Developing a Patient-centered Care Information System for Hemodialysis Clinic Services

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Abstract

BACKGROUND: Patient-centered care is a service process that focuses on the patient. All health workers collaborate in providing services to patients undergoing dialysis at risk of adverse events. The information system is very urgent to develop as a tool for monitoring hemodialysis (HD) services. System monitoring can prevent medical errors in the hospital.

AIM: The aim of the study was to develop a Patient-Centered Care Information System at the HD clinic and make the monitoring systems for doctors and nurses. This study was conducted in Nitipuran Health Center of HD care specialists. The data were obtained from the interview in 12 participants consisting of nursing in Nitipuran Health Center of HD care specialist.

METHODS: This was a qualitative research with a design case study with focus group discussion.

RESULTS: An electronic medical record was built to provide better service for dialysis patients at HD clinics. According to the healthcare workers' convenience, the system that could input PCs and tablets used two different approaches. A PC-based system is for doctors, and the tablet-based system is used by nurses who frequently monitor dialysis patients.

CONCLUSION: The system built will make it easier for healthcare workers to monitor dialysis care from start to finish.

Introduction

More than 2 million patients undergo long-term dialysis treatment globally, with a shallow survival rate. In the general population, with increases in blood pressure, the risk of cardiovascular disease and all causes of mortality increases continuously and linearly, without indications of a threshold. Since hemodialysis (HD) is a costly treatment procedure for patients with chronic renal failure, evaluating the treatment's effectiveness in life quality is essential. Long-term and chronic home HD patients are subject to feelings of loneliness and distress due to a lack of physical interaction with health-care providers and input on their dialysis therapies. Thus, health-care professionals at home for HD are critical for these patients to respect the dialysis system better and cooperate with the health-care professionals [1].

A small study showed that patients could better understand their conditions and better communication between doctors and patients through electronic medical records (EMRs). As health records evolve into electronic form, increasing demand develops a system to provide patients access [2].

Meanwhile, patient-centered care and hospitals encouraged everyday ideal conduct for clinical/patient interactions and established behavioral expectations that employees kept accountable. Different approaches can achieve positive input on plan execution, engagement, and transparency by workers and leaders [3]. Patient-centered care needs a sound information system for easier collaboration with all professions in the hospital. The creation and appropriate patient empowerment policies and reforms are critical to the growth of the country's world-class patient-centered healthcare [4].

An electronic-based patient outcome report for a dialysis patient is essential and will ease health care workers' job in deciding what is best for their patients [5]. Telemonitoring is the utilization of information technology advancements in health services. According to the World Health Organization (WHO), telemedicine (also known as telehealth) is sciences and uses information and communication technology that consist of (1) exchange of diagnosis information, (2) treatment and prevention of disease and trauma, (3) research and evaluation, and (4) continuing education for health service providers [6]. Telemedicine is an umbrella term that covers any medical activity that involves a distance element. In its ordinary sense, telecommunication is a doctor-patient interaction, and it goes back at least to the ship's use to shore radio to advise sea captains [6].

The telemonitoring system developed for the HD clinic is intended to help facilitate healthcare workers' coordination in giving care for a dialysis patient. This system may allow for patient-centered care [3]. Healthcare workers will be more focused on providing care to dialysis patients [7]. Telemonitoring (well-being observing and Home Health Care) is a part of telemedicine that plans to reestablish autonomous living in their homes. Individuals experiencing different ailments and inabilities would drive them to hospitalization or situations in specific foundations (patients experiencing certain incessant illnesses, incapacities, yet fragile older) [8]. Telemonitoring for [9], [10] patients with chronic renal failure undergo peritoneal dialysis [11]. Telemonitoring from a nurse for patient chronic renal failure [9].The system can assess patients who have chronic kidney failure and health workers can determine the appropriate treatment for patients [12].

Over the past few years, a few independent inquiries have been carried out but with contradictory findings. Studies about patient satisfaction and the telemonitoring economic consequences can suggest potential reviews [13]. The Nephrology experiment is organizing to determine the cost-effectiveness, clinical/biological impact, and patient understanding of home monitoring among chronic kidney disease

(CKD) patients. The authors aim to explain this report's rationality, design, and organizational aspects [14]. The results indicated that the peripheral devices used in telemonitoring services and the technical support system are highly adaptable, making them perfect targets for budget-cutting steps to ensure its sustainability, the telemonitoring system [10].

