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Research Article

The Impact of Pharmaceutical Care in the Cardiothoracic Intensive Care Unit (CT-ICU) of the University of Nigeria Teaching Hospital (UNTH), Enugu

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Abstract

Background: Preventable drug related morbidity and mortality represent a serious medical problem that urgently requires attention in the CT-ICU where patients with critical cardiovascular problems (who may have other co-morbidities) are usually cared for, both pre-, peri- and post-operatively. Pharmaceutical Care (PC) involves three major functions performed by the Pharmacist: identifying potential and actual drug-related problems (DRPs), resolving actual DRPs and preventing potential DRPs.

Aim: To evaluate the impact of pharmaceutical care in the UNTH CTU-ICU.

Specific Objectives:

1. To assess the level of clinical significance of the Pharmacists' interventions (whether it is severe/high; important/moderate; minor/low or of no clinical significance).
2. To ascertain the most frequent drug therapy problem encountered.
3. To ascertain if the interventions are acceptable to the other Health Care Providers
4. To assess whether the intervention prevented an occurrence of DRP.

Method: The research was an interventional prospective study done for a period of 14 months (March 2015 - February 2016 and May - June 2018). During daily multidisciplinary Medical-Team rounds the Pharmacist ensured that no DRP complicated patient care. The Pharmacist's interventions were verified by a Physician/Surgeon and an Anaesthetist to rate the level of clinical significance of each intervention which was used to evaluate the impact of PC in the CT-ICU.

Results: Ninety-five (95) patients (42 adults, 53 paediatrics) were managed; 139 interventions were done. Ninety-two percent (92%) of the interventions were accepted and 7% rejected and 1% was initially rejected. Seventy six percent (76%) potential DRPs were prevented, 12% were closely monitored and managed to prevent DRP and 12% DRP-resolved. DRPs identified were: Drug choice-36%, drug Dosing-24%, interaction-3%, drug-information-27% and others-9%. Level of clinical significance of interventions were: potentially severe/high-44%, important/moderate-36%, minor/low-18% and No clinical significance-2%.

Conclusion: From the result it is obvious that PC does have great impact on patient care in the CT-ICU and the presence of a clinical Pharmacist is necessary for positive therapeutic outcome.

Keywords: *Pharmaceutical Care; Drug Therapy Problem; Level of Clinical Significance; Clinical Pharmacist*

Introduction

As medical practice shifted from disease-oriented to patient-oriented practice, in parallel pharmacy practice has also shifted from drug-oriented to patient-oriented and inter professional relationships with clinical pharmacy. With clinical pharmacy, the Physicians were responsible for therapeutic outcome whereas with pharmaceutical care the Pharmacists share responsibility for therapeutic outcome [1,2].

Pharmaceutical care is defined as the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life. These outcomes are: cure of disease, elimination or reduction of a patient's symptomatology, arresting or slowing of a disease process or preventing a disease or symptomatology. Pharmaceutical care involves the process through which the Pharmacist, in cooperation with the patient and other Health Professionals, designs, implements and monitors a pharmaceutical care plan that will produce specific therapeutic outcomes for the patient [3,4].

In the Cardiothoracic Intensive Care Unit, patients with critical cardiovascular problems are cared for, both pre-, peri- and post-operatively - cardiovascular disease that may be a complication of another cardiovascular disease or it is the primary disease with some complications. The patient may even have a disease not related to the CV disease that requires treatment. Whatever the case pharmacological intervention cannot be avoided and several drugs are needed by the patient both pre-, peri- and post-operatively. Some medication(s) may of necessity be discontinued until the surgery has been done, some may be continued with reduced doses and some continued as was prescribed because it does not interact with anaesthetic drugs or that discontinuation may worsen prognosis. In such cases, separation of the needed medicines that may interact with anaesthetic agents and/or close monitoring (which is the hallmark of intensive care) will be needed to run intervention as early as possible before the occurrence of drug related problem(s) [3,5].

Responsible provision deals with subjective and objective findings about the patient's problem which are properly assessed to develop an appropriate care plan, devoid of drug related problems. Again, the entire patient's drug need must be provided within a definite time lag. There is no room for stock-outs. In the care plan, the social needs, patient caring (counselling, education, lifestyle and modification thereof) and pharmacotherapy are involved. Pharmaceutical Care (PC) therefore involves three major functions performed by the Pharmacist: identifying potential and actual drug related problems, resolving actual drug related problems and preventing potential drug related problems. The other Care Providers will then concentrate on their areas of expertise [3,4,6].

