



## A STUDY TO ASSESS THE KNOWLEDGE OF INTRAVENOUS FLUID IN THIRD MBBS STUDENTS IN TERTIARY CARE HOSPITAL.

### Pharmacology

**Mayur Phulpagare** Junior resident Dept. of Pharmacology, B. J. Govt Medical College and SGH, Pune

**Smita Tiwari\*** Assistant Professor Dept. of Pharmacology, B. J. Govt Medical College and SGH, Pune  
\*Corresponding Author

**Rajesh Hiray** Professor and Head Dept. of Pharmacology, B. J. Govt Medical College and SGH, Pune

### ABSTRACT

**Introduction-** Third MBBS students represent the budding doctors and may perform the complex task of deciding the most suitable intravenous fluids for patient. Therefore evaluation of such critical knowledge of these potential candidates becomes important for a better future of health care.

**Method-** Cross-sectional, questionnaire-based study conducted among third year MBBS students (n=200) at tertiary care government teaching hospital.

**Results-** 170 students of the 200 scored overall between 21%-50%. Scores of understanding clinical use of IV fluids in students ranged from 8% to 44%. As regards to its knowledge about adverse effects and limitations, only 34% and 15% respectively recorded correct responses. Students also lacked knowledge of about correct fluid used for various drug dilutions.

**Conclusion-** The present study concludes that students had an idea but lacked adequately detailed knowledge about intravenous fluids for correct clinical application.

### KEYWORDS

Intravenous fluid, Third MBBS students.

### INTRODUCTION

Intravenous (IV) fluid therapy is an essential and integral component of medical and surgical care. Use of intravenous fluid in patients requires a sound knowledge of fluid and electrolyte balance in the human body. IV therapy undoubtedly helps salvage patients but the other side of the coin is that inappropriate IV therapy has been associated with increased complications. Poor IV therapy has been associated with increased complications (1).

It is a fascinating paradox that though IV fluid knowledge forms an essential component of the curriculum of undergraduate medical training. Yet, only a minority (15%) of junior resident doctors are apparently adequately trained in this area. Additionally, approach to IV fluid prescribing amongst junior resident doctors across hospitals is highly variable and have poor awareness of the national guidelines. (2) Studies have also highlighted the fact that as many as 90% of IV fluid prescriptions managed by junior doctors which aggravate the gravity of the situation. (1)

Errors in prescribing IV fluids and electrolytes are not limited to emergency departments or acute admission units. Surveys have shown that many health care providers who prescribe IV fluids know neither the likely fluid and electrolyte needs of individual patients nor the specific composition of the many choices of IV fluids available to them. Likely, as many as 1 in 5 patients on IV fluids and electrolytes suffer complications or morbidity because to their inappropriate administration. Despite this known fact that there is mismanagement of fluid therapy is rarely reported as being liable for patient harm, yet it is lesser reported. (3) Hence, it has been debated that fluid prescribing should be attributed to the same status as drug prescribing (4).

The third MBBS students are the face of tomorrow's practitioners. They will prescribe the IV fluids to the patients in future and their knowledge about the type of IV fluids and adverse reactions due to them is critical for the benefit of the patients. As discussed earlier, despite the complexity of estimating a patient's IV fluid needs, assessment and prescription are usually delegated to healthcare professionals who have received little or no specific training on the subject. In 1999 National Confidential Enquiry into Perioperative Deaths (NCEPOD) report, which elaborated that a significant number of hospitalised patients were deteriorating as a result of the inappropriate infusion of intravenous fluid. (3)

The medical students & interns at any teaching hospital also play a pivotal role in administering the IV fluids to the patients; therefore their knowledge about the type of IV fluids and related adverse reactions are an important part of their training and application not only to them as doctors but also for the benefit of the patients. In an effort to improve current practice and the importance of accurate and

proficient IV fluid prescribing as a measure the first step is understanding or assessing the basic knowledge possessed by third MBBS students about IV fluids. The aim of the study was to assess the knowledge of third MBBS students regarding Intravenous fluid administration by using a standard questionnaire.

