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Reducing Medical Errors: Strategies of Increasing Awareness in Treatments Among Elderly Chronic Kidney Disease Patients and Their Caregivers in Thailand

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Abstract

This paper explores the rising prevalence of chronic kidney disease (CKD) among the elderly population and highlights medical errors in CKD treatment. It will cover CKD stages, risk factors, and the effects of aging on kidney function, and existing treatments for CKD, their benefits and drawbacks, are examined. The importance of CKD awareness among the elderly is emphasized. To mitigate medical errors, two potential solutions are proposed: fundraising initiatives and educational events, along with the implementation of strategies to raise the standard of dialysis systems in Thailand. The fundraising methods include producing and selling dialysis bags and dialysate fertilizer to gain more funds for promoting CKD educational events among the elderly, while more qualified standard of dialysis systems must be constructed, and all hospitals must implement efficient dialysis systems so that CKD patients can receive better treatment. The primary goal of this research is to enhance CKD management practices and improve CKD outcomes after receiving treatments.

Keywords: non-communicable disease, chronic kidney disease, dialysis, aging, the elderly, medical errors

Introduction

Chronic kidney disease (CKD) is considered one of the leading non-communicable diseases (NCDs) in terms of mortality among the aging population. According to the Nephrology Society of Thailand, CKD affects around one million people, or 17.5% of the country's total population [1], and its prevalence is predicted to increase rapidly every year, especially among the elderly. Since such disease cannot be fully cured, continuous treatment is required which further produces substantial financial burdens for even the wealthiest countries.

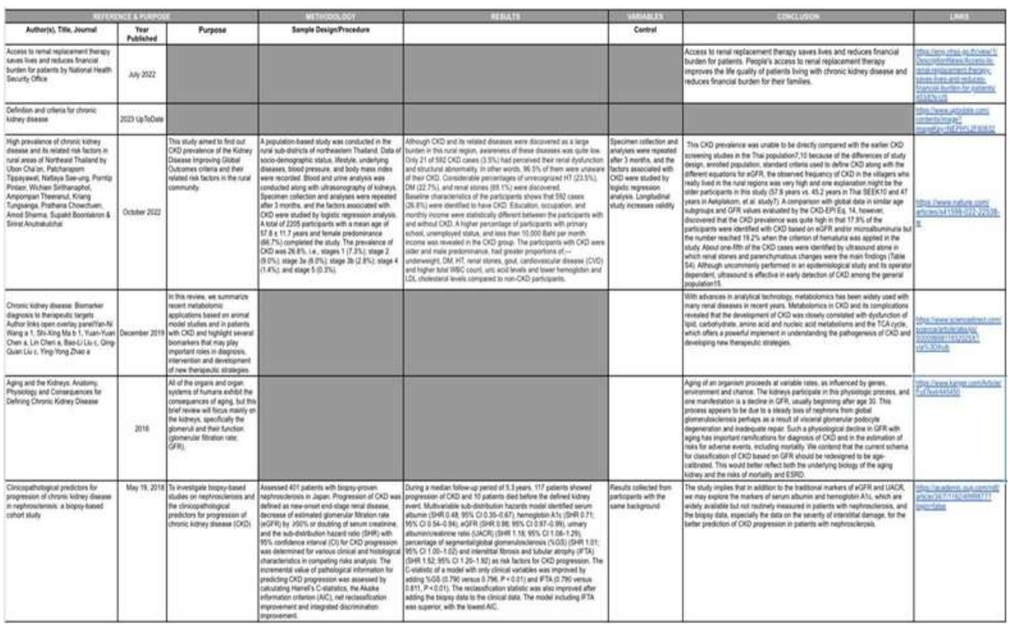
CKD is diagnosed based on long-term abnormalities of kidney functioning in more than three months, which is assessed using glomerular filtration rate (GFR), Albumin-to-creatinine ratio (ACR), and reviewing abnormal kidney structures.[2] Although treatments such as kidney transplantation are confirmed to be successful in increasing patients' lifespan, only a few can afford such exorbitant treatment in Thai society. Nonetheless, another contributory factor to the rising trend of CKD is the unawareness and ignorance of specific symptoms and treatments, especially among the older population with less access to information on the internet and social media. Only 3.5% of those with early CKD reported being aware of their disease in the northeast part of Thailand [3], let alone being able to decide the best-suited treatment strategies for their condition or to consider hidden errors in existing CKD medications.

