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Drug Dosage Calculation Abilities amongst Doctors in a Tertiary Care Hospital in India

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Abstract

Introduction: Medication errors play a major role in world today. International studies have been done which found incorrect dosage calculation was the most common medication error. *Objective:* The objective of the study was to assess the ability of drug dose calculation abilities among doctors in a tertiary care hospital in India. *Method:* It was a prospective, questionnaire based study during the year 2014-2015. Doctors from different specialities were involved. *Result:* 70 doctors completed the questionnaire. The mean actual score on the test was 74.8% (95% CI, 68.6%–81.1%). It was found that senior & doctors of emergency & critical care specialities scored better than others. *Conclusion:* Drug dose calculation abilities were found to be overall lower than expected. So training in this field is recommended for the benefit of patients.

Keywords: Drug; Medication; Critical Care; Tertiary Care.

Background

Medication errors are a great concern in healthcare in world today. Many international studies have been done which found that drug complications were the most common cause of adverse events. Among the causes of these adverse events, incorrect dosage calculation was the most common.

Patients come to a hospital with expectation to get cured. Of course it is not expected that all patients will get well. There will always be morbidity and mortality; that's nature. But it is a matter of serious concern if that morbidity and mortality is due to a preventable cause and Incorrect Dosage of Medicine being delivered to a patient is very much a preventable cause.

There had been very less number of studies regarding dosage calculation abilities among doctors in India. According to a latest news report, India has recorded around 5.2 million injuries per year due to medical errors and adverse effects. Among these errors, one of the most common errors is due to medication errors which include the wrong dose delivered to the patients.

Thus, a study on drug dosage calculation abilities in India can help us in giving an overview of the problem, if any persists, and help us making the required change in due course to improve our overall outcome.

Objective

To assess the ability of drug dose calculation abilities among doctors in a tertiary care hospital in India.

Material and Methods

The study was conducted during the year 2014-2015 in a tertiary care hospital in India. It was a prospective, observational multiple choice questionnaire based study. The focus of the study was to determine the competency of the doctors in drug dosage calculation abilities through a multiple choice

questionnaire. The questionnaire was obtained designed to be a descriptive analytical survey.

The questionnaire was distributed randomly among physicians of different specialties, age group and experience. With due permissions from the HODs, questionnaires were provided to the doctors at various time interval without their prior knowledge. Calculators will be allowed for calculation of dosage.

Only psychiatrists were kept out of the loop as the questionnaire focuses on the emergency resuscitation scenarios that are comparatively less common in psychiatric practice. The sample size that was recruited for this study was calculated with the help of Raosoft sample size calculator.

All variables were examined using IBM SPSS Statistics, Version 22 for missing values, outliers and accuracy of data entry. One sample *t* tests were used to detect any significant difference in mean actual scores. For categorical data, the Chi-square test was used to detect differences in proportions. This test was used as the test for association of various characteristics of Specialty with different self-evaluation techniques. An α value less than 0.05 was deemed statistically significant.

Results and Analysis

91% of participants never had formal testing of their drug-dose calculation skills. 39% of participants indicated they need to calculate a drug dose 1X/Day. 77% said they usually double-check their own drug-dose calculations. The 9% of participants had another staff member check their calculated doses. 25% participants felt that they had inadequate training regarding the skill of drug dosage calculation. 49% participants reported that they have made drug dose calculation errors at their workplace.

Pearson's Chi-square test was used as the test for association of various workplace prescribing habits with Specialty. There were statistically significant association were found between specialty and the participants who calculate the drug dose per day, weekly and monthly ($P<0.05$). Similarly, the participants who recheck the dose with second person was statistically significantly associated with specialty ($P < 0.05$). Majority of participant reported that they never formally tested or had any training in drug dosage calculation ($P < 0.05$).

Table 1: Demographic characteristics of the study population (N=70)

	No.	**% of total**
Age		
20-30	31	44%
30-40	32	46%
>40	7	10%
SEX		
Male	44	63%
Female	26	37%
EXPERIENCE_in_YRS		
Junior (3 years) (n = 41 (59%))		
1 Yr	14	20%
2 Yrs	17	24%
3 Yrs	10	14%
Senior (> 3 years) (n=29 (41%))		
4 Yrs	4	6%
>5 Yrs	25	36%
SPECIALITY		
Critical care (n=37 (53%)		
EMERGENCY	28	40%
CRITICAL CARE & ANAESTHESIA	9	13%
Non-critical care (n=33 (47%))		
MEDICINE	11	16%
SURGERY	12	17%
PEDIATRICS	10	14%

Table 1 analysed the demographic characteristics of the study population which revealed-

Table 2: Drug-dose calculation test and answers, and percentage of doctors who answered correctly