There is therefore a need to assess prescribing behaviours of Prescribers, correct or clarify medicine orders, provide drug information and therapeutic drug monitoring, identify potential and actual drug interaction or medication errors and to suggest alternative therapies for better patient care [7-9].

Pharmaceutical Care provision will improve the patient's quality of life [9,10] reduce the incidence of medication errors, adverse drug events [11,12] and cost of health care both for the patient and the facility [13-15].

Preventable drug related morbidity and mortality represent a serious medical problem that urgently requires expert attention [16,17].

Drug-related problem (DRP) is defined as an event or circumstance involving drug treatment that actually or potentially interferes with the patient experiencing an optimum outcome of medical care. It can be as a result of adverse drug reaction (ADR) or medication error (ME) [18].

Research has shown that more than 40% of patients receiving drug therapy had at least one DRP [16].

Drug related problems can be divided into intrinsic and extrinsic toxicities.

Intrinsic toxicities are caused by the interaction of pharmaceutical, chemical and/or pharmacological characteristics of the drug itself with the bio-system and can be synonymous with ADR which WHO defines as "a response to a medicine which is noxious and unintended, and which occurs at doses normally used in man". Previously unknown drug-drug interactions and lack of therapeutic action are included in this definition [19].

The World Health Organization (WHO) classifies ADRs by causes [20-22]:

- **Type A**: Dose related; pharmacologically predictable. In a study of older adults, this type was the most common with the most common offending drugs being warfarin, insulin and digoxin.
- **Type B:** Non-dose related; bizarre and unpredictable - Immune related reactions such as hypersensitivity reactions, non-immune reactions such as porphyria, malignant hyperthermia or neuroleptic malignant syndrome. As the mechanisms of these specific reactions are better understood, these reactions may be re-classified as Type A (if found to be dose related or pharmacologically predictable).
- **Type C:** Dose related and time related. This is related to duration and dosage of exposure. An example is hypothalamic-pituitary-adrenal suppression from glucocorticoid therapy.
- **Type D:** Time-related; delayed reaction. An example is tardive dyskinesia.
- **Type E:** Withdrawal; end of dose reaction. An example is narcotic or beta-blocker withdrawal.
- **Type F:** Unexpected failure of therapy. This may be caused by drug interactions. An example is failure of oral contraceptives due to induction of enzymes by a second drug.

Types A and B were proposed in the 1970s [22] and the other types were proposed subsequently when the first two proved insufficient to classify ADRs [20].

Extrinsic toxicities are problems caused by handling of drugs by Health Care Professionals (HCP) and patients- Medication Errors (ME).

ME is a preventable event that may cause or lead to inappropriate medication use or patient harm while the drug is in the control of the HCP, patient or consumer [19] which may not result in harm to the patient.

ME may be as a result of: Prescribing Errors, Dosage Errors, Therapeutic Errors, Dispensing Errors, Administration Errors and "Across Settings" Errors [19].

Medication error is classified according to the seriousness of the result thereof:

- A - An error has made but it did not reach the patient.
- B - An error has been made and the medication got to the patient but no harm was done.
    - B_1 - Medicine was not administered.
    - B_2 - Medicine was administered but no harm was done to the patient.
- C - An error was made which results in an increased frequency of monitoring of the patient, but no harm was done.
- D - An error has been made and harm is done.
    - D_1 - Temporary damage was done to the patient necessitating treatment.
    - D_2 - Temporary damage resulting in elongation of Hospital stay.
    - D_3 - Permanent damage was done to the patient.
    - D_4 - Patient nearly dies (critical care intervention was needed).
- E - An error has been made which results in the death of the patient.

Drug related problems have been divided into six major classes with twelve sub-divisions where all these different classes of ADR and ME can fit in [23]:

1. Drug Choice: a. Need for additional drug, b. Unnecessary drug, c. Inappropriate drug choice.
2. Dosing: a. Too high dose, b. Too low dose, c. Sub-optimal dosing scheme, d. Sub-optimal formulation.
3. Adverse Drug Reaction (ADR)
4. Drug Interaction
5. Drug use: a. Drugs administered by health personnel, b. Drugs administered by the patient.
6. Others: a. Need for/lack of monitoring of effect and toxicity of drugs, b. Lack of or unclear documentation of the drug chart/prescription, c. Others.

