

Clinical Interventions of Critical Care Pharmacist in the Therapeutic Management of Critically Ill Patients: a Retrospective Study in Bangladesh

Md Jahidul Hasan¹, Raihan Rabbani² and Sitesh C Bachar³

¹Clinical Pharmacy Services, Department of Pharmacy, Square Hospitals Ltd., 18/F, Bir Uttam Qazi Nuruzzaman Sarak, West Panthapath, Dhaka-1205, Bangladesh

²Internal Medicine and ICU, Square Hospitals Ltd., Dhaka, Bangladesh

³Department of Pharmacy, University of Dhaka, Bangladesh

(Received: February 17, 2019; Accepted: May 27, 2019; Published (Web): June 30, 2019)

ABSTRACT: Critically ill patients at ICU are treated with poly pharmacy and conservative drug management is necessary for ensuring drugs' safety and accuracy. The objective of this study was to analyze the qualitative intervention of critical care pharmacists (CCP) in critically ill patients' effective medication management. This was a 6 months long observational study. All the provided suggestions of CCP were categorized into- A (drug-drug interaction), B (addition of new drug therapies), C (rational dosing of antibiotics), D (acceleration or deceleration of the doses) and E (adverse drug reaction). Out of total CCP's 650 suggestions, 566 (87.08%) suggestions were accepted by doctors and modified the therapies, accordingly. CCP being a part of ICU's multi professional team contribute the professional roles in generating safe, appropriate and quality prescriptions, which finally turns into quality pharmacotherapy for critically ill patients at ICU.

Keywords: Critical Care Pharmacist; Intensive Care Unit; Critically ill patients; Multi professional team

INTRODUCTION

The perception of taking special care for critically ill patients firstly introduced in 1954, by Florence Nightingale during the Crimean War.¹ In 1954, first multidisciplinary intensive care unit (ICU) was established in USA.² Critical care pharmacy service, as a core clinical pharmacy profession, began around 1970s.³ The clinical pharmacists of ICU, also known as, Critical care pharmacists (CCP), is one of the most useful and supporting persons in the ICU team, and a CCP is a trained specialist of ICU's conservative pharmaco-therapies, pathophysiology of critical diseases and pharmacokinetics/pharmacodynamics of drugs. They have amalgamated clinical knowledge and practical experience on effective poly-medication therapy for critically ill patients and

being a core ICU team member, CCP plays his potential roles in the comprehensive treatment management for ensuring medication safety and optimum effectiveness of medications.⁴

Patients at ICU are at high risk of potential medication-induced adverse drug reactions, drug-drug or drug-disease interactions, dose related drug toxicity and some cases of inadequate drug therapy.⁵ The disease and treatment complexity of critically ill patients at ICU is due to patients' poly-medication therapies, which make the pharmacological evaluations of the medications significantly tough.⁶ A multiple studies showed that presence of critical care pharmacists reduce prescription medications errors, improve patient-treatment outcomes, ensure cost effectiveness of medications, minimize wastage of drugs and reduce overall mortality rate in most of the disease conditions.^{7,8} In 2006, in the United States of America USA), a survey was done over 1,034 ICUs of 382 hospitals, only 62.2% of ICUs reported that

Correspondence to: Md Jahidul Hasan
E-mail: jahidrj@gmail.com
Mobile: +8801911011167

Dhaka Univ. J. Pharm. Sci. **18**(1): 113-119, 2019 (June)
DOI: <https://doi.org/10.3329/dujps.v18i1.41898>

they have clinical pharmacy services, and pharmacists participate in ICUs' grand round is 4.4 +/- 1.5 days/week and at least 75% of patient ICU days, they involve in fundamental clinical pharmacy activities.⁹