In a 2010 UK review, there was an increased understanding of telehealth in palliative care but no evidence-based research to support its use. Telehealth is expanding and its use in palliative care can solve the pressure on treatment services. This review's main aim was to describe the current use of telehealth in UK pain management and evaluate telehealth initiatives concerning digital service quality. The second aim was to assess whether telehealth leads to reduced access to emergency services [15]. Since HD is an expensive treatment method for chronic renal failure patients, it is essential to determine the quality of treatment results. The study's main aim was to evaluate the impact of patient therapy on the quality of life of end-stage renal diseases in patients with HD on the World Health Organization quality of life and evaluate the variables that influence the quality of life of such patients [16].

CKD is an acute global health issue that further pressures the health sector's finances. Patients with CKD are routinely treating with peritoneal dialysis as
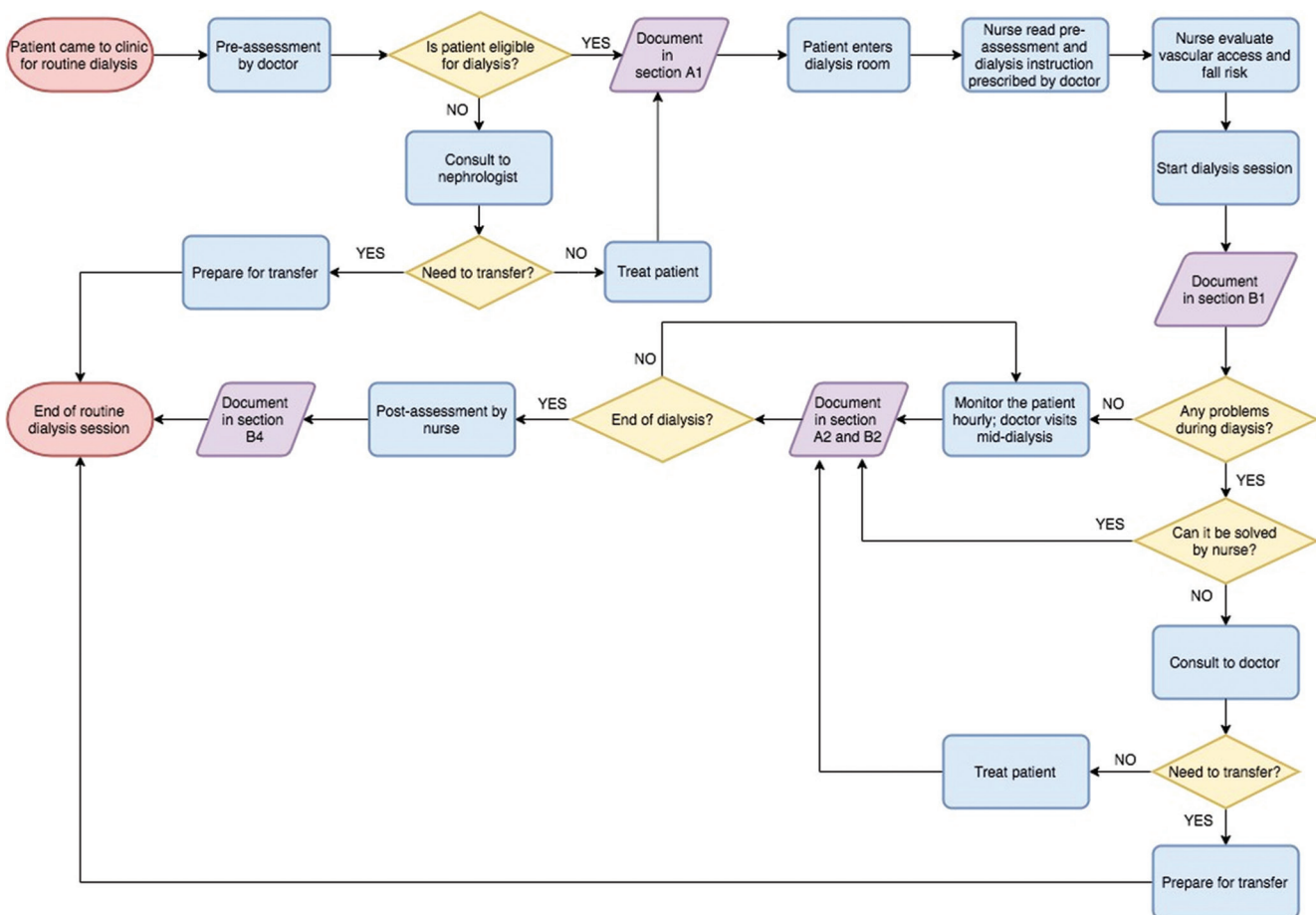