The Clinical Pharmacist's interventions in a Cardiac Surgery ICU were evaluated in a study, with regards to their acceptance by the medical team, rate, clinical significance and targeted patients' outcome. It was a pilot, prospective, non-comparative, observational study. Each day the Pharmacist went on multidisciplinary ward round and all the interventions of the day were verified by the Physician in the team for validity and clinical significance [9,24].

It was found that this resulted in a significant reduction of drug related morbidities and enhanced therapeutic outcomes.

Specific Objectives

1. To evaluate the impact of pharmaceutical care on patient management in the UNTH CTU ICU.
2. To assess the level of clinical significance of the Pharmacists' interventions (it can be severe/high - intervention reduced mortality, organ damage/system failure or reduced length of hospital stay; important/moderate - intervention prevented additional pharmacological management which may elongate hospital stay and increase cost of care; minor/low - intervention may result in close monitoring of the patient to avoid crisis, improved convenience and adherence, reduced cost of management or improved quality of care or of no clinical significance) [25].
3. To ascertain the most frequent drug therapy problem encountered.
4. To ascertain if the interventions were acceptable to the other Health Care Providers
5. To assess whether the intervention prevented an occurrence of DRP.

Method

This was an interventional prospective study. The study centre was the Intensive Care Unit of the National Cardiothoracic Centre of Excellence of the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu State. It has a seven bedded cardiothoracic intensive care unit and a six bedded general intensive care unit.

Sample size calculation

Taro Yamane equation for finite population was used to determine sample size [26]:

$n = N/1 + Ne^2$

n = sample size, N = population size, e = error margin (if confidence 1nterval is 95% then error margin is 0.05); where N = 95/1 + 95 (0.0025) = 95/1.2375 = 76.77 = 77 participants. All the 95 patients participated in the study: (42 adult (25 Males, 17 Females) and 53 paediatric (29 Males, 24 Females)) patients.

List of procedures and frequency

S/No	Procedure	Frequency	Percent %	Cumulative %
1	Atrial Septostomy/PA banding	1	1.05	1.05
2	ASD closure	9	9.47	10.52
3	ASD closure + Atrial Septostomy/PA banding	1	1.05	11.57
4	ASD closure + Pul Valve commissurotomy	1	1.05	12.62
5	ASD closure + MV repair	2	2.11	14.73
6	AVr (AV repair)	1	1.05	15.78
7	AVR + CABG	1	1.05	16.83
8	AVR	7	7.37	24.20
9	AVR + MVR	10	10.53	34.73
10	AVR + MVR + TVR	1	1.05	35.78
11	MVR	31	32.63	68.41
12	MVR + TVR	2	2.11	70.52
13	PDA ligation	1	1.05	71.57
14	PDA lig + Mediasternal re-exploration	1	1.05	72.62
15	PDA lig + MVr	1	1.05	73.67
16	PDA lig + Repair of Coarctation of the Aorta	1	1.05	74.72
17	Repair of Truncus Arteriosus Type 1	3	3.16	77.88
18	RVOT plasty + shunt	1	1.05	78.93
19	TOF - Total Correction	3	3.16	82.09
20	TOF - Total Correction + ASD closure	2	2.11	84.20
21	VSD closure	2	2.11	86.31
22	VSD closure + AVR	1	1.05	87.36
23	VSD closure + PDA lig	10	10.53	97.89
24	VSD closure + inspection of RVOT	1	1.05	98.94
25	VSD closure + PDA lig + MVr	1	1.05	99.99
		95		

Legend: *ASD: Atrial Septal Defect; AVR: Aortic Valve Replacement; MVR: Mitral Valve Replacement; MVr: Mitral Valve repair; PDA: Patent Ductus Arteriosus; RVOT: Right Ventricular Outflow Tract; TOF: Tetrology of Fallot.*

Daily, during the multidisciplinary round with the Medical Team on duty, all drug-related interventions were documented on an intervention form which details the type of DTP encountered: Drug Interaction, possible ADR, need for extra drug for an indication not treated etc. It was also on this form that the mode of communication and whether the intervention was accepted or rejected were documented.

