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# SUSTAINABILITY IN DIALYSIS: ECONOMIC AND ENVIRONMENTAL CONCERNS

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**ABSTRACT**
Dialysis tends to become a necessary procedure for patients with end-stage renal disease (ESRD) hoping to stay alive. However, there has been growing concerns regarding the financial burden and resource depletion brought about by dialysis services. The present review tackles the challenges of the economics of dialysis including the impact on the healthcare systems and patents of dialysis, and the waste and resource consumption challenges related to dialysis. It explains what potentially can be done so that cost of dialysis can come down while some deterioration in the quality of care is not encountered.

**KEYWORDS:** Dialysis, Economical burden, environmental concerns.

## INTRODUCTION

The past years have seen a surge in the burden of chronic kidney disease (CKD). Which has escalated the demand for dialysis.[1] in India, there was a significant increase in the death toll from chronic kidney disease from 0.59 million in 1990 to 1.18 million in 2016.[1] Data related to the occurrence and prevalence of kidney failure are based on rough estimates because there are no registries recording occurrences of kidney failure.[2] As explained by Million Death Study, 135,000 deaths were attributed to kidney failure in active witness year 2015.[1] Additionally, a 2018 estimate put the number of persons on shadows in India at 175,000 translating to a prevalence rate of 129 across a million.[2] Current reports show that there are about 785,000 patients with end stage renal disease (ESRD) within America today, a number likely to be hallmarked in other regions.[2] One of the vulnerabilities of dialysis is the threat it faces regarding the inflation of costs and problems linked with the society.[3]

In this particular article, the economic and environmental aspects of dialysis are analyzed and possible measures of how to address those factors are recommended.[3]

## Economic Challenges of Dialysis

### Cost of Treatment

Dialysis is a costly therapy that varies in price depending on the region and the type of healthcare system practiced. Seeking first hand views, in India, cost of one treatment of hemodialysis (HD) varies between *150 Rupees* in government hospitals and *2000 Rupees* in some of the corporate hospitals.[2] Thus, on average, one could expect to spend about 12,000 Rupees in a month or 140,000 Rupees about $3000 per year.[4] This amount is in stark contrast to the amount spent in the US and UK which approaches nearly $60,000 per year.[5] Unbelievably, this makes India the most inexpensive country in the world for availing hemodialysis treatment however, 90 percent of the citizens cannot afford such treatment[5]. The cost that comes with getting an arteriovenous (AV) fistula is based on the adoption of government hospitals as well as private hospitals standards it lies between, 6000 rupees and 20,000 rupees.[4] For biosimilar drug treatment, mascarade e 4,000 rupees. However, brand names can cost as high as 10,000 rupees.[7]

The average cost of a kidney transplant in India varies between Rs 50,000 for a government hospital and Rs 300,000 for a normal private hospital. On top of that, the yearly cost of medication after the transplant is also considerable, averaging about Rs 120,000 a year or Rs 10,000 a month. Patients are also affected financially and their out-of-pocket costs can be very high if the level of insurance coverage is low or restricted.[8]

## Healthcare System Implications

### Value-Based Care Models

The introduction of value-based care models has been seen as the way to solve both the economic challenges posed by providing dialysis treatment services and those existing in the health care system as a whole.[6] Unlike traditional fee-for-service models that inter-wallet range of treatments provided instead of the outcome achieved,

value-based care focuses on improving the outcomes of the patients in addition to the amount of care provided.[7] That transformation encourages healthcare providers to address the delivery of efficient yet high-quality care with low unnecessary procedures, hence having enhanced results in the long term when it comes to patients.[8] Since it places the greatest emphasis on pre-existing and primary phases of intervention on at least the effective control of chronic illnesses such as CKD, this model of care would appear to reduce reliance on nephron-expanding dialysis care.[8] Additionally, these models tend to make the healthcare providers work in a more holistic and patient-oriented way which results in better patient satisfaction and adherence to the treatment plans.[9] Therefore, this would also help improve both the clinical outcomes and cost efficiency. These methods include telemedicine and remote monitoring which can enhance the effectiveness of value-based care models.[9]