Figure 1: The flow chart of Routine HD Services

a standard treatment for CKD. Telehomecare is an evolving technical approach to support patients receiving PD in their homes. The telehomecare technology is used in practice to improve CKD patients witnessing PD outcomes and the accessibility, acceptability, and scalability of this virtual care program [17]. Hence, the most critical aspect of information management is data collection, and a simple data collection method guarantees reliable and correct access to health data. The most capabilities needed for the HD information system were measurement of an adequacy Index, advice on an appropriate dialysis dose for any patient. Without time and place constraints, the information systems received warnings when the dialysis adequacy index was below the norm, interchange in hospitals, and capacity to answer requests [18].

This study aims to develop an information system for patient HD to simplify patient-centered care based on the evidence.

Methods

This research used qualitative research with a case study approach. The stages of designing a patient-centered care information system for HD patients are as follows:

1. Analyzing and defining system requirements.

At this stage, focus group discussions would determine the user's needs in carrying out the patient-centeredcare process for HD patients. The flow of HD services is as shown in the flow chart.

The flow of routine activities for providing HD patient services begins with an assessment by a doctor and then an assessment by the nurse. If the patient meets the requirements, the patient can carry out the dialysis process brief description as shown in Figure 1.

Figure 2 shows that the communication pattern is created in the information system. Communication in patient-centered care for hemodialysis patients consists of two stages: (1) The doctor conducts an assessment before the patient carries out dialysis. (2) The nurse's results are examined, then the patient who meets the requirements can do dialysis, then the nurse monitors during the HD process.

2. Creating a system design

Making a patient centered-care information system design as in the component diagram below includes several steps, as in the component Figure 3:

View manages the idea to the user (view). Controller bridges the model and the view. Model is the subset whose job is to organize, prepare, manipulate, and organize data. Security is the part that regulates data security in the form of a username and password. Remote repository is the subset whose job is to send and receive data changes. Communication bridges communication between the server and the device. HTTP is a protocol used for data communication. Api Service Repository is an application to bridge the data exchange process. Database is part of the management and storage of data. JQuery Framework is a framework with the javascript programming language to create web views. PHP Native is a programming language used to program the web. MySQL is a database management system used to manage and store data.

3. Evaluating the system

Testing of the system has been created to determine its validity. Information systems tested and evaluated subjects who tried the information system. System testing was carried out individually, hoping that system input and fault finding of system applications have been necessary for the application improvement process. The stage distributed a questionnaire with open questions of the obstacles and suggestions for the system tested.

Results

1. Identification of the need for a patient-centered care information system for hemodialysis patients, seen in the Figure 4.

System information patient-centered care for HD services is an EMRs created to suit dialysis unit needs. It consists of two different dashboards to suit each medical practitioner's needs better. The
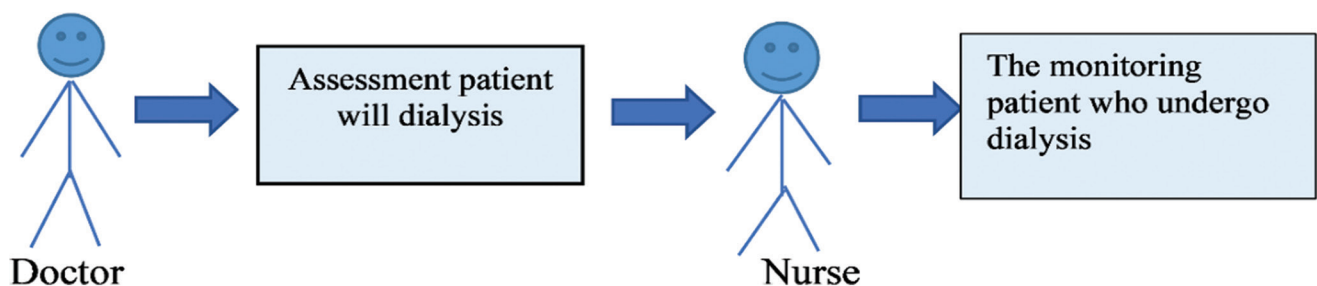