As a member of the ICU's multi professional team, critical care pharmacist inputs his additional values in the targeted patient care by suggesting doctors mostly in prescribing the medications appropriately, monitoring drug administration and efficacy of administered medications and giving drug related up to date information to healthcare professionals.^{9,10} Under the provision of clinical pharmacy, the existence of a dedicated pharmacist at ICU setup systematically ensures the development of some essential tools for better patient care service like, conservative treatment guidelines for critically ill patients management, different drug-treatment policies, pharmaceuticals care monitoring protocols, incorporation of new or latest drug therapies in the ordinary treatment paradigm and so on.¹¹

In Asia and in most of the developing countries, the role of clinical pharmacists and the possible advantages of having pharmacists in clinical activities are not well understood by the healthcare professionals as those are well established from many years ago in most of the developed countries like, USA and United Kingdom (UK).¹² In Bangladesh, the journey of hospital pharmacy started around 2005 and till today, this service is limited in few tertiary level private hospitals of some mega cities. Following that initiation of hospital pharmacy practices in Bangladesh, Square hospitals Ltd., a tertiary level private hospital in Dhaka, as a local pioneer, initiated the Clinical pharmacy activities since its inception in 2006. Due to various reasons, this service was stopped after few years and started again through establishing 'Critical care pharmacy service' in 2015, especially at adult ICU department with one dedicated clinical pharmacist, named as 'Critical care pharmacist' and that clinical pharmacy support had been extended soon to other critical care areas like, CCU, Neuro-ICU, HDU, Neonatal-ICU, Pediatric-ICU, successfully. The continuous

professional contributions of critical care pharmacist were appreciated and accepted by the concerned doctors and other medical staffs and as a result, day by day that service became the cornerstone of the critical patient care management at critical care areas of that hospital. The target of this study was to analyze the contributions of a critical care pharmacist in the therapeutic management of critically ill patients at ICU of a tertiary level hospital.¹³

MATERIALS AND METHODS

The 8 months' data (March, 2018 to October, 2018) for this retrospective study were collected from the master service-record data of general adult ICU department of Square hospitals Ltd., Dhaka, Bangladesh. During that period, CCP clinically served total 8,28 critically ill patients in the ICU and 7,92 patients' data were considered for the study purpose. The rest of the admitted patients' data were not considered for the study because CCP did not find any suggestion from their prescriptions. The ratio between patients and CCP in that ICU was 8:1.

Data collection process for this study was based on the records of regular critical care pharmacists' patient-wise suggestions to doctors of the ICU and the responses of the doctors in respect to those suggestions on real-time basis.

The flow of CCP's suggestion. The CCP analyzed all prescribed medications and laboratory reports of every ICU patient before participating in ICU doctors' grand round once in the morning everyday and during round time, CCP shared the associated findings and suggestions to the consultant doctor (head of round team). After reviewing prescriptions, CCP provided drug-related suggestions, also concerning the current associated-diseases or disease progression in a manual individual patient-wise form, named as 'Pharmacist's Suggestion Form' and doctors followed-up those suggestion-notes written by the CCP. The final decision always was taken by the consultant doctors and if accepted, changes were made accordingly. Beyond the doctors' grand round, CCP routinely checked up medications of the prescriptions of

patients as per the requirement and newly generated suggestions were shared to the doctors, spontaneously. CCP's provided suggestions and associated modifications of the prescriptions were categorized as follows-

- A. Drug-drug interaction associated modification or deletion of drug therapies
- B. Addition of new drug therapies
- C. Rational dosing of antibiotics
- D. Adjustment of the doses of prescribed medications
- E. Prescribed drug induced adverse drug reaction

The CCP recorded patient-wise all the suggestions he forwarded to doctors and the number of suggestions accepted accordingly by the doctors in the hospital's own online record system. All those retrospective data of this study were analyzed by using IBM SPSS software (version 22). The ethical approval for this study was taken on February, 2018 from the hospital ethical committee.