### MATERIALS AND METHODS

It was a prospective, observational, questionnaire-based study that was conducted among third MBBS students at Govt. Medical College, a tertiary care teaching hospital in Western Maharashtra. The study was carried out after approval from the Institutional Ethics Committee (BJGMC/IEC/Pharmac/ND-Dept 0819092-092) was obtained before initiating the study. The survey was performed amongst the third MBBS students using a validated, structured questionnaire. It included 25 questions pertaining to the responder's knowledge and its practical aspects regarding the use of intravenous fluids.

### Statistical Analysis:

All detailed data entered in MS Excel 2018 and values expressed in percentages.

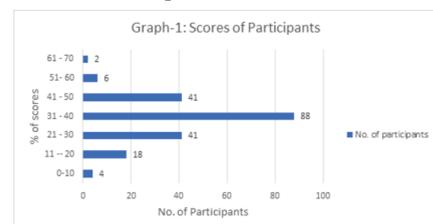
### RESULTS

200 students gave consent to participate in this study and responded to the questionnaire.

#### 1) Percentage of scores obtained by participants

Among the percentage of scores obtained by the 200 participants as shown in the **Graph no.1**, only 2 students obtained the highest marks between 61% - 70%. The Lowest score obtained by 4 students between 0% - 10%. Maximum i.e. 88 students scored between 31% - 40%.

#### Graph-1: Scores of Participants



2) Total percentage of correct response given for each question

Table No-1

Q no	Total % of correct response	Q No.	Total % of correct response
1	59.82	11	33.93

2	59.82	12	34.82
3	36.61	13	15.18
4C	15.18	14	8.04
4D	6.25	15	25
4E	28.57	16	21.43
4F	5.36	17	68.75
5A	12.5	18	32.14
5B	7.14	19	53.57
6	32.14	20	75
7	44.64	21	33.93
8	33.04	22	51.79
9	17.86	23	64.29
10	28.57	24	43.75

Maximum correct answers were obtained for question no.20 (75%) followed by a question no. 17 ( 68.75%) which evaluated knowledge about tonicity and use of IV fluids. This was followed by question no. 1 & 2 (59.82 % each) tested awareness about types of colloids and detailed knowledge of colloids.

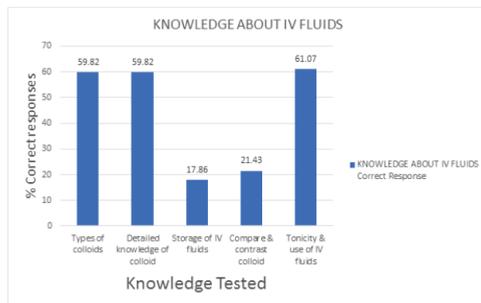
Least number of students i.e. 5.36 % and 6.25% knew that quinine and vancomycin are not diluted in normal saline and 7.14% of students give correct answer that ampicillin cannot be diluted in dextrose.8.04 % of students give a correct indication for the use of albumin.

**3) Evaluation of knowledge about IV fluids**

The questionnaire that was presented to the students had 25 questions, of which 9 questions were formed to evaluate the knowledge of IV fluids. 59.82% of students gave correct response regarding the types of colloids & had detailed knowledge about colloids. 17.86% of students were aware regarding the storage about IV fluids. Only 21.43% were able to compare & contrast about colloids & could not differentiate between two. More than half the number of students i.e. 61.07% gave correct response regarding the tonicity & use of fluids. (Graph No-2)

