J Young Pharm, 2022; 14(2) : 244-248
A multifaceted peer reviewed journal in the field of Pharmacy
www.jyoungpharm.org | www.phcog.net

Original Article

Evaluation of Pharmacist and Nurses Practices of IV Admixture Preparation Outside Pharmacy in Saudi Arabia

Nuzhat Banu, Naher Mohammed Aldubaisi, Batool Mohammed Al Dubaisi, Mohammad Daud Ali,* Ayaz Ahmad, Yousif A M Hassan
Department of Pharmacy, Mohammad Al-Mana College for Medical Sciences, As Safa, Dammam, SAUDI ARABIA.

ABSTRACT

Background: Compounding and dispensing sterile preparation is a major part of pharmacy practice and the responsibility of pharmacists. The intravenous admixtures are sterile products prepared by mixing a medication or a combination of medications with a different intravenous solution. Errors during IV preparations have been reported to ISMP national medication error reporting program and are regularly discussed. **Methods:** An online survey-based, descriptive, cross-sectional study was conducted among Pharmacists and nurses working in Eastern Province, Saudi Arabia. The questionnaire was distributed among pharmacists and nurses compounding IV admixtures in the hospitals. **Results:** Out of 206, 115 (55.8%) respondents reported preparing IV admixtures outside pharmacy out of which 79 (68.7%) prepared it daily. Maximum were IV infusions. 63 (54.8%) of them prepared more than one IV admixture at one time. Although there were a high number 93 (80.8%) of people who said that they were provided with the established guidelines for preparing IV admixtures outside pharmacy however there is enough number 16 (13.9%) who said that they were not aware of them. Antibiotics 93 (80.8%) were frequently prepared in the form of IV admixtures. 22(19.1%) respondents reported experiencing errors during preparing IV admixtures. Use of wrong dose, concentration, diluent, diluent volume 12 (54.54%) was the most frequent error reported. Rushing during an emergency was the main challenge 56 (48.7%) faced. **Conclusion:** Although great emphasis is made to prepare the most IV preparations inside the pharmacy still there are situations where many IV medications had to be prepared outside the pharmacy. Intravenous infusions, antibiotics were the most commonly prepared IV admixtures. The most common error reported was in preparing the dose which could be due to the rushing during emergencies. Our study suggests that proper IV admixture training during the course study and on job must be made mandatory and wherever possible ready to use IV injections must be used.

Key words: IV Admixture, Outside Pharmacy, Pharmacist, Nurses, Saudi Arabia.

Correspondence

Dr. Mohammad Daud Ali,

Department of Pharmacy, Mohammad Al-Mana College for Medical Sciences, Abdulrazaq Bin Hammam Street, Al Safa, Dammam-34222, SAUDI ARABIA.

Email id: dali.niper@gmail.com

DOI: 10.5530/jyp.2022.14.46

INTRODUCTION

The intravenous admixtures are sterile solutions prepared by mixing a medication or a combination of medications with a different intravenous solution, and are administered via intravenous administration sets directly into the patients' veins. Most hospital inpatients need intravenous solution therapy. There is a global concern related to medication safety and patient care quality.[1]

Compounding is a major area of pharmacy practice, and compounding and dispensing sterile preparations with appropriate quality is the responsibility of the pharmacist.[2] Compounding of sterile preparations outside pharmacy in any department of the institution, like the doctors' room, nursing room, outpatient clinic, or pharmacy, is monitored by the pharmacist's director. Guidelines on staff training for assuring proper implementation of aseptic techniques, preparation and labelling of preparations, and regularly assuring the competency of the staff should be followed.[3] Errors during IV preparations have been reported to the ISMP national medication error reporting program and are regularly discussed in the ISMP medication safety alert.[4]