RESULTS

CCP reviewed all critically ill patients' prescribed medications from the day of admission to the day of discharge from ICU. Among the total 8,28 (N) critically ill patients, CCP worked on 7,92 patients (95.65%; N= 828) and made 650 (82.07%) suggestions for doctors' considerations (table 1).

CCP found 36 (4.35%) patients' prescriptions where no suggestion required (Table 1).

CCP analyzed all prescribed medications of prescriptions in the drug safety's point of view and after reviewing drug therapies, they made suggestions for doctors considering all five categories (A, B, C, D & E) in order to make the drug therapies appropriate, safe and effective. In this study, among 650 CCP's suggestions, under category-A (Drug-drug interaction associated modification or deletion of drug therapies), category-B (Addition of new drug therapies), category-C (Rational dosing of antibiotics), category-D (Acceleration or deceleration of the doses of prescribed medications) and category-E (Prescribed drug induced adverse drug reaction), 84 (12.92%, n = 650), 102 (15.69%, n = 650), 358 (55.08%, n = 650), 57 (8.77%, n = 650) and 49 (7.54%, n = 650) (Table 2) suggestions were generated by CCP, respectively, and placed to doctors for further therapeutic considerations and modifications of prescriptions, accordingly. Among all the suggestions given by the CCP during that time-period, the highest number of suggestions came under the category C (Rational dosing of antibiotics) (358 suggestions, 55.08%, n= 650) (table 2) and the lowest number of suggestions came under the category E (Prescribed drug induced adverse drug reaction) (49 suggestions, 7.54%, n= 650) (table 2).

Table 1. Review of prescriptions and CCP's suggestions.

Total patients admitted (N)	Number of patients' prescriptions reviewed and %	Number of suggestions given and %	Number of prescriptions required no suggestion and % (N= 828)
828	792 (95.65)	650 (82.07)	36 (4.35)

Table 2. Categorization of suggestions.

Suggestion categories	Number of suggestions given	Total suggestions given (%)	Number of suggestions accepted by doctors	Total suggestions accepted by doctors (%)
A	84	12.92	73	86.90
B	102	15.69	88	86.27
C	358	55.08	326	91.06
D	57	8.77	40	70.18
E	49	7.54	39	79.59

After getting suggestions from CCP, doctors assessed all the clinical evidences like, pathological and microbiological data, disease conditions, current signs and symptoms, recent physiological status and most possible optimum target of the treatment, and finally reconciled the prescriptions. In contrast with those CCP's clinical suggestions regarding the modifications of patients drug therapies in the prescriptions, under category- A, B, C, D and E, 73 suggestions (86.90%, n= 650), 88 suggestions (86.27%, n= 360), 326 suggestions (91.06%, n= 650), 40 suggestion (70.18%, n= 650) and 39 suggestions (79.59%, n= 650) (table 3) had been accepted and necessary adjustments in the prescriptions were accomplished by the doctors, accordingly. In

response to those CCP's suggestions, the highest number of CCP's suggestions (326, n= 358) were accepted under category C (91.06%, n=358) (table 2) and the lowest number of CCP's suggestions (40, n= 57) were accepted under category D (70.18%, n= 57) (table 2) by doctors.

After working on 828 patients, CCP generated 650 suggestions (table 1) for ICU's doctors during that 6-month period and among those suggestions, 566 (87.08%, n= 650) (table 3) suggestions were successfully accepted by doctors and prescriptions were modified, accordingly. On the other hand, 84 (12.92%, n= 650) (table 3) suggestions were not accepted by doctors.

Table 3. Overall acceptances of CCP's suggestions by doctors.

