

# A Review on the Impact of Clinical Pharmacists Intervention in the Management of Patients with Kidney Failure

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**Abstract:** Renal failure is a major public health problem that occurs with high mortality and morbidity in developed and developing countries. It is a loss of kidney function that starts and develops slowly and progressively over a period of several years. The loss of function of kidney may be asymptomatic for several years until the disease is more advanced, complicated and leads to the final stage known as end stage renal disease (ESRD) which is goes to renal replacement therapy. The literature was conducted using different studies and reviews that reveals renal failure, the intervention and impact of pharmacist to patients and role of pharmacists. Pharmacist's manage lab tests, patients follow up, management drug dosage according to guidelines and reduce risk factors to decline in renal function. The research results identified 37 studies (38 articles), involving 4743 participants were shows pharmacists intervention reduced all cause of hospitalization mean from 3.1 to 1.8 and cumulative time hospitalized from 16.3 to 14.7 days, anemia improvement from 43.9 to 69.8, blood pressure (systolic) from 175.8 to 145.3 and (diastolic) from 91.8 to 77.0 mmHg., Calcium and phosphate levels [serum from 2.7 to 1.81 mmol/liter, LDL from 305.48 to 191.78 mg/dL, and cost reduction from 15,363 USD to 2,250 USD in between the year of 1992 to 2007. However, all available studies reported some positive impact resulting from clinical pharmacist involvement and the intervention of pharmacist is true impact on outcomes of patients with chronic kidney disease to improve their life and also an expected objective of pharmacist intervention in the management of renal failure is to aware the patients to make their lives better during their life time.

**Keywords:** Clinical Pharmacist, kidney failure or CKD, Intervention, Management, ESRD.

## 1. Introduction

At the era of the 20th century the cause of mortality and morbidity is mostly related to infectious disease in developing as well as developed countries, but nowadays this is completely shifted. In the 21<sup>st</sup> century, the main cause of death around the world is due to non-communicable or non-infectious diseases [1]. So renal failure is one of the progressive and emerging diseases of the century [2]

Chronic renal failure is a critical issue of all peoples in the world. It is the disease put to death silently and difficult to prevent or control early [3]. The disease was ranked 27<sup>th</sup> from

all causes of death globally in the year 1990, eventually, this rank is rise to 18<sup>th</sup> two decades later in 2010 according to the Global Burden of Disease study 2010 [4]. For several years glomerulonephritis is one of the most common causes of the disease but now this is changed and not as such significant, because of decreasing of infection as a cause of the disease in the developed countries or western world [5]. Now a day's hypertension and diabetes are the major and the leading causes of renal failure [6]. The nature of the disease is characterized by symptomatically and also asymptotically. Due to the asymptomatic nature of the disease, it becomes difficult to control at early stage [7].

As the study of Kidney Disease Outcomes Quality Initiative (K/DOQI) at 2002, Chronic renal failure is defined as total damage of the kidney or GFR rate below 60ml/min/1.73m<sup>2</sup> in the period of 3 months [8]. From 2005 to 2015, the prevalence of diabetic kidney disease rises by 39.5% globally [3] Latin America Especially Mexico is the highest CKD death rate in the world [3]. This increment is due to the cost acquire for of the renal replacement therapy or dialysis [9]. According to conventional study at 2010 implicated that more than half of the population in Latin America needs transplantation or dialysis, this is also the issue of Middle and East Africa were the problems is outshine and only 3% of peoples are getting this service [9].

Depending on the economies and incomes of the peoples of the country renal failure is treated by dialysis or replacement therapy. The highest and emerged incidence of ESRD is shown in developed countries like Europe, Japan, and North America [10]. In the world, over one million dialysis patients are there with an occurrence of over a quarter per year. The incidence of CKD in the USA increased from 12 to 14 % in the year between 1988 and 1994 but stable at 2004 [11], as the US Renal Data System report in 2003 Shows that there are 93,883 dialysis and 2,412 kidney replacement incident patients with 402,081 end-stage kidney disease prevalence, this prevalence rate is emerged to near twofold i.e. a total of 661,000 patient cases [12]. Renal replacement therapy and dialysis is the only choice to survive. Some studies in sub-Saharan countries reveal that 2.3 to 3.2

million peoples are dying with a shortage of dialysis per year [13]. In some African countries, governments provide services of dialysis for renal failure patients, some are funded by the state government at rationing system, and others are provided free with reducing the frequency of hemodialysis from three to two times per a week [14]. But the majority of renal failure patients are cover their cost by themselves [15]. Patients with chronic kidney disease are must be alert for self-managing, change and symptoms of the disease, progressive of the treatment by changing their lifestyle, and ready for physiological and psychological consequences with other associated problems [14] and also important to improve their knowledge about the disease, build self-confidence on medical aspects, knowing, identifying and activating access of resources, modify their living styles, this all are included under self- management [16].