Figure 2: Case diagram of the communication in patient-centered care between doctor and nurses
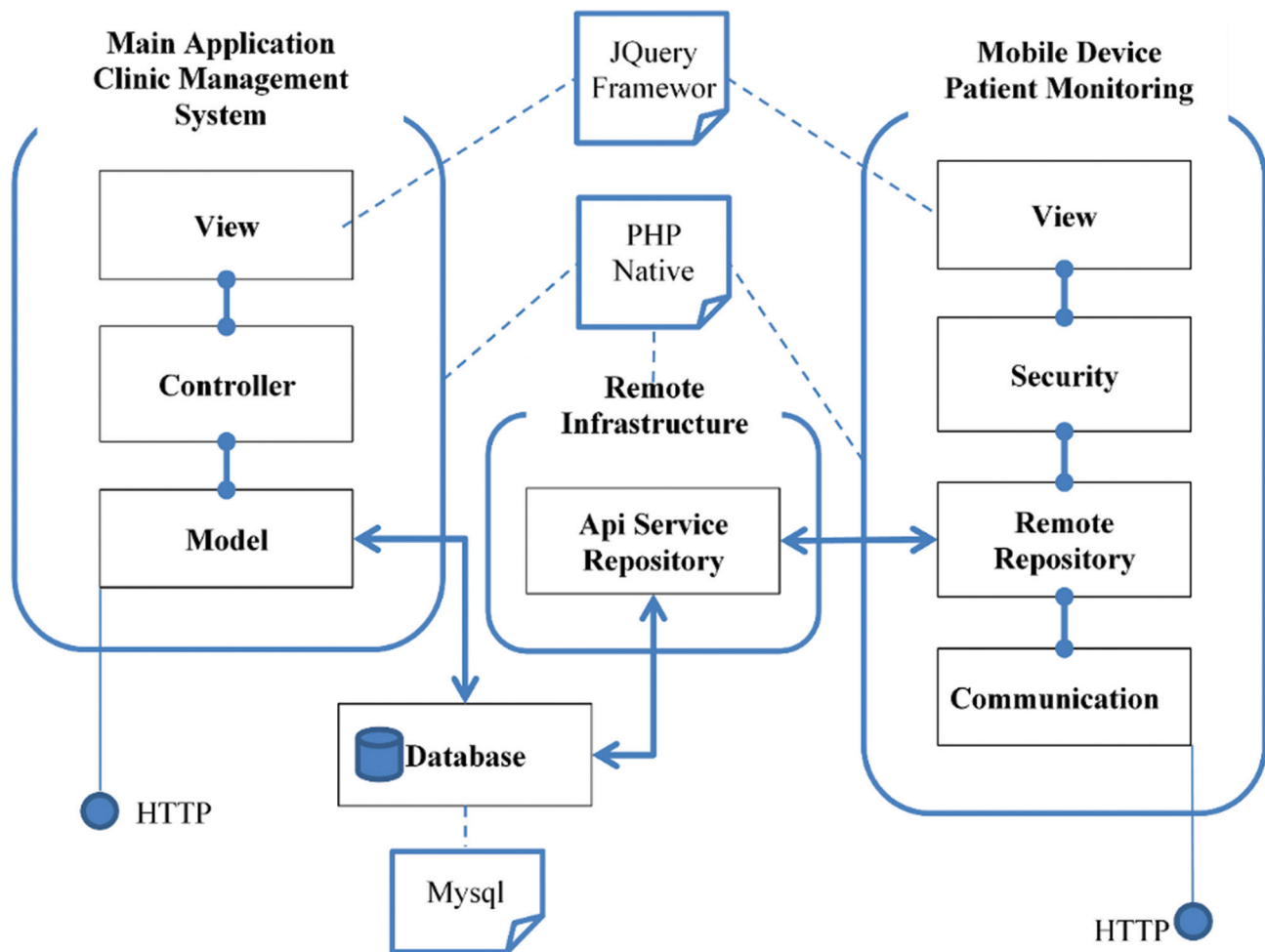
Figure 3: Hemodialysis patient monitoring application component diagram information
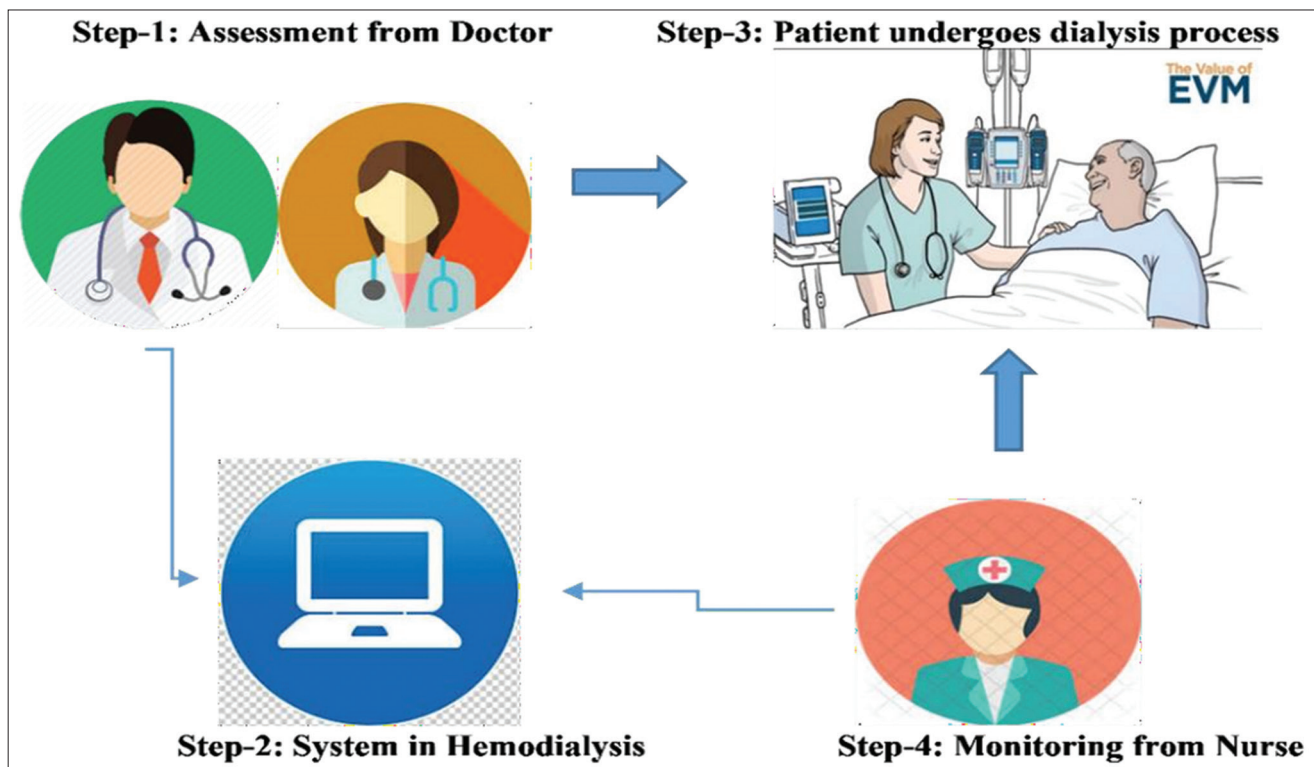