As an individual who has cared for an elderly person with severe chronic kidney disease and has learned more about the disease, We are aware that there are certain medical errors that can occur during the treatment process. Our literature review provides significant knowledge on the effects of aging on CKD, as well as current treatments for CKD patients. We provided the critical algorithm and mechanism of such treatments, as well as the benefits and drawbacks of administering the treatment to patients. By exploring the elements and causes of nephrosclerosis and nephron hypertrophy which are the main influences of CKD, we gain more in-depth information and can better comprehend the underlying causes of this disease. This information further contributes to our decision in choosing the best-suited strategies to increase CKD awareness among the elderly.

MATERIALS AND METHODS

In order to locate the relevant materials for CKD information regarding the overview of CKD, its correlation with aging, and existing treatments for this research's objectives, systematic searches were made using reliable, well-known databases such as PubMed, ScienceDirect, Frontiers, Elsevier, etc. We used keywords that are relevant to the information we aimed to find out, such as chronic kidney disease, aging, the elderly, evaluation of kidneys, CKD treatments, etc. Additionally, we also constantly checked the abstract to ensure whether the overall content is relevant to our topic of information and the objectives. Subsequently, the information we collected was noted and summarized in our review paper and is also provided in a review matrix sample in order to make it simpler in browsing the references.

Figure 1: The sample of our review matrix



REFERENCE & PURPOSE			METHODOLOGY	RESULTS	VARIABLES	CONCLUSION	LINKS
Author(s), Title, Journal	Year Published	Purpose	Sample Design/Procedure		Control		
Access to renal replacement therapy saves lives and reduces financial burden for patients by National Health Security Office	July 2022					Access to renal replacement therapy saves lives and reduces financial burden for patients. People's access to renal replacement therapy improves the life quality of patients living with chronic kidney disease and reduces financial burden for their families.	[illegible]
Definition and criteria for chronic kidney disease	2023 UpToDate						[illegible]
High prevalence of chronic kidney disease and its related risk factors in rural areas of Northeast Thailand by Ubon Cha'on, Patcharaporn Tippayawat, Nattaya Sae-ung, Porntip Pinlaor, Wichien Sirithanaphol, Amponpan Theeranut, Kriang Tungsanga, Prathana Chowchuen, Amod Sharma, Supakit Boontakron & Sirirat Anutrakulchai	October 2022	This study aimed to find out CKD prevalence of the Kidney Disease Improving Global Outcomes criteria and their related risk factors in the rural community	[illegible]	[illegible]	Specimen collection and analyses were repeated after 3 months, and the factors associated with CKD were studied by logistic regression analysis. Longitudinal study increases validity	[illegible]	[illegible]
Chronic kidney disease: Biomarker diagnosis to therapeutic targets Author links open overlay panelYan-Ni Wang a 1, Shi-Xing Ma b 1, Yuan-Yuan Chen a, Lin Chen a, Bao-Li Liu c, Qing-Quan Liu c, Ying-Yong Zhao a	December 2019	In this review, we summarize recent metabolomic applications based on animal model studies and in patients with CKD and highlight several biomarkers that may play important roles in diagnosis, intervention and development of new therapeutic strategies.				[illegible]	[illegible]
Aging and the Kidneys: Anatomy, Physiology and Consequences for Defining Chronic Kidney Disease	2016	All of the organs and organ systems of humans exhibit the consequences of aging, but this brief review will focus mainly on the kidneys, specifically the glomeruli and their function (glomerular filtration rate; GFR).				[illegible]	[illegible]
Clinicopathological predictors for progression of chronic kidney disease in nephrosclerosis: a biopsy-based cohort study	May 19, 2018	To investigate biopsy-based studies on nephrosclerosis and the clinicopathological predictors for progression of chronic kidney disease (CKD)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Results

Overview of Chronic Kidney Disease

Chronic kidney disease can be categorized into 5 stages, which are commonly diagnosed from the estimated Glomerular Filtration rate (eGFR) or albuminuria level (conversion factor 1.0 mg/g = 0.113 mg/mmol).[4] The National Kidney Foundation had adapted and arranged the different stages by using the following scale:

Table 1 : Stages of chronic kidney disease (CKD) and the estimated level of eGFR and albuminuria.[5]

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Stages	Description	eGFR (mL per minute per 1.73m^2)	Albuminuria (mg/g)	Interventions
1	Normal/increased GFR value	≥90	>30	Diagnosis and comorbid conditions, reducing cardiovascular risks
2	Mildly decreased GFR value	60-89		Estimate progression
3a	Mildly to moderately decreased GFR value	45- 59	30-300	Evaluate treatment complications
3b	Moderately to severely decreased GFR value	30-44		
4	Severely decreased GFR value	15-29	<300	Prepare for renal replacement and dialysis
5	Kidney failure/ End -stage kidney disease (ESKD)	<15 or dialysis		Renal replacement therapy if uremia present

Risk factors

There are modifiable traditional factors, modifiable non-traditional factors, and non-modifiable factors that contribute to CKD. Here is the table allocating possible causes that contribute to CKD.

Table 2 : 3 types of CKD risk factors.[7]

Modifiable traditional factors	Modifiable non-traditional factors	Non-modifiable factors
• Hypertension • Diabetes • Obesity • Cardiovascular disease • Glomerular and tubulointerstitial disease • Metabolic acidosis • Smoking	• Anemia • Hyperuricemia • Nephrotoxic herbs • NSAIDs • Antibiotics • Hyperphosphatemia	• Old Age • Ethnicity • Gender (male) • Family history

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Aging and CKD

Aging is a natural biological process characterized by a gradual decline in cellular function and progressive changes influenced by both genetic and environmental factors.[6] These alterations, which occur over time, are part of the normal aging process and are distinct from changes caused by specific diseases. The kidneys, like other organs, also experience the effects of aging as people grow older. This is due to the natural aging of the kidneys itself as well as the increased likelihood of developing certain diseases such as diabetes and hypertension, which are more commonly seen in the elderly.[8] These age-related changes in the kidneys can contribute to the overall decline in renal function that occurs with advancing age. The age-related evaluation of kidneys that influences CKD can be categorized into two groups:

Nephrosclerosis and morphometric analysis of microanatomy (particularly glomerular size)

Nephrosclerosis refers to the histological changes of microstructural biopsy pattern observed in its features, specifically involving arteriosclerosis, glomerulosclerosis, tubular atrophy, and interstitial fibrosis. While nephrosclerosis is commonly associated with hypertension, it has also been identified in healthy kidney donors with mild or no hypertension.[16] Focusing on its mechanism, arteriosclerosis, a fibrous thickening and hyalinosis of the intima in the kidneys, is believed to trigger ischemia. Ischemic-related alterations include the development of fibrous tissue around the kidney (pericapsular fibrosis), wrinkling of capillary tufts, and an increase in the thickness of the basement membrane. As a result, Bowman's space, which normally contains fluid, becomes filled with a hyaline material due to the extracellular matrix produced by mesangial cells, replacing the glomerulus. Consequently, the collapse of the glomerular tuft leads to global sclerotic glomerulosclerosis (GSG), accompanied by atrophy of the attached tubules and adjacent interstitial fibrosis.[15] These changes contribute to a decline in the glomerular filtration rate (GFR), ultimately progressing to severe CKD.[17]

Numerous investigations, including both autopsy-based studies and those using living kidney donors, have consistently replicated the increasing frequency of GSG with aging. Based on statistical data analysis of The Hisamaya Study, it is revealed that, in both genders, the frequency of GSG rose with advancing age. For example, in the subject with a 40 to 59-year-old age range, the prevalence of GSG was 2.9% for men and 3.5% for women; however, it dramatically rose to 24.3% and 38.5%, respectively, in participants 80 years of age or older.[21] Thus, we can conclude that aging has a positive association with CKD.

Several studies investigating the relationship between changes in glomerular size and aging have provided conflicting findings. Some have found no significant alterations in glomerular size as individuals age, while others have reported a decrease in both glomerular volume and surface area.[19] However, it has been observed that sclerotic glomeruli tend to be smaller compared to functional ones, which may contribute to a decrease in glomerular size. Nonetheless, compensatory hypertrophy of the remaining functional glomeruli occurs in response to the presence of sclerotic glomeruli.[20] It is, therefore, crucial to consider the simultaneous increase in the size and volume of functioning glomeruli, along with the growing proportion of sclerosed glomeruli that may occur in old age.

