Measuring The Quality of Renal Care Using Information System Design:An Early Warning System to Improve Health Care Quality

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Keywords: Hemodialysis, quality of healthcare, information system design, quality of renal care.

Abstract: The morbidity and mortality rates among hemodialysis patients are persistently high. The availability of this data is needed for planning and delivering treatments through the plan effectiveness analysis. However, no data analysis and information are ever reported to show the quality of renal care services. The purpose of this study was to describe an application system design that shows some of the clinical performance indicators and the dialysis unit indicator. This is an action research study conducted in PERNEFRI. The steps of the design system were covered by the Indonesian renal registry data and importing it to the application. Data was collected via the in-depth interview, document study by the administrator and PERNEFRI staff. The output of the application described and evaluated the health care quality through % calcium, % phosphate, % Ca x P, % albumin, the machine of dialysis-nurse ratio, the machine of the dialysis-patients ratio for mortality detection and dialysis product for adequacy dialysis. The renal unit that did not meet the standard will be shown in the application automatically with the mark. Overall, this study showed that the application design could describe the quality of care through the following quality of care indicators and can improve the clinical practice as an early warning system.

1 INTRODUCTION

Non-communicable diseases (NCDs) become health problems in various parts of the world. Increasing cases of non-infectious diseases are indirect results of a change to a passive lifestyle, consuming food that contains a lot of fat and cholesterol, smoking, and high-stress levels (Smeltzer, 2001). One of the noncommunicable diseases is chronic kidney disease.

Chronic kidney disease is a disorder of progressive and irreversible kidney function. Chronic kidney disease stage 5 is called End Stage Renal Disease. One of the treatments for it is hemodialysis (HD). The amount of morbidity and mortality among HD patients is persistently high because of the complexity of the dialysis process and the need for continuous treatment plans. The availability of this data is needed for planning and delivering treatments through the plan effectiveness analysis. However, no data analysis and information is reporting to show the quality of renal care services.

In Indonesia, the incidence of a dialysis patient was 14.5 patients per one million inhabitants in 2002, 18 patients in 2004, and it was improving consecutively until 2006 (Prodjosudjadi, 2009). In East Java, the incidence of dialysis patients also increased from 2013 to 2014 (IRR, 2014). The increasing number of patients hemodialysis patients made a hospital develop a renal unit. The data showed that renal care was for 29 patients in 2012, 40 in 2013, 50 in 2014, and 58 in 2015 (IRR, 2015). The increasing of the renal care has to be evaluated to control the service quality. Measuring the quality of renal care based on clinical performance measurement and renal care performance could describe the condition of the healthcare. The quality measurement in healthcare was the important thing because it could describe the healthcare system through the quality services improvement (Morris and Bailey, 2014).

In developed countries, the incidence and the prevalence of kidney failure data was collected in the renal registry (Levy et al., 2009). In Indonesia, It was gathered from the Indonesian Renal Registry website (IRR).

The regulations of the Health Minister of Indonesia state that for consent to permit hemodialysis services, they must have a recommendation from the Provincial Health Office and Indonesian Society of Nephrology (PERNEFRI).

PERNEFRI of East Java Regional Coordinator used manual and non-standard forms sent via email for the supervision and evaluation of the hemodialysis unit. It forwarded via email most of the data entered by the hemodialysis unit to the IRR so that HD units did the double entry to the IRR and the form submitted Pernefri before the visitation of both the East Java Province Health Office and Pernefri. Therefore, to avoid redundancy or double data entry, hemodialysis units needed an application that could be used by Pernefri to process IRR data into simple data that could show the quality of the HD unit services. IRR data processing was a feedback for the hemodialysis unit of data transmitted to Pernefri. Measuring quality of renal care to identify practice patterns will engage and support clinicians in improving the healthcare quality.

This study was to describe an application system design through processing data of the Hemodialysis Unit in East Java Hospital for maintenance quality of care in the hemodialysis unit.

2 METHOD

This was an action research study conducted in the Indonesian Society of Nephrology, East Java Region (PERNEFRI) from March to September, 2017. The step of design system covered the IRR data and imported the data to the application. Data was collected by an in-depth interview and document study by two informants, one of which was the administrator and the other one was a Pernefri staff member.

System analysis was carried out by describing an HD unit's reporting activities along with variables present in the IRR Test design of applications that have been designed to determine the weakness and strength of the application. Evaluation of this application used some indicator, i.e., simplicity, ease, quality for processing the data, information quality, intention to use, and user satisfaction (Urbach and Müller, 2012). The informants were interviewed about the evaluation of the application with a questionnaire about the satisfaction theory of DeLone and McLean.