These advances allow clinicians to monitor patients well, to identify early warning signals of imminent onset of bad events and to personalize treatment regimens which do not require the vast majority of usual face-to-face contacts.[10] Remote monitoring tools (wearables, health apps) enable the collection in real time of data related to the patient's health status, which could be used to avoid acute events leading to readmission or other costly interventions.[10] Simultaneously, telemedicine may reduce the spatial gap between patients and the other sense (geographically remote or underserved localities of rurality/underserved population) on the one side, regular care, routine care spots (ROCs) on the other side, and lower the patient travel cost and healthcare access.[10] Higher engagement, e.g., such as by providing the patient an active role in his/her treatment process, can enable more profound patient involvement as well as higher treatment adherence/acceptability of lifestyle adaptation.[11] By this effect, these care and participation enhancements will be expected to result in lower total healthcare costs through the prevention of hospitalizations, the prevention of prolonged hospital stays, and the ability to avoid expensive late stage interventions such as dialysis or transplantation.[10] Integration of integrated delivery of value-based-ambulatory care, telemedicine, and remote patient monitoring is not only likely to provide, in itself, cost savings, it also is expected to encourage better clinical outcomes, and hence, contribute to the sustainability of health care in patients with chronic kidney disease (CKD) and end-stage renal disease (ESRD).[11]

**Environmental issues in dialysis**

**waste generation**

Dialysis, particularly hemodialysis, is a treatment that requires much resource input and produces a lot of waste, thus exacerbating the critical challenge of medical waste management.[6] Each session of hemodialysis can produce as much as 20 kilograms of waste, which includes single-use medical items such as dialyzers, tubing, needles, bloodlines, and sterile gauze, among others, as well as chemicals used in cleaning and disinfecting equipment.[6] In certain instances, this waste may also include hazardous materials like medications and anticoagulants.[12] Although these disposable products are essential for maintaining the safety and efficacy of the treatment, they impose a considerable environmental strain due to their sheer volume and the complexities involved in their disposal.[12] Unlike reusable medical equipment, the majority of the devices have been designed to be single-use and thus not to be recycled, further exacerbating the amount of nonbiodegradable wastes deposited into landfills.[13] The ever-increasing rate of global demand for dialysis has compounded the effects of the environmental impacts since this can be largely linked to increased cases of ESRD, especially within populations where aging is increasing, coupled with high occurrences of diabetes and hypertension.[13]

As more people need chronic dialysis, the aggregate volume of waste generated by dialysis centres continues to grow, further demanding increasing volumes from waste management systems while increasing the carbon footprint of dialysis treatment.[14] In most healthcare settings, this waste is typically incinerated, which, though reducing the volume, can release toxic pollutants into the atmosphere, thereby furthering environmental damage. Moreover, disposing of used dialysis fluids, including wastewater and used chemicals, is highly environmental contaminating and requires specific waste facilities for treatment. There is, therefore a pressing need to find more sustainable ways for managing dialysis waste with all the concerns attached.[15]

Potential initiatives might include the development of recyclable components for dialysis, more efficient waste recycling systems, and improved waste treatment technologies.[15] In addition, reducing the dependency on consumables of dialysis procedures—through the incorporation of more technologically advanced and sustainable technologies—could significantly reduce the environmental footprint associated with dialysis care. Hence, addressing the environmental implications of dialysis waste is as crucial in terms of healthcare system efficiency as it relates to sustaining this high demand for services under an optimal and resource-smart management of dialysis.[17]

**Water and Energy consumption**

Dialysis requires significant quantities of resources in terms of purified water as well as considerable amounts of energy in order to effectively function.[2] One of the principal resource consumptions is for the creation of dialysate-the specialized solution utilized in hemodialysis as well as peritoneal dialysis, which serves the critical function of removing unwanted waste and excess fluids from the patient's blood supply.[16] The preparation of dialysate requires huge amounts of purified water, which have to be treated to meet stringent safety requirements. For hemodialysis, for every

treatment session, hundreds of liters of water can be used in producing the required dialysate and in cleaning and sanitizing the equipment[3]. This water footprint puts significant stress on water supplies in areas which are already prone to water shortage. Given the increased demand for dialysis services worldwide, it is crucial that such high usage of resources is understood in terms of its overall impact on the environment.[18]