A 2018 study looked into nurses' knowledge of compounding IV admixtures and discovered that half of the nurses were unaware that IV admixtures should be prepared in specific clean areas to avoid microbial contamination. This will be highly dangerous for preterm and newborn patients. The factors that may have an effect on the stability of reconstituted antibiotic admixtures were light, humidity, and temperature.[5] A study based on an ISMP survey revealed numerous issues related to IV admixture preparation knowledge and practices outside of the pharmacy. It was reported that a lot of preparations for IV admixtures are prepared outside pharmacies. The medications that were prepared frequently were IV push medications, intramuscular injections, and IV intermittent infusions. Many respondents stated that they were not trained to prepare IV admixtures, and that the most difficult aspect was rushing to prepare IV admixtures during emergencies, which may limit the quality and jeopardize the safety of preparation.[6] Research from Paris reported that there were no written procedures or labelling guidelines for preparing IV admixtures. This study helped in developing the proper procedural guidelines and training sessions for the staff and emphasized the importance of using ready-to-use packages whenever possible.[7] According to a study conducted in five US hospital pharmacies, the contamination levels in IV admixtures prepared in traditional practice locations and in class 1000 clean rooms were similar. The most important difference revealed was the technique used by the pharmacist in aseptic preparations and not the environment of the preparation area.[8] A systematic review conducted on published reports of IV admixture compounding errors reported the need to standardize the IV admixture compounding process, workflow, preventive strategies for errors, and the need for training and assessing the staff competencies.[9] Preparation of IV admixtures in bedside and clinician rooms and operating rooms is sometimes required in certain emergency situations. A study that compared the preparations made in the horizontal laminar flow hood, clean room, ward pharmacy, and operating room found that the rate of contamination was highest in the wards, followed by the operating room and cleanroom.[5] A review was conducted that compared the

contamination rate in controlled environments and wards, and it was found that the contamination rate was found to be higher in wards as compared to controlled environments for preparing pharmaceuticals.[10]

A case was reported, where the patient was given an overdose of the medication Pentostam for the treatment of cutaneous Leishmaniasis. Factors causing errors were pointed out and suggestions were made. Factors responsible for errors could be improper communication between nurses and pharmacists, label checking, and double checking of preparation calculations.

For decades, pharmacy practices' major area of concern was the safety of compounded sterile preparations (CSPs). Although the benefits of preparing IV admixtures in patient care areas outweigh the risks, there appear to be various errors and microbial contamination in syringes prepared in these areas. In this study, IV admixture practices will be evaluated among pharmacists and nurses in the Kingdom of Saudi Arabia. The types of medications prepared outside the pharmacy, their frequency, training needs of staff, the areas in which they prepare most IV admixtures, medication errors that occur frequently, the reasons for the errors, and challenges faced by the nurses and pharmacists will be evaluated.

MATERIALS AND METHODS

A prospective cross-sectional survey was be conducted among pharmacists and nurses in the Eastern province, Saudi Arabia using a questionnaire.

Study Design area and settings

An online survey-based study was conducted among pharmacists and nurses working in the Eastern Province of Saudi Arabia. It is a descriptive, cross-sectional study design. The questionnaire was distributed among pharmacists and nurses preparing IV admixtures for different hospital departments. Pharmacists and nurses working in the outpatient department was excluded from the study, while those working in the inpatient department and involved in preparing IV admixtures outside pharmacy was included in the study.

Identification of study participants

The targeted population was nurses and pharmacists, practicing in the Eastern Province. The survey link was sent through social media to a community of identified nurses and pharmacists. The survey was filled out by nurses and pharmacists of both genders based on their willingness to participate in the study.

Study tool and Validation of the study tool

A 23-item questionnaire was utilized to attain the objectives of the study. About 10 questions are related to demographics and 13 statements about IV admixtures preparation practices and challenges. The contents of the tool is a partially adapted questionnaire (3) that is designed, keeping the objective of study in mind. After approval of the research proposal. Google form, trial survey was carried out by researcher and final checking of the responses was done by the researcher. After checking the response and validation of response and questionnaire, survey link was disseminated through social media among Pharmacists and nurses working in inpatient and involved in preparing IV admixtures outside pharmacy.

Samples size

At least 100 (50 Pharmacist and 50 nurses) sample size was targeted to achieve the objective of the study.

Statistics

Response rate was calculated in terms of percentage and frequency.

RESULT

The survey was disseminated among nurses and pharmacists and the following results was collected. All together 216 nurses and pharmacists filled the survey.

