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A study to assess the impact of clinical pharmacist intervention on administration of selected antimicrobials by nurses in a tertiary care hospital in south India

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ABSTRACT

Reconstitution of injectable antimicrobials, storage after reconstitution and dilutions by nurses are very important as errors in these processes can not only lead to negative outcomes of treatment but also promote the development of antimicrobial resistance. Our study aimed to analyze the impact of clinical pharmacist intervention on the administration of selected antimicrobials by nurses. One-group pre-test post-test experimental study was conducted for a 6 month period among nursing professionals in a tertiary care hospital using a validated KAP questionnaire comprising questions to assess knowledge, practice and attitude level of the respective nurses regarding selected antimicrobials. Study population comprised of 106 nurses. Majority (54.7%) were Diploma holders and rest degree holders in nursing. On analyzing the years of experience of study sample, it was found that majority had 1-5 years' experience (61.3%) followed by 5-10 years (23.6%) and least percentage had experience for more than 15 years. Pre-test value shown that most of the nurses had poor score in knowledge, average score in attitude and excellent score in practice domains related to the antimicrobials studied. After clinical pharmacist intervention, there was a statistically significant improvement in all the three domains ($p<0.001$).But there was no association with the selected variables like educational level or years of experience ($P>0.05$).The study highlighted the importance of continue education programs for the nurses related to antimicrobials by clinical pharmacists as there were a statistically significant improvement in all three domains after intervention irrespective of educational back ground or years of experience.

INTRODUCTION

Antimicrobials are the widely used pharmaceutical agents for curing various infectious conditions. They include antibacterial, antiviral, antifungal and anti-parasitic agents. Among these antibacterial are the most commonly used categories. [1] The golden era of antibiotics begin from the introduction of penicillin. Antibiotics are class of drugs that are used for targeting bacterial infections and are ineffective in the management of viral infections.[2]

The efficacy of the antimicrobial therapy depends on pharmacokinetic (PK) and pharmacodynamic parameters (PD). The PK and PD evaluation help in determining best dosing regimens for new agents and to analyze the adequacy of existing dosing regimens of already marketed agents. The pharmacokinetic process involves absorption distribution metabolism and excretion (ADME) of a drug .And these process is influenced by several physiochemical factors of the drug and its transportation across cell membrane. The physiochemical properties involve molecular size, shape, and degree of ionization, lipid solubility and capability of binding to tissue protein. The time- course of a drug is determined by the ADME of the drug similarly the effect of the drug is attained when its concentration exceed the minimum effective concentration.[3]

Bactericidal activity is either concentration or time dependent. Area under the plasma concentration time curve

(AUC) measures how much concentration and how much time is required for the antibiotic to remain above the MIC level. Betalactum antibiotics like pencillins, cephalosporins, carbapenems, monobactums, Macrolides like erythromycin, azithromycin, clarithromycin and, clindamycin, oxazolidinones (linezolid) are considered as the time dependent antibiotics whereas, aminoglycosides and fluroquinolones are the concentration dependent antibiotics. The efficacy of time dependent antibiotics relays on how much time the antibiotic remains in the body, while the efficacy of latter depends on the concentration of antibiotics attained in the body.[4]

Antibiotics are designed to eradicate bacteria but the sharpness of this weapon loses overtime and lead to emergence of antibiotic resistance. Increased antimicrobial resistance is a major cause for several infections, increased hospitalization, and mortality. Several factors include: inappropriate prescribing, easy availability of antibiotics, Lack of skilled practitioners from manufacture till the administration in patients, overuse of antibiotics and unhygienic procedures.