3 RESULT

The design system of the application could show the hemodialysis unit quality. The design system consists of diagram context. The diagram context is shown below:

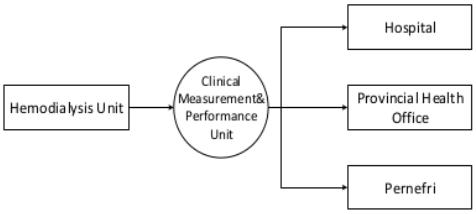

Figure 1: Diagram Context of application

Based on Figure 1, the input entity forwarded data from the Hemodialysis unit. The application processed and showed the output that could be information for the hospital, Provincial Health Office, and Pernefri. The composition of the application is as follows:

Table 1: Import data as the result of processing the application

Data	Output	Function
Percentage of Calcium serum	Graphic	Describing the management of mineral bone condition
Percentage of Phosphor serum	Graphic	Describing the management of mineral bone condition
Percentage of Ca x P	Graphic	Describing the management of mineral bone condition
Percentage of Albumin	Graphic	Describing the nutrition condition
The machine of the dialysis-nurse ratio	Graphic	A substance for the number of nurses needed
Machine-patients' ratio	Graphic	A substance for mortality rate detection
Dialysis Product	Graphic	One of early warning for adequate of hemodialysis treatment

The application was web-based. However, the users ran an offline version. The interface of the application is as follows:

Figure 2: The interface of the application

The user should have a username and a password to maintain the confidentiality of the data. The import data could be processed after logging in to the application.

The output of the application that is used for monitoring and evaluation the hemodialysis unit is below:

Figure 3: Percentage of calcium serum

Figure 4: Percentage of phosphor serum

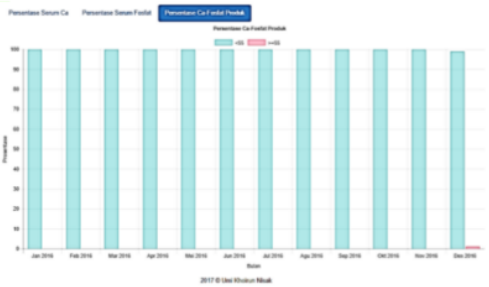

Figure 5: Percentage of Ca x P

Figures 3,4, and 5 show details about the early warning of the mineral bone disease detection. The color of the graphic was green, yellow, and red to describe the severity level. The color of green indicated normal, yellow moderate, and red was severe.

Protein-energy malnutrition (PEM) and wasting are common among patients with Chronic Kidney Disease (CKD) and is associated with higher rates of morbidity and mortality. Malnutrition develops in patients undergoing hemodialysis treatment, and it relates to adverse outcomes. The level of albumin serum could show a malnutrition condition. The percentage graphic of albumin serum is as follows:

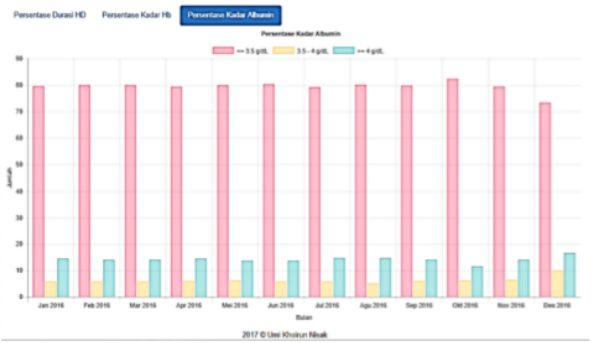

Figure 6: Percentage of albumin serum

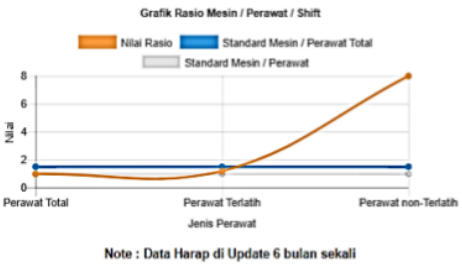

Figure 7: Graphic of machine and nurse ratio

Figure 7 shows the ratio of machine and nurse. The information could decide the number of nurses needed in the healthcare of hemodialysis and the adequacy of the nurse and device for dialysis. Based on the data, the hemodialysis unit could determine whether they have to add the nurse and machine or whether they are not needed.