The increased energy consumption and water usage by dialysis elevate the cost of operation but also enhance the environmental footprint of healthcare.[18] It is therefore necessary to look into more sustainable options, such as better efficiency in dialysis machines, optimized water usage, and renewable energy use within dialysis facilities.[19] Such initiatives could reduce the ecological impact of dialysis by a significant margin while making sure that patients have access to the necessary treatment they need.[7]

**Strategies for Reducing Environmental Impact**

**1. Recycling Programs**

Dialysis-related material recycling efforts represent a valid route towards environmental mitigation.[7] As medical institutions incorporate recycling materials of dialysis, there would be an enormous cut-down waste from landfills. Indeed, many centers dealing with dialysis are beginning to recycle plastics as in use with dialyzers and tubing and packagings. Paper, as well as metal can be included among these material components to be recycled.[8] These initiatives have been proved to be very essential in lowering the ecological impact of dialysis by reusing valuable assets and reducing the need to acquire new ones.[19] Other recycling efforts that can reach more dialysis facilities further reduce waste, alleviate strain on the environment caused by medical disposables, and help create a more healthy and sustainable health care context.[18] Further, collaboration with the waste management organizations can be considered to enhance the efficiency of these recycling programs by proper sorting and processing of materials.[20]

**2. Green Dialysis Centers**

In our step by step approach to reducing the ecological footprint brought about by dialysis treatment, constructing green dialysis centers remains one of the most important objectives one can set out for. This centers can minimize the amount of carbon dioxide gas emissions by making use of renewable energy resources such as wind and solar power and by implementing energy utilization efficient techniques. Finally, looking at modern technologies of conservation of water in the form of recycling and purification should lessen the overall amount of water needed for dialysis treatment. Such measures not only alleviate environmental pressures but also accrue savings on operational expenditures in the long run. If provider would systematically include green strategies in planning and operations of dialysis centers, they would help shape the healthcare sector that is more environmentally and resource-conscious but still provides high quality patient care.

**3. Education and Awareness**

An awareness program for both healthcare professionals and patients concerning the environmental implications of dialysis should be established in order to cultivate a culture of sustainability in the health care sector.[16] Providing education in waste minimization techniques and optimum practices in reducing the environment's impact, healthcare institutions can help bring about responsible and efficient utilization of resources.[17] Motivating patients to undertake sustainable practices, such as reducing waste or choosing alternatives that are more environmentally friendly, can further strengthen the initiatives.[12] When healthcare providers and their patients work together on sustainability activities, it can lead to important improvements in the environmental impact of dialysis treatment, which can improve the health system and the world at large.[14]

## KNOWLEDGE GAPS AND FUTURE RESEARCH DIRECTIONS

There is perhaps one of the biggest knowledge gaps regarding the understanding of the long term economic effects of dialysis practices on the health care systems. Although there is a huge research base that discusses the costs of dialysis therapy as the treatment of choice for ESRD in the short run, there is little research that examines the economic effects in the long run. This includes the effects on the health care resources, the well-being of the patients and the potential benefits that can be realized from efficient policies.

There is a need to conduct more interdisciplinary research that will incorporate findings from the economic and environmental fields as well as healthcare policies in order to address the issue of dialysis sustainability in its entirety. Such gaps should be addressed in order to outline the proper course of action that will help not only to provide for the needs of the patients in the short run, but also to ensure the sustainability of the dialysis market.

Further research should concentrate on the creation and assessment of the sustainable dialysis systems, the ways of incorporating technology in the delivery of the treatment, and the analysis of the economic and environmental consequences of the various dialysis regimens in the future. In this manner, the healthcare sector will be able to guarantee that dialysis is still an option for patients with ESRD without overburdening the financial and natural resources.

## CONCLUSION

The sustainability of dialysis is one of the significant concerns that unites economic and environmental hardships. With the increasing need for dialysis services, these challenges need to be faced so that patients can

obtain the necessary care while their health is safeguarded. Therefore, by studying new ideas and implementing sustainable practices, the dialysis community should work towards a more sustainable future that balances patient needs with economic and environmental considerations of treatment.

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