## 2. Methodology

A literature review was conducted by searching from different articles like research and review articles, medical publications, journals, from Googles or Internets, Web of Science for articles published in English, from sub-Saharan Africa reporting dialysis outcomes in patients with ESKD publications, in general about 18 articles which are published in in the year between 2011 and 2018 are used. Different studies about current situation in sub-Saharan African countries, clinical and economic outcomes of pharmacists before and after management of chronic renal failure, access to dialysis, mortality, duration of dialysis, and markers of dialysis quality in patients with ESKD are included. The following words were used for this search: "chronic kidney (or renal) disease", kidney (or renal) disease", "kidney (or renal) dysfunction", decreased kidney (renal) function", "glomerular filtration rate".

## 3. Literature review

### A. Chronic kidney failure Definition

Chronic kidney failure is a loss of complete or incomplete filtration of circulatory fluids and removal of wastes from the body due to reversible or irreversible dysfunctions of kidney cells/ glomerulus. These gradual loos of function lead to filtration rate below 15ml/min. and difficult to cure, reversible to normal situation except renal replacement treatment (RRT). Generally, renal failure is not only the challenge of some parts of the world, categories of people's, and ages, rather the problems of all over the world and attack any groups of peoples, ages and gender without discrimination [17].

### B. Mortality

According to Global Burden of disease (GBD) 2015 study, CKD is one of unexpected and observed cause of death, that responsible for 1.1 million deaths worldwide by increasing 31.7% over the last 10 years [18] and also 10.1 million Americans [19], 12- 23 % of Sub Saharan Africans is life with CKD and risk of developing end-stage kidney disease (ESKD)

[20].

### C. Incidence and prevalence

In the USA the incidence and prevalence of ESKD are 354 and 1665 p.m.p respectively in the year of 2009, [21] and In Australia 116 and 822 p.m.p respectively in the year of 2008 [22] and also the prevalence of renal replacement therapies in Europe in the year 2008 ranged from 421 to 1152 p.m.p. [23]. The rate of infection is more displayed on White Americans, African-Americans, Asians, and Asian-Americans (61%, 32%, 5%, and 1%) respectively. Africans and Native Americans are more affected than white Americans, Non- Hispanic are more affected than Hispanic, not only this but also gender and age wise males 45- 65 years are more affected than females [17].

### D. Causes

Diabetes, Hypertension, and Glomerulonephritis are the leading causes [24], Poor sanitation, inadequate supply of safe water, and high concentrations of disease-transmitting vectors are the other causes of renal failure. Environmental pollution, pesticides, analgesic abuse, herbal medications, and the use of unregulated food additives also contribute to the burden of chronic kidney disease in developing countries [25]. Rapid urbanization, globalization and [26] Genetic factors also included [27].

### E. Risk Factors

One risk of CRD is hypertension, from 972 Million's (26%) populations globally prevalence of hypertension estimated in 2000, 639 million (66%) being in developing countries and this expected to increase to 1.56 billion by 2025. Worldwide [28]. In Similar way diabetes is the other risk and the worldwide prevalence of diabetes in adults is estimated to be 6.4%, affecting 285 million people, and is projected to rise to 7.7% (439 million peoples. by 2030 [29]. The largest increases in prevalence are expected in developing regions (the Middle East, 163%; sub-Saharan Africa, 161%; India, 151%; Latin America, 148%; and China, 104%) [30]. Worldwide an estimation of the prevalence of obesity is increasing from time to time and being 312 million peoples are under risk of obesity at the binging of 21 century. With the other hand, the increasing of childhood overweight and obesity is shocking. In between the year 1992 and 2002 in China the prevalence is increased by 49.3% and categorized as obesity and overweight. Obesity in developing countries is increasing in wealthy and literate populations as compared to developed countries [31].