Demographics of the respondents

Among the people who filled out the survey, 148 (71.8%) were male and 58 (28.1%) were female. 59 (28.6%) were in the age range of 18-30, 118 (57.3%) in the age group 31-40, 23 (11.2%) in the age range 41-50, and 6 (2.9%) in the age range 51-60. A maximum of 132 (64%) of the respondents were married. Nurses received the most responses 131 (63.3%), followed by pharmacists 68 (33%), and other professions 7 (3.8%).

Maximum respondents 127 (61.6%) were from the health professionals of outpatient and 56 (27.2%) from the inpatient and the rest 23 (11.2%) from other departments. When enquired about the department in which they work, maximum respondents 41 (20%) were reported to be from the surgical department, followed by 22 (11.7%) from emergency department, physician's clinic 20 (9.8%), 15 (7.3%) from labor, delivery and pediatric department each, 10 (4.9%) from long term care facilities, and least 4 (1.9%) from oncology department. The other 79 (37%) respondents were from the other departments. Most of them had experience of 1-5 years and similar respondents were among 6-10, 64 (31.1%) followed by 10years experience group 65 (31.6%), and 9 (4.4%) were the fresher's without any experience.

Highest qualification of 102 (49.5%) respondents were graduates and very low number 12 (5.8%) were PhD qualifications. Diploma respondents 62 (30.1%) were almost double of those having postgraduate degree 30 (14.5%). When asked about their role, 83 (40.3%) was inpatient nurse, 31 (15.1%) in patient pharmacist, 27 (7.3%) outpatient pharmacist and similar number of outpatient nurse 27 (7.3%). 1 (0.5%) was a clinical pharmacist and 37 (23.7%) were in other roles. When asked about their IV admixture preparation practice only 115 (55.8%) respondents agreed that they prepare IV admixtures and the rest 91 (44.2%) did not prepare IV admixtures. Table 1 displays the detail demographic characteristics of the study participants.

Further analysis was done on only those responses that prepare IV admixtures that is 115 (55.8%).

IV admixture Preparation Practice

When asked about their frequency of preparing IV admixtures, 79 (68.7%) prepared daily, 7 (6.1%) prepared weekly, 3 (2.6%) prepared monthly and 26 (22.6%) revealed that they prepare sometimes when needed only. The type of medications that were prepared the most were the IV infusions 81 (73.8%), followed by IV push 70 (60.8%) and then IM injections 65 (56.5%). There were few 4 (3.47%) other categories of drug that were reported to be prepared as IV admixtures. 63 (54.8%) of them revealed that they prepare more than one IV admixture at one time while 48 (41.7%) said they don't. Although there was high number 93 (80.8%) of people who said that they were provided with the established guidelines for preparing IV admixtures outside pharmacy there was enough number 16 (13.9%) who said that they were not and 6 (5.2%) were not sure if they were provided with the guidelines for preparing IV admixtures outside pharmacy. 88 (76.5%) people revealed that they were given training for preparing IV admixtures outside the pharmacy on the job, 25 (21.7%) revealed that they were not and 2 (1.8%) were not sure of it. 74 (64.3%) respondents reported that they received training to prepare the IV admixtures during their undergraduate internship or residency

Table 1: Demographic characteristics of the study participants: *n*=206.

Variable	Number (n)	Percent (n %)
Gender		
Male	148	71.8%
Female	58	28.1%
Age (years)		
18-30	59	28.6%
31-40	118	57.3%
41-50	23	11.2%
51-60	6	2.9%
Above 60	No	0%
Marital status		
Married	132	64%
Single	69	33.5%
Divorced	5	2.4%
Profession		
Nurse	131	63.6%
Pharmacist	68	33%
Other	7	3.8%
Area of work		
Inpatient	56	27.2%
Outpatient	127	61.6%
Other	23	11.2%
Department in which you work		
Surgical department	41	20%
Physician's clinic	20	9.8%
Long term care facility	10	4.9%
Emergency department	22	11.7%
Labor and delivery room	15	7.3%
Pediatric department	15	7.3%
Oncology department	4	1.9%
Other	79	37%
Experience (years)		
0	9	4.4
1-5	68	33%
6-10	64	31.1%
>10	65	31.6%
Highest qualification		
Diploma	62	30.1%
Graduate	102	49.5%
Postgraduate	30	14.5%
Ph.D.	12	5.8%
Currently working as		
In patient pharmacist	31	15.1%
Outpatient pharmacist	27	13.1%
Clinical Pharmacist	1	0.5%
Inpatient nurse	83	40.3%
Outpatient nurse	27	7.3%
Other	37	23.7%
Do you prepare IV admixtures?		
Yes	115	55.8%
No	91	44.2%