A second documentation where a Clinician/Surgeon and an Anaesthetist verified the level of clinical significance of the intervention made by the Clinical Pharmacist was captured on another form prepared for this purpose. If the two assessed the level of significance differently, the more inferior level of significance was chosen but preference was given to the Assessor whose Specialty is more affected by the intervention. Example: for a patient's INR, the Physician/Surgeon's assessment is chosen.

The data was described and stratified using descriptive statistics like frequency, percentages mean and ± standard deviation.

The total number of interventions for the number of patients involved in the research for the 14-month period was calculated.

Ethical issues

On admission consent was sort from the adult patients and representatives of the paediatric patients. As is stipulated on the consent form rejection would not prevent pharmaceutical care from being rendered to the patient.

Also, ethical clearance was obtained from the UNTH Ethical Committee.

Results

A total of 95 patients participated in the 14-month period under review.

Patient population and distribution

	Patient Type	Number of Patients	Frequency of Interventions	Valid %	Cumulative %
	Adults	42	109	78.42	78.42
	Paediatrics	53	30	21.58	100.00
Grand total		95	139		

To evaluate the impact of pharmaceutical care on patient management in the UNTH CTU ICU, assessment was made to find out if the intervention prevented an occurrence of DRP (outcome of the interventions) and the level of clinical significance of the Pharmacists' interventions (whether it is severe - may result to patient death or disability, moderate - the crisis will result to additional pharmacological management which may elongate hospital stay and increasing cost of care, minor - may result in close monitoring of the patient to avoid crisis or no clinical significance).

It is also necessary to find out if the interventions were acceptable to the other Health Care Providers and the most frequent drug therapy problem encountered.

Seventy six percent (76%) drug therapy problems were prevented. Of the 24% that were not prevented, 12% DRPs were resolved and 12% DRPs were closely monitored to ensure no problem emanated.

Outcome of intervention

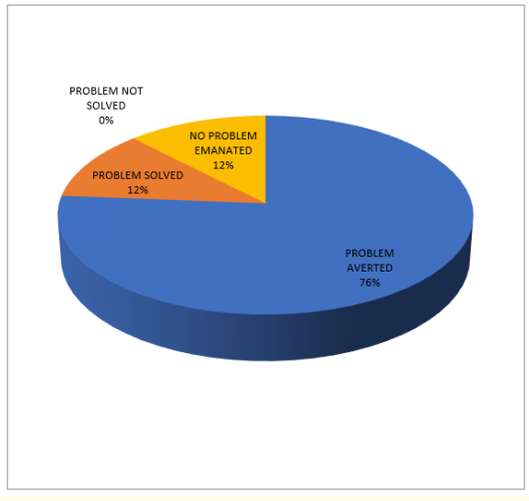

Figure 1

Forty-four percent (44%) of the interventions were of potentially severe/high clinical significance, 36% were of moderate clinical significance, 18% were of minor/low clinical significance and 2% had no clinical significance.

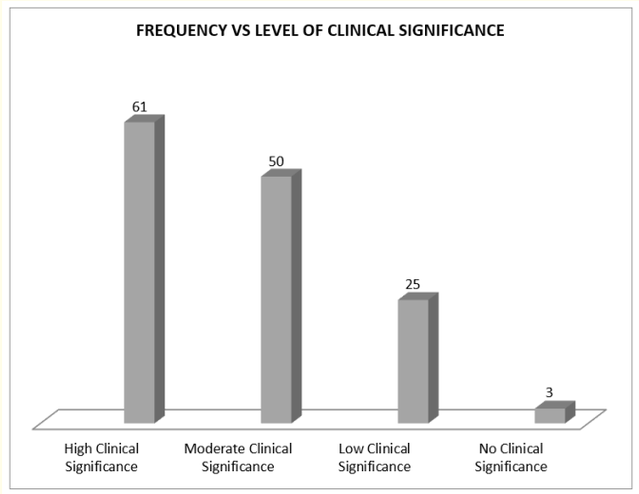

Figure 2

The most frequent DRP encountered was Drug choice (36%) which includes need for additional drug (25%), unnecessary drug (7%) and inappropriate drug choice (4%). This was followed by Drug information to care providers and patients (27%), then by drug dosing (22%) which includes dose too high (7%), dose too low (8%) and sub optimal dosing scheme (7%). Drug interaction was 3% and need for/Lack of Monitoring of Effect and Toxicity of Drug was 9%.

