Implementation of Clinical Pharmacy Services in a Pediatric Dialysis Unit

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List of abbreviations

ACCP	**American College of Clinical Pharmacy**
ADR	**Adverse Drug Reaction**
ARF	**Acute Renal Failure**
AVF	**Arterial Venous Fistula**
BUN	**Blood Urea Nitrogen**
Ca*P	**Calcium- Phosphorus Product**
CAPD	**Continuous Ambulatory Peritoneal Dialysis**
CCPD	**Continuous Cyclic Peritoneal Dialysis**
CKD	**Chronic Kidney Disease**
CRF	**Chronic Renal Failure**
DI	**Drug Interaction**
DTRs	**Drug Therapy Related Problems**
DWI	**Drug use Without Indication**
ESRD	**End Stage Renal Disease**
GFR	**Glomerular Filtration Rate**
GH	**Growth Hormone**
GN	**Glomerulonephritis**
HD	**Hemodialysis**
IDS	**Improper Drug Selection**
IGF-1	**Insulin like Growth Factor-1**
IPD	**Intermittent Peritoneal Dialysis**
IWD	**Indication Without Drug Therapy**
KDOQI	**Kidney Disease Outcomes Quality Initiative**
LVH	**Left ventricular hypertrophy**
NKF	**National Kidney Foundation**
OD	**Over-Dosage**
PCP	**Pharmaceutical Care Plan**
PD	**Peritoneal Dialysis**
PILs	**Patient Information Leaflets**
pmp	**per million populations**
PTH	**Parathyroid Hormone**
QoL	**Quality of Life**

rhuEPO	**Recombinant Human Erythropoietin**
rhGH	**Recombinant Human Growth Hormone**
RTSQ	**Renal Treatment Satisfaction Questionnaire**
UD	**Sub-Therapeutic Dosage**
USRDS	**United State Renal Data System**
VUR	**Vesicouretric Reflux**

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Abstract

Introduction:

Chronic kidney disease (CKD) in children is a major public health problem that refers to a condition related to irreversible kidney damage that can further progress to end-stage renal disease (ESRD). When disease progresses to a stage where kidney failure occurs, patients are required to start renal replacement therapies, either through dialysis or transplantation. ESRD patients who are on hemodialysis (HD) have complex drug regimens and receive nearly 10 to 12 medications daily, many of which requires multiple doses/day. Due to poly pharmacy, frequent medication adjustments on dialysis versus non- dialysis days, medically unstable nature of the disease and restricted life styles, these patients are at high risk for developing drug therapy related problems (DTRPs). Identification and resolution of DTRPs can occur through presence of clinical pharmacist as a member of multidisciplinary care CKD team via the provision of pharmaceutical care.

Aim of the work:

The current study was designed to detect drug therapy related problems in children undergoing hemodialysis and to assess and evaluate the impact of clinical pharmacist interventions on the clinical outcome of children undergoing hemodialysis.

Patients and Methods:

A group of 50 patients, underwent hemodialysis were divided into 2 groups each of 25 patients, the control group received the usual care by the physicians, while the test group received the pharmaceutical care by the clinical pharmacist in addition to the usual care over a nine months period. The outcome the pharmaceutical care plan implemented by the clinical pharmacist was assessed by estimation of several parameters including: {measurement of blood pressure, serum calcium level, serum phosphorus level, serum PTH level, serum calcium-phosphorus product level and using renal treatment satisfaction questionnaire (RTSQ)} that were assessed at baseline (prior to intervention) and at end of study (after intervention).

Results:

The results of the current study have showed that there was a highly significant decrease in both mean systolic and diastolic blood pressure in the test group and a highly significant decrease in median serum phosphorus level, median serum Ca*P product level, median serum PTH level in the test group and there was a significant increase in median serum calcium level in the test group as compared to their baseline values. There was a highly significant difference between the test and control group in both the individual score of each question of the RTSQ and the total score of the 11 items of the RTSQ.

Conclusion:

The clinical pharmacist is of paramount importance to be present as a member of the healthcare team taking care of ambulatory HD patients to provide pharmaceutical care services to resolve DTRPs and hence, improve overall patient care.

Key words:

End stage renal disease – Hemodialysis – Poly pharmacy – Drug therapy related problems – Pharmaceutical care plan.

Aim of the Work

The main aim of the study is to detect drug therapy related problems in children undergoing hemodialysis.

In addition to assessment and evaluation of the impact of clinical pharmacist interventions on the clinical outcome of children undergoing hemodialysis.

Part 1: Renal insufficiency

I. Definitions

Impairment of normal kidney function is referred as renal insufficiency or renal failure, based on the time course of development, renal failure has been historically divided into 2 broad categories: acute renal failure and chronic renal failure. **(Schonder, 2010)**

1-Acute renal failure (ARF) is a clinical syndrome in which a sudden (hours to weeks) deterioration in renal function results in the inability of the kidneys to maintain fluid and electrolyte homeostasis, the loss of renal function is reversible in the majority of cases.