and 36 (31.3%) said that they did not undergo any such training and 5 (4.4%) were not sure about their training. 84 (73%) respondents agreed that their competencies in preparing IV admixtures is checked annually whereas 24 (20.9%) said that their competencies were not checked and 7 (6.1%) said that they were not sure about it. Most 84 (73.1%) of the IV admixtures were reported to be prepared in medication room or dedicated area, 9 (7.8%) were reported to be prepared in Laminar flow hood outside pharmacy and there were preparations done in other areas like, 16 (13.9%) reported at bedside ward, 5 (4.4%)anesthesia workstation, 9 (7.8%) nursing station, 5 (4.4%) operating room, 1 (0.9%) said that they even prepare in patients home and few 1 (0.9%)were reported in other areas like recovery room. 107 (93%) of the respondents said that they double check after preparing IV admixtures and the rest 8 (7%) said that they don't check them after preparation. Antibiotics 93 (80.8%) were the highly prepared medications in the form of IV admixtures followed by, high alert medication 51 (44.4%), electrolytes 35 (30.4%), TPN 30 (26.1%) and 13 (11.3%) chemotherapeutics and anesthetics each. Table 2 displays the detail IV admixture preparation practices of the study participants.

Medication errors and challenges faced

22 (19.1%) respondents reported that they experienced errors during preparing IV admixtures while maximum respondents didn't experience any errors 92 (80%). Use of wrong dose, concentration, diluent, diluent volume 12 (54.54%) was the error mostly faced by the respondents, followed by no label or error in label by 8 (36.36%) respondents, wrong drug by 5 (22.7%) and wrong route by 2 (9.09%) people. When asked about the challenges they face during the IV admixture preparations, they reported that rushing during emergency was the main challenge 56 (48.7%), followed by interruption during multitasking 42 (36.6%), lack of 24/7 pharmacy in 23 (20%), lack of training or experience in 20 (17.39%), independent double check failure in 16 (13.91%), lack of accuracy and lack of labeling guidelines, Lack of space, poor lighting, noisy environment, Lack of needed diluents and devices in 14 (12.2%) respondents each. Table 3 and 4 displays the medication errors and challenges faced by the study participants.

DISCUSSION

Nurses were among the health professionals who were majorly concerned with the preparation of IV admixtures. And among them, inpatient nurses made up the highest number. The highest respondents were from the emergency department. Most of the participants were graduates. More than half of the respondents reported preparing IV admixtures and infusions were highly prepared as IV admixtures' preparations, and more than half of the respondents reported preparing many IV admixtures at one time. A high percentage reported that they double checked the preparation. In comparison to our study, a case of medication overdose was identified, and the analysis of this case came up with the factors that were lacking in IV admixture preparations. These were improper communication channels, proper labeling, and quality assurance checks.[11] More than three-fourths of the respondents revealed that they were provided with the established guidelines for preparing IV admixtures in the organization as well as training on the job. In a study, it was reported that nearly one fourth of the nurses were unaware of the existence of an IV admixture preparation procedure for IV infusions. This study also emphasized the importance of staff training and establishing guidelines to avoid medication errors and switch to ready-to-use packages when available.[4] More than half of the respondents reported having taken IV admixture training during an internship or residency program, but there was still a higher number who reported that they were not exposed to any such training for preparing IV admixtures

Table 2: IV admixtures preparing practices of the study participants.