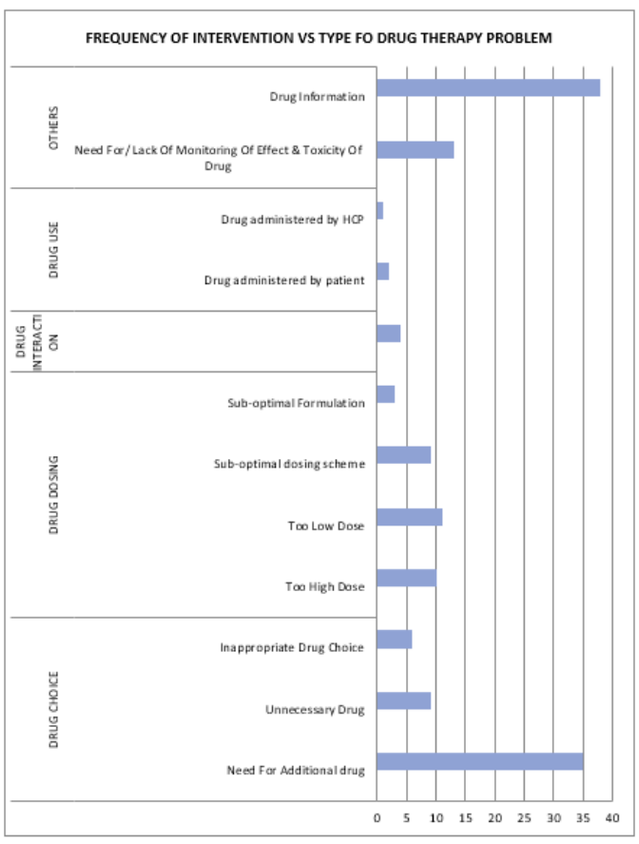

Figure 3

Ninety-two percent (92%) of the interventions were accepted by the affected health Care Providers, 7% were denied especially when the anticipated DRP is of minor or no clinical significance and 1% was initially denied but was eventually accepted when close monitoring revealed the potential DRPs.

Reception of intervention

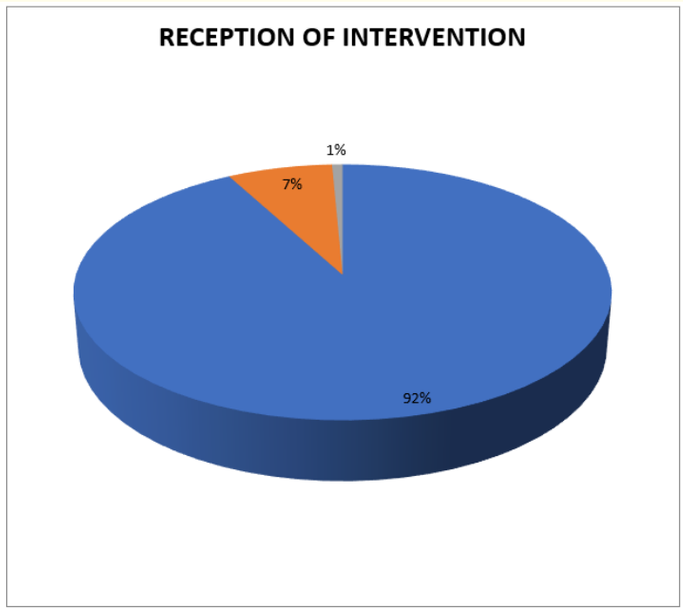

Figure 4

Mode of communication was mostly verbal during the team ward round (78%), when the team was not complete it was both verbal with the present care provider and written for others to be aware of the intervention (15%) and written only especially when the need for dose conversion arose (7%).

