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Assessing the Length of Hospital Stay and Economic Outlay for Therapy in Chronic Kidney Disease Patients in a Tertiary Care Hospital

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ABSTRACT

Background: To assess the LOS and costs for hospitalized CKD patients, to compare the pharmacoeconomic-related direct medical and non-medical costs among pre-dialysis and dialysis patients, and to determine the impact of CKD with other comorbidities on hospital LOS and cost.

Methods: An observational study was conducted on 160 patients admitted to the Nephrology Department. From the collected data, the direct and indirect costs of the treatment were analyzed using a standard questionnaire.

Results: Dialysis was significantly correlated with total cost and total indirect cost rather than total direct cost. The statistical analysis showed that comorbidities and LOS were not significantly correlated, which shows that CKD alone is responsible for increased LOS. Both LOS and cost were significantly correlated (p-value 0.00). The stage of CKD and the type of treatment being used are the main determinants of LOS. Direct medical, direct non-medical, and total direct costs were significantly related to comorbidities (p-value 0.004, 0.005, and 0.058, respectively).

Conclusion: The study revealed that dialysis was significantly correlated with total cost and total indirect cost. Dialysis treatments, hospital stays, and other CKD-related requirements necessitated many time-consuming visits and procedures. According to the study's analysis of the data, there is no statistically significant relationship between comorbidities and LOS. This demonstrates that the lengthening of stays is solely attributable to CKD.

Keywords: Chronic Kidney Disease, Dialysis, Length of Stay, Cost, Comorbidities

Introduction

Pharmacoeconomics plays a pivotal role in the socioeconomic examination of the global healthcare system, especially in developing nations (1). This field, a subset of health economics, focuses on economically assessing pharmaceutical products and services. It delves into the evaluation of the value these medical treatments bring to patients, healthcare systems, and society as a whole (1,2). This discipline is crucial for informed decision-making by policymakers, healthcare professionals, and payers, aiding in optimal therapy selection and resource allocation. By weighing the benefits, risks, and costs of various medical procedures, pharmacoeconomics becomes instrumental in identifying the most cost-effective methods to improve patient outcomes and reduce healthcare expenses (3). The analysis typically involves comparing the costs and benefits of different interventions, considering direct medical expenses, such as prescriptions and hospital stays, alongside indirect costs, like diminished quality of life and productivity. Health outcomes, including life expectancy, quality of life, and symptom relief, serve as key metrics in quantifying the advantages of these interventions (4,5).

Cost-effectiveness analysis (CEA) stands out as a widely embraced pharmacoeconomic evaluation method, comparing the costs and benefits of different interventions using a common outcome measure, such as the cost per quality-adjusted life year (QALY). QALY, a measure incorporating both life duration and quality, is a pivotal metric in assessing the effectiveness of diverse interventions in the medical field (6). Cost-utility analysis (CUA), another facet of pharmacoeconomic evaluation, scrutinizes the costs and benefits of therapies concerning their impact on specific health-related quality of life (HRQOL) measures, such as the EuroQol-5 Dimension (EQ-5D) index. EQ-5D, a standardized tool, assesses HRQOL in terms of mobility, self-care, daily activities, pain/discomfort, and anxiety/depression (5,6). Additionally, cost-benefit analysis (CBA) is part of pharmacoeconomic analysis, contrasting the financial costs and benefits of therapies. While less frequently utilized compared to CEA and CUA, CBA can pose challenges in accurately estimating the monetary value of health outcomes (7,8). Pharmacoeconomic analysis plays a crucial role in pharmaceutical pricing and the development of novel drugs. Given the escalating costs of developing new treatments and the growing demand for cost-effective healthcare, this analysis is instrumental in evaluating the value of new pharmaceuticals and establishing their prices. It provides a robust framework for weighing the costs and benefits of diverse therapies, offering insights into cost-effective strategies for improving patient outcomes and reducing healthcare expenses (8). As the demand for affordable healthcare continues to rise, pharmacoeconomics is poised to become increasingly significant in the coming years.