Question	Answer	% correct (n = 70)
1: Lignocaine is available in 20ml vials of 1%. How much ligoncaine, in milligrams, is in the vial?	200 MG	63%
2: Supposing the maximum safe dose of lignocaine is 3mg/kg. What is the maximum safe volume, in ml, of 2% lignocaine solution to be given to a 80kg patient for suturing?	12ML	71%
3: How many ml of 1:10000 solution would you need to obtain 1 mg of adrenaline?	10 ML	71%
4: On attending a cardiac arrest patient of a 70 yr old male, how many ml of 1:1000 adrenaline do you need to give a dose of 1 mg of adrenaline?	1 ML	66%
5: A 4 year old on your ward is in cardiac arrest. He weighs around 16 kgs. The dose of intravenous adrenaline in paediatric arrest is 10mcg/kg. How many ml of 1:10000 will you need to draw up for a single dose?	1.6 ML	77%
6: You plan to sedate a 25 kg child with midazolam. A vial of midazolam has 15 mg in 3 ml. The intravenous sedation dose of midazolam for children is 0.1mg/kg. How many ml will you need to draw up?	0.5 ML	70%
7: During rapid sequence intubation of a patient of 70 years, Succinylcholine injection is ordered. The patients weight is 60 kgs. Dosage of succinylcholine is 1.5mg/kg. What is the dose of injection succinylcholine to be given to the patient?	90 MG	84%
8: A vial of 10ml contains 1mg atropine. What is the concentration, in mg/ml, of this solution?	0.1 MG/ML	76%
9: A 45 kg female patient develops symptomatic bradycardia. You elect to treat this patient with atropine, 20 mcg/kg, given intravenously. How many ml of atropine (1mg in 10 ml) will be required?	9 ML	81%
10: A 50 kgs gentleman needs to given injection mannitol over 30-60 mins. Dosage of mannitol is 1.5g/kg. Vial of mannitol available contains 20g in 100ml. How much ml is to be given to the patient intravenously?	375 MG	89%

Table 2 analysed drug-dose calculation test and answers, and percentage of doctors who answered correctly. It revealed-

Table 3a: analysed mean of scores achieved by participating doctors (actual score)

	Actual score (Mean Score)		P Value	Confidence Interval (95%) Lower	Upper
Total	74.86	(3.13)	< 0.001	68.60	81.11
Sex					
Male	77.04	(3.51)	< 0.001	69.97	84.12
Female	71.15	(6.03)	< 0.001	58.73	83.58
Seniority of doctor					
Junior (≤3 years)	74.39	(3.81)	< 0.001	66.69	82.09
Senior (> 3 years)	75.52	(5.40)	< 0.001	64.45	86.59
Specialty					
Critical care (n = 37)	77.57	(4.27)	< 0.001	68.91	86.23
Emergency	76.79	(5.04)	< 0.001	66.44	87.12
Critical Care & Anaesthesia	80	(8.33)	< 0.001	60.78	99.22
Non-critical care (n = 33)	71.82	(4.64)	< 0.001	62.38	81.26
Medicine	74.55	(5.29)	< 0.001	62.77	86.32
Surgery	52.50	(8.89)	< 0.001	32.94	72.06
Pediatrics	92 (2.49)		< 0.001	86.36	97.64

Table 3b: Mean of scores achieved by participating doctors (actual score)

	Actual Score	Mean Score	P Value	Confidence Interval (95%) Lower	Upper
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Male	77.04	(3.51)	< 0.001	69.97	84.12
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Surgery	52.50	(8.89)	< 0.001	32.94	72.06
Paediatrics	92	(2.49)	< 0.001	86.36	97.64

Table 3 analysed– Mean scores achieved by participating doctors –

Table 4: Workplace prescribing habits of the study population (n = 70)

Habits	No.	% of total
How often do you need to calculate a drug dose?		
>2X/DAY	25	35.7
1X/DAY	27	38.6
WEEKLY	14	20.0
MONTHLY	2	2.9
NEVER	2	2.9
Have you ever made a drug dose calculation error?		
YES	34	48.6
LIKELY	22	31.4
POSSIBLE	13	18.6
UNLIKELY	1	1.4
When calculating drug dosage do you recheck your own calculations?		
ALWAYS	13	18.6
MOSTLY	34	48.6
SOMETIMES	21	30.0
HARDLY	2	2.9
When calculating drug dosage do you recheck the dose with a second person?		
ALWAYS	6	8.6
MOSTLY	26	37.1
SOMETIMES	31	44.3
HARDLY	7	10.0
How often are you formally tested or have you had any training in drug dosage calculation?		
ONCE	6	8.6
NEVER	64	91.4
Do you feel you have had adequate training regarding the skill of drug dosage calculation?		
NONE	3	4.3
POOR	14	20.0
AVERAGE	39	55.7
GOOD	14	20.0