**Table No-2**

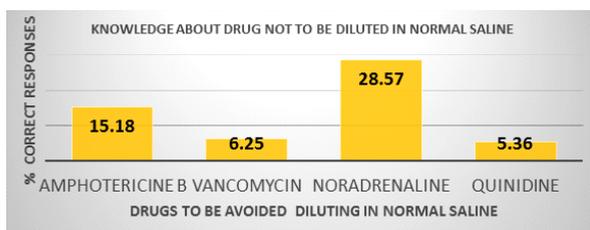
KNOWLEDGE ABOUT IV FLUIDS	
Types of colloids	59.82 %
Detailed knowledge of colloid	59.82 %
Storage of IV fluids	17.86 %
Compare & contrast colloid	21.43 %



**Graph-2: Knowledge About Iv Fluids**

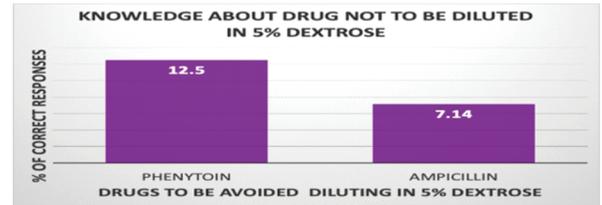
**4) Evaluation of knowledge about Drug dilution:-**

Certain questions were framed to assess the knowledge regarding the choice of correct IV fluid as a vehicle for diluting certain drugs. Less than 10% of students knew that normal saline should not be used for dilution of quinidine (5.36%) and vancomycin (6.25%). Antifungal antibiotic amphotericin B should not be diluted in normal saline was known by few (15.18%) students. Life-saving drug noradrenaline also should be diluted in 5% dextrose and not in normal saline was known by only (28.57%) students. (Graph No-3)



**Graph-3: Knowledge About Drug Dilution In Normal Saline**

Overall less than 13% of students knew that Phenytoin (12.5%) and Ampicillin (7.14%) should not be diluted in 5% dextrose but should be diluted in normal saline. (Graph No-4)



**Graph-4: Knowledge About Drug Dilution In 5% Dextrose**

**5) Evaluation of knowledge about clinical use of IV fluids :-**

Student's knowledge about the clinical use of IV fluids was evaluated using 10 various disease-related questions. The Correct response obtained for those 10 questions shown in table-3

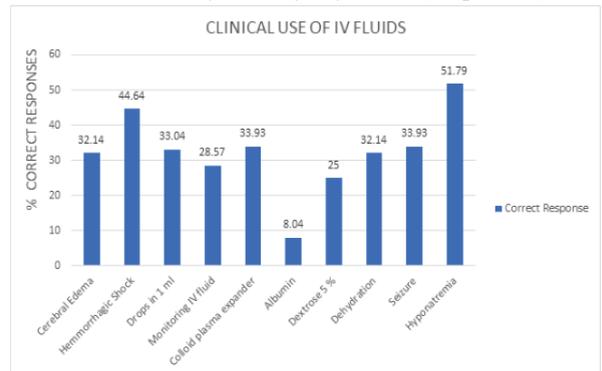
**Table No-3-CLINICAL USE OF IV FLUIDS**

CLINICAL USE OF IV FLUIDS	
Type of IV fluid used in Cerebral Edema	32.14 %
Type of IV fluid used in Haemorrhagic Shock	44.64 %
Calculation of no. drops in 1 ml	33.04 %
Best non-invasive method of Monitoring IV fluid	28.57 %
C/I of use of Colloid plasma expander	33.93 %
Indication of Albumin	8.04 %
Indication of Dextrose 5 %	25 %
Choice of IV fluid in Dehydration	32.14 %
Dose of IV fluid in Seizure due to hypoglycaemia in a new born	33.93 %
Correct tonicity to be used in Hyponatremia	51.79 %

Albumin is the safest and most commonly used colloid yet only 8.04% of students knew the correct indication for use of same. Similarly, only 25% of students knew the correct indication for 5% dextrose.

As regards to the correct choice of iv fluids in certain important clinical scenarios such as cerebral oedema, haemorrhagic shock, dehydration and hyponatremia only 32.14%, 44.64%, 32.14% and 51.76 % respectively knew the appropriate fluid to be used for rehydration and therapy.