The duration of hospitalization can significantly impact patients, their families, and the healthcare system on various fronts. Prolonged stays not only lead to increased expenditures but also elevate the risk of hospital-acquired infections, negatively affecting a patient's quality of life (9). Furthermore, an extended hospitalization may limit bed availability, causing delays in treatments for other patients (10,11). Beyond the physical implications, lengthy hospital stays can induce psychological and emotional stress, including feelings of loneliness, despair, and anxiety. Independence is compromised, and patients may become more reliant on caregivers, impacting their ability to carry out everyday tasks (12,13). The financial implications are substantial as well. The complete cost of hospitalization, encompassing medications, hospital beds, lab testing, physical exams, and surgery, is shared by the patient, government, and insurers (14). Prolonged stays can escalate the costs associated with prescription drugs, diagnostic testing, and surgical procedures, coupled with potential productivity loss, increased impairment, and a diminished quality of life. In response, measures such as infection prevention practices, enhanced care coordination, and streamlined early-release planning have been implemented to mitigate hospital stays. These initiatives aim not only to improve patient outcomes but also to reduce healthcare costs and alleviate the strain on the healthcare system (11).

Chronic kidney disease (CKD), a widespread and progressive disorder affecting millions globally, poses a substantial impact on healthcare pharmacoeconomics, leading to significant expenses (7,15). This condition impairs the kidneys' ability to efficiently filter waste from the blood, with an estimated 10% of the world's population affected, making it a growing public health concern (16). CKD, categorized into five stages based on estimated glomerular filtration rate (eGFR) and protein levels in urine, often goes unnoticed in its early stages due to the absence of symptoms (17). However, as the disease advances, patients may experience fatigue, nausea, and swelling in the legs and feet. Advanced CKD can lead to complications like anaemia, bone disease, and

cardiovascular issues (18). Diagnosing CKD involves blood and urine tests assessing eGFR and creatinine levels, alongside imaging examinations like ultrasounds or CT scans to evaluate kidneys and the urinary tract (19,20). Prevention plays a crucial role in managing CKD effectively. Screening for risk factors like diabetes and high blood pressure and implementing lifestyle changes such as smoking cessation, regular exercise, and maintaining a healthy weight are essential to detect the condition in its early, more treatable stages (21). Treatment aims to control symptoms, slow disease progression, and prevent complications. Lifestyle modifications, including reduced salt intake, regular exercise, and smoking cessation, may be recommended.

Additionally, medications to manage cholesterol, blood sugar levels, and blood pressure could be prescribed (22). In severe cases, dialysis or a kidney transplant may be necessary (7). The pharmacokinetics of medications, encompassing their uptake, distribution, metabolism, and elimination in the body, can be influenced by CKD. This alteration may lead to changes in drug toxicity and efficacy, impacting the cost-effectiveness of therapies (23). CKD patients often contend with multiple comorbidities, complicating treatment and elevating healthcare costs (24). Medication expenses constitute a significant financial burden for CKD patients, necessitating various medications for conditions like blood pressure control, anaemia management, and the treatment of side effects such as hyperphosphatemia and hyperkalemia (25). The overall management of CKD, including medication costs, diagnostic testing, and renal replacement therapy (RRT) like dialysis or kidney transplantation, can be financially demanding. RRT, notably dialysis, is particularly costly, exceeding $100,000 per patient-year in the United States (26).

Identifying cost-saving opportunities through pharmacoeconomics, such as the use of less expensive pharmaceuticals or preventative measures to reduce medical interventions, becomes crucial (Senanayake et al., 2020). Evaluating the cost-effectiveness of CKD therapies reveals that early-stage treatment and diagnosis can improve patient outcomes while lowering medical expenses (20). Implementing programs to enhance blood pressure control in CKD patients has proven to be a cost-effective measure (1,26). The impact of CKD on patients' quality of life further influences its pharmacoeconomics (27). Regular clinic visits, blood tests, and lifestyle adjustments for CKD management can significantly affect the patient's quality of life (28,29). Indirect costs, such as reduced productivity and increased disability, may arise from the decline in quality of life associated with CKD.

Moreover, the psychological and emotional strain can lead to depression and anxiety, exacerbating the quality of life and escalating medical expenses for patients (19,30). Conducting pharmaco-economic analysis provides a means to evaluate the impact on Length of Stay (LOS) and cost-effectiveness associated with the use of drugs in Chronic Kidney Disease (CKD) (31). Notably, studies have shown that the utilization of ACEIs (Angiotensin Converting Enzyme Inhibitors) and ARBs (Angiotensin Receptor Blockers) in CKD treatment can effectively reduce the risk of hospitalization and improve patient outcomes (32). Moreover, the use of these medications has demonstrated a reduction in CKD-related medical expenses (33). Implementing patient education initiatives, medication adherence programs, and early referral to nephrology specialists are additional strategies aimed at mitigating LOS and economic burdens in CKD patients. Research has substantiated that these approaches not only enhance patient outcomes but also result in reduced hospital stays and lowered overall healthcare costs (34).