Intravenous infusion therapy is the most commonly opted administration route of antibiotics. There are certain factors to be considered while adopting the infusion therapy. The antimicrobials are marketed either as dry powder form or as solutions. The dry powdered medicines have to be reconstituted with suitable diluents. Stability of the administering drug after reconstitution, Incompatibilities associated with the drug and the diluents or Y-site incompatibilities, duration of administration.[5]

It is found that some products are stable for a few hours only after dilution while some are stable for as long as a month without losing its therapeutic potency. It is important to understand the stability of the reconstituted solutions before usage and usage beyond the stated period reduce their effectiveness and thereby diminishing their therapeutic response. Most of them are stable at room temperature as well as refrigerated, exceptions like antivirals (acyclovir and ganciclovir) which loses its stability when the reconstituted solutions are stored in refrigerator. In case of ceftazidime the constituted solutions should be used immediately as it darkens in colour on storage.[6]

Medication administration errors occur while during infusions which is nowadays a leading problem. Intravenous medicines have greater threat as it requires considerations for preparation, administration, storages etc. There are procedural and clinical errors for infusion therapies. Procedural failures includes failure to check the patients details (patients name, age, sex, date of birth), not identifying the drug labels, storage conditions of the intravenous drugs that is storing in the nursing stations, failure to record the medicine administration in the medication chart, not following proper hygienic precautions like sanitizing the hands before and after drug administration, failure to check the preparation of antimicrobials. [7]

Clinical intravenous errors include Wrong rate of infusion (administration of intravenous medicines at a faster rate than the prescribed timing example, giving time dependent antimicrobials as bolus), Wrong usage of mixtures (inappropriate diluents, solvents),Wrong volume of diluent/solvent(utilizing wrong volume of dilution fluids which can deteriorate the drugs stability),incompatibilities with drugs (if two incompatible drugs administered in the same infusion bag e.g. administrating cefoperazone /sulbactam with amikacin).[8] These medication errors can affect patients quality of life ,treatment cost, prolonged length of stay. Medication errors can be caused any one from prescriber to the endorser in the chain.[9]

The errors during administration of drugs can lead to either therapeutic failure or decreased efficacy. Here, nurses are playing an important role. Any errors during the handling or administration of the antimicrobial agents by the staff nurses may diminish the effect. Such errors can occur during the handling, reconstitution and administration of the antimicrobials. This may be due to the lack of awareness about the proper handling and administration of the agents. Different antimicrobial agents require different temperatures conditions and stability characteristics. They differ from each other in case of the reconstituted fluids, incompatibilities during 'Y' site administration etc. It may not be possible for them to study the characteristic features of these agents due to their busy schedules. But such unawareness can contribute to therapeutic failure.

Antibiotic resistance is a global threat and it is the need of the hour to preserve the efficacy of the existing antibiotics as the pharmaceutical companies are not interested to bring new antibiotics into the market due to the lack of ensured return of their expenditure behind it before developing resistance to it. To preserve the efficacy of currently used antibiotics various strategies have been developed and antibiotic stewardship ranks first among these. Though a number of research works have been carried out around the globe to reduce the medication errors from prescriber level to the endorser level the studies about administration of antibiotics by nurses especially during reconstitution of dry powder injections, its storage is limited. Knowledge attitude and practice of nursing staff about antibiotic handling need to be improved for preventing the actual or potential errors which can occur while reconstituting, administering or storing after reconstitution.

So, through this study, our main aim is to identify the knowledge level of staff nurses regarding the reconstitution, stability, storage requirements and administration of antimicrobial agents. From this, it is possible to find the errors which may occur during the handling and administration of antimicrobial agents by the nurses. By identifying these, they can be provided with adequate information regarding the handling, reconstitution and administration of the agents along with emphasizing on the need of practicing continuous intravenous infusion of time dependent antibiotics to ensure better therapeutic efficacy and controlling the emergence of antibiotics resistance.

METHODOLOGY

One-group pre-test post-test Experimental study was conducted for a period of six months in a 600 bedded multi-speciality tertiary care hospital with the help of Pre-validated questionnaire comprising of knowledge(15), attitude(12) and practice(9) domains. Each correct answer was assigned with 1 mark with no negative marking for wrong answers. The practice level of the samples was directly observed by the researchers and recorded in a specially designed data collection form.