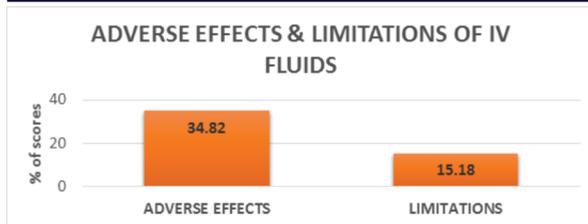
In clinical set up giving correct dose and monitoring of iv therapy is important but only 33.04% students knew the correct drip rate and 33.93% students possessed correct knowledge of dose of 10% dextrose in seizure due to hypoglycaemia in newborn. The best non-invasive method of monitoring is urine output this fact was known only by 28.57% of students. Knowledge regarding contraindications for use of plasma colloid expander is also important to avoid the serious adverse event. This was correctly known by only 33.93%. (Graph No-5)



**Graph 5: Correct responses for clinical use of intravenous fluid**

**6) Evaluation of adverse effects & limitations of iv fluids**

Only 34.82% of students that polyvinylpyrrolidone i.e. it interferes with the grouping and cross-matching of blood. Astonishingly a small proportion i.e. 15.18 % of the students knew the immediate corrective action for a simple adverse like phlebitis due to the intravenous therapy. (Graph No-6)

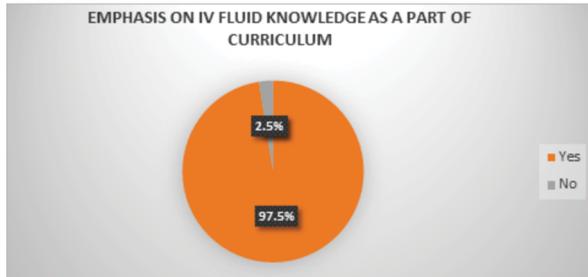


Graph 6 :- Adverse effects & Limitations of iv fluids

7) Attitude about IV fluid knowledge as a part of training

Table No-4 Attitude about IV fluid knowledge as a part of training

IV fluid knowledge as a part of training	
Yes	97.5
No	2.5



Graph no-7 IV fluid knowledge as a part of training

A total of 97.5% of students agreed that intravenous fluid knowledge (clinical ) needs to be emphasized in third MBBS as a part of training is necessary. (Graph No-7)

DISCUSSION:-

According to a prospective study conducted by Walsh, around 20% of general surgical patients suffered from complications related to inappropriate IVF prescription. (5)

In spite of previous studies highlighting similar concerns and the development of guidelines, it is worrying that knowledge around IV fluid requirements and prescribing remains so poor. (6)

This study was done in 200 third MBBS students highlight the fact that knowledge regarding IV fluid preparation was satisfactory.

A similar study was done in first year residents doctors tested the knowledge about the daily requirement of electrolytes, normal limits electrolytes, composition of intravenous fluids. Difference between third MBBS students and first year resident doctor is that they have completed one year rotation of internship where they might have obtained orientation. That study concluded that first year resident doctors have knowledge about IV fluids but still lack knowledge and understanding around key concepts of fluid and electrolyte management. This appears to be at least partly due to disregard towards the teaching of the topic at medical school and inconsistent training during the foundation years. (7)

In the current study, 59.82% of students gave correct response regarding the types of colloids & had detailed knowledge about colloids. Only 21.43% were able to compare & contrast about colloids & could not differentiate between two. No studies have assessed this yet, whereas other researchers Lobo, et al. assessed knowledge of the composition of common IV fluids especially crystalloids and principles that govern their use. The questionnaire that was framed by them included concepts based on minimum (obligatory) 24 h urine volume essential to excrete the solute load, sodium and potassium content of 0.9% saline, isotonic dextrose saline, Hartmann's solution and Gelofusine, Best serial measure of fluid balance(8). They did not focus on tonicity.