Nephron Hypertrophy

Nephron hypertrophy is one of the main renal disorders contributing to severe CKD. Regarding the larger size of the nephron, nephron hypertrophy can be caused by three major factors: a greater glomerular area, an enlarged tubular profile area, and a reduced density of nonsclerotic glomeruli, which is often the consequence of glomeruli being spread apart by an increase in the volume of cortex per glomerulus and tubular compartment as we age. Moreover, studies revealed that a rising age, higher GFR, male gender, family history, hyperuricemia, and obesity are also conducive to the three morphometric factors mentioned above, giving rise to a larger nephron size and CKD.[22]

However, nephron hypertrophy appears to have a minimal association with older age alone, but it will cause a stronger effect with other comorbidities that are more prevalent as people age, such as obesity and hyperuricemia. It is important to note that nephrosclerosis is significantly more strongly related with older age (independent of comorbidities) than with nephron hypertrophy.[22]

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Additionally, the renin-angiotensin-aldosterone system (RAAS) is another essential mediator in managing hemodynamics and reactive cell hypertrophy. Because of its stimulation of pathways that mediate hypertrophy, fibrogenic cytokines production, and the generation of reactive oxygen species (ROS), inflammation may occur with the tubule, leading to tubular damage. From such circumstances, the remaining nephrons must raise their circulation so that they can maintain GFR. The surface area of glomerular capillary increases, making it undergo hypertrophy. Furthermore, the glomerular or tubular injury may invoke the cellular dedifferentiation cycle, inflammation, endothelial dysfunction, acidosis, or the generation of ROS, which may potentially contribute to the progression of CKD.[23]

In summary, the aging or senescence of the kidneys is characterized by the progressive nephron hypertrophy and the development of nephrosclerosis, which involve the loss of functioning glomeruli and a decline in overall renal function, as measured by the glomerular filtration rate (GFR). Consequently, they increase the risk and severity of CKD.

Treatment Methods

Despite being one of the world's leading causes of death among other NCDs, there is still no treatment that can completely cure CKD except kidney transplantations. Most of the treatments focus on controlling sides effects and slowing down the progression of kidney damage, which can be divided into complication treatments and treatments for end-stage kidney disease (ESKD)

Complication treatments

Complication treatments are normally applied in order to control and alleviate any severe complications and side effects that may occur to patients, by utilizing various types of medications. The treatment of hypertension is an excellent illustration of the available treatment methods to assist reduce the course of CKD. Studies portrayed that focusing on such therapy can reduce both the decline in kidney functioning compared to its counterpart and cardiovascular events, though there are limited clinical trials that have undergone such treatment and more studies are required to confirm its effectiveness.[9]

Treating anemia is also another recommended solution since an advanced stage of CKD may develop anemia (lack of red blood cells). When your kidneys are not functioning in a normal state, they do not create enough of an erythropoietin hormone (EPO) that sends a signal to your body to make more red blood cells, leading to anemia.[13] In some studies, erythropoiesis-stimulating agents and iron supplements have been suggested to help make red blood cells in order to avoid having an inadequate amount of EPO and red blood cells.[9,13]

Finally, another common complication treatment for CKD is the elimination of acid in healthy kidneys through urine and maintaining proper amounts of bicarbonate in the blood, since bicarbonate components help balance acid levels in your body. Because CKD-damaged kidneys cannot function in acidic manners, sodium bicarbonate pills are prescribed for patients to promote alkalinization, which can eventually assist minimize the injury from acidic environment caused by metabolic acidosis.

Treatments for end-stage kidney disease (ESKD)

Dialysis is a medical procedure commonly utilized in patients who have reached an advanced stage of CKD to filter and remove unwanted substances, excess fluids, and waste products from the bloodstream when there is kidney dysfunction. This treatment can be divided into hemodialysis (HD) and peritoneal dialysis (PD).[14] While HD involves diverting blood via a tube attached to the patient's arm and passing it to a machine to be cleaned, PD uses the inside lining of an abdomen (the peritoneum) as a filter to draw out excess fluid from the blood, which is done at the peritoneal cavity.[14]. Although there is an improvement in CKD patients' life after undergoing dialysis, research had shown that the life expectancy following dialysis is relatively low among elderly patients: only around 16 months among patients aged 80–84 years who undergo dialysis and 12 months in those aged 85–89 years.[10] Moreover, some studies suggested that dialysis has very little effect on the physical function loss of kidneys in people over the age of 75. [9] Therefore, physicians and the elderly must discuss and decide the most suitable treatment for their conditions.