The study comprised three phases: Pre test phase, intervention phase and post -test phase. Pre-test phase was conducted by using specially designed KAP questionarie. The initial performance was assessed and areas of improvement were identified. After the assessment, educational intervention was carried out in the forms of lectures regarding different aspects of antibiotic infusion therapy including its reconstitution, storage, dilution, incompatabilities. One month after the intervention phase, post-test was performed by administering the same KAP

questionnaire. The collected data was compiled and analyzed using statistical softwares and SPSS .Paired t-test was employed to analyse the significance of clinical pharmacist intervention. Association between selected variables on knowledge, attitude and practice was determined by chi-square test.

RESULT

The study sample comprised of 106 nurses. Among the 106 samples, about 54.7% fall in the GNM category, 39.6 % in Bachelor's degree holders and 5.7% in Post BSC based on their educational background. On analyzing the age of study sample it was found that age ranged from 26- 30years constitute about 38.7% , 21-25years about 33% followed by 22.6% of 31-35 years of age. Least number of study sample were aged between 41-45 years. On analyzing the years of experience of study sample ,it was found that majority were having 1-5 years' experience (61.3%) followed by 5-10 years of experience(23.6%) and least percentage of study sample had experience for more than 15 years.[table 4.01]

Table 1 : Demographic variables of the study sample

		Frequency	Percentage
QUALIFICATIONS	BSC	42	39.6
	GNM	58	54.7
	POST BSC	6	5.7
AGE IN YEARS	21-25	35	33.0
	26-30	41	38.7
	31-35	24	22.6
	36-40	4	3.8
	41-45	2	1.9
EXPERIENCE IN YEARS	<1	8	7.5
	1-5	65	61.3
	5-10	25	23.6
	10-15	5	4.7
	15-20	3	2.8

Table 2 : Comparison of pre-test and post-test levels of knowledge, attitude and practice domains regarding anti-microbial administration

DOMAINS		Pre-test		Post-test		P-value
		Freq.	%	Freq.	%	
KNOWLEDGE LEVEL	Poor	60	56.6	12	11.3	P<0.001
	Average	33	31.1	29	27.4	
	Good	13	12.3	32	30.2	
	Excellent	0	0.0	33	31.1	
ATTITUDE LEVEL	Poor	27	25.5	5	4.7	P<0.001
	Average	41	38.7	25	23.6	
	Good	33	31.1	46	43.4	
	Excellent	5	4.7	30	28.3	
PRACTICE LEVEL	Poor	5	4.7	2	1.9	P<0.001
	Average	10	9.4	1	0.9	
	Good	22	20.8	5	4.7	
	Excellent	69	65.1	98	92.5	

There is statistically significant improvement from Pre test level knowledge, attitude, practice to Post test level knowledge, attitude, practice with p value (P<0.001) in paired t-test.

Comparison of association of baseline variables with Knowledge, Attitude and Practice Levels.

KNOWLEDGE LEVEL DOMAIN

Association of knowledge with selected baseline variables of staff nurses

Table 3 : Statistical analysis of knowledge with selected baseline variables

		Pre level of knowledge			χ2	df	*p-value*
		Poor	Average	Good			
Qualification	BSc.	23	13	6	1.74	4	0.78
	GNM	34	17	7			
	P-BSc	3	3	0			
Age in years	21 - 25	21	12	2	10.09	8	0.259
	26 - 30	25	10	6			
	31 - 35	11	10	3			
	36 - 40	2	0	2			
	41 - 45	1	1	0			
Experience in years	< 1	6	2	0	5.397	8	0.714
	1-5	38	20	7			
	5-10	12	8	5			
	10-15	3	2	0			
	15-20	1	1	1			

