, but sometimes we receive irregular doses, when we contact prescribers they reply as they brought it from a guideline rather than our reference, which leads us to spend more time searching for his/her meant guideline to check its applicability."*

3.3.2. Lack of decision supporting information system

In a case of accepting an inappropriate dose, the pharmacist stated that the information system could be one of the causes for the error.

Participant 2: *"One of the factors of this ME is the absence of such a system helping in reducing errors."*
Other participants reported some difficulties with the system.

3.4. Work factors

3.4.1. Distraction and interruptions related to noise

Participants mentioned several sources of noise at the workplace which affect their ability to concentrate.

Participant 5: *"During weekend shifts, when I dispense medications, the phone won't stop ringing. After each phone call I answer, I forget what I was doing, I had to ask the patient again "what is your name? is this your prescription?"*

A participant discussed the unauthorized entrance to the pharmacy as it was increasing the noise and distracted him.

Participant 12: *"There is noise because of the entrance of nurses to deliver prescriptions, the sound of opening the door is annoying. It is a fast-moving place; people are going in and out rapidly which distract me."*

3.4.2. Workload

Several consequences of workload were identified such as insufficient task performing, task delay, multi-tasking, and preventing staff from attending educational activities.

Participant 1: *"During weekend, we have prescriptions for the discharge patients and new requests, and there are only two pharmacists covering, do you expect that they can double-check? On regular days, if there is a sufficient number we will definitely double-check, otherwise, we can't."*
Participant 14: *"If you want to attend medical courses, you can, but how could you attend and there is a staff shortage? Sometimes, when I ask for permission to attend a course, they would refuse because there is no one to cover my place."*

In an incident of delayed medication by the pharmacy, the pharmacist talked about the omitted tasks due to the workload.

Participant 15: *"It might be that we received the order at the beginning of our shift, which is the peak period. Maybe the nurse forgot to contact me and ask about the drug."*

He also expressed the difference in task performing time during busy versus free time.

Participant 15: *"The time consumed in printing labels takes minutes if the prescription is clear and there are no problems, preparing would take five minutes sometimes. On the other hand, when work is heavy, the time increases, the preparation will be delayed, but the printing isn't as it's fast, the preparation may take 15 min."*

An error of approving an inappropriate dose, the pharmacist mentioned the high workload as a contributing factor for that.

Participant 7: *"One of the reasons for making errors is multitasking when we perform more than one job at the same time. For me, I don't pay attention to Pyxis orders, I check it quickly then I accept it. I do that because I don't want to delay the patient who is waiting in the discharge area."*

3.4.3. Physical layout

Several participants talked about the effect of the physical layout of the workplace on the task flow such as the narrow spaces and lacking a suitable restroom.

Participant 5: *"In the IV room, there are three technicians and three pharmacists, so I had to take a little desk on the side, sometimes I had to leave the IV room to check medications appropriately which could be risky for some medications."*
Participant 15: *"We now have a place to take our break in, although it is small, but before that, we hadn't. The toilets weren't nearby, things such as cafes weren't available. So, I preferred to spend my time working because there is no place for someone to spend the break time in."*

3.4.4. Medication safety measures

In an event where a medication was replaced in another medication's box which both were placed in the same refrigerator leading to a dispensing error to be occurred.

Participant 8: *"I expect the reasons are mainly the same cartoon colors, differing only in the writing of the letter D. As a solution, the boxes should be colored differently. The second thing is the lightning inside the large refrigerator is bad."*

3.5. Team factors

3.5.1. Poor communication

Participants talked about communication in different domains. The majority of thee participants reported having good communication with colleagues at the pharmacy, however, they stated that communication was affected by workload.

Participant 15: *"Our problem is in the communication… Sometimes, during workload, we aren't communicating well with each other, as it may prevent errors when colleagues are sharing and discussing errors they detected."*

On the other hand, pharmacists were suffering in matters of communication with prescribers, which prevent dispensing medication at a proper time.

