



# The design of the Inpatient Care Monitoring and Evaluation System for the Executive Report at X Hospital

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<p><b>Track Record Article</b></p> <p>Accepted: 28 February 2024 Revised: 03 March 2024 Published: 20 March 2024</p> <p><b>How to cite :</b> Agustina, S. J., &amp; Siregar, K. N. (2024). The design of the Inpatient Care Monitoring and Evaluation System for the Executive Report at X Hospital. <i>Contagion : Scientific Periodical of Public Health and Coastal Health</i>, 6(1), 395-407.</p>	<p style="text-align: center;"><b>Abstract</b></p> <p><i>One of the information systems needed in a hospital to support services is the inpatient information system. Several field constraints that often occur and can impede patient services include: limited bed space, hindered coordination between units or rooms, sudden changes in bed space requirements, the lack of integration of information systems, incomplete and inaccurate documentation of patient mobilization, the length of the patient discharge process, unavailable facilities in rooms, and the existence of hospital service indicators that must be achieved. Based on the above, a real-time and integrated information system is required, starting from the registration of inpatients to their discharge, in order to improve the quality of service and patient satisfaction. The design of the Inpatient Monitoring and Evaluation System for the Executive Report is an enhancement of the hospital information system that integrates all inpatient patient service activities, including supporting facilities, to generate useful information for monitoring and developing inpatient care services. This information can be used as a basis for decision-making by the leaders. The design of the Inpatient Monitoring and Evaluation System for the Executive Report utilizes the Systems Development Life Cycle (SDLC) method in the form of a prototype, with the drafting phase starting from design to development. The final result of this information system design consists of comprehensive, integrated, and real-time information related to patient activities from admission to discharge, presented in a dashboard that is useful for monitoring and evaluating inpatient care services. It can also serve as a basis for decision-making by hospital leaders and achieving hospital indicators.</i></p> <p><b>Keywords:</b> <i>Bed management, dashboard, information, inpatient, integration</i></p>
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## INTRODUCTION

The hospital is a healthcare institution that provides comprehensive individual health services, including inpatient, outpatient, and emergency care (Peraturan Pemerintah Nomor 47 Tahun 2021 Tentang Penyelenggaraan Bidang Perumahasakitan, 2021). Hospitals play a role in providing quality medical, nursing, medical and non-medical support, rehabilitation, and preventive healthcare services (Diana et al., 2023).

Information system is a collection of interconnected systems forming a single component consisting of input, process, and output that are related in the processing of data into information, making it beneficial for users (Zafitri et al., 2019). Management information system in an institution is crucial in the current era of digitization, particularly in the field of healthcare, known as Hospital Information System (HIS).

The increasing number of patients makes hospital staff ineffective in manually managing patient data; hence, sophisticated technology with computer-based data management is needed for faster, more accurate, and effective processes (Amalia & Huda, 2020). The

increasing competition among hospitals and the rising demand for quality healthcare services drive hospital managers to develop and formulate strategic policies such as Hospital Information Management Systems (HIMS). The aim is for hospitals to gain a competitive edge over their competitors. Additionally, this is also aimed at enabling hospitals to provide healthcare services that align with the desires and needs of patients (Fahrul Pratama & Purwanto, 2023). Management information system is a computerized system that produces accurate and timely information for managers, which is useful in decision-making and the effective implementation of organizational operational functions (Rustiyanto, 2010).

Hospital Information Management System (HIMS) is a communication technology information system that processes and integrates the entire flow of hospital services in the form of a network of coordination, reporting, and administrative procedures to obtain information accurately and promptly. It is part of the Health Information System (Peraturan Menteri Kesehatan No 82 Tahun 2013, 2013). The use of Hospital Information System (HIS) to control service quality. HIS users can make decisions based on the generated information to enhance healthcare services, streamline services, conduct research, support education, estimate benefits and needs, and plan and evaluate programs (Septiyani & Sulistiadi, 2022). Hospital reporting supported by good and accurate data and information will ensure the quality of services in the hospital (Diniah & Pratiwi, 2020). In order to provide comprehensive healthcare services, hospitals require the support of a reliable information system to enhance services to patients (Widiastuti et al., 2019).