Table 4 analysed- Work Place Prescribing Habits –

Table 5: Workplace prescribing habits by Specialty

Workplace prescribing habits	Specialty					P-Value
	Medicine	Surgery	Pediatrics	Emergency	Critical care and Anesthesia	
Recheck own calculations during calculating the drug dosage						
Always	9.1%	0.0%	20.0%	28.6%	22.2%	0.5
Mostly	63.6%	50.0%	60.0%	35.7%	55.6%	
Sometimes	18.2%	50.0%	20.0%	32.1%	22.2%	
Hardly	9.1%	0.0%	0.0%	3.6%	0.0%	
Calculate a drug dose						
>2X/DAY	18.2%	8.3%	100.0%	32.1%	33.3%	**< 0.05**
1X/DAY	36.4%	50.0%	0.0%	39.3%	66.7%	
WEEKLY	36.4%	41.7%	0.0%	17.9%	0.0%	
MONTHLY	9.1%	0.0%	0.0%	3.6%	0.0%	
NEVER	0.0%	0.0%	0.0%	7.1%	0.0%	
Made a drug dose calculation error						
YES	45.5%	50.0%	60.0%	42.9%	55.6%	0.3
LIKELY	27.3%	50.0%	30.0%	25.0%	33.3%	
POSSIBLE	18.2%	0.0%	10.0%	32.1%	11.1%	
UNLIKELY	9.1%	0.0%	0.0%	0.0%	0.0%	
Recheck the dose with a second person						
ALWAYS	0.0%	0.0%	0.0%	21.4%	0.0%	**< 0.05**
MOSTLY	36.4%	33.3%	0.0%	42.9%	66.7%	
SOMETIMES	54.5%	58.3%	70.0%	32.1%	22.2%	
HARDLY	9.1%	8.3%	30.0%	3.6%	11.1%	
Formally tested or had any training in drug dosage calculation						
ONCE	0.0%	0.0%	0.0%	21.4%	0.0%	**< 0.05**
NEVER	100.0%	100.0%	100.0%	78.6%	100.0%	

Table 5 analysed– Work Place habits according to Speciality

Discussion

It is important to have these types of surveys from time to time where we can try to fathom the

Drug dose calculation abilities among doctors, the doctors will also be alert regarding the same and the institution will try to formulate some sort of teaching in this field in any forms like CME. Above all the morbidity and mortality of patients will come down due to this preventable error.

This was a prospective, observational study done in a single tertiary care centre. A multiple choice questionnaire was used along with 5-point Likeart scale. Where it was found that the mean actual score achieved by the doctors of varied specialities was 74.9%. Among critical care specialists, we found that they had an actual mean score of 80% compared to that of emergency physicians 76.79%.

Among other specialities, it was found that paediatricians did the best with 92% actual score and this was also confirmed by the finding that they were the most to calculate (100%, >2times/day) and mostly recheck their own calculation (60%) thus probably helping them in making least number of mistakes during dose calculation. More than 60% of internists and paediatricians confirmed that they rechecked their own calculation and less than 35% emergency physicians re An U.K study found that doctors generally had poor level of skill in calculating drug doses [3,4]. This probably will lead to more errors and hence can lead to more medico legal consequences. In an USA study it was found that 83% of 175 respondents believed prescribing errors were unacceptable and should not occur [5]. When it came to differentiate in accordance to the seniority of doctors which was based on years of experience it was found that seniors fared better than the juniors and this was similar to the studies previously done in Australia [1] and U.K [2] checked their own calculations.

In this study, it was very encouraging to know that majority of the participants accepted to have made drug dose calculation error with medicine (45%), surgery (50%), paediatrician (60%), emergency (42.9%) and critical care (55.6%).This helps us to understand that we do make mistakes and probably we need to have some type of training to help in reducing our calculation errors and creating a safer environment to treat our patients. It is still difficult to know and understand if our results truly reflect better workplace practice in India. Most doctors (77%) said they "mostly" or "always" double-check their own drug-dose calculations. The 9% of participants who stated they always had another staff member check their calculated doses performed worst in the calculation test. It was also very interesting to note that emergency physicians "always" and "mostly", 21.4% and 42.9% respectively checked their calculations with second person, thus showing that they are aware of their limitations and willing to check through twice with another to have least mistakes as possible. In this today's world of technology only 54% of the participants reported that they used mobile applications in dosage calculations and around 70% used internet sources like Google, and 67% used drug formulary books.

Some may say that a written test is a poor predictor of the true performance of doctors in acute medical scenarios. However participants who show poor calculation skills in a written examination are likely to perform even more poorly under stressful conditions. It is a huge concern to know that 91% of the participants have never had training in drug dose calculation abilities during their careers and as a student in college, suggesting that this skill assumed. This is significant and it has a huge impact in our drug dose calculation abilities.

The study had number of limitations. It cannot exclude of selection bias but the response rate was high. It had few missing data. It also had calculated a sample size target of 130 but it was not possible to get all participants as quite a few participants have declined to do the study. It also had set a time limit, keeping in mind the acute medical scenarios, but it was not possible at all time to be done within time limit by the participants. Finally, it was not possible to access whether the calculation errors would have led to clinical errors and invariably patient outcomes.

Conclusion

The study showed that we need to improve our dose calculation skills overall. It also showed that junior doctors and doctors of specialities excluding paediatrician need to improve calculation abilities. We recommend that to reduce the medication calculation errors over all there needs to some sort of training to help better our calculation skills. This way the skills of every individual doctor irrespective of their specialities can improve in drug dose calculation abilities. That way we can decrease one of the preventable errors and thus decrease the preventable morbidity and mortality of patients who come in to a hospital with lots of hope.

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