

Klakson: Innovation in the Development of a Barber Johnson Charting Calculator Based on an Early Warning System (EWS)

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Abstract. Data on bed management in Indonesia is currently managed in an integrated manner by the Ministry of Health through the Integrated Referral System (SISRUTE) on the Satu Sehat website. Hospital bed management data can be presented in the Barber-Johnson Graph. The Barber Johnsons graph is a good tool. It makes it easier for managers to monitor the efficiency of bed use, because TOI (Turn Over Interval), LOS (Length Of Stay), BTO (Bed Turn Over), and BOR (Bed Occupation Rate) are presented in one graph. The problem currently faced by society is that the management of beds in healthcare facilities is not yet efficient and is still done manually. In some hospitals, they still describe the Barber-Johnson Chart in Microsoft Excel. Therefore, innovation is needed to develop the Barber-Johnson Graph Calculator application Johnson is based on an Early Warning System (EWS) called Klakson. The existence of efficient bed management will demonstrate quality service. This is certainly expected to impact improving public health in Indonesia. This research uses action research, with a qualitative data collection approach. Data analysis uses content analysis. The results of need identification show that hospitals, health centers, and clinics that provide inpatient care need a Klakson application based on the Early Warning System (EWS) in the form of notifications and sound to support early decisions. The results of the feasibility study show that users are accustomed to using computers, software, and hardware available to support the development of web-based information systems. Information system development using prototype methodology. The prototype test results using the Blackbock method show that the function/reaction is according to the actor, the system works well and can meet user needs. The development of the web-based Klakson application using prototype methodology stages has been tested in DIY clinics and shows that the system can meet user needs.

Keywords: Barber-Johnson Graph, Early Warning System, Development, Information System, Website

I. BACKGROUND

The Sustainable Development Goals (SDGs) are a global development program from the United Nations (UN) targeted to be achieved by 2030 and agreed upon by 193 heads of state. Indonesia is one of the countries that agrees to this, therefore the Indonesian Government is trying to achieve 17 goals and 169 SDG targets. One of the goals of the SDGs, namely SDGs 9, is To achieve sustainable development goals, including building strong infrastructure, promoting inclusive and sustainable industrialization, and encouraging innovation, as well as ensuring healthy lives and improving the welfare of all residents of all ages, health service facilities in Indonesia provide promotive, preventive, curative and rehabilitative.

Referring to Law 17 of 2023 concerning health, one of the curative (curing disease) and rehabilitative (health restoration) efforts is that hospitals provide inpatient services to patients who need continuous care to carry out observation, diagnosis, therapy, or rehabilitation where the patient stays. This inpatient service greatly influences the level of efficiency of health facility bed management [1]. With good bed management, hospitals can receive referral patients more optimally and on time.

Data on bed management in Indonesia is currently managed in an integrated manner by the Ministry of Health through the Integrated Referral System (SISRUTE) on the Satu Sehat website <https://sisrute.kemkes.go.id/> [2]. SISRUTE aims to simplify and speed up the patient referral process between health facilities. Apart from that, health facilities also report data on hospital bed management through the Hospital Information System (SIRS) on the page <http://sirs6.kemkes.go.id> [3] health centers through the Puskesmas Management Information System (SIMPUS) [4].

Presentation of data on the management of hospital beds and clinics with inpatient services can be presented in the Barber Johnson Chart (GBJ). The Barber-Johnson graph is a graph that presents processing or calculations using hospital statistics with the aim of meeting management needs for efficiency indicators for hospital bed management [5]. The benefits

of the Barber-Johnson graph can be used in evaluating efficiency in hospitals, comparing several periods in one activity, and monitoring activities [6]. The Barber Johnsons graph can be used as a good tool and makes it easier for managers to monitor the efficiency of bed use because it is presented in visual graphic form [7]. The Barber-Johnson graph is used as an indicator of bed management efficiency which is presented in four parameters in one graph. These four parameters include the average length of stay (LOS), the Turn Over Interval (TOI), and the Bed Occupancy Rate (BOR) and Bed Turnover Rate (BTO) [6].