Variable	Number (n)	Percent (n %)
If yes, how frequently do you prepare them?		
Daily	79	68.7%
Weekly	7	6.1%
Monthly	3	2.6%
Sometimes	26	22.6%
What type of medications do you prepare outside pharmacy?		
IV Push medications	70	60.9%
IM injections	65	56.5%
IV infusions	76	66.08%
Other	4	3.47%
Do you prepare more than one IV admixtures at a time?		
Yes	63	54.8%
No	48	41.7%
I don't know	4	3.5%
Did the organization provided you with the established guidelines for preparing IV admixtures outside pharmacy?		
Yes	93	80.8%
No	16	13.9%
I don't know	6	5.2%
Did you receive training to prepare IV admixtures outside pharmacy "on the job"?		
Yes	88	76.5%
No	25	21.7%
I don't know	2	1.8%
Did you receive training to prepare IV admixtures during "undergraduate internship or residency program"?		
Yes	74	64.3%
No	36	31.3%
I don't know	5	4.4%
Is your competency to prepare IV admixtures checked annually?		
Yes	84	73%
No	24	20.9%
I don't know	7	6.1%
Where do you prepare IV admixtures?		
Medication room/dedicated area		
Bedside/Ward	84	73.1%
Anesthesia workstation	16	13.9%
Laminar flow hood outside pharmacy	5	4.3%
Nursing workstation	9	7.8%
Computer workstation	9	7.8%
Ambulance	1	0.9%
Operating room	2	1.7%
Patient's home	5	4.4%
Other	1	0.9%
Do you double check after preparation prior to administration?		
Yes	107	93%
No	8	7%
I don't know	0	0%
What kind of medications are prepared outside pharmacy?		
High alert medications	51	44.4%
Chemotherapeutics	13	11.3%
Anesthetics	13	11.3%
Antibiotics	93	80%
Electrolytes	35	30.4%
TPN	30	26.1%
Did you experience any error when preparing/ admixing sterile medications in the past 1 year?		
Yes	22	19.1%
No	92	80%
I don't know	1	0.9%

Table 3: Type of preparation error encountered by the study participants *n*=22.

Variable	Number (n)	Percent (n %)
If yes, which one?		
Use of wrong drug	5	22.7%
Use of wrong dose, concentration, diluent, diluent volume	12	54.5%
No label/ error in label	8	36.36%
Use of wrong route	2	9.09%
Other		

Table 4: Challenges faced by the participants in the IV admixture preparation.

Variable	Number (n)	Percent (n %)
What are the challenges faced in preparation of IV Admixtures outside pharmacy?		
Rushing during emergency	56	48.7%
Interruptions due to multitasking	42	36.6%
Lack of accuracy	14	12.2%
Lack of training or experience	20	17.39%
Lack of labelling guidelines	14	12.2%
Lack of preparation guidelines	13	11.3%
Independent double check failure	16	13.9%
Lack of space, poor lighting, noisy environment	14	12.2%
Lack of needed diluents and devices	14	12.2%
Lack of 24/7 pharmacy coverage	23	20%

outside pharmacy. There were nearly one fourth of the respondents who reported that their competency in preparing IV admixtures was not checked annually. There were nearly three-fourths of the preparations made in the medication room, but there were also preparations reported to be made at the bedside, operation room, nursing station, operating room, ambulance, and even patients' homes where the environment is uncontrolled. There was a study conducted to evaluate the effect of the environment on the contamination rate of preparations, and it reported that it was not the environment but the aseptic technique that affected the rate of contamination.[8] A significant number experienced errors during the preparation of IV admixtures and use of the wrong dose, concentration, diluent, or diluent volume was reported by more than

half of the respondents. Rushing during an emergency, multitasking, and training deficiencies were among the challenges that were most affecting them. Similarly, a study conducted in US hospitals for evaluating IV admixture errors in hospital pharmacies reported that the wrong dose was the most commonly reported error.[12] Similar research done by ISMP highlighted the similar problems faced during IV admixture preparations. The safety issues reported were increased time pressure, lack of adherence to guidelines, and insufficient staff training.[6]