The overall incidence of ARF in pediatrics is 0.8 per 100,000 total population, while the incidence of ARF in neonates ranged from 8% to 24% of newborns**. (Andreoli, 2009)**

Fifty to seventy five percent of ARF patients require dialysis to compensate loss of kidney function. (**Vogt and Avner, 2007**)

The three leading causes of acute renal failure in children in developing countries are: hemolytic uremic syndrome (31%), glomerulonephritis (23%), postoperative sepsis and pre-renal ischemia (18%). **(Chan et al, 2002)**

2-Chronic renal failure (CRF) is defined as gradual and usually permanent (irreversible) loss of kidney function over months to years, and is characterized by gradual replacement of normal kidney architecture with interstitial fibrosis.

(National kidney foundation, 2008a; Matzke, 2011)

The progression of renal malfunction towards end stage renal failure is common among patients with CRF irrespective of the underlying kidney disorder. **(Phan et al, 2008)**

3-End- stage renal disease (ESRD) refers to a stage of chronic kidney disease where there is total or near total loss of kidney function and most individuals in this stage of kidney disease need dialysis or transplantation to stay alive. ESRD is one of the main health problems in Egypt. (**Broscious and Castagnola, 2006; Allam et al, 2010)**

Chronic Kidney disease (CKD):

The National Kidney Foundation (NKF) and the Kidney Disease Outcomes Quality Initiative (KDOQI) workgroup defined CKD as either:

A- Kidney damage for 3 months or longer, as defined by structural or functional abnormalities of the kidney, manifested by either: pathological abnormalities, or markers of kidney damage abnormalities in the composition of blood or urine, or abnormalities in imaging tests.

B- Glomerular filtration rate (GFR) < 60/ml/min/1.73m^2 for 3 months or longer, with or without kidney damage. (**National Kidney Foundation, 2008a)**

This definition is not applicable to children younger than 2 years because they normally have a low GFR, even when corrected for body surface area.

GFR is equal to the sum of the filtration rates in all of the functioning nephrons and therefore, can give an estimate of renal function. Interpretation requires a clear understanding that GFR varies according to age, gender, and body size. The normal GFR is much lower in infancy and reaches adult values after one year of age. Despite this, a calculated GFR based upon serum creatinine can be compared to normative age-appropriate values to detect renal impairment even in toddlers and infants with CKD. (Table 1) shows the normal GFR in children and adolescents.

Table (1): Normal GFR in children and adolescents

Age	Mean GFR±SD (**ml/min/1.73m^2**)
1 week (males & females)	41 ± 15
2 week (males & females)	66 ± 25
>8 week (males & females)	96 ± 22
2-12 years (males & females)	133 ± 27
13-21 years (males)	140 ± 30
13-21 years (females)	126 ± 22

(**Jayaranan and Vander voort, 2010**)

II. Staging of CKD:

The KDOQI has developed a classification system for the severity of CKD based on GFR and independent of primary renal diagnosis (Table 2). (**National Kidney Foundation, 2008a)**

Stage (1): Kidney damage with normal or increased GFR (> 90 ml/min/1.73m^2)

This stage is defined by the presence of structural or functional abnormalities of the kidney, initially without decreased GFR which over time can lead to decreased GFR.

Stage (2): Mild reduction in GFR (60 to 89 ml/min/1.73 m^2)

At this stage, patients usually have hypertension and may have laboratory abnormalities indicative of dysfunction in other organ systems, but most patients are asymptomatic.

Stage (3): Moderate reduction in GFR (30 to 59 ml/min/1.73 m^2)

This stage is characterized primarily by the presence of azotemia, defined by the accumulation of the end products of nitrogen metabolism in the blood and expressed by an elevation in serum creatinine and blood urea nitrogen (BUN) concentrations. Erythropoietin production decrease and laboratory abnormalities reflecting dysfunction in other organ systems are usually present. Although patients may have symptoms, they often remain remarkably asymptomatic even though their kidney function may be reduced as much as 70 %.

Stage (4): Severe reduction in GFR (15 to 29 ml/min/1.73 m^2):

In this severe stage of CKD, the worsening of azotemia, anemia and other laboratory abnormalities reflect dysfunction in several organ systems. However, patients usually have mild symptoms.

Stage (5): Kidney failure GFR < 15 ml/min/1.73 m^2):

In most cases, this level of kidney function is accompanied by a constellation of symptoms and laboratory abnormalities of several organ systems, which are collectively referred to as uremia. Initiation of kidney replacement therapy (dialysis or transplantation) is typically required for treatment, of co-morbid conditions or