Kidney transplantation is a surgical procedure aiming to replace diseased kidneys with healthy ones. The kidney can be donated from either a deceased donor

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or a living donor. In addition, one of the members of a family who is a good match can also donate one of their kidneys to the patient. Fortunately, donors can normally live with only one kidney left. On the one hand, kidney transplantation has been shown to decrease mortality rates across all age groups. For instance, in 74-year-old individuals, receiving a kidney transplant from a deceased donor was associated with a 0.67 rate of mortality, compared to the remaining age groups. Furthermore, utilizing kidneys from deceased donors and older living donors has also been found to reduce mortality rates in elderly patients with kidney failure compared to similar patients.[10] Nevertheless, one study illustrated that cancer can be a significant outcome among patients who undergo transplantation. The Standardized Outcomes in Nephrology-Transplantation study identified cancer as one of the top five outcomes observed in kidney transplantation trials.[11] Additionally, infections are one of the common causes of non-cardiovascular mortality following transplantation, accounting for approximately 15% to 20% of deaths.[12] Patients undergoing transplantation may also experience adverse reactions to immunosuppressive agents, which are medications that suppress the body's immune response. Viruses such as herpes simplex virus and cytomegalovirus are among the most common agents associated with such adverse reactions.

Solution guidelines

With the research we had reviewed, we found that there have been several medical errors arising from current CKD treatments, such as inevitable outcomes and side effects from applying such treatments to CKD patients in both short term and long term. Therefore, we have come up with a total of 2 main solutions to mitigate and reduce the problems regarding CKD medical errors:

Fundraising and educational events

Nowadays, social media platforms play a significant role in our lives and are now considered the key way to raise public awareness as well as provide information, especially in the health industry. However, the majority of the older population reported barriers and difficulties using social media. There are several factors contributing to these challenges, including the issues of affordability and lack of technological knowledge. For example, an elderly participant stated in an in-depth semi-structured interview that while there is valuable medical information available on social media channels, the cost of internet access remains a notable obstacle for them.[25] Another participant highlighted the difficulty of learning how to use social media from individuals who have more experience with it.[25] Moreover, a study investigating the Thai elderly behavior of internet usage among 385 elderly people in Khon Kaen Province revealed that over 80% of the elderly did not have access to the internet.[24] This depicts the struggles elderly people have encountered when using social media, thus reducing their internet usage. Additionally, as society today grows increasingly digital, and with the internet becoming the primary source of healthcare information, this poses a major challenge to the older population.

Subsequently, to acclimatize and adapt to the aging society, we came up with alternative ways to help the elderly access vital healthcare information, particularly on NCDs, with the idea of arranging a non-profit educational event through fundraising.

Fundraising: Eco-dialysis

Due to various concerns about the infection risks associated with reusing equipment, disposing of medical equipment and the adoption of precautionary principles are now widely used in healthcare settings, including dialysis. HD and PD is a resource-intensive medical operation. For example, a session of hemodialysis needs a considerable amount of water (around 500 L) and over 7 kW of energy. Thus, HD and PD add to global warming while saving the lives of patients.

Some of these waste products can pose a threat to organisms by being infectious or poisonous, potentially causing contamination and harm to living beings. Moreover, they can also have damaging effects on the environment, particularly in the case of non-recycled waste and plastics. In addition, we came up with two strategies to raise funds, while also reducing dialysis waste:

Dialysis fashion bag

Assuming that all CKD patients dialyze 3 times a week, about 185,250 tonnes of post-dialysis plastic waste are produced each year in the US alone. The

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financial cost of plastic waste disposal is substantial, with expenditures ranging from 2.2 to 16 euros each session (79.9 to 576.6 Thai baht) depending on the waste management strategy.[32] Nonetheless, its environmental cost is also high: only around one-third of dialysis trash (23-28%) is theoretically recyclable.[32] Hence, a solution to reduce the number of plastic dialysis waste must be established: we came up with the idea of assembling used dialysis plastic bags, sterilizing them, and combining them with polyesters to produce durable and functional bags. These bags will be creatively refined and modified further into modern fashion bags to fit modern society, and for us to sell them further and raise funds.