Participant 11: *"Because there is no pager system. To contact a physician, I should call the central who doesn't know the physician's name, which would take ten minutes to bring the physician's phone number and call him/her from my mobile."*

An incident of hyperkalemia happened when the patient was receiving potassium from the total parenteral nutrition (TPN) and potassium side drip. The clinical pharmacist mentioned that it was because of the miscommunication between the clinical pharmacist preparing the TPN and other healthcare providers.

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Participant 4: *"Before ordering any electrolyte for a patient on TPN, the physician should inform the on-call clinical pharmacist. So, miss-communication between the health care providers is one of the major causes of this error. I don't know why they gave potassium without calling me!"*

3.5.2. Lack of teamwork and unity

Responses regarding teamwork varied among participants, as some participants believed they have good teamwork and work ethics, while others stated having issues regarding that. A participant discussed the lack of team unity in situations requiring their agreement.

Participant 10: *"Even if we agreed on a word, it would be changed when meeting the administration. I have a good relationship with my colleagues, but our word is unitized in the pharmacy, but it would be changed with administration."*

3.5.3. Prescriber behavior

Issues with prescribers such as not writing full patient information at the information system or being conservative about their opinion was mentioned.

Participant 17: *"There is a problem in medication entry... Usually, they don't write patient's information. So, the patient comes to me without diagnosis nor weight, so it is difficult for me to calculate doses, and this at the same time is causing a delay."*

They also stated the inferior look to pharmacists and not accepting their interventions.

Participant 17: *"Usually in errors like this, we would contact the prescriber, the prescriber is the one who insists to dispense the medication. Who are you to question me? They would state that the patient needs the medication and you should dispense it. So, as pharmacists, we need to do what prescriber wants only"*

4. Discussion

This study examined human factors for MEs using human factors framework in a tertiary hospital in Riyadh, KSA. Participants revealed high burnout scores in terms of work disengagement and emotional exhaustion, this came along with themes explored during interviews such as multifactorial emotional stress and the lack of organizational support (to be discussed later).

On the other hand, fatigue scores were moderate among pharmacy staff that required using alertness strategies, taking short breaks, and removing the person from a high-risk area as Pilbara Ports Authority suggested for moderate fatigue (Pilbara Ports Authority, 2018). This is similar to the results of our study as participants reported that fatigue sometimes was transient and controllable by drinking coffee or taking a short break.

Contributory human factors were identified and categorized into five categories (individual, organizational, task, work, and team factors), among those factors, some were similar to those reported in the literature elsewhere including fatigue, emotional stress, the role of staff support and feedback, lack of decision supporting system, workload, and poor communication (Cunningham and Austin, 2007; West et al., 2009; Schiff et al., 2015; Bannan et al., 2018; Weir et al., 2019). However, these factors were rarely studied in hospital pharmacy settings, which is important since each healthcare profession has its own uniqueness and working

conditions. On the other hand, our study highlighted several human factors such as poor policy compliance and the other organizational factors that were rarely reported in the literature. The study is giving an insight into the possible relationship between these human factors and MEs that needs to be investigated in future research.

Despite the moderate fatigue scores, fatigue as a contributory factor to MEs broadly appeared throughout the interviews, and as far as we know there is no such study that explored the relationship between fatigue levels and the risk for MEs. So, it's possible that even moderate fatigue could contribute to MEs.

Participants in our study linked between sleep and fatigue, in days when they didn't sleep well, they reported being tired and facing difficulties in staying concentrated. Similar results from Zhang et al. study revealed anaesthetists who received less sleep than they required to be fully rested reported inattention as a contributing factor for administration error more frequently than those anaesthetists indicated having sufficient rest (Zhang et al., 2012).

Fatigue and emotional stress had overlapped in several underlying causes and each one of them was leading to the other. Family responsibilities were discussed from several aspects such as being a parent of dependent children or a responsible husband and the issue of lacking quality time to spend with family. Participants explained how they're trying to balance their work/home life and how that would affect their sleep and energy level. Findings from literature revealed that both parents are labile for sleep problems and time pressure which contribute to the risk of fatigue (Gay et al., 2004; Gander et al., 2010). Here in our study, females revealed children's responsibilities as a cause of fatigue more than male participants, as here in the KSA, mothers play the majority of children's responsibilities, while male participants were focusing on parents' and partner's responsibilities.