Total number of suggestions created by CCP (n)	Total number of suggestions accepted by doctors (n= 650)	Total suggestions accepted by doctors (%)	Total number of suggestions not accepted by doctors (n= 650)	Total suggestions not accepted by doctors (%)
650	566	87.08	84	12.92

DISCUSSION

Critical care pharmacist, the more specialized form of clinical pharmacist, has profound therapeutic knowledge and tremendous clinical efficiencies in order to play role in medication review, complicated therapeutic management, pharmacokinetic evaluation of medications and decision taking in crucial live saving times.¹⁴ In this study, during the study period, the critical care pharmacist worked at general adult ICU department and reviewed 828 ICU's admitted critically ill patients' prescriptions thoroughly for finding possible modification of the drug therapies for ensuring medications' safety, accuracy and appropriateness. A critically ill patient in ICU setup is continuously monitored by ICU's multi professional team and the presence of poly pharmacy in the prescription is very common. Medication errors is the more or less frequently occurring fault in the poly pharmacy prescriptions of these patients and nurses sometimes do errors in medications' administration or dose calculation. Study shows that the presence of a responsible pharmacist in critical

care areas like, ICU, is highly demandable in this perspective who can sensibly consider these issues and work for ensuring quality patient care.¹⁵

Studies found that among the ICU's multi professional team members, the importance of presence of clinical pharmacist was clearly distinguished through its quality patient care service, which ultimately represented the integrated better treatment management for critically ill patients.^{16, 17} Generally, patients at ICU always go through multiple disease conditions and use of complex poly pharmacy in these patients increase the chance of possible drug-drug interactions. A study found that clinical pharmacists are able to reduce 40% drug interactions by reviewing all ICU prescriptions and reduced incidences of drug interactions ensured quality doctors' prescriptions at ICU.¹⁸ In our study, CCP provided 84(n=650) drug-drug interaction based suggestions and among those, 73 (86.90%) suggestions were accepted by doctors and modification of prescriptions were accomplished accordingly, which ultimately ensured the medication

safety and enhanced the overall quality of prescriptions at ICU.

Sometimes, drug management in ICU patients become so critical for doctors specially when patients are found intolerable or unresponsive to existing drug therapies and require alteration or addition of new drug therapies for immediate management. In this study, during ICU grand round, CCP provided his suggestions (102, n=650) regarding new drug therapies when doctors are looking for additional new drug therapies for the management of critically ill patients and at that moment, those suggestions opened the doors of required treatment.

Body's fluid volume changes and one or more organ dysfunction in ICU's critically ill patients are mostly common, which ultimately alter the pharmacokinetics of many drugs including antibiotics and require dose adjustments.¹⁹ A study found that antibiotics' doses adjustments according to the correspondent organ failure are managed perfectly by involving clinical pharmacist in the ICU's multi professional team and enhanced the activity of antimicrobial stewardship.²⁰ In the current study, CCP suggested highest 358 (55.08%, n=650) suggestions on antibiotic rational dosing and highest number of suggestions (326, 91.06%) were accepted by doctors in this regard. CCP continuously monitored prophylactic and therapeutic antibiotics of every patient; those were given immediately after patients' admission at ICU or at review stage after having microbiological reports. This study indicates that CCP's supports to doctors are highly required and effective for ensuring rational and appropriate use of antibiotics in critically ill patients which is essential for quality treatment of overall infections in ICU's patients. Other than antibiotics, general medications were also monitored by the CCP and among 57 suggestions on medications' dose adjustment, 40 (70.18%) suggestions were accepted by doctors and prescriptions were reconciled accordingly, which justified an updated drug therapy management in concern with the current diagnosed disease conditions of critically ill patients. Multiple studies showed that medication errors during

admission are observed among one third of patients and among 256 general medicine in-patients, every third patient's prescription has one or more unintentional medication discrepancies. So, clinical pharmacist's intervention ensures better medication management and associated drug safety.