Dialysate fertilizer

Dialysate is a body temperature, non-sterile electrolyte solution combined with treated water that has the same normal levels of electrolytes found in extracellular fluid, except for the buffer bicarbonate and potassium. Additionally, the common electrolytes found in dialysate include sodium, potassium, calcium, magnesium, chloride, and bicarbonate.[30] These components are also found to be beneficial for plants, for instance, magnesium is important in the development of chlorophyll. Thus, with further modification (e.g. diluted with water) dialysate can potentially be used as fertilizer.

Spent dialysate

A study investigated the use of dialysate as fertilizer and gathered the filtrate from renal failure patients during the first hour of dialysis. The dialysate contained specific concentrations of urea, potassium, and sodium per liter, which were found to be lower than the levels typically found in urine. These levels of urea and sodium could be harmful to several plants. However, researchers tested numerous dilutions in water and discovered that 1:10 per weight is best suited. Extracted potassium and other nutrients can then be added to make the fertilizer more plant-friendly.[31] Thus, this portrays the potential use of dialysate to serve as a substitute for commercial fertilizers, offering financial, social, and environmental benefits. However, further research is still required to approve the efficiency of dialysate fertilizers.

Unusable dialysate

A variety of factors can contribute to the unusable dialysate. The approximate shelf life of a dialysate solution is about 1.5 years according to the MesaLabs. However, the shelf life of an opened-bottle dialysate reduces to only 30 days.[27] Although there are not enough research studies to determine the real consequence of using expired dialysate, it may be argued that complications such as infusion pain can arise due to utilizing dialysate with an abnormal concentration of its content or expired dialysate.[26] Moreover, overheated dialysate has been reported as the main factor leading to fatal hemolysis.[28]

In Thailand, the water used for dialysate is typically obtained from the municipal water supply. However, it could also be obtained from an alternative source such as groundwater, which is oftentimes contaminated with inorganic ions and trace elements,[29] leading to unusable dialysate that needs to be disposed of. Collecting spent and unusable dialysate for further modification, producing, and selling these fertilizers will not only enable us to raise funds but also help remove dialysate waste from the environment.

Educational events

Following our funding efforts and with the results from our questionnaire, we will incorporate vital NCDs information, especially on CKD (e.g. symptoms and risk factors), including the pros and cons of specific treatment methods from reliable social media publications and other resources. In addition, we will organize non-profit educational events for community seniors in both Thailand's rural and urban areas to help spread NCD awareness. This will be done through social activities, such as games and interactions between the elderly and healthcare professionals to make it easier for the elderly to access key healthcare information and understand treatment complications.

Moreover, healthcare financial information, such as the Universal Coverage Scheme (UCS) or 30 Baht Scheme, is also provided and explained. These schemes, managed by the National Health Security Office, aim to clarify the options available for individuals to receive the necessary care and treatment they require. By providing information about them, people can explore alternative avenues

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for accessing the healthcare services they need, regardless of their financial situation or income level.

Qualified standard of dialysis system

Thailand is currently struggling with healthcare inequalities: healthcare is likely to be more emphasized in urban areas than in provincial areas.[33] Of around 674 HD centers in Thailand, about 25% are located in the capital city, Bangkok (urban area).[34] Moreover, while almost all HD centers use standard procedures of water purification, the water quality used for making dialysate is still a significant issue, especially in rural areas. Climate changes and drought in certain areas also increase the risks of contamination in dialysate solutions. Hence, to reduce the inequality of healthcare systems, particularly HD and PD, Thailand needs to equalize resource distribution in medical technologies. More qualified standard of dialysis systems must be constructed, and all hospitals must implement efficient dialysis systems that satisfy certified standards. Additionally, to achieve this, dialysis systems in both rural and urban areas should be checked and evaluated by healthcare authorities frequently.