CONCLUSION

Although great emphasis is made to prepare the most IV preparations inside the pharmacy, there are situations where many IV medications have to be reconstituted outside the pharmacy. Intravenous infusions and IV push medications are the most frequently prepared medications. There were a significant number of respondents who revealed they were not getting on job training and had no established procedures for preparing IV admixtures. There were few preparations made in an inappropriate environment for IV preparation. The most common errors that may cause harm to the patient were reported to be the incorrect dose, concentration, and diluent. Rushing in emergencies and multitasking are the greatest challenges reported and could be the leading causes of errors and patient harm. The study suggests that proper IV admixture training during the course study and also on the job must be made mandatory and, wherever possible, ready-to-use IV injections should be made available instead of preparing them during emergencies in an inappropriate environment.

ACKNOWLEDGEMENT

We would like to express our gratitude to all the respondents for responding on our research questionnaire.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

ISMP: Institute for Safe Medication Practices; **IV:** Intravenous; **CSPs:** compounded sterile preparations; **US:** United States.

REFERENCES

1. Taxis K, Barber ND. Causes of intravenous medication errors: An ethnographic study. Qual Saf Health Care. 2003;12(5):343-7. doi: 10.1136/qhc.12.5.343, PMID 14532365.
2. American Society of Health System Pharmacists. ASHP guidelines on compounding sterile preparations. Am J Health Syst Pharm. 2014;71(2):145-66. doi: 10.2146/sp140001, PMID 24375608.
3. ismp-hosp-temp-Master.qxd.
4. Farhan Yasir Mohammed. Medical assistants' knowledge about preparation and administration of intravenous admixtures in the teaching hospitals of AlAnbar governorate. Int J Pharm Phytopharmacol Res. 2018;8(5):31-4.
5. Available from: https://www.ismp.org/resources/ismp-survey-provides-insights-preparation-and-admixture-practices-outside-pharmacy [cited 8/4/2022].
6. Tilleul Patrick, Mons Bisserka, Schmitt Claude, Laporte Jean-Marie, Begue Dominique. Intravenous drug preparation practices: A survey in a French university hospital. Pharm World Sci. 2003;25(6):276-9. doi: 10.1023/B:PHAR.0000006522.84493.4e, PMID 14689816.
7. Thomas Mark, Sanborn Michael D, Couldry Rick. IV Admixture contamination rates: traditional practice site versus a class 1000 cleanroom. Am J Health Syst Pharm. November 15 2005;62(22):2386-92. doi: 10.2146/ajhp050078, PMID 16278330.
8. Hedlund Nancy, Beer Idal, Hoppe-Tichy Torsten, Trbovich Patricia. Systematic evidence review of rates and burden of harm of intravenous admixture drug preparation errors in healthcare settings. BMJ Open. 2017;7(12):e015912. doi: 10.1136/bmjopen-2017-015912, PMID 29288174.
9. Stress effects on the body. American Psychological Association. November 1, 2018. https:.
10. Li Yuanyuan, Hao Yanli, Fan Fang, Zhang Bin. The role of microbiome in insomnia, circadian disturbance and depression. Front Psychiatry. 2018;9:669. doi: 10.3389/fpsyt.2018.00669, PMID 30568608.
11. American Society of Health System Pharmacists. ASHP guidelines on compounding sterile preparations. Am J Health Syst Pharm. 2014;71(2):145-66. doi: 10.2146/sp140001, PMID 24375608.
12. Flynn Elizabeth Allan, Pearson Robert E, Barker Kenneth N. Observational study of accuracy in compounding i.v. admixtures at five hospitals. Am J Health Syst Pharm. April 15 1997;54(8):904-12. doi: 10.1093/ajhp/54.8.904, PMID 9114922.

Article History: Received: 15-03-2022; Revised: 04-04-2022; Accepted: 07-05-2022.
Cite this article: Banu N, Aldubaisi NM, Dubaisi BMA, Ali MD, Ahmad A, Hassan YAM. Evaluation of Pharmacist and Nurses Practices of IV Admixture Preparation Outside Pharmacy in Saudi Arabia. J Young Pharm. 2022;14(2):244-8.