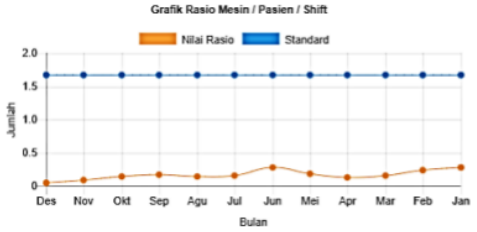

Figure 8: Graphic of machine and patient ratio

Figure 8 shows the machine and patient ratio that could be compared with mortality rate data. The ratio could indicate the number of emergency patients that need hemodialysis therapy.

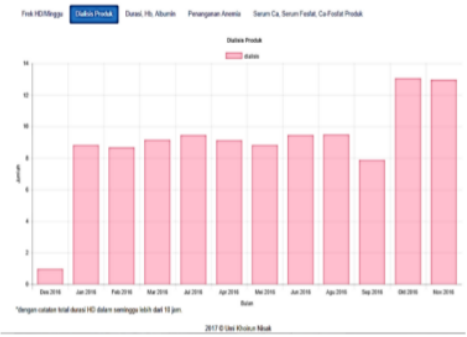

Figure 9: Percentage of dialysis product

Figure 9 shows one of the variables that indicate the adequacy dialysis. The graphics level of more than 20 suggested the dialysis was adequate.

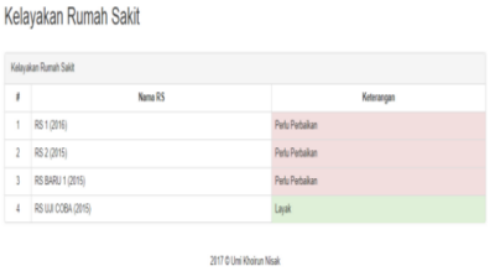

Figure 10: The quality of renal unit services

Figure 10 shows the output of the application that evaluates whether the renal unit works properly or needs improvement.

The renal unit that did not meet the standard will be shown in the application automatically with the appropriate mark.

Respondents tested the data processing unit HD applications and filled out the evaluation sheet of HD data processing unit applications. They were interviewed about the variable of simplicity and ease of evaluation.

The application was a simple app and user-friendly. However, it has both a weakness and a strength. The weakness of this application was that it could not detect that annual data is in a single Excel file. The strength of this application was that there were no data processing unit HD applications.

Respondents tried to test the accuracy of the application by comparing manual calculations before and after importing the data on Excel and the result was the same. Furthermore, the application provides relevant information, which is complete and accurate, and they were satisfied with it.

4 DISCUSSION

The application design was used to measure the quality of the renal unit with an advanced application form from the Indonesian Renal Registry. In a developed country, surveillance of chronic kidney failure data has a separate system such as a US Renal Data System (USRDS), End-Stage Renal Disease Clinical Performance Measures (ESRD-CPM) the Project Database in the USA.

According to S.N. van der Veer et al. (2013), there was a category of the indicator to measure the quality of the renal unit. The categories were the structure, process and the outcome. This was consistent with the study about the variable of this application.

The Department of Health and Human Services, USA (2000) state that a minimum standard of hemodialysis unit was mortality rate, albumin serum, Hb serum, Kt/V, Stop HD, and hospitalization. The application used some variables from the Department of Health and Human Services, USA with the standard.

The health ministry regulation No. 812, 2010 states that a requirement of human resources in the hemodialysis unit was the nurse with hemodialysis expert capability with three nurses for four of the machine ratios. Therefore, it used machine and nurse ratio to measure the hemodialysis unit. Pernefri would evaluate the renal unit over or under the standard.

The mineral functions disrupted in CKD were critically important in the regulation of both initial bone formations during growth. The bone abnormalities are found almost universally in patients with CKD requiring dialysis (stage 5), and the patients with CKD stages 3 to 5 were the majority of it. The concern of extraskeletal calcification is increasingly that the results of the mineral and bone metabolism of CKD and the therapies were used to correct the abnormalities (KDIGO, 2013). The mineral bone disease was a systemic disorder of mineral and bone metabolism due to CKD manifested by either one or a combination of the abnormalities in calcium, phosphorus, and Ca x P (Moe et al., 2006). Therefore, the application used the variables of Ca, Phosphore, and Ca x P for evaluated management of the mineral bone disease.

The renal unit that did not meet the standard will be shown in the application automatically with the mark. The expected quality improvement of the information system design development happened by adding a security system to the application. This was related to confidential data.

5 CONCLUSION

The design can describe the quality of care through following quality of care indicators and improve clinical practice as an early warning system through Laboratory data, nurse, machine, patients ratio, and mortality data.

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