Policy compliance was poor by some individuals, the responsibility of optimal policy compliance is shared between individuals and organizations, as the greatest benefit will be accomplished when there is proper control of staff compliance with policies aside with the internal motivation to follow them (Tyler and Blader, 2005). This is comparable with our study which emphasized having good polices is not enough if no one is following them.

Organizational factors are correlated to MEs and patient safety, as organizations that provide a culture of support, belonging, and consider staff wellbeing are linked with improving patients' clinical outcomes and a better work environment (Fogarty and Mckeon, 2006; Braithwaite et al., 2017).

Different motivational strategies are available which could be challenging for leaders to choose the appropriate one (Amabile, 1993; American Society of Health-System Pharmacists, 2003; Cunningham and Austin, 2007). To do so, leaders should understand the staff's perspective of motivation and continuously implement different strategies to test their validity in their own settings (Bennett et al., 2017). Here in the study, participants had different perspectives of motivation ranging from simple moral recognition of their work to financial support. The effect of the absence of an effective staff supporting system was minor on some participants which reported having alternative strategies to motivate them self, while this wasn't the case for others who felt detached from their organization and had poor work engagement.

Factors such as the lack of an effective communication between the organization and staff and the work regulations dissatisfaction were comparable to the reported high work disengagement score. Job satisfaction is one of the predictors of work engagement, as

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staff with low job satisfaction together with low interprofessional interactions tend to be disengaged from their work (Simpson, 2009).

An example of the ineffective communication in this study was the lack of task clarification and uncertainty. From literature, staff satisfaction, and their ability to accept changes and the assigned tasks were linked to how appropriately information is delivered to them and the level of management trust (Rousseau and Tijoriwala, 1999; Hicks, 2011).

Allen et al. studied the uncertainty during organizational change, they emphasized the importance of effective communication to address employees' uncertainties regarding the change and the quality of the delivered information. High-quality communication led to a better understanding and acceptance of the change (Allen et al., 2007). Moreover, the staff's ability to accept change's justifications is more likely to be under conditions of high management trust (Rousseau and Tijoriwala, 1999), this explained the participant's action toward the assigned task (Section 3.2.5.) who felt stressed by perceiving the goal of the management to be personal rather than developmental.

Moving for task factors, there was a clear potential relationship between the time of the shift and the risk for MEs, as evening or night shifts were linked to MEs by several participants. Staff number was reduced to two pharmacists and one technician in the main inpatient pharmacy plus three technicians in IV room, in addition to one pharmacist and one technician for emergency department and discharge in those shifts while the tasks they should perform were expanded to cover other services. As well as, medical residents are those who cover these shifts which generally have limited experience in the field (Ulmer et al., 2009). Furthermore, counselling the on-call consultants were done in some situations, and sometimes they were inaccessible which could increase the risk for MEs as studies showed that frequent consultation with the on-call physician is linked with reduced the rate of resident's medical errors (Naveh et al., 2014).

Health information technology could contribute to MEs or improve patient safety at the same time (Kushniruk et al., 2016), as participants in our study reported several problems with the information system implemented in the hospital and suggested some practical solutions for that. A report by the United States Pharmacopeia analyzing medical errors showed that 56.3% of 63,040 computerized system-related errors were entered easily without decision support aids such as showing warning (Schiff et al., 2015). Therefore, clinical decision-supporting tools including drug interaction alert, patient allergy, or improper doses notifications play an essential role in proper therapy management (Alotaibi and Federico, 2017).

Several issues regarding the workplace were discussed, distraction and interruption related to the noise coming from different sources were affecting the staff's ability to concentrate. In our study, noise sources such as people's communication, machine sounds, and the unauthorized entrance of non-pharmacy staff were identified. Guérin et al. study revealed that most machines in the pharmacy produce a high level of noise such as ventilation systems, pneumatic tube systems, and refrigerators (Guérin et al., 2013). High noise levels are linked to affect verbal recognition of drug names (Lambert et al., 2010) and increase medication errors (Beso et al., 2005; Westbrook et al., 2010).