### F. Phases of renal failure

- Phase 1. Regular glomerular filtration rate is 90ml/min.
- Phase 2. A modest decrease of glomerular filtration rate 60- 89 ml/min.
- Phase 3. An averagely decrease in glomerular filtration rate 45- 59 and 30 to 44 ml/min.
- Phase 4. A critical decrease of glomerular filtration

rate 15- 30 ml/min. and

- Phase 5. Absolute renal failure step with glomerular filtration rate is below 15ml/min [32].

#### G. Role of Pharmacists

- Maximizing the effectiveness of drugs by selection of an appropriate drug for each patient and minimizing drug adverse reactions by improving drug handling, usage with patients by counseling and monitoring [33].
- Pharmacists have a role with minimizing the cost of the drug and healthcare depending on patient care [34].
- Pharmacist's estimate renal function, refer to literature references and adjust medication doses for renal dysfunction and also monitoring drug-related problems focused, detect and give solution [35].
- Pharmacists devote their time to improving medical management, education to change the perception about disease and works on the delivery of medication and save patients with improving compliance and communication with other health care professionals.
- Clinical pharmacists advise in correcting and optimizing drug therapy, making therapeutic recommendations and cooperating with physicians and involving in the significant reduction of blood glucose level.
- Clinical pharmacist involvement is one way to reduce the mortality and make a significant improvement in the case of Anemia problem and minimize inpatient and all cause of hospitalization with minimizing of all the incidence of ESRD in relation to other [19].

#### H. Pathophysiology

Renal failure is the disease known by the loss of kidney function and damage of the kidney slowly through time. The kidney function is the main and important that removing fluid wastes from all parts of our circulatory system. Any foreign and unwanted substances above the limits are excreted through urination. The kidney is performing the balance of substances like Sodium, Calcium, Hydrogen, potassium besides removal of Creatine and uric acid. Kidney also adjusted blood composition and maintain a volume of blood pressure and volume<sup>36</sup>.

#### I. Dialysis

- The action of reducing some unwanted substances (minerals) and accumulation of fluids from all over the body including circulatory system (blood) through well prepared instruments (Dialyzer).
- Increase the life span of the patients by reduction of mortality and morbidity.
- An instruments (dialyzer) used to filtrate fluids in the case of irreversible kidney damage or dysfunction of

glomerular filtration rate (GFR) is below 15ml/min.

*Types of dialysis:*

*Primary Dialysis:* peritoneal and hemodialysis

*Secondary dialysis:* Intestinal and hemofiltration [19].

*Hemodialysis:* Eliminating of harmful and dangerous materials and fluids from the circulating blood in the form of filtration by the help of dialysis.

*Peritoneal dialysis:* Is the process of eliminating an excess amount of unnecessary fluids in the body absorbed or removes from the body through a tube which is inserted in the abdomen. The fluids are filtered by the membrane of the abdominal cavity and then the dialysis removes the wastes from the body by transporting system [37].

*Renal transplantation* therapy is the exchanging of a healthy kidney by the diseased one by the help of surgical operation for Chronic kidney patient. Healthy kidney used for transplantation is gained from donors, and sometimes from persons dead with an accident. For the last 5 years, the survival of the life expectancy or survival rate for the transplant patients is 85.5% and also 35% for the dialysis patients. The therapy is needed for patients they are under risky condition and patients which their kidney does not respond to dialysis [38].

#### J. Management of renal Failure

*Hypertension Control:* It is important to control the blood pressure by decreasing the range of Systolic below 120 to 135 mmHg. and diastolic range 70 to 80 mmHg. Drugs like ACE inhibitors of a class of antihypertensive are important for the control of hypertension [37].

*High protein restriction:* protein-rich foods are increasing the risk of diabetes problem, rise glomerular filtration rate and hypertension. Limitation of high protein rich diet is important for patients based on the nutritional status and glomerular filtration rate. Not more intake of proteins and also decrease the progress of damage of kidney by heavy works related to more excretion [37].