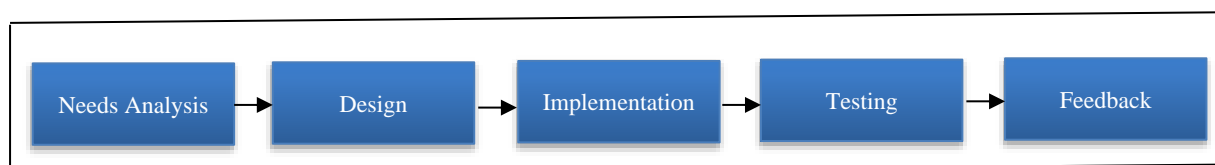
One utilization of information technology in hospitals is the inpatient information system, which includes a bed management system to generate information about the availability of empty rooms in the hospital quickly and accurately, thus expediting the inpatient service process (Kholili et al., 2022). This bed management information system is dynamic and essential for both internal and external purposes of the hospital, including patient needs and referrals from other hospitals, which begin with the patient registration process. Inpatient registration serves as the initial gateway to inpatient services, necessitating the support of a reliable, fast, and accurate information system (Intansari, 2018).

Bed management is a hospital's operational activity related to inpatient quality indicators. Indicators that need attention in inpatient management involve BOR (Bed Occupancy Rate), TOI (Turn Over Interval), LOS (Length Of Stay), and BTO (Bed Turn Over) to monitor inpatient activities, as well as GDR (Gross Death Rate) and NDR (Net Death Rate) to assess the quality of inpatient services. These indicators can be presented in Barber Johnson charts (Ramadani & Ullatifa, 2020).

Several common challenges in hospitals that can hinder patient services include: bed limitations, preventing patients from entering treatment rooms or leading to placements in different classes; hindered coordination between units or rooms; changes in bed composition; unaccommodated required information; incomplete and inaccurate documentation of patient mobilization; lengthy patient discharge processes; rooms that cannot be used due to issues with supporting facilities; and the need for hospital service indicators to be achieved and reported periodically. Based on these conditions, to avoid problems in inpatient care, the bed management system must be designed properly. The bed management business process must be clear to generate the reports needed by the hospital (Siswanto, 2018). The bed management system should not only include information about occupied and vacant beds but also encompass various details related to inpatient transactions and bed usage from patient registration to discharge. This makes it a source of information for monitoring and evaluating inpatient services and serves as a basis for decision-making by hospital leadership.

## METHODS

The research design employs a qualitative approach with the Systems Development Life Cycle (SDLC) model in the form of prototyping. The stages of the SDLC method include: needs analysis, design, implementation, testing, and feedback. This research is limited to the prototype development stage.



**Figure 1. The stages of prototype development**

The research was conducted at Hospital X in Jakarta, during January-February 2024. Hospital X has an average of 30 inpatient admissions per day. The research begins with a needs analysis by collecting information from users about the system to be created, followed by the design of the information system. Subsequently, a prototype is developed based on this design to provide an overview to users for evaluation (Dhamayanti & Rahmaniati, 2020). The data collection process can be carried out through literature review, observation, interviews, and document analysis (Rahardian, 2017).

The subjects of this study were selected using the Purposive Sampling method, which involved selecting hospital staff engaged in the use of inpatient information systems and

possessing good competency as primary informants to provide the necessary information for the information system design.

The information system design is carried out through the logical system design starting from the Context Diagram, Data Flow Diagram, Entity Relationship Diagram and Table Relationship Diagram, aiming to ensure that service activities run smoothly, can address issues, and anticipate potential occurrences (Maulida et al., 2023).

This information system design is an enhancement of the existing inpatient information system in the X Hospital. Based on observations, several functions have been added, including inputting data on patient waiting lists, patient discharge preparation, and room facility damage causing inactivity. The output consists of dashboard reports containing the information needed by the hospital to depict the inpatient condition over a period, along with service indicators and a warning system for discrepancies.

