Continuous Ambulatory Peritoneal Dialysis(CAPD) Assistive Device

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***Abstract*— The use of the various forms of automated peritoneal dialysis (CAPD) has increased considerably in the past few years. This increase has in part been driven by technology, through improved cycler design. Other contributing factors include better adjustment of CAPD to patient lifestyle, the flexibility that CAPD offers to patients, and the increased ability of CAPD to achieve adequacy and ultra filtration targets. For high transporters and for patients unable to perform peritoneal dialysis (PD) on their own (for example, pediatric and elderly patients), CAPD is considered the most suitable PD modality.**
Furthermore, CAPD has been associated with improved compliance, lower intraperitoneal pressure, and lower incidences of peritonitis. On the other hand, concerns have been raised regarding increased complexity and cost, a more rapid decline in residual renal function, inadequate sodium removal, and disturbed sleep. Automated PD is an alternative to continuous ambulatory PD when a higher dialysis dose is needed, and it could be a reliable alternative for unplanned or urgent dialysis start. Other than beneficial results in high transporters, the medical advantages of CAPD remain controversial. Individual patient choice therefore remains the main indication for the application of CAPD, which should be made available to all patients starting CAPD.

Keywords*— *Continuous Ambulatory Peritoneal Dialysis(CAPD), Peritoneal Dialysis(PD), Automated Peritoneal Dialysis(APD).

I. INTRODUCTION

Kidneys are the purifying factories of the body. Kidneys contain millions of tiny blood vessels that filter waste from your blood and eliminate it in your urine. If your kidneys are failing, you may need dialysis to help control your blood pressure and maintain the proper balanceof fluid and various chemicals – such as potassium and sodium in your body. It is an artificial way to remove waste products and extra fluid from your blood when kidneys can no longer do so on their own. There are two types of dialysis: Hemodialysis and peritoneal dialysis. In Hemodialysis, transfer of metabolites from blood into the dialysate is carried out in a mass exchange device and cleanses the blood outside the body. In peritoneal dialysis, sterile solution is poured into the peritoneal cavity of the patient through special catheter. Fresh fluid is replaced with spent dialysate. CAPD provides mobility for the patient, and thus improved quality of life. The user can do this according to his/her daily routine. It can be carried out by the patient in home or office.

Section 2 presents literature survey on existing continuous ambulatory peritoneal dialysis assistive devices. Section 3 presents the proposed model for CAPD. Section 4 provides the discussion and suggests the improvements. Lastly, section 5 concludes the paper.

II. LITERATURE SURVEY

Akanksha Fadnavis et al. [1] proposed Automated Peritoneal Dialysis. This paper is aimed to draw a sense of awareness in people regarding the option of APD for a much regular & healthier lifestyle. This paper tells the pros and cons of the available systems in market. In this, a low cost machine for APD has designed which will be easily available and affordable to common man. Also this paper proposes a model for APD which is cost effective system and can be efficiently used by any patient who chooses home automation. It concludes that patients can't visit hospital 3-4 times a week for dialysis eschanges.

Arifah Fasha Rosmaniet al. [2] proposed a system which evaluate the usefulness of CAPD eBook, an interactive multimedia application which is developed by integrating various multimedia elements such as text, animation, graphics, and audio. It is designated for renal patients who undergo CAPD as their dialysis method. The application helps to increase the knowledge and understanding of renal patients in practicing and training CAPD. Images used in the application are simple to understand and can help patients to visualize the step by step process that they need to follow. CAPD animation picture is to illustrate the whole general process that is experienced by CAPD users. The patients can see the whole picture of CAPD before they learn and perform it by themselves. It can facilitate them to perform the dialysis. The patients and their family members can also learn the CAPD process together with the patient at their own pace.

Vivekanand Jha [3] written an article about challenges and current status of peritoneal dialysis in India. With its ambulatory nature and freedom from complicated and expensive technology, PD is ideal renal replacement therapy for resource poor India. The number of patients initiated on

therapy has increased in recent years and PD has limited in its growth because of economic factors, inadequate govt policies and lack of adequate pre-dialysis care. By using PD as integrated therapy for end stage kidney disease would improve utilization of the PD modality.

Kamarudin et al. [4] developed an aseptic technique assistive tool for CAPD users to avoid Peritonitis. This is one of the most important step that need to be utilized by CAPD users. This technique is crucial to avoid bacterial contamination which leads to peritonitis while performing CAPD procedures. Therefore , this study was conducted to assist users in learning and practicing aseptic techniques. A multimedia application has been developed with the integration of elements such as image, video in order to help renal patients in learning aseptic techniques.