*Metabolic acidosis:* For buffering of hydrogen ions production of ammonia is very important, but if the kidney cells or nephrons are loss their function, production ammonia is impossible, and bicarbonate is not reabsorbed this leads to the accumulation of bicarbonate that shows the imbalance presence of ions or high amount of acid ion formation, this resulting metabolic acidosis formation [19]. Sodium bicarbonate 650mg should be prescribed 3 times a day when the level of bicarbonate is under the level or giving 22mmol/L for overcoming the problem [39].

*Glucose control:* Appropriate monitoring of glucose leads to improving diabetes mellites management and proteinuria, to decrease glomerular filtration rate, and also reduce the risk of diabetic nephropathy progress and cardiovascular complication with other related problems. The current data sows target of glycemic control is hemoglobin of A1c(HbA1c) of approximately recommended 7% [40].

*Fluid and electrolyte balance:* in case of improper activity of kidney nephrons, fluids and electrolytes are accumulate in our

body circulatory system, this leads to edema in different parts of our body, heart failure, arrhythmias. The management of salts is controls by a fluid of sodium intake and the urine output. Management is possible by giving loop diuretics in combination or alone [19].

*Hyperkalemia:* when renal failure occurs potassium, excretion is decreases or accumulation of high amounts of potassium (hyperkalemia) this resulting weakness, confusion, muscle problem, and heart failure. This is treated or managed by using appropriate amounts of potassium in the diets, or by restricting intake of potassium, and also the administration of calcium in the case of heart failure patients by insulin and glucose through dialysis [19].

*Anemia:* Erythropoietin is important for the production of red blood cells (RBC) in kidneys, Anemia is occurring due to a reduction of erythropoietic cells. GFR <60ml/min indicates the presence of anemia. The cause is controlled by iron tablets, blood transfusions and erythropoiesis-stimulating agents and confirmation test are performed by ferritin and another laboratory tests [19].

#### K. Treatment

Treatment of renal failure is it includes both the management and medication part. Medication is not as such important when the disease is at high stage (Stage 4 and 5) except reduce the complication and progress of the diseases. Some drugs are ACE inhibitor drugs, ARB, blockers, Calcium channel blockers, Diuretics, BETA blockers, and Vasodilators [19].

## 4. Result and discussion

### A. Intervention of pharmacist on CKD

The occurrence of chronic kidney disease frequently increases from time to time<sup>41</sup>. The patients suffer from chronic kidney failure and those who are used dialysis are under unexpected risk of drug therapy problems (DTPs) [42]. According to the Canadian Journal of Hospital Pharmacy, 2013 controlled trials, clinical pharmacist's intervention has reduced the entrance of new patient, readmission, length of stay in hospital and emergency department visits [43]. The action of pharmacists highly related with motivated patient results with participating on rounds, asking and sharing the problems of patients, awareness creation about medication, guide patients on removing discharges and post-discharge flow-up [44]. Some controlled trials also patients with chronic kidney disease that clinical pharmacist's intervention reduced returning and stay length in hospital and occurrence of end-stage renal disease or death [45]. So many researches are done and recorded participation of pharmacists' in identifying drug-related problems and participation to limit this complication. The benefit impact has seen in both acute and chronic renal failure including inpatient [46]. and outpatient care [47]. One of the most important interventions delivered by pharmacists is approval or correction about drug adjustment related with education [48]. There is cost reduction intervention but not

critical as drug adjustment intervention [49]. Generally, pharmacists have a great, critical and important role in the health care multidisciplinary group that are well trained related to drugs prescribed for patients with renal disease. Intervention delivered by pharmacists mostly include identifying diseases occur due to drugs [50], not only this, other study shows pharmacist intervention included adjusting and improving drug [51], according to the prescription of drug, clear interaction with other health professional teams [52], perform any laboratories according to guidelines and procedures[53], assessing any activities of institution related to medication and records [54], identify and give solution for drug-record problems [55], prepare different procedures for mineral management for anemia [56]. Lipid and [57]. Phosphate [58], create awareness about disease and drugs for patients [59] and improve any compliance faced [60]. The contribution of pharmacists in medical fields is important for different research's [51]. and also important for communication of another multidisciplinary health team [61]. or oral /written consultation of patients in any conferences [62].