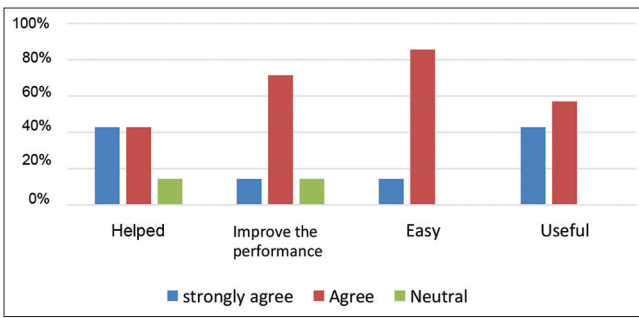Figure 4: Step of Telemonitoring System in Hemodialysis Unit

Figure 5: Analysis of the perceived usefulness of the system

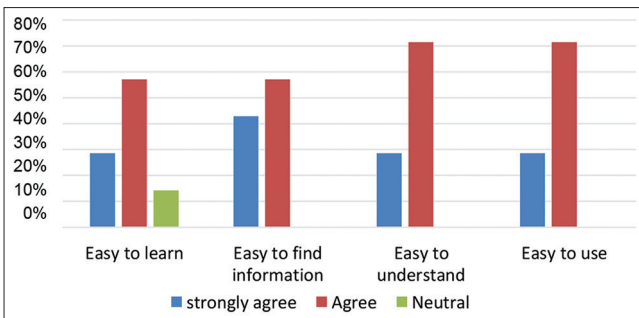doctor's dashboard is desktop-based, while nurses are tablet-based. Both systems are integrating.