In summary, the pivotal role of pharmaco-economic studies in Chronic Kidney Disease (CKD) management lies in evaluating their impact on Length of Stay (LOS) and the cost-effectiveness of treatments. Healthcare professionals can optimize patient outcomes, reduce healthcare costs, and effectively utilize resources by identifying and implementing cost-effective therapies.

The main aim of the study is to evaluate the length of hospital stays and costs for CKD patients in tertiary care hospitals. The objective is to compare the pharmacoeconomic-related direct medical and non-medical costs among pre-dialysis and dialysis patients and to determine the impact of CKD with other comorbidities on hospital length of stay.

Materials and Methods

The study was conducted in the Department of Nephrology in a Medical College over a period of 6 months. All hospitalized patients of age >18 years diagnosed with CKD with hospitalization of

more than two days were taken as the study population, excluding patients with cancer, pregnant women, patients with other neurodegenerative diseases, and patients who were not willing to participate in the study. The patient admitted to the department enrolled in the study, considering the study criteria after obtaining their consent to participate in the study. The minimum sample size was 160, with a 5% level of significance. Descriptive statistics like frequency, percentage, mean, SD, median, and interquartile range were used. Independent sample t-test was used to test the significant difference in the cost of treatment between pre-dialysis and dialysis groups. A p-value < 0.05 would be considered significant.

The data was collected in a suitably designed data collection form. From the collected data, the direct and indirect costs of the treatment were analyzed using a standard questionnaire. The study also recorded the length of hospital stay for each hospitalization and the number of hospitalizations. Only those hospitalizations with more than two days hospital stay were identified because others were assumed not to influence the outcome. The cumulative length of hospital stay and number of hospitalizations were used as exposure variables in statistical analysis. The study was approved by the Institutional Human Ethical Committee of Government Medical College Kannur, filed under IECNo.09/2023/GMCK. Permission to conduct the study was obtained from the Medical Superintendent of Government Medical College Kannur.

Calculation of direct medical cost

Direct medical costs are medically related inputs used directly to provide treatment. This may include the cost of:

Medications

Diagnostic tests

Dialysis

Medication costs are calculated based on the unit cost (cost of individual tablet/capsule/ampule calculated from their pack cost) of the corresponding generic drug. Costs for different diagnostic tests and dialysis are calculated for individual patients.

Calculation of direct non-medical cost

Indirect costs involve costs that result from the loss of productivity due to illness. This may include:

Travel cost to receive health care for the patient

Non-medical assistance related to the condition of the patient(food)

Lost productivity for unpaid patient

All of these are summed up to give the direct medical and non-medical costs of each patient.

Calculation of indirect cost

Travel cost for the companion

Non-medical assistance related to the condition (food for the caretaker)

Lost productivity for the caretaker (10).

All of these costs are summed up to give the indirect cost of each patient.

Results

A comprehensive cohort comprising 160 patients satisfying the criteria was included in the study. The duration of the study was six months, and the data were collected from the Department of Nephrology of a Government Medical College.

Within the cohort of 160 patients, 15 individuals fell within the age bracket of 18-40, 34 within 41-50, 35 within 51-60, 53 within 61-70, 25 within 71-90, and a diminutive 3 in the 81-90 age range. Predominantly, the demographic bulge was noted among those aged 61-70, constituting a substantial 53 individuals. The calculated mean age of the study population stood at 59.11±12.430. 60% of the study population (96) were male, while 40% (64) were female, which aligns seamlessly with the investigation led by S. Fathima et al., which encompassed 39 patients (2). In that particular study, a preponderance of male participants was observed, accounting for 66.2%, while females constituted 33.8% of the cohort. A substantial majority, constituting 47.5% (76), exhibited the presence of Hypertension (HTN) alongside other concurrent comorbidities. Notably, 16.9% (27) solely had HTN as their singular comorbidity, while 6.3% (10) had both Diabetes Mellitus (DM) and HTN concurrently. This pattern aligns harmoniously with the findings of Zhen Wang et al., whose study underscored that both diabetes mellitus and hypertension stand as formidable risk factors for chronic kidney injury, collectively contributing to over 70% of cases culminating in end-stage renal disease (35). The duration of hospitalization for the majority of patients encompassed five days (24), followed by seven days (22) and six days (20). A cumulative total of 56 patients experienced a stay of up to 5 days, while 82 patients endured a hospitalization spanning 6 to 10 days, and a more protracted duration of 11 to 15 days was observed for 18 patients (Table 1). Among 160 patients, a mere three individuals surpassed a stay exceeding 15