According to the study of (Teresa M. et al., 2011) randomized controlled study designs of 37 studies (38 articles) including 4743 participants at baseline, were analyzed in this review clinical outcomes were reported (55.3%), humanistic outcomes (13.2%), economic outcomes (31.6%), both clinical and economic outcomes (26.3%), and also humanistic and economic outcomes (2.6%) reported [63].

### B. Clinical outcomes

According to the study and designs of (Pai AB et al., 2009) the intervention of pharmacists to indicate significant and remarkable decrease in all cause of hospitalization means shows 3.1 to 1.8 as well as the cumulative time hospitalized mean from 15.5 to 9.7 days [47] and the study by (Bucaloiu ID et al.,2007) shows that pharmacist intervention resulting a significant increase in the number of patients meet the target of hemoglobin and transferrin mean from 43.9 to 69.8% and 40.4 to 64.8% respectively [56] and (Anonymous., 1998) shows that the overall decrease in percentage of patients with secondary hyperparathyroidism from 42 to 31% and the percentage of patients with moderate to severe hyperparathyroidism 23 to 7 % [64]. The other study done by (Yoakum D et al.,2008) also shows that management of pharmacist's intervention results a significant reduction in serum phosphate levels mean 2.07 to 1.81mmol/L, and a greater improvement in calcium-phosphate product mean 4.80 to 4.43 mmol<sup>2</sup>/L<sup>2</sup> when compared to standard practice [65]. And (Leal S et al., 2008) shows Pharmacist intervention is also an absolute reduction of blood glucose in chronic kidney disease mean 209 to 163 mg/dL, LDL mean 107 to 91 mg/dl and cholesterol mean 198 to 170 mg/d L [53].

Additionally, (Chisholm MA et al., 2007) study clarify that the LDL value decreases from 305.48 to 191.78 mg/dl total cholesterol levels 345.83 to 239.91mg/dl., triglycerides mean from 290.78 to 223.13 mg/dL, a significant decrease in blood

pressure (systolic) mean from 140.52 to 134.3 mmHg and (diastolic) blood pressure mean from 79.19 to 77.04 mmHg. and blood glucose reduction from 129.22 to 112.22mg/dl [66]. Generally the improvement Concluded and shows by a graph as follows:

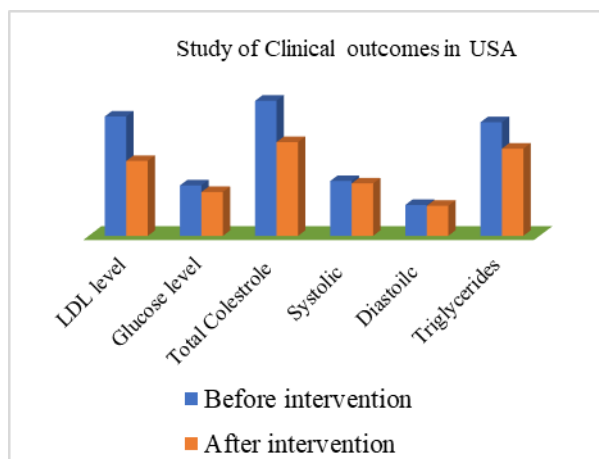


Fig. 1. Clinical Outcomes Before and after Pharmacists Intervention in USA

The other report by (Leung WY et al.,2005 and Pai AB et al., 2009) done in China show that the decrease stays in hospitalization from 15.5 to 9.7 days, systolic mean from 148.0 to 139.7, diastolic 71.8 to 67.6, total cholesterol 15.0 to 4.4, and Creatinine serum level from 82.4 to 32.5 micromole/L/year to show the improvement by the intervention of pharmacists is valuable in the Chronic renal failure [67], [68]. This is shows by the graph below:

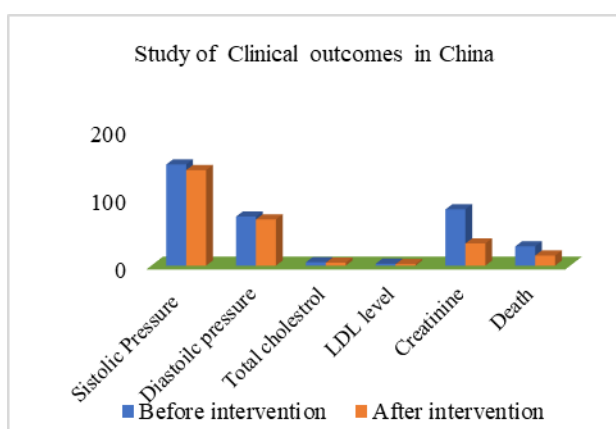


Fig. 2. Clinical outcomes before and after pharmacist’s intervention in China

C. Humanistic outcomes

As the report of (Teresa M. et al., 2011) reveals that Intervention of pharmacists shows an increased health-related quality life as the whole mean 38.57 to 49.47, social functioning mean 40.02 to 50.4, role emotional mean 38.79 to 41.59, mental health scales mean 41.81 to 46.72 and on the physical component summary mean 43.79 to 46.72 and mental component summary mean 40.61 to 46.14. Additionally, it has also been reported a statistical improvement in energy mean 3.3

to 7.1, daily activities mean 4.9 to 7.7 and patients general well-being mean 4.6 to 7.5, using linear the help of analog scales [63].

D. Economic outcomes

Based on 12 articles observed by (Teresa M. et al., 2011) results pharmacist interventions were reported [67]. the amount of cost shows 15,363 [68]., 172,220 [69]., 1,018,638 USD [70] reduction in the year of 1992,1992 -1995 and 1995 -1998 respectively and 2,250 USD during a period of 4 months in 2007 [51]. The number of epoetin alpha units decreased non-significantly from 8.5 to 7.7 million when a pharmacist became responsible for anemia management [71]. Once the study of Japanese showed that pharmacist intervention reduced the monthly costs of erythropoietin from 1.86 to 1.37 million Japanese yen (equivalent to 22,600 USD and 16,600 USD) in 9 months of the year 2002 [72].

E. Impact of pharmacist interventions

According to (Teresa M. et al., 2011), Most studies reporting clinical outcomes found hopeful relation between pharmacist intervention and clinical outcomes improvements such as reduction in blood pressure, reduction in LDL and total cholesterol levels decrease in serum phosphate and calcium-phosphate levels and all reason hospitalizations. The studies also show pharmacist interventions in anemia not as such improvement on anemia management and by demonstrate more studies, also on hemoglobin and transferrin saturation [56] and hematocrit in time between 4-years [70]. Anemia correction has been related to an enhancement in health-related quality of life between dialysis and non-dialysis patients [72] and patients with better health-care, quality of life have a meaningful and more favorable survival rate [73]. Anemia adjustments have the probability to improve other clinical and economic outcomes in patients with chronic kidney disease [74] like left ventricular hypertrophy [75], the rate of improvement of chronic renal failure [76] and death [77].

Pharmacists also play a role in a remarkable reduction in the number of patients with secondary hyperparathyroidism [64], as well as a reduction in serum phosphate and calcium-phosphate level [65]. Serous flow-up and correction of phosphate and calcium levels in case of serous cause for cardiovascular death patients under hemodialysis [78]. But some studies not appreciated results in relation to humanistic outcomes with controlled and uncontrolled studies and not a significant difference in relation to quality life after the intervention of pharmacists [79]. Pharmacist intervention the best way to perform cost reduction according to some studies and reports in relation to medication cost also. There is some study reported a substantial benefit-to-cost ratio resulting from pharmacists’ interventions [80]. Additionally, hospitalization is the major component of the cost of care for patients on dialysis [81], therefore, reducing hospitalization rate [50]is related to cost reduction. Drug-related problems are the most frequent result to be studied. There is different argument int related to the definition of drug-related problems and not been cleared

demarcation [82]. Increasing of Hospital admissions and increasing of drug-related problems are its own relatons [83], health care management improvement [84] increment of morbidity and mortality because of the cost of drugs [85]. According to the report of some other study 28% of hospital

admissions directly connected with drug problems [86]. Generally, drug-related problems are avoided by identifying, adjusting and correcting the costs with medicinal care for dialysis patients [87].