Like medication errors in the prescription, drug induced adverse drug reactions (ADR) are another serious and life threatening incidences in poly pharmacy dependent patients of critical care areas like, ICU. Several studies showed that lower incidences of ADRs found among ICU's patients when clinical pharmacists are involved in ICU's multidisciplinary team.²³ CCP of the current study found 49 ADR incidences during the study at ICU and among those, 39 (79.59%) justified suggestions were accepted by doctors and ADR associated symptoms management therapies were applied, immediately. Continuous observation of patients in response to current medication therapies was the basic mechanism of CCP to identify suspected ADRs in patients and after complete justifications of the incidences, doctors reconciled the prescription, accordingly; that ultimately ensured patients' present and future medications' safety. The clinical pharmacist is the person who is selectively responsible for monitoring these adverse events in patients, to suggest the doctors for taking necessary management to overcome the incidence and to educate the patients regarding the occurred incidence and its proper management techniques in future.

Though this study did not focus on CCP induced cost reduction of medications of patients, but definitely a cost effective treatment management for every patient was observed through the inclusion of CCP's service at ICU. Globally, multiple studies found that intervention of clinical pharmacist at critical care areas ensured quality treatment with a significant treatment cost reduction phenomenon.^{24, 25}

As a newly developing country, in Bangladesh, where pharmacists' roles in hospital settings are still a very new and not well familiarized profession, the provision of having clinical pharmacist in multi professional team at local hospitals, are clearly a

controversial, too much challenging and dreamy profession, nowadays. Nevertheless, the practice of clinical pharmacy has been initiated in the very few tertiary level hospitals in some mega-cities of Bangladesh and they are trying to ensure safe and appropriate drugs for the critically ill patients.

CONCLUSION

CCP can intervene in the ICU's complex therapeutic management as the core ICU-team member and through this contribution, medications' safety, appropriateness and accuracy are ensured, successfully. ICU doctors can frequently get clinical supports from CCP and closely adhering to this service, they can extremely upgrade their quality of prescriptions which ultimately ended into optimized quality of patient care.

CONFLICT OF INTEREST

There is no conflict of interest declared.

ACKNOWLEDGEMENT

Authors are very grateful to all the doctors of ICU and the management team of Square hospitals ltd. for their utmost supports and cooperation to successfully complete this study.