days, reaching 53 days, an extension necessitated by severe conditions such as cellulitis and septicemia. The majority of the patients, specifically 114 individuals, were undergoing dialysis, while the remaining 46 were not, aligning with the outcomes delineated in the study titled 'Pharmacoeconomic evaluation of chronic kidney disease patients' authored by Sarada Sheethal Y et al. (36).

The study found that only a small number of patients personally covered their medication expenses, while a majority of patients had access to government-sponsored insurance (Table 2). The average indirect costs totaled Rs. 1992.81 with a standard deviation of ±1769.762, and the average direct costs amounted to Rs. 9800.49 ±7960.074 was revealed in the study. Additionally, the mean direct non-medical expenses were determined to be Rs. 1871.40 ±1022.600, while the total average medical expenditures were calculated to be Rs. 7929.09 ±7447.030 (Table 3). Within the study, it was discovered that 83 study populations allocated less than 5,000 rupees toward their medical expenses. Furthermore, 38 study populations expended between 5000-10000 rupees, while ten populations spent between 10000-20000 rupees. Only two populations surpassed the 30000-rupee mark, with expenditure amounts of 56513 and 72980 rupees, respectively. The exorbitant cost was ascribed to the necessity of admission to the intensive care unit and the presence of grave comorbidities like septicemia and cellulitis.

Discussion

This observational study compared direct and indirect costs with dialysis, and the p-values for direct medical and nonmedical expenses and total direct costs were determined to be 0.905, 0.97, and 0.129. Remarkably, these values did not attain statistical significance, denoting an absence of substantive impact. The p-value for total indirect cost was determined to be 0.004, while for total cost, it was found to be 0.047. These significant findings indicate a noteworthy association in these domains. CKD often leads to decreased productivity and work disability. As the disease progresses, individuals may experience fatigue, decreased cognitive function, and physical limitations, making it difficult to maintain regular employment. This results in lost workdays, reduced work productivity, and income loss, both for the affected individuals and their caregivers. The financial burden of transportation and caregiving responsibilities can also contribute to indirect costs. Overall, recognizing the relationship between CKD and indirect costs is crucial for policymakers, healthcare providers, and society to develop effective strategies that address the economic impact of the disease and improve the overall well-being of individuals affected by CKD.

The statistical analysis unveiled a lack of significant correlation between comorbidities and the length of stay. This elucidates that the escalation in length of stay is primarily attributed to CKD itself. Individuals with CKD frequently necessitate extended hospitalization periods owing to complications and the need for specialized interventions like dialysis or kidney transplantation. Prolonged hospital stays, in turn, accentuate healthcare costs, encompassing expenditures related to medications, procedures, and the valuable time of healthcare professionals. The obtained p-value of 0.00 underscores the strong statistical significance, affirming a substantial correlation between the length of stay and cost, which was consistent with the findings of the study Costs of Hospitalization for Chronic Kidney Disease in Guangzhou, China, carried out by Hui Zhang et al. The stage of CKD and the specific therapeutic approach being employed are the main determinants of the length of stay. In the initial phases of CKD, hospitalization may be deemed unnecessary, provided that routine follow-up appointments and outpatient treatment suffice. Nonetheless, as the condition progresses, individuals may find themselves requiring hospitalization for a multitude of factors, including complications, surgical interventions, or the initiation of dialysis. Hospital stays can vary significantly in duration, ranging from a brief span of a few days to an extended period of several weeks or even longer, contingent upon the patient's overall health and the specific medical interventions required.