ATTITUDE LEVEL DOMAIN

Association of attitude with selected baseline variables of staff nurses

Table 4 : Statistical analysis of attitude with selected baseline variables

		Pre level of attitude				χ2	df	*p-value*
		Poor	Average	Good	Excellent			
Qualification	BSc.	5	20	14	3	8.686	6	0.192
	GNM	19	20	17	2			
	P-BSc	3	1	2	0			
Age in years	21 - 25	9	13	12	1	13.287	12	0.349
	26 - 30	8	19	11	3			
	31 - 35	9	6	9	0			
	36 - 40	1	1	1	1			
	41 - 45	0	2	0	0			
Experience in years	< 1	2	4	2	0	12.153	12	0.433
	1-5	18	25	18	4			
	5-10	6	8	11	0			
	10-15	1	2	2	0			
	15-20	0	2	0	1			

PRACTICE LEVEL DOMAIN

Association of practice with selected baseline variables of staff nurses

Table 5 : Statistical analysis of practice with selected baseline variables

		Pre level of practice				$\chi 2$	df	*p-value*
		Poor	Average	Good	Excellent			
Qualification	BSc.	1	1	9	31	7.796	6	0.253
	GNM	4	8	13	33			
	P-BSc	0	1	0	5			
Age in years	21 - 25	2	3	8	22	10.62	12	0.562
	26 - 30	2	2	9	28			
	31 - 35	1	4	4	15			
	36 - 40	0	0	0	4			
	41 - 45	0	1	1	0			
Experience in years	< 1	1	0	1	6	14.58	12	0.265
	1-5	4	5	16	40			
	5-10	0	2	3	20			
	10-15	0	2	1	2			
	15-20	0	1	1	1			

On analyzing association between selected variables with knowledge, attitude and practice levels using chi-square test showed the p-value greater than 0.05,so there is no statistically significant difference with respect to qualification, years of experience or age of the study sample.

DISCUSSION

This study was conducted to assess the impact of clinical pharmacist intervention among staff nurses regarding the antibiotic infusion. This study results demonstrated an increase in knowledge ,attitude and practice level of nurses regarding antibiotics infusions after clinical pharmacist intervention (P<0.001). This finding is similar to a pre-post interventional study conducted by Marwa Ali Tahoon et al in the surgical department and ICU in Egypt to assess the effect of educational intervention on healthcare provider's knowledge, attitude and practice towards antibiotic stewardship program. [8] A study conducted by Meera Nk et al to assess the role of clinical pharmacist in nursing education and to evaluate knowledge and attitude of practicing nurses on medication administration and medication errors in a tertiary care hospital in Bangalore. The result of the study shown impact of educational intervention on improvement in the score from pre to post test was significant (p value 0.001) emphasizing that the educational intervention was beneficial and effective. Also the knowledge attitude and practice were not influenced by variables like age, educational qualification and year of experience. [9]

This study also indicated that there is no association between selected variables (age, years of experience, qualification) with knowledge, attitude and practice level of nurses(P>0.05). This findings is similar to a descriptive study done by Ms.Rekha Kumari in Haldwani Uttarakhand among staff nurses to assess the knowledge regarding the use of antibiotics which concluded that there was no significant association between the knowledge score with demographic variables.[10] The study period was limited to 6 months remained the major limitation of our study.

CONCLUSION

This study highlights the need for including topics of appropriate reconstitution; storage and administration of injectable antimicrobials in the routine continue education programmes of nursing care staff. It is the need of the hour as there was no association between the levels of education or years of experience and their scores in all the three domains of knowledge, attitude and practice related to handling of injectable antimicrobials and the fact that sharpness of antimicrobial will fade due to inappropriateness in any of these activities. Clinical pharmacists working in association with clinicians and nursing care team can definitely play a key role to update the knowledge related to pharmaceutical products to nursing care staff. This implies the essentiality of clinical pharmacist activities in health sectors and thereby enhancing the calibre of health-care team.

Conflicts of Interest: No conflict of interest

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