Tonicity is the capability of a solution to modify the volume of cells by altering their water content. Cells swell by gaining water (hypotonicity) or shrink by losing water (hypertonicity) through osmotic pressure differences between the intracellular compartment (IC) and the solution tested. Solutions are isotonic when the volume of cells suspended in them does not change by osmotic fluid transfers.

Disturbances in tonicity have clinical consequences. The brain is the site of the principal clinical manifestations of both hypotonicity and hypertonicity. The neurological manifestations of either hypotonicity or hypertonicity may result in irreparable deficits or death.

Consequently, proper management of disturbances in tonicity is critical and requires an understanding of the qualitative and quantitative aspects of their pathophysiological mechanisms. (9)

In clinical situations, solutions are usually described in terms of their tonicity rather than their osmolarity. An IV solution is said to be isotonic or hypotonic. More than half the number of students i.e. 61.07% gave correct response regarding the tonicity & use of fluids.

A lot of research is going on to decrease the wastage of IV fluids and decrease the economic burden on the hospital but in our study, we found 17.86% students were aware regarding the storage about IV fluids which may account to disastrous increase in the wastage of IV fluid and false increase in consumption. There aren't many studies that have assessed this part of knowledge in students which is an important aspect of pharmacoeconomics in resource limited settings.

Intense research studies and meta-analysis have suggested the use of crystalloids preferably over colloids due to a higher incidence of adverse effects with colloids.(10) Additionally in SAFE study researcher found that in patients in the ICU, use of 4% albumin is comparable with normal saline for fluid resuscitation with results had similar outcomes at 28 days. Albumin is the only natural colloid used for intravascular volume replacement in humans. (11)

Albumin is the safest and most commonly used colloid yet only 8.04% of students knew the correct indication for same. Similarly, only 25% of students knew the correct indication for 5% dextrose. These aspects are not studied by other researchers.

As regards to the correct choice of iv fluids in certain important clinical scenarios such as cerebral oedema, haemorrhagic shock, dehydration and hyponatremia only 32.14%, 44.64%, 32.14% and 51.76 % respectively knew the appropriate fluid to be used for rehydration and therapy.

The aptitude to use IV fluids in the clinical the setting was poor. This is supported by a study from Nottingham. This study showed that many prescribers had a poor understanding of physiological concepts and fluid electrolyte balance and, thus, inappropriate prescribing of IV fluid (8) This emphasizes the fact that third year students who later enrol for PG courses carry on with the lack of knowledge.

Prescribing and administering medications involves not only knowing what and when to give but also how much to administer. Knowing the dose calculation, dose of drug and infusion rate is important to lower the risk of potential medication errors and help doctors to administer the right amount of medicine to patients. (12)

In clinical set up giving correct dose and monitoring of iv therapy is important but only 33.04% students knew the correct drip rate and 33.93% students possessed correct knowledge of dose of 10% dextrose in seizure due to hypoglycaemia in new born. Similarly, According to data from the National Patient Safety Agency (NPSA), Dose calculation errors comprise 28.7% of all reported drug errors. (NPSA, 2007). (13)

The best non-invasive method of monitoring was known only by 28.57% of students.

Knowledge regarding contraindications for use of plasma colloid expander is also important to avoid the serious adverse event. This was correctly known by only 33.93%. Only 34.82% students that polyvinylpyrrolidone i.e. it interferes with the grouping and cross matching of blood.

The reported incidence of phlebitis in clinical practice ranges from 25 to 59%(14). Still, Astonishingly a small proportion i.e 15.18 % of the students knew the immediate corrective action for a simple adverse like phlebitis due to the intravenous therapy.

A study done by Cousin et al to determine medication errors in intravenous drug preparation and administration shows that the wrong

diluent was used in 1%, 49% and 18% of cases. (15) Systemic evidence review of intravenous admixture drug preparation errors says that selection of a wrong diluent solution was reported to have occurred with results varying across studies (~0% to 49.0%). (16)

As shown in the current study less than 10% of students know about the dilution of vancomycin & quinidine. & less than 13% of students know about the dilution of phenytoin and ampicillin.