Table 1  
Summary of results

R. N	Author	Country	Study design	Study Setting	Aim	Intervention	Participants	Outcomes
01	Leung et al. <sup>65</sup>	China	Prospective Cohort Study (2 years)	University based Public hospital	To develop a disease management program for patients with Type 2 diabetic nephropathy and evaluate its effects on the onset of time to ESRD or all-cause death compared with usual care.	Pharmacists	160HD	Systolic blood pressure means from 148.0 to 139.7, diastolic blood pressure means from 71.8 to 67.6 mmHg, total cholesterol level decreases from 5.0 to 4.4 mg/dL.
02	Pai et al. <sup>47</sup>	USA	Randomized Controlled Study (2 years)	Non-profit university-affiliated dialysis clinic	To assess the impact of patient counselling on HRQOL of HD patients.	Clinical Pharmacists	104CKD	Significant decrease stays in hospitalization time from 15.5 to 9.7 days.
03	Chisholm et al. <sup>80</sup>	USA	Prospective Uncontrolled Study 2 years	Tertiary care teaching hospital	To study the effects of medication assistance program with medication therapy management on the clinical outcomes and HRQOL of renal transplant recipients.	Pharmacists	36TX	Decreases of LDL from 305.48 to 191.78 mg/dl total cholesterol levels 345.83 to 239.91mg/dl., triglycerides mean from 290.78 to 223.13 mg/dL., a significant decrease in blood pressure (systolic) mean from 140.52 to 134.3 mmHg and (diastolic) blood pressure mean from 79.19 to 77.04 mmHg. and blood glucose reduction from 129.22 to 112.22mg/dl.
04	Teresa M. et al., 2011 <sup>63</sup>		Controlled and uncontrolled studies	Hospital based	To assess the impact of pharmacists 'intervention in patients with chronic kidney disease	pharmacists	4743	Shows (55.3%), humanistic outcomes (13.2%), economic outcomes (31.6%), both clinical and economic outcomes (26.3%), and also humanistic and economic outcomes (2.6%) reported.
05	Bucaloiu ID et al.,2007 <sup>56</sup>	USA	Non-randomized Controlled Study (6 months)	Nephrology department of a medical center	To assess the effect of pharmacist-driven Anaemia management program in patients with CKD.	Pharmacists	134CKD	significant increase in the number of patients meet the target of hemoglobin and transferrin mean from 43.9 to 69.8% and 40.4 to 64.8% respectively.
06	Anonymous et al., 1998 <sup>64</sup>	USA	Prospective Uncontrolled Study (12 months)	Hemodialysis unit of a tertiary medical center	To develop a protocol to allow for pharmacist management of the IV administration of calcitriol and to manage hypocalcemia and hyperphosphatemia.	Pharmacists	335HD	Decrease in percentage of patients with secondary hyperparathyroidism from 42 to 31% and the percentage of patients with moderate to severe hyperparathyroidism 23 to 7 % <sup>9</sup>
07	Yoakum D et al.,2008 <sup>65</sup>	UK	Randomized Controlled Study (4months)	Hemodialysis units of teaching hospital and satellite units	To evaluate the effectiveness of a protocol designed to optimize serum phosphate levels in patients undergoing regular HD.	Pharmacists	34 HD	Significant reduction in serum phosphate levels mean 2.07 to 1.81 mmol/L, and a greater improvement in calcium-phosphate product mean 4.80 to 4.43 mmol <sup>2</sup> /L <sup>2</sup> when compared to standard practice.
08	Leal S et al.,2008 <sup>53</sup>	USA	Prospective Uncontrolled Study	Community health center	To evaluate pharmacist-based disease-state management service to improve the care of indigent patients at high risk to develop CKD	Pharmacists	601CKD	Absolute reduction of blood glucose in chronic kidney disease mean 209 to 163 mg/dL, LDL mean 107 to 91 mg/dl and cholesterol mean 198 to 170 mg/d.

## 5. Conclusion

Pharmacists' intervention in patients with chronic kidney disease is a positive impact and acceptable improvements are displayed, and also variable quality with heterogeneous outcomes. On the basis of best available evidence, pharmacists' interventions may have a positive impact on the outcomes of patients with chronic kidney disease in general, clinical pharmacist intervention there was a decrease in the hospital stay of patients, decrease readmission, increase the life expectancy of the patients or improvement of quality life, decrease cost effectiveness, increase in the health-related outcomes, increasing medication adherence, decrease drug related problems, significant reduction of phosphate level, hypertension, systolic and diastolic rate, slowing the progression of their stages of disease to end-stage kidney disease.

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