Also, lacking sufficient facilities and narrow places were discussed in the study, a participant revealed how the IV room was designed inappropriately and how he and his colleagues were fac-

ing problems working there. A study demonstrated a decrease in work-related stress after moving to a more spacious workplace, while it was resulting in an increased staff workload and fatigue (Lyman and Gwyther, 1989). Thus, it's important to have a balance between providing sufficient spaces to facilitate tasks and eliminate unnecessary spaces that increase staff fatigue (Stichler, 2007; Mahmood et al., 2009).

Participants agreed that high workload was a contributory factor for MEs and identified several consequences of the high workload such as insufficient task performing, not having the time to double-check medication appropriately, task delay, multi-tasking, and missing some educational activities. A study reported that among 24 dispensing errors, 58% of those errors were under high workload conditions, also the study revealed that pharmacists experienced mental stress as a consequence of the high workload (James et al., 2008).

Results from other studies identified similar consequences of high workload such as lack of time to check medications (Harvey et al., 2015), less time to evaluate drug interactions warnings (Malone et al., 2007), multi-tasking (Odukoya et al., 2015), and considered as a challenge for pharmacist to engaged in MEs prevention activities (Acheampong and Anto, 2015). Malone study revealed that the risk for dispensing a potential drug-drug interaction increases by more than 3% for each additional prescription processed per pharmacist work hour (Malone et al., 2007).

Regarding team factors, the relationship between poor interprofessional communication and MEs is well established (O'Daniel and Rosenstein, 2008; Murphy and Dunn, 2010). Interprofessional communication isn't similar between healthcare providers and it seems like each profession is working independently rather than working together (Rixon et al., 2015; Foppe van Mil et al., 2016), studies regarding interprofessional communication are conflicting, several studies reported poor communication between pharmacists, physicians, and nurses (Bolster and Manias, 2010; Spiridonov, 2017), while Manias et al. reported good communication between pharmacists and graduate nurses (Manias et al., 2005).

Here, our study presented an insight into different levels of communication. By working at the same workplace, pharmacists had better communication with each other compared to communication with other healthcare providers, with worse reported communication was with physicians due to the lack of proper communication tools such as pager systems. However, communication within the pharmacy was affected during heavy workload. Studies showed that a heavy workload decreases the opportunity for effective communication with healthcare providers and patients (Carayon and Gurses, 2008; Curtis et al., 2011).

Prescriber behavior was discussed as a factor for MEs as well as task delaying, several prescribers were neglecting filling important patient information such as weight, concomitant medications, and patient allergy. By doing that, doses were calculated incorrectly especially pediatric doses, as their doses were weight-based.

Another observed behavior was the perceived superiority of prescribers and not accepting other opinions. Although pharmacists have a valuable contribution to reduce MEs and improve patient's clinical outcomes (Al Rahbi et al., 2014; Alomi et al., 2019), some prescribers still neglecting their role. A study discussed the underlying causes for this behavior, the act of neglecting pharmacists' role was emerging from questioning pharmacists' authority to make clinical interventions, underestimating their competency to be involved in patient therapeutic

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management, and lack of collaboration. Pharmacist's poor attitude may affect the communication process and make prescribers tend to be defensive and reject pharmacists' recommendations (Acheampong and Anto, 2015).

4.1. Implications for practice

The current study has important practice implications. Hence, we recommend organizations to take these factors into consideration for designing interventions and improving patient safety.

4.2. Implications for research

This study would help researchers to investigate the relationship between the reported factors and MEs. As linking those factors with MEs quantitively will support the evidence in medication safety practice.

5. Strength and limitations

The study has both strengths and limitations, it explored contributory factors for MEs in relation to human factors which has rarely been implemented in the hospital pharmacy settings. By using HFF, it helped in getting deeper and comprehensive understanding of the contributory factors and categorizing them in an appropriate manner. Interviewers were diverse in terms of gender, years of experiences, and background which offered a representative view of the human factors in their workplace.