Not only imparting knowledge regarding fluid use, fluid composition and monitoring important but also its use as diluent should be emphasized in the undergraduate curriculum.

A study was done in final year medical students by McCloskey et al, students expressed that teaching of fluid prescription varied considerably, not only within and between years but also across specialities & also insufficient vertical and horizontal integration of the teaching between and within years. (17)

A survey done in undergraduate medical textbooks by Powell and Dortmund showed that textbooks for undergraduates cover the topic of intravenous therapy badly, which may partly explain the poor knowledge and performance of junior resident doctors in intravenous fluid prescribing. (18)

In a study done by Mansour Tobaigy, et al in first year foundation doctors agreed that more extensive undergraduate education was required in clinical pharmacology and therapeutics. (19)

A very few theory lectures about intravenous fluid types and its clinical application are incorporated in the MBBS curriculum. In the current study also 97.5% student emphasizes the need for training of IV fluid not only for knowledge but also for its application.

A study done by Swayamprakasamet et al showed that after a single focused teaching session in first year junior resident doctors baseline knowledge of intravenous fluid therapy which was inadequate (36%) significantly improved (85%) and this knowledge was retained (79%) after 2-5 weeks. Inadequate teaching on intravenous fluids is believed to be responsible for poor baseline knowledge. (20) Prior research has shown the benefits of interventions such as lectures, workshops, teaching measures in improving the knowledge and application of IV fluids in doctors. (21,22,23)

## CONCLUSION

The present study shows that participants had an idea but lacked detailed knowledge about intravenous fluids. This was reflected in their responses to the questionnaire. Therefore providing detailed information about intravenous fluids and impart its practical application in form of case based scenario, discussions is utmost important to improve the knowledge among third MBBS students and to promote the accurate and proficient IV fluid prescribing.

**Funding:** No funding sources

**Conflict of interest -** The authors declare that there is no conflict of interest.

**Acknowledgements –** Authors would like to acknowledge the third MBBS students who participated in the study.

## REFERENCES :-

1. Lim, C. T., Dunlop, M., & Lim, C. S. (2012). Intravenous fluid prescribing practices by foundation year one doctors—a questionnaire study. *JRSM short reports*, 3(9), 1-7.
2. Lobo, D. N., Dube, M. G., Neal, K. R., Allison, S. P., & Rowlands, B. J. (2002). Perioperative fluid and electrolyte management: a survey of consultant surgeons in the UK. *Annals of the Royal College of Surgeons of England*, 84(3), 156.
3. National Confidential Enquiry into Perioperative Deaths 1997/1998, & Callum, K. G. (1999). Extremes of age: the 1999 report of the National Confidential Enquiry into Perioperative Deaths (pp. 35-44). NCEPOD.
4. National Institute for Clinical Excellence. (2013). Intravenous fluid therapy in adults in hospital. NICE clinical guideline, 174.
5. Walsh, S. R., & Walsh, C. J. (2005). Intravenous fluid-associated morbidity in postoperative patients. *Annals of the Royal College of Surgeons of England*, 87(2), 126.
6. Powell, A. G. M. T., Walker, V. C., Paterson-Brown, L., Clark, G., Drummond, G. B., & Paterson-Brown, S. (2013). Intravenous fluid prescribing knowledge and confidence in first year doctors. *The Bulletin of the Royal College of Surgeons of England*, 95(6), 1-6.
7. Lupi, M. M., Maweni, R. M., Shirazi, S., & Wali, U. J. (2019). Fluid and electrolyte balance—establishing the knowledge base of Foundation Year One doctors. *Irish Journal of Medical Science (1971-)*, 188(3), 1047-1055.
8. Lobo, D. N., Dube, M. G., Neal, K. R., Simpson, J., Rowlands, B. J., & Allison, S. P. (2001). Problems with solutions: drowning in the brine of an inadequate knowledge base. *Clinical Nutrition*, 20(2), 125-130.
9. Christos, Argyropoulos, Rondon-Berrios Helbert, Dominic S. Raj, Malhotra Deepak, Emmanuel I. Agaba, Mark Rohrscheib, Khitan Zeid, Glen H. Murata, Joseph I. Shapiro,