Figure 6: Analysis of the Perceived Ease of Use of the system

2.   Patient-centered care information system for HD patients

The system was made according to the results of the identification of the HD clinic user's needs. Users are doctors and nurses. The information system is as shown in the procedure of the information system patient-centered care for patient HD:

3.   The procedure of the information system patient-centered care for patient hemodialysis

- Doctor's dashboard
- Nurse's dashboard

4.   Analysis and evaluation of information systems

- The results of the information system analysis can be seen in Figures 5-8. That the system can be useful, useful and makes it easier for users to operate this system.
- Evaluation of information systems

Evaluation of information systems can be seen in Table 1 regarding the perceived obstacles and suggestions of users.
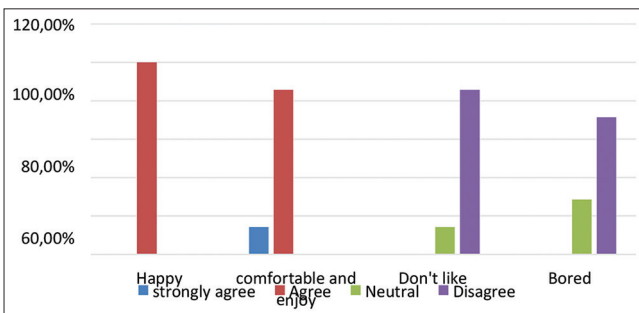

Figure 7: Analysis of the Attitude Toward Using of the system

Table 1: Evaluation results after using the Information System that has created at the Hemodialysis Clinic

Obstacles	Suggestion
1. Remove the number 0 to fill the numbers	1. The numeric filling should be cleared only (so there is no need to remove the number 0 to fill it)
2. The signal does not support/ slow, so it is not easy to get into the application	2. Expanded/upgraded network
3. The name of the registered patient not entered (the admin must change the contents of the patient's initial medical record to poly hemodialysis first, and the doctor cannot enter the patient data	3. It is recommended that the doctor directly see the patient's names when inserted into the HD patient queue list.
4. Scrolling down too much	4. The identity of the patient in the medical review was shortened. Since most patients are in good condition (the same), it is best to fill in the default; the newly changed sat patient state is not the same.
5. Hours in intra HD sometimes to double	5. Application or system repaired
6. Some patients cannot fill intra HD, even if it is not stored (lost)	6. More research to insert hours in intra HD
	7. There is a sign that the patient data has already been filled in

Discussion

Patient-centered care information system for HD patients is made based on all health workers' needs in providing services at the HD clinic. The patient-centered care information system is an integration of all health workers who provide services to patients. Each patient was assessed by a nurse doctor then monitoring for 4 h by the nurse. Hence, patients can be quickly treated if complications occur due to HD. Patient-centered care needs a sound information system for easier collaboration with all professions in the hospital. The creation and appropriate patient empowerment policies and reforms are critical to the growth of the country's world-class patient-centered healthcare [4]. Communication and collaboration among health workers are essential to avoid mistakes.
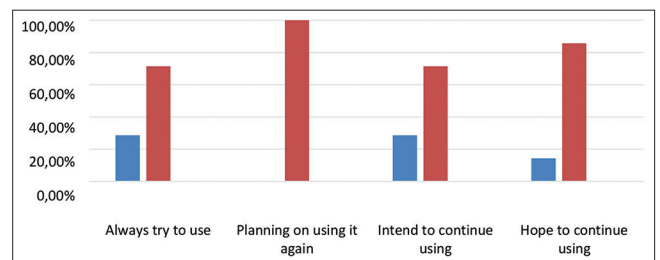

Figure 8: Analysis of the Behavioral Intention of the system

A tool that will facilitate collaboration and communication among health workers is an urgent matter. An electronic-based patient outcome report for a dialysis patient is essential and will ease health care workers' job in deciding what is best for their patients [5]. Telemonitoring is a form of utilization of information technology advancements in the field of health services. According to the WHO, telemedicine (also known as telehealth) is sciences and uses information and communication technology that consist of (1) exchange of diagnosis information, (2) treatment and prevention of disease and trauma, (3) research and evaluation, and (4) continuing education for health service providers [6]. Telemedicine is an umbrella term that covers any medical activity that involves a distance element. In its ordinary sense, telecommunication is a