The study compared the direct and indirect costs with comorbidities. The p-values for direct medical cost, total direct nonmedical cost, and total direct cost were statistically evaluated and found to be 0.004, 0.005, and 0.058, respectively. These results underscore a significant association between all of these cost categories and the presence of comorbidities. The financial burden associated with addressing comorbidities in CKD can be substantial, primarily driven by the necessity for a multitude of medications, frequent surveillance, and potential hospitalizations. Costs encompass healthcare provider charges, diagnostic tests,

radiological examinations, surgical interventions, hospitalizations, and continuous medical oversight. The severity and complexity of the comorbidities, as well as the healthcare system and insurance coverage, can further influence the overall cost. The p-values were found to have a statistically significant value of 0.001, indicating a substantial and meaningful association between age and comorbidities. The probability of having several comorbidities seems to rise with age. This phenomenon can be chiefly attributed to the compounding influence of ageing on various physiological systems, coupled with the escalating susceptibility to the onset of chronic conditions such as CKD over time.

Conclusion

The study analyzed the cost of therapy and length of stay of hospitalized CKD patients in tertiary care hospitals. Six months of analysis on 160 individuals revealed that the condition was more prevalent in men (60%) than in women (40%) overall. Most of the patients were in the 61–70 age range (53). The prevalence of CKD dramatically rises with age. The study also revealed that most of the patients had HTN as the comorbidity, followed by DM. The risk for the onset and progression of chronic kidney disease, as well as morbidity and mortality, is significantly increased by the presence of diabetes mellitus and hypertension, particularly when these conditions are not properly treated. Only three patients out of a total of 160 had stays longer than 15 days, with a maximum stay of 53 days. The patient with a 53-day length of stay had cellulitis and septicemia while in the intensive care unit, both of which would have contributed to the patient's prolonged LOS. Most patients paid for their medications out of their own pockets, while the majority of patients had access to government insurance.

Total mean indirect costs were found to be Rs. 1992.81 ±1769.762, and the total mean direct costs were found to be Rs. 9800.49 ± 7960.074. Mean direct non-medical costs were found to be Rs. 1871.40 ±1022.600, and the total mean medical costs were found to be Rs. 7929.09 ± 7447.030. The study revealed that dialysis was significantly correlated with total cost and total indirect cost. Dialysis treatments, hospital stays, and other CKD-related requirements necessitated a lot of time-consuming visits and procedures. This may cause scheduling disruptions and poor attendance or productivity at the workplace. Indirect expenses may also be impacted by the financial burden of travel and care responsibilities. There is no statistically significant relationship between comorbidities and length of stay, according to the study's analysis of the data. This demonstrates that the lengthening of stays is solely attributable to CKD. A diversified strategy is needed to address how CKD affects costs and duration of stay. This entails encouraging the early diagnosis and treatment of CKD to slow the disease's progression, putting preventive measures in place to lower the prevalence of CKD risk factors, improving access to reasonably priced healthcare services, and funding renal replacement therapies like dialysis and kidney transplantation. Healthcare systems can reduce the financial burden and improve outcomes for people with CKD by concentrating on these methods.

Ethical Considerations

The Institutional Review Board of Government Medical College, Kannur, Kerala, granted ethical approval for this study. The approval reference number is IEC No.09/2023/GMCK, and it was issued on May 9, 2023.

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Authors' contributions

All authors contributed to obtaining final approval.

Conflict of interest

The authors declare that they have no known competing conflict of interests – be it financial or personal relationships that could have appeared to influence the work reported in this paper.

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Tables

Table 1. Distribution of sample according to the length of stay

Length of stay	Frequency	Percentage
3	18	11.3
4	14	8.8
5	24	15.0
6	20	12.5
7	22	13.8
8	16	10.0
9	10	6.3
10	14	8.8
11	5	3.1
12	6	3.8
13	1	.6
14	2	1.3
15	5	3.1
22	1	.6
49	1	.6
53	1	.6

Table 2. Source of medication

Source of medication	Frequency	Percent
Out of pocket	31	19.4
Government insurance	129	80.6
Total	160	100.0

Table 3. Direct cost and indirect cost as per pharmacoeconomic distribution

	Direct non-medical cost	Direct medical cost	Total direct cost	Total indirect cost
MEAN	1871.40	7929.09	9800.49	1992.81
SD	1022.600	7447.030	7960.074	1769.762

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