- and Antonios H. Tzamaloukas. "Hypertonicity: Pathophysiologic Concept and Experimental Studies." *Cureus* 8, no. 5 (2016).
10. Lewis, S. R., Pritchard, M. W., Evans, D. J., Butler, A. R., Alderson, P., Smith, A. F., & Roberts, I. (2018). Colloids versus crystalloids for fluid resuscitation in critically ill people. *Cochrane Database of Systematic Reviews*, (8).
11. SAFE Study Investigators. (2004). A comparison of albumin and saline for fluid resuscitation in the intensive care unit. *New England Journal of Medicine*, 350(22), 2247-2256.
12. Gage, C. B., & Toney-Butler, T. J. (2019). Dose Calculation. In: *StatPearls* [Internet]. StatPearls Publishing. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK430836/>
13. National Patient Safety Agency (Great Britain). National Reporting and Learning Service. (2009). Safety in Doses: Improving the Use of Medicines in the NHS. National Patient Safety Agency. [Internet]. [Patientsafetyoxford.org](https://www.patientsafetyoxford.org). 2020 [cited 12 February 2020]. Available from: <https://www.patientsafetyoxford.org/wpcontent/uploads/2018/03/NPSA-DetiorPatients.pdf>
14. Tagalakis, V., Kahn, S. R., Libman, M., & Blostein, M. (2002). The epidemiology of peripheral vein infusion thrombophlebitis: a critical review. *The American journal of medicine*, 113(2), 146-151.
15. Cousins, D. H., Sabatier, B., Begue, D., Schmitt, C., & Hoppe-Tichy, T. (2005). Medication errors in intravenous drug preparation and administration: a multicentre audit in the UK, Germany and France. *BMJ Quality & Safety*, 14(3), 190-195.
16. Hedlund, N., Beer, I., Hoppe-Tichy, T., & Trbovich, P. (2017). Systematic evidence review of rates and burden of harm of intravenous admixture drug preparation errors in healthcare settings. *BMJ open*, 7(12), e015912.
17. McCloskey, M., Maxwell, P., & Gormley, G. (2015). Learning fluid prescription skills: why is it so challenging?. *The clinical teacher*, 12(4), 250-254.
18. Powell, A. G., Paterson-Brown, S., & Drummond, G. B. (2014). Undergraduate medical textbooks do not provide adequate information on intravenous fluid therapy: a systematic survey and suggestions for improvement. *BMC medical education*, 14(1), 35.
19. Tobaigy, M., McLay, J., & Ross, S. (2007). Foundation year 1 doctors and clinical pharmacology and therapeutics teaching. A retrospective view in light of experience. *British journal of clinical pharmacology*, 64(3), 363-372.
20. Swayamprakasam, A. P., Bijoer, P., Khalid, U., Rana, M. S., Boulton, R., & Taylor, A. (2014). A simple and effective strategy for improving junior doctors' knowledge of intravenous fluid therapy. *Clinical Audit*, 6, 1.
21. Allenby-Smith, O. C., Alexander, R. J., Moffat, C. E., & Carty, N. J. (2008). Back to basics: the impact of teaching on intravenous fluid prescribing. *Journal of evaluation in clinical practice*, 14(3), 477-479.
22. Awad, S., Allison, S. P., & Lobo, D. N. (2008). Fluid and electrolyte balance: the impact of goal directed teaching. *Clinical Nutrition*, 27(3), 473-478.
23. Weisgerber, M., Flores, G., Pomeranz, A., Greenbaum, L., Hurlbut, P., & Bragg, D. (2007). Student competence in fluid and electrolyte management: the impact of various teaching methods. *Ambulatory Pediatrics*, 7(3), 220-225.