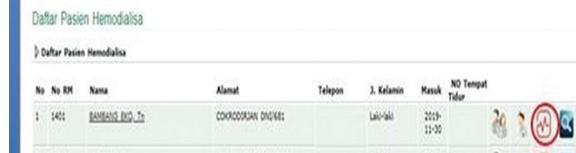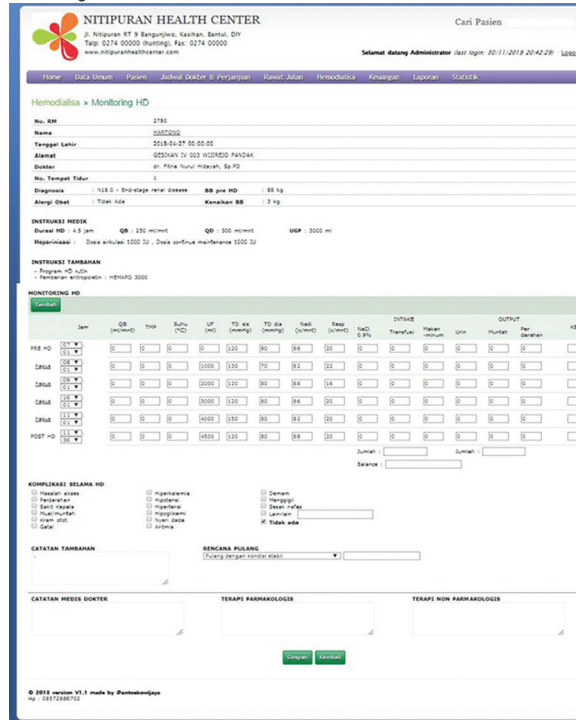| Ste p	Activity	Figure in system information
1.	The doctor enters the Username and Password to log into the system. A list of hemodialysis patients scheduled for the day. When a patient enters the doctor's room, the doctor must choose the first button next to the patient's name.	 List of hemodialysis patients shown in doctor's dashboard
2.	The doctor must examine the patient and record the pre-assessment and dialysis instructions in section A1.	 Section A1: Pre-assessment and dialysis instructions
3.	The patient may enter Hemodialysis Room after being examined.	
4.	A doctor can monitor the patient through the computer in section A2 during the dialysis session by clicking the third button next to the patient's name. It consists of a monitoring page filled by the nurses.	 Button to get into section A2
5.	The doctor is required to document any medication and laboratory test ordered for the patients in this section. A doctor may also add additional notes if needed.	 Section A2: Patient's monitoring and dialysis session's summary

Stage	Activity	Description
1.	Nurses enter their Username and Password to log into the system.	
2.	A list of HD patients scheduled for the day is shown, in specific criteria are listed below.	Patient number 1, the patient is scheduled for a dialysis session but has not yet been examined by a doctor. If a nurse chooses this patient, there will be a warning sign telling them that a doctor has not discussed this. Patient number 2 is a patient examined by a doctor but has not yet started dialysis. The patient who the nurse should choose Patient number 3 patient who already started dialysis session. Patient number 4 patient who already finished his/her dialysis session.

List of hemodialysis patients shown in nurse's dashboard.

| 3. | After choosing the patient, the nurse will get into section B1, in which a summary of pre-assessment and dialysis instruction by the doctor is showing. The nurse must read it before starting the dialysis session. | |
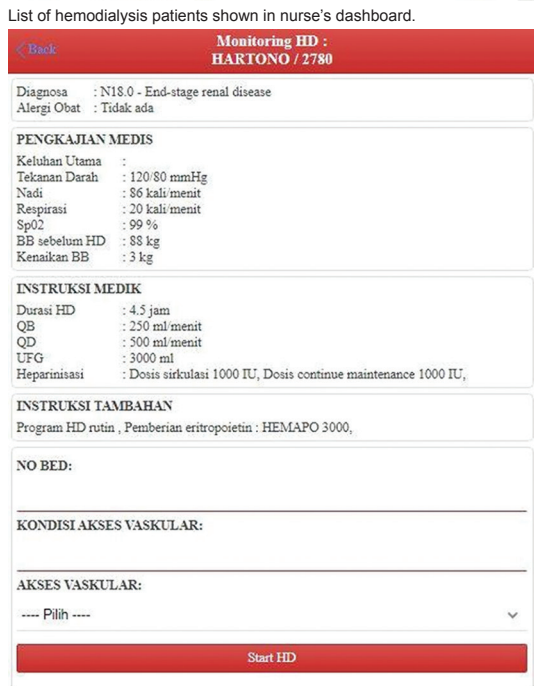
Section B1: Summary of pre-assessment and dialysis instruction