Karlien Francois et al. [5] proposed a paper to evaluate the benefits of home-based PD. The majority of patients suffering from kidney failure are eligible for PD. It offers patient survival comparable to or better than in-center hemodialysis while preserving residual kidney function and reducing financial burden to payers. This paper says that PD decreases hospitalization rates and duration. This paper discusses the benefits of chronic PD and it can be performed by patient at home.

Hongjian ye et al. [6], In this author specified that peritoneal dialysis–related peritonitis remains the major complication and primary challenge to the long-term success of peritoneal dialysis. Data from a 2004 survey reports the percentage of patients with end stage-stage renal disease treated with peritoneal dialysis to be 5%-10% in economically developed regions like the US and Western Europe to as much as 75% in Mexico. This disparity is probably related to the availability and access to hemo dialysis. The mortality for an episode of peritonitis is 5% and is a cofactor for mortality in another 16% of affected patients. Prevention of peritonitis and prompt and appropriate management of peritonitis is essential for the long term success of peritoneal dialysis in all patients. In this review challenges and solutions are addressed regarding the pathogenesis, clinical features, diagnosis, treatment and prevention of peritoneal dialysis-related from the viewpoint of an infectious disease physician.

Catarina Peixoto et al. [7] This article explore the data information from patients undergoing CAPD procedure. This information helps to comprehend how interoperability acts in a Health Information System since this data contains patient's information also the blood samples results. In this paper, it is used Business Intelligence process to prove that all the information available can be useful to understand the treatment above mentioned and also how can several factors influence or not the number of patients going through kidney failure and CAPD by the study of indicators. This information says, it is a new way to see the world brought us several opportunities to change what was wrong and to improve the services offered.

Nicola Wearne et al. [8] The main intension of this research is that high cost of CAPD due to unavailability of fluids, low Education and motivation, low remuneration for nephrologists, lack of experience for catheter insertion and motivation and management of complications. Cost of CAPD fluids seems to be a major constraint given that many countries do not have the capacity to manufacture fluids. There is need to invest in fluid manufacturing in LMICs to improve to uptake of patients treated with CAPD. Training of nephrology workforce in CAPD a more acceptable RRT modality with improved outcomes. The cost of CAPD fluids and lack of trained workforce and necessary expertise in carrying out CAPD is underutilized.

Bazaev N.A et al. [9] This paper proposes approach to artificial blood purification and overcome disadvantages of hemodialysis and peritoneal dialysis. WAK implements combination of dialysate regeneration methods that are sorption with electrolysis or enzymatic urea elimination. The aim is to determine main requirements and basic approaches of WAK development. It is said that, wearable artificial kidneys is one of the prominent technologies, which might take place as the next generation of RRT devices. This method can be applied to both hemodialysis and peritoneal dialysis. Overall technology of dialysate regeneration is prominent and can be potentially used in case of wearable artificial development.

Rafia I choudry et al. [10] proposed system tells about the cyclers used in PD as an aspects for the clinician. The invention and technological advancement of the PD cycler further makes PD a convenient option. This paper reviews the basics, technical aspects, challenges, and advancements of the cycler. Author said that his aim is to provide a better understanding of today's cycler, and it is the main advancement in the field of PD for a large number of patients. Many companies working on technical advancements, and newer models of cycler are in the development and to be available in near future.

Xuemei Li et al. [11] This paper reports the outcomes compared to continuous ambulatory peritoneal dialysis. There is an emerging practice pattern of automated peritoneal dialysis. Automated peritoneal dialysis is associated with an overall lower adjusted risk of death compared with CAPDin China. Analyses are limited by the likelihood of important selection bias arising from group imbalance. As a final note, the benefit of APD is certainly well established for patient experience, with generally better reported patient centered outcomes. This study suggests the possibility of a additional relationship between PD sub-modality and mortality risk in China.