Advances in information technology open up new opportunities to improve bed management in hospitals. One example is using the Early Warning System (EWS) and Decision Support System (DSS). The Early Warning System is the output or result of the system in the form of an early warning and the Decision Support System is a decision support system. The early warning and decision support system is a system that is easy to design and use. This EWS helps users to identify problems earlier so that they are more profitable and can manage risks earlier [8] while the Decision Support System is used to help stakeholders make the right decisions to produce added value for an organization [9]. EWS is a system that can predict the risk of complications or death in patients. EWS uses various parameters, such as vital signs and laboratory test results, to calculate a patient's risk score. By using EWS, hospitals can identify patients who are at high risk of complications or death [10]. EWS allows hospitals to carry out early intervention and improve the quality of patient care [10;11]. The results of the systematic review also show that EWS helps users mitigate problems that took too long to realize [12].

The urgency in this research is that the management of beds in health service facilities is not yet efficient and is still done manually. Some hospitals still depict the Barber Johnson graph in Microsoft Excel form [13]. Officers process data manually using Microsoft Excel, so it takes quite a long time to create a Barber Johnson chart. Sometimes medical recorders often make errors approximately 3 times when inputting, which can hamper data processing and result in an ineffective report creation process [13]. Therefore, we need a system that is capable of displaying bed usage efficiency graphs using TOI, LOS, BTO and BOR indicators [14]. Therefore, this research developed a Barber Jonshon (Klakson) graph calculator application to present BOR, LOS, TOI, and BTO comprehensively and automatically in the form of a Barber Johnson graph. The Early Warning System (EWS) based Horn application is equipped with notifications and sounds, which It is hoped can proactively assist health facility management in managing the efficient use of beds.

II. METHOD

The development of the Klakson application uses descriptive research with a qualitative approach. This research was tested in a clinic that provides inpatient services in the DIY area.

Researchers conducted observations and in-depth interviews with reporting officers and the head of the medical records installation. From the results of the in-depth interview, primary data will be obtained regarding flow, problems processing BOR, LOS, TOI, and BTO to become Barber Jonshon graphs, and the need for developing the Barber Jonshon Graph calculator application. Secondary data was collected from guidelines, Standard Operating Procedures (SPO), and bed management reports obtained by document review. To maintain the validity of qualitative research, the Triangulation method was used. In this research, triangulation of sources, techniques, and time was carried out. Furthermore, after all the data was collected, the researcher carried out data analysis using content analysis, namely to analyze qualitative data obtained from the results of in-depth interviews, observations, and documentation studies. Content analysis is a method used to analyze communication systematically, and objectively regarding the visible message. Next, the data is selected according to its relevance, and the data is presented in narrative form.

Development of the Barber Jonshon (Klakson) graphic calculator application using the prototype method. Prototypes are very appropriate for use in a system that will be redeveloped. Rapid design creation can be re-evaluated before being implemented appropriately.

The development of the Klakson application includes the following stages: analysis of user needs (communication), quick planning (quick design) in making designs in general, rapid modeling and design is carried out as a basis for making prototypes (quick design modeling), the design is quickly translated into programming language and system testing (construction of prototype) is carried out using the Black Box method, then the Klakson application prototype is tested at Clinic to evaluate the prototype and provide feedback with the aim of improving the system according to specifications needs (deployment delivery and feedback).

III. RESULTS AND DISCUSSION

The results of the feasibility study show that users are accustomed to using available computers, software, and hardware to support the development of web-based information systems. The results of the needs analysis can provide a design proposal for the Klakson application as follows:

Table 1. The Need Analysis

Problem	Proposals and Problem Solving	Proposed design
Health facilities present bed management data (BOR, LOS, TOI, BTO) still in the form of numbers and bar graphs separately (not comprehensive) using MS Excel (manual)	It is necessary to develop an application to present bed management data (BOR, LOS, TOI, BTO) comprehensively and automatically in the Barber Jonshon Graph to make it easier to analyze the efficiency of bed management.	The KlaKson application innovation is the development of the Barber Jonshon Graph calculator application to present BOR, LOS, TOI, BTO comprehensively and automatically in the form of a Barber Johnson Graph
Health facilities do not yet understand the meaning of the efficiency area on the Barber Jonshon Graph	a. The meaning of the efficiency area is translated into database logic b. Conduct bed management training	The KlaKson application presents efficiency areas on the Barber Jonshon Graph through database processing so that users can quickly see an overview of the bed management map KlaKson application training is carried out for users in limited environments, namely clinics that have inpatient services
Health facilities that are already advanced in presenting graphic efficiency data on Barber Jonshon are not yet equipped with an <i>Early Warning System</i> (EWS) so that conclusions about the efficiency of bed management are carried out by <i>the user</i> .	Drawing conclusions about bed management efficiency on the Barber Jonshon graph can be done early through automated EWS system warnings	The EWS-based KlaKson application features in the form of notifications and sounds, to provide early and proactive warnings.