Discussion

Overall, the previous studies that were referred to depicted different types of renal disorders relating to CKD that correlate to aging and possible outcomes from applying different treatments to CKD patients.

Aging of the kidney comes with different complications and may eventually lead to renal disorders such as nephrosclerosis and nephron hypertrophy. While nephrosclerosis is the alteration of the biopsy patterns of the arteriosclerosis, glomerulosclerosis, tubular atrophy, and interstitial fibrosis, which results in triggering ischemia, nephron hypertrophy is associated with having a large nephron size. Similarly, researchers found that both nephrosclerosis and nephron hypertrophy portrays a positive correlation with aging, although other factors such as gender, GFK values, and family histories of CKD are also a key contributor to developing these diseases. By exploring the elements and causes of nephrosclerosis and nephron hypertrophy which are the main influences of CKD, we gain more in-depth information and can better comprehend the underlying causes of this disease. This information further contributes to our decision in choosing the best-suited strategies to increase CKD awareness among the elderly.

Turning to its existing treatments, however, it is important to acknowledge that most of the existing CKD treatments can only alleviate the symptoms and complications of the disease itself, except the kidney transplantation that can do so albeit risky considering other adverse outcomes that may trigger from this treatment. The treatment of complications from CKD can be categorized in many ways based on the type of complications. While some of the specific treatments are approved for their effectiveness to alleviate the complications (reducing hypertension, treating anemia, and eliminating acid in healthy kidneys) and help patients live with it as long as they can, they are not directly effective to treat CKD considering other methods that focus into the kidneys, such as dialysis and kidney transplantation. Normally used to treat ESKD, they can improve the quality of life in CKD patients and avoid several risks, especially in the case of kidney transplantation in which the kidney is completely replaced with a healthy one from the donor. It is proved that this method can highly reduce the mortality of CKD elderly patients. Nevertheless, these treatments may have long-term outcomes (i.e. cancer, viral infection) that gradually harm CKD patients.

From several negative outcomes coming from receiving current CKD treatment, we outlined 2 main solutions to help the patients have access to CKD general information including the details of treatments, positive and negative outcomes that might come with each of them, and to improve the standards of the dialysis system in Thai hospitals. These solutions are very vital to many CKD elderly patients because having knowledge will help them decide to choose the best treatments that suit their current CKD conditions or symptoms and that all CKD patients deserve the same standards of receiving dialysis treatment with acceptable quality, no matter the area they live in. In addition, we proposed another creative way of fundraising by selling dialysis fashion bags and dialysate fertilizer. Not only does this way help raise more funds, but it also yields benefits of dialysis wastes to many individuals instead of disposing of it.

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Our solution guidelines can provide both medical and environmental benefits to society. To elaborate, the proposed guidelines aim to maintain an equal standard of CKD dialysis system in Thai hospitals and raise awareness of CKD medication errors among the elderly, while also saving the environment by reducing the amount of waste products from the CKD dialysis process from the fundraising method. Moreover, our research will cover both primary and secondary data hence both new and existing information will be obtained, increasing the validity of the study. Nevertheless, with regard to the first solution, there are limited information resources to provide for CKD knowledge due to the fact that some resources containing detailed statistics and experiment processes may require substantial payment to access, which limits us from exploring in-depth information and evidence to clarify the provided content. However, eventually, we were able to locate other alternative resources. Furthermore, it is also important to note in the second solution that the initial expense of modifying dialysis waste can be considerable, but this problem can eventually be alleviated by using the remaining funds left after holding CKD educational events for the elderly.

Conclusion

Aging of the kidney comes with different complications and may lead to renal disorders such as nephrosclerosis and nephron hypertrophy, eventually resulting in CKD and EKSD. Unfortunately, most of the existing CKD treatments can only alleviate the symptoms of the disease itself, except for kidney transplantation that comes with high risks and complications. From several negative treatment outcomes due to lack of information and unstandardized CKD treatments, we proposed 2 solutions to help patients, especially the elderly, choose the best CKD treatment by raising awareness of CKD treatment errors and maintain an equal standard of CKD dialysis systems. Furthermore, they also save the environment by reducing the amount of waste products from CKD dialysis processes. However, more studies and experiments on the proposed guidelines should be conducted in order to confirm the practicality, success rate, and positive impacts they have among CKD elderly patients.

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