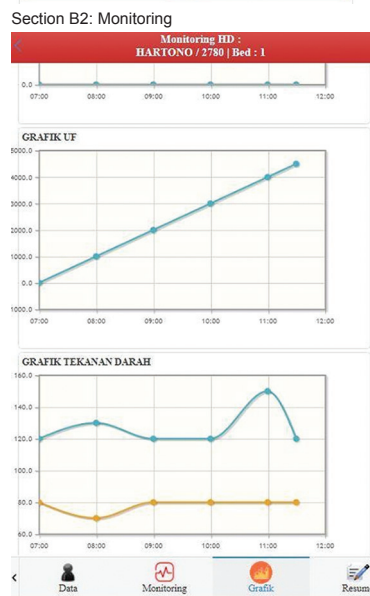| 4. | When the dialysis session has started, the nurse must fill in the patient's Bed Number, Vascular Access, Vascular Access Condition, and Fall Risk Assessment, and click the "Start HD" button in section B1. | |
| 5. | The monitoring page, or section B2, will be shown afterward. During the dialysis session, nurses must monitor the patient every hour and time a problem arises and document it on the monitoring page. | |

Section B2: Monitoring

Stage	Activity	Description

Section B2: Monitoring

6.	To easily track the patient's condition, monitoring graphs can see in Section B3.	

Section B3: Monitoring graphs

7.	When the dialysis session has ended, the nurse must record any complications during the dialysis session, add a note if needed, choose the right return plan in Section B4, and click on the "End" button.	

Section B4: Dialysis session summary

doctor-patient interaction, and it goes back at least to the ship's use to shore radio to advise sea captains [6].

Hepatitis C virus (HCV) infection is common in dialysis patients and is associated with increased morbidity and mortality. Hospital management can assess trends in the prevalence, incidence, and risk factors for HCV infection as defined by a documented diagnosis or antibody positivity. HCV infection is an independent mortality risk factor in this population, associated with severe morbidity and lower quality of life [19]. The patient care information system is expected to identify patients who have a history of HCV so that health workers can anticipate it to avoid transmission.

The risks that occur in HD patients are anticipated by doing patient-centered care. In the Nitipuran clinic, the collaboration between doctors and nurses has not included a dashboard for other professions that provide services for HD patients. The professions that provide services to HD patients and doctors and nurses are pharmacy, nutrition, and physiotherapy. Furthermore, nutritional needs in dialysis patients are essential. Known protein waste energy (PEW) is a death risk factor. However, PEW cutoff values were not tailored for the early detection of malnutrition patients with HD. High rates of dialysis malnutrition were recorded. PEW is the state of diminished body reserves of protein and fat mass, frequently associated with death, comorbid conditions, and reduced daily living activities. Early detection of PEW patients and nutritional interventional therapies is requiring [20]. Assessment of the nutrition profession is necessary for dialysis patients to the lower mortality rates for HD patients.

An assessment conducted by a doctor to determine the patient's condition who will be hemodialyzed is an early warning of the death of HD patients due to various comorbidities. One that was identified is obesity. Frail obese older adults in the population have an increased risk of mortality. Friction is standard among patients with HD, associated with increased mortality risk, but obesity is associated with decreased mortality risk during dialysis. It remains uncertain if the frail-obese phenotype is associated with increased mortality risk in HD patients [21]. Hence, the assessment done by the doctor regarding the requirement to undergo HD is very important. However, the assessment was that doneness should be coupled with human resources capable of caring and nutrition. Patient-centered care cannot run properly if collaboration between professions in hospitals does not run. Until now, the fragmentation of foster care is still often shown in hospitals. Therefore, this information system can provide convenience for health workers in providing the right treatment for patients.

This research's strength is the comprehensive flow in creating information systems, from the beginning of determining the needs of health officials until the evaluation. As for this study's weaknesses, the new patient-centered care information system is at the stage of preparing a dashboard for doctors and nurses. Dashboards for other professions do not exist. Considering the clinic used for research requires a dashboard for the two professions. Other disciplines do not yet exist, still in the form of cooperation with other parties.

This information system can continue by creating telehealth. Telehealth is the distribution of health-related services and information through electronic information and telecommunication technology. Home HD calls for early investment education and health transition dialysis job. Professionals at-home treatment centers for patients. Home HD (HHD) makes it possible to increase the frequency of treatment. However, attrition due to technological failure reduces the modality's clinical efficacy. The ongoing telehealth platform HHD assessment and patient burden reduction [22]. So that the risks that will occur for patients who become HD detected early on. Patient-centered care is carried out in hospitals and can continue in the provision of care at home.

Conclusion

Information systems patient-centered care for the patient in HD clinics can help ease healthcare workers' jobs in doing assessments and monitoring. By having the procedure, any unpredicted patient's condition can detect earlier. Adverse events that may happen to a patient during dialysis can prevent, and coordination between healthcare workers in patient-centered care can implement well.

Acknowledgments

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