Based on the proposed design (table 1), an Entity Relationship Diagram (ERD) was prepared which describes the manufacturing flow diagram. ERD is a diagram used to design a database, used to show relationships or connections between visible entities or objects and their attributes. In other words, ERD is a model for explaining relationships between data in a database based on basic data objects that have interrelationships [15].

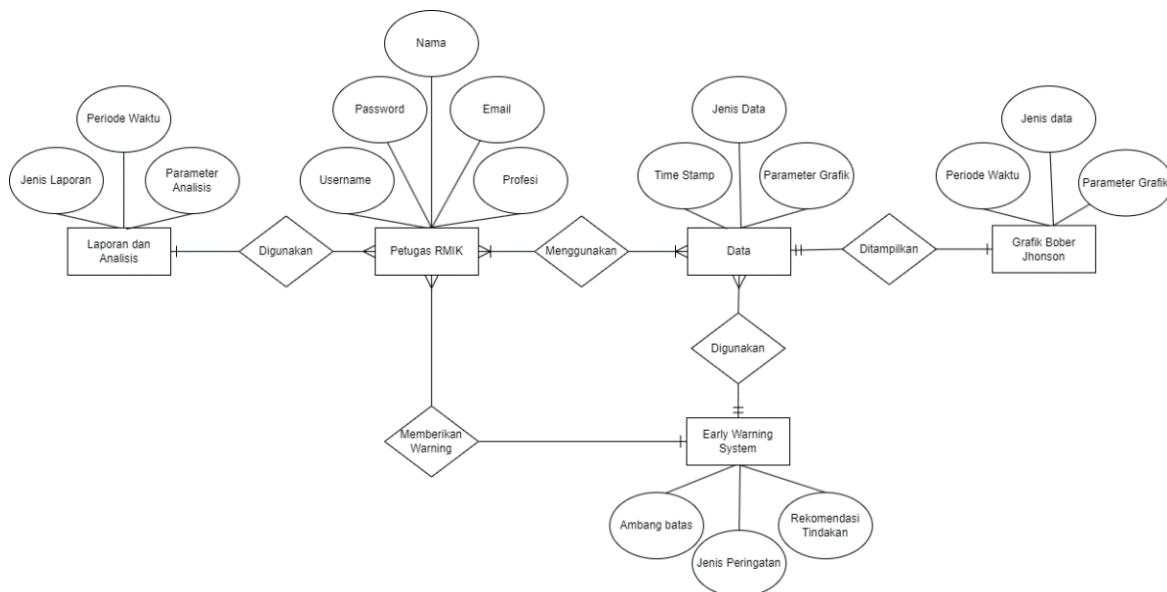


Figure 1. ERD



Figure 4. Architectural Information

User Interface (UI) is the study of graphic design layout on the appearance of a website or application. UI focuses more on the beauty of the appearance of a website or application. A UI designer is tasked with arranging text elements, colors, lines, buttons, images, and all elements in the appearance of a website or application [18]. The following is the UI display of the horn application (figure 5).



Figure 5. User Interface

The EWS-based Klakson application features in the form of notifications and sounds, to provide early and proactive warnings. This EWS helps users to identify problems earlier so that they are more profitable and can manage risks earlier [8] while the Decision Support System is used to help stakeholders make the right decisions to produce added value for an organization [9]. The results of the systematic review also show that EWS helps users mitigate problems that took too long to realize [12].

The Klakson application was tested at a clinic that provides inpatient services. The results of prototype testing using the Blackbock method show that the function/reaction matches the actor, the system works well and can meet user needs.

IV. CONCLUSIONS AND SUGGESTIONS

The results of the feasibility study show that users are accustomed to using computers, software, and hardware available to support the development of web-based information systems. Information system development using prototype methodology. The prototype test results using the Blackbock method show that the function/reaction is according to the actor, the system works well and can meet user needs. The development of the web-based Klakson application using prototype methodology stages has been tested in DIY clinics and shows that the system can meet user needs.

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