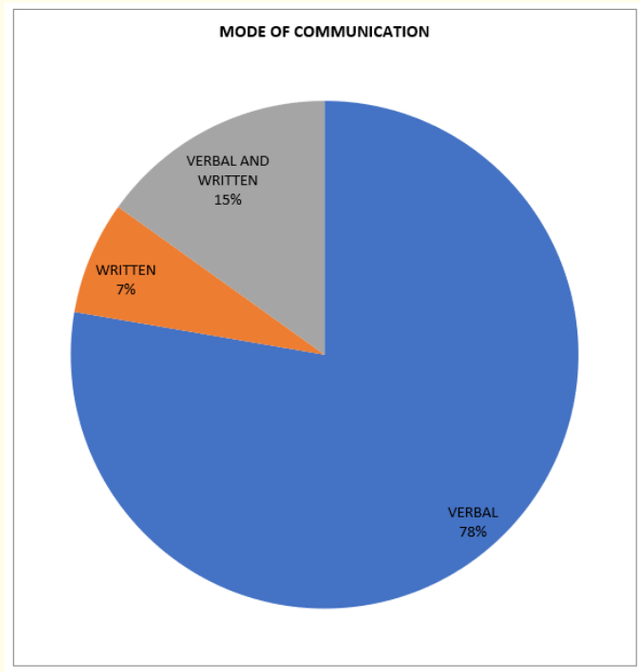

Figure 5

It was noted that more interventions were done on the adults patients than on the paediactric patients - 78% were adults as against 22% paediatric patients

Discussion

There was a total of 139 cases of interventions on 95 patients within the period of study (1.46 interventions per patient) which was almost double the 0.66% obtained by Al-Jazairi., *et al* [24].

Forty-four percent (44%) of the interventions were potentially severe/high clinical significant while 36% were important/of moderate clinical significance making it a total of 80% that improved quality of care compared with 77% discovered by Al-Jazairi., *et al.* [24] (21.8% that prevented adverse drug reaction and 55.7% that targeted improved outcome). Example of such interventions are placing patients with mechanical valves on anticoagulation therapy or in some cases bridging with heparin for the first 48 hours before warfarin effect is seen or placing patients on invasive monitoring who have high temperature (probably as a result of sepsis) on antibiotics of wide coverage before microbial culture and sensitivity test results was released. Twenty percent (20%) were minor/of low or no clinical significance indicating that the impact of Pharmaceutical care in the cardiothoracic unit of UNTH is high. This compares well with the findings of Talasaz AH [27] which confirms the necessity of having a clinical Pharmacist on the multidisciplinary Team. One should be careful to make guideline based and scientifically proven interventions, however patient specific data should be integrated to ensure rational interventions. The interventions that were rejected required close monitoring of the patient for optimal patient outcome.

One should however be sure of the severity of clinical significance of interventions as one insists on the interventions in order not to appear trivial or antagonistic to other care providers.

Seventy-six percent (76%) of potential DRP were prevented which is same as observed by Al-Jazairi., *et al* [24]. In 12 % that were not intercepted before drug administration, no problem emanated since appropriate monitoring and intervention ensured that drug therapy problems were not precipitated. In 12% who manifested evidence of DTP, the problems were resolved.

The most frequent DTP encountered was Drug Choice (36% - (need for additional drug alone was 25%, unnecessary drug 7% while inappropriate drug choice was 4%)) closely followed by drug information (27%) and drug dose was 24%. For Al-Jazairi., *et al*. [24], drug Choice problem was a total of 47.5% while drug dose problem was 28.9%. The need for appropriate and reliable drug information to all involved in patient care including the patient himself cannot be over emphasised.

Ninety-two percent (92%) of the interventions were accepted by other Care Providers. This compares favourably with the findings of Al-Jazairi., *et al*. [24] where 95% was accepted.

Seventy-eight percent (78%) of the interventions were communicated verbally only. These indicate that the presence of the Clinical Pharmacist is necessary in the multidisciplinary team rounds as was also noted by Anne Man [28]. All the team members will be there to discuss and quickly come to a rational decision.

Conclusion

The impact of Pharmaceutical care in the Cardiothoracic Intensive Care Unit was high as the level of clinical significance of interventions were mostly potentially severe/high clinical significant or important/moderate clinical significance.

The most frequent DTP encountered was Drug Choice, closely followed by drug information and drug dose

Reliable and appropriate information empowers the Care Providers to achieve optimal outcome.

The presence of a Clinical Pharmacist in the multidisciplinary Team rounds is necessary as most of the interventions were verbal and acceptable.

The number of DTP prevented and resolved also makes the inclusion of a Clinical Pharmacist in the multidisciplinary Team very necessary for optimal patient care.

The Clinical Pharmacist should constantly update himself so as to efficiently proffer pharmaceutical care services.

Recommendation

It is worthy of note that despite the fact that the paediatric population was higher (56% paediatrics, 44% adults), DTPs were more in adults 78% than in paediatrics 22%; possibly due to co-morbid states that make therapy in the adults more complicated and challenging. More work is needed in this area.

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