The study also has some limitations. First, we aimed to include MEs in both inpatient and outpatient pharmacies, reports we found were including MEs happened in the inpatient pharmacy only as in the outpatient pharmacy, the pharmacist is the final step in the dispensing process, thus their errors are difficult to be detected. Also, our study was conducted in a single center. However, hospital settings were resembling other general hospitals in the KSA, also, pharmacists and technicians were from different cities and backgrounds which is helping in generalizing our findings in other hospital pharmacies.

6. Conclusion

The study provided a unique insight into the contributing factors to MEs in the hospital pharmacy. These factors were identified and categorized using the HFF. Emotional stress, lack of motivation due to the poor staff supporting system, high workload especially during evening and night shifts, poor effective communication between pharmacists and management or other healthcare providers, and missed patient information on the information system due to prescribers' negligence, are examples of the human factors contributing to MEs. This study found that organizational factors had a major contribution to medication safety and staff wellbeing.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

Appendix A

Pilbara Ports Authority personal fatigue assessment tool*

CIRCLE THE MOST APPROPRIATE RISK CATEGORY FOR EACH QUESTION LISTED BELOW		Low Risk	Medium Risk	High Risk
How many hours sleep have you had in the last 24 hours?		7 or more	5 to <7	Less than 5
How many hours sleep have you had in the last 48 hours?		14 or more	12 - <14	Less than 12
How many hours will you have been awake by the end of your shift including travelling home? How many hours sleep have you had in the last 48 hours?	A = _____ B = _____ A – B = _____	A - B is 0 or negative	A - B is equal to 1 or 2	A - B is 3 or more
Do you feel alert? Rating Description 1 Feeling active, alert or wide awake 2 Functioning at a good level, but not at peak, able to concentrate 3 OK, but not fully alert 4 A bit groggy, hard to concentrate 5 Sleepy, groggy, would like to lie down		1 - 2	3	4 - 5
How many alcoholic drinks did you have before your sleep?	Male	0 - 4	5 - 6	7 or more
	Female	0 - 2	3 - 4	5 or more
Are you on any medication or other substances that could cause drowsiness or cause you to be unfit for work?		No		Yes
Do you have any stress, health problems or other personal problems that are significantly affecting your concentration and/ or sleep?		No		Yes
Add up the number of answers circled in each risk category Times this number by the multiplier number to get a Risk Score for each risk category		Number of Low Risk boxes ticked _____	Number of Medium Risk boxes ticked _____	Number of High Risk boxes ticked _____
	Multiplier	x 0	x 1	x 2
	Risk Score			
Add your Risk Scores together and use this number to follow the Recommended Controls listed below				

Level of Risk	Recommended Controls

Low Risk
 	
Total Score = 0 - 2
AND
individual is
  • Alert
  • Normal eye blinks (less than 1 second)
  • Coordinated body movements
  • Tolerant of others
	• Continue to monitor.
	• Remind individuals about fatigue and alertness management strategies (interaction with others, exercise, cold air on face, etc).

Medium Risk Total Score = 3 - 7 OR The individual reports they are fatigued and/or are showing some of the following signs: • Irritable/impatient • Longer eyelid closure (1 - 2 seconds) • Wandering thoughts • Rubs eyes or face • Facial contortions • Restless movements • Yawning	As above plus … • Discuss possible reasons for fatigue • Rotate tasks • Encourage the use of alertness strategies • Provide opportunity for short breaks of no more than 15 minutes. • Have personnel work together (if possible). • Remove from high risk work. • Assess fitness for work before you allow person to return to work. • Schedule regular supervision for remainder of shift.
High Risk Total Score = 8 - 14 OR The individual reports they are significantly fatigued and/or may be showing the following serious signs: • Quiet and withdrawn • Long eyelid closure (2 or more seconds) • Fixed staring • Frequent yawning/Micro sleeps	• Immediately prevent person from working and discuss the possible causes and action required. • Determine if the individual can be placed on alternate duties for the remainder of shift and managed at work. • If unable to be managed on alternate duties, send the individual home (provide transportation)

*Adapted from Pilbara Ports Authority, 2018).

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