TABLE I. COMPARISON OF EXISTING PAPERS

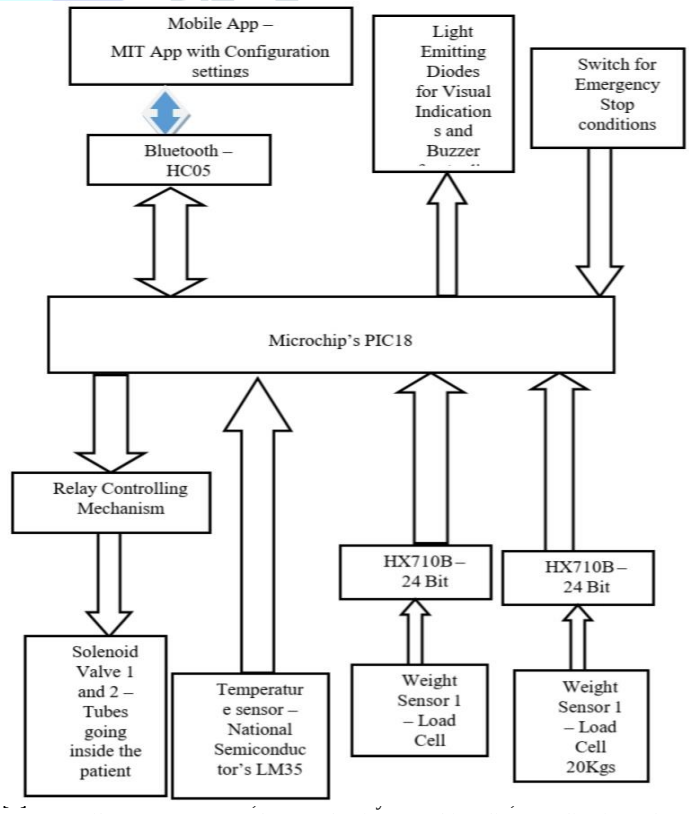
Sl. No.	Title	Device used	Advantage	Disadvantage
1.	Automated Peritoneal Dialysis	Temperature sensor, Alarms, Timing and Control circuitry	Cost effective	Here to prior controlling device through mobiles are not introduced.
2.	Assistive tool	CAPD eBook	Multimedia application as a guide for	Here prior to devices and

			patients to assist in learning and performing CAPD	application from doctors are not introduced
3.	Status and Challenges	Challenges that are faced	Information regarding challenges	Here prior devices are not introduced
4.	Aseptic Technique assistive tool	Multimedia Application	To avoid bacterial contamination while performing CAPD procedures	Here to prior devices are not introduced
5.	Home based PD	Benefits of using PD	Decreasing Hospitalization rates and duration	Here to prior devices are not introduced
6.	Impact - peritonitis	Infection related	Collecting records of patients and death events	Here prior to devices are not introduced
7.	Patient monitoring	Business Intelligence and Information	Collecting information and monitoring them to treat in a good way	Here prior to devices are not introduced
8.	Perspectives	Low to middle income countries	Role of cost and availability of CAPD services, Workforce training	Here continuous suggestions from doctors are made
9.	Artificial Kidney	Dialyzer	Device do the operation and most of things done in hospitals	Cost effective
10.	Cyclers	Automated cyclers	Carries out steps involved in continuous cycling	Remote live access of the cycler are not introduced
11.	Effects	Automated versus CAPD	Uses an 'as-treated' approach rather than ' intension-to-treat'	Study is likely to be limited by the ascertained error that is inherent in all registries around the world

III. PROPOSED SYSTEM

The CAPD assistive device circuitry has the following controls:

- Temperature & pressure control: The dialysate filled in the abdomen cavity of the patient is to be heated at a temperature of 37 to 40 degrees. This is to be controlled and monitored as per the body temperature of the patient.
- Flow rate control: the rate at which the fluid enters the cavity should be uniform. A timing circuit is used to control the flow of dialysate in the body.
- Microcontroller PIC: PIC is a flexible microcontroller. Its features include- (a) ideal for motor control, (b) in-built 10 bit ADC and other features like low power consumption.
- Solenoid Valves: When the dialysate is to be filled in the cavity, the solenoid opens the valve and pumps the dialysate from the solution bag into the abdominal cavity, after which the valve is closed, by sending a signal.
- Timing circuitry: the timing circuit monitors all the operations since the machine is turned on, also gives the alarm when the machine is ON/OFF or any error is identified during the process.



IV. CONCLUSIONS

The major issue with the existing CAPD machine is that the available resources are expensive and hence not affordable to common man. To deal with this issue, the project proposes a CAPD system which is flexible, easy to be operated and cost effective. The system is flexible because of the use of microchip (PIC) which efficiently monitors the connected circuitry and controls the operation of CAPD machine components. This system can be used in rural areas where dialysate centres are not available. This machine reduces the cost by nearly 50% of the traditional methodologies where a patient is required to visit hospital 3-4 times a week for dialysis exchanges. The proposed system is expected to provide a better and flexible lifestyle for dialysis patients.

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