REFERENCES

- Grenvik, A. and Pinsky, M.R. 2009. Evolution of the intensive care unit as a clinical center and critical care medicine as a discipline. *Crit. Care Clin.* **25**, 239-250.
- Chant, C. 2012. How critical are critical care pharmacists? *Can. J. Hosp. Pharm.* **65**, 5-6.
- Dasta, J. 2006. Critical care. *Ann. Pharmacother.* **40**, 736-737.
- American College of Clinical Pharmacy. 2014. Standards of practice for clinical pharmacists. *Pharmacotherapy* **34**, 794-797.
- Rothschild, J.M., Landrigan, C.P., Cronin, J.W., Kaushal, R., Lockley, S.W., Burdick, E., Stone, P.H., Lilly, C.M., Katz, J.T., Czeisler, C.A. and Bates, D.W. 2005. The critical care safety study: The incidence and nature of adverse events and serious medical errors in intensive care. *Crit. Care Med.* **33**, 1694-1700.
- Kane-Gill, S. and Weber, R.J. 2006. Principles and practices of medication safety in the ICU. *Crit. Care Clin.* **22**, 273-290.
- Kane, S.L., Weber, R.J. and Dasta, J.F. 2003. The impact of critical care pharmacists on enhancing patient outcomes. *Intensive Care Med.* **29**, 691-698.
- MacLaren, R. and Bond, C.A. 2009. Effects of pharmacist participation in intensive care units on clinical and economic outcomes of critically ill patients with thromboembolic or infarction-related events. *Pharmacotherapy* **29**, 761-768.
- Maclaren, R., Devlin, J.W., Martin, S.J., Dasta, J.F., Rudis, M.I. and Bond, C.A. 2006. Critical care pharmacy services in United States hospitals. *Ann. Pharmacother.* **40**, 612-618.
- Claus, B.O., Robays, H., Decruyenaere, J. and Annemans, L. 2014. Expected net benefit of clinical pharmacy in intensive care medicine: a randomized interventional comparative trial with matched before-and-after groups. *J. Eval. Clin. Pract.* **20**, 1172-1179.
- Calvert, R.T. 1999. Clinical pharmacy: a hospital perspective. *Br. J. Clin. Pharmacol.* **47**, 231-238.
- Khalili, H., Farsaei, S., Rezaee, H. and Dashti-Khavidaki, S. 2011. Role of clinical pharmacists' interventions in detection and prevention of medication errors in a medical ward. *Int. J. Clin. Pharm.* **33**, 281-284.
- Mazid, M.A. and Rashid, M.A. 2011. Pharmacy education and career opportunities for pharmacists in Bangladesh. *Bangladesh Pharm. J.* **14**, 1-9.
- Kucukarslan, S.N., Peters, M., Mlynarek, M. and Nafziger, D.A. 2003. Pharmacists on rounding teams reduce preventable adverse drug events in hospital general medicine units. *Arch. Intern. Med.* **163**, 2014-2018.
- Erstad, B.L., Haas, C.E., O'Keeffe, T., Hokula, C.A., Parrinello, K. and Theodorou, A.A. 2011. Interdisciplinary patient care in the intensive care unit: Focus on the pharmacist. *Pharmacotherapy* **31**, 128-137.
- Kim, M.M., Barnato, A.E., Angus, D.C., Fleisher, L.A. and Kahn, J.M. 2010. The effect of multidisciplinary care teams on intensive care unit mortality. *Arch. Intern. Med.* **170**, 369-376.
- Ng, T.M., Bell, A.M., Hong, C., Hara, J.M., Touchette, D.R., Danskey, K.N., Lindsay, T.T. and Puumala, S.E. 2008. Pharmacist monitoring of QTc interval-prolonging medications in critically ill medical patients: A pilot study. *Ann. Pharmacother.* **42**, 475-482.
- Natasha, T.G., Carvalho, C.S., Correia, L.C., Tenorio, D.S., Cristina, T.M., Dias, A.O. and Pereira, D.L. 2015. Pharmaceutical intervention assessment in the identification and management of drug interactions in an intensive care unit. *J. Appl. Pharm. Sci.* **5**, 13-18.
- Scoville, B.A. and Mueller, B.A. 2013. Medication dosing in critically ill patients with acute kidney injury treated with renal replacement therapy. *Am. J. Kidney Dis.* **61**, 490-500.

20. Scaglione, F. and Paraboni, L. 2008. Pharmacokinetics/ pharmacodynamics of antibacterials in the intensive care unit: setting appropriate dosing regimens. *Int. J. Antimicrob. Agents.* **32**, 294-301.
21. Gleason, K.M., McDaniel, M.R., Feinglass, J., Baker, D.W., Lindquist, L., Liss, D. and Noskin, G.A. 2010. Results of the medications at transitions and clinical handoffs (MATCH) study: an analysis of medication reconciliation errors and risk factors at hospital admission. *J. Gen. Intern. Med.* **25**, 441-447.
22. Hellström, L.M., Bondesson, L., Höglund, P. and Eriksson, T. 2012. Errors in medication history at hospital admission: prevalence and predicting factors. *BMC Clin. Pharmacol.* **12**, 9.
23. Leape, L.L., Cullen, D.J., Clapp, M.D., Burdick, E., Demonaco, H.J., Erickson, J.I. and Bates, D.W. 1999. Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. *JAMA* **282**, 267-270.
24. De, Rijdt, T., Willems, L., Simoens, S. 2008. Economic effects of clinical pharmacy interventions: a literature review. *Am. J. Health. Syst. Pharm.* **65**, 1161-1172.
25. Kopp, B.J., Mrsan, M., Erstad, B.L. and Duby, J.J. 2007. Cost implications of and potential adverse events prevented by interventions of a critical care pharmacist. *Am. J. Health. Syst. Pharm.* **64**, 2483-2487.