## **RESULTS**

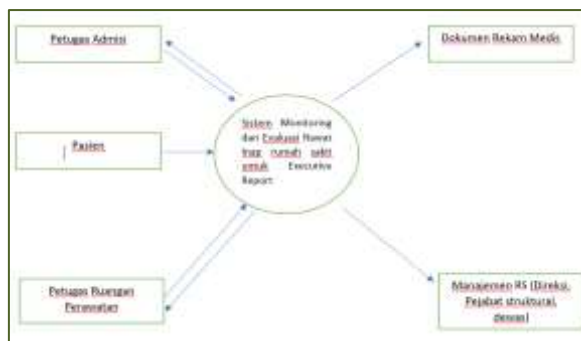
### **1. Data Collection and System Requirements Analysis**

In this stage, the researcher conducts a system requirements analysis through the collection of data and information to understand the problems and needs in the system design. This process is crucial to ensure that the developed information system meets the needs and objectives of the institution (Maulida et al., 2023).

Currently, some information is already generated automatically from the existing information system, but many still require further processing using Excel. Some information that is not yet facilitated includes waiting list information for inpatient rooms, the alignment of patient discharges with discharge plans, inactive rooms along with their reasons, and comprehensive report outputs that depict the care conditions within the assessed period.

### **2. System Design**

After identifying and analyzing system needs, the system design stage is carried out to determine whether a new system should be created or developed from the existing one. In this stage, an analysis of each created step is performed (Inggi et al., 2018).

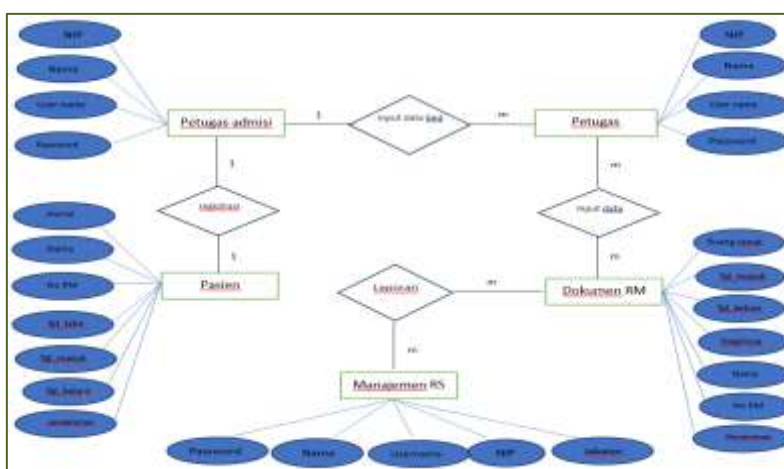


**Figure 2 Context Diagram for the Design of Inpatient Monitoring and Evaluation System for the Hospital Executive Report**

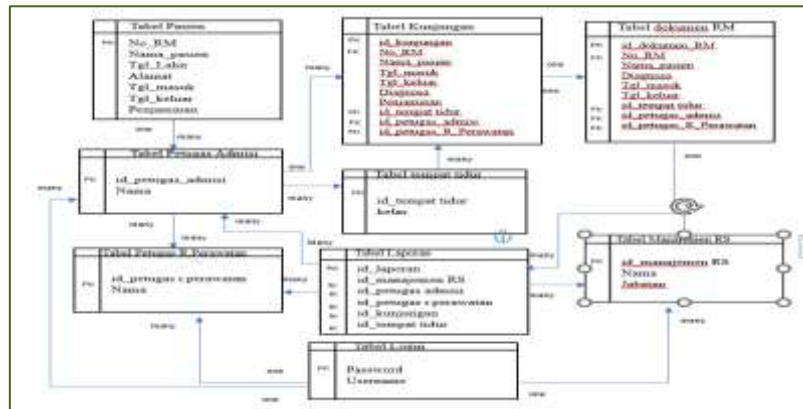
Context Diagram is a simple and clear diagram that illustrates a system or process by showing the relationships between the system or process and external entities related to it (Febyana & Nursamsiyah, 2023). Based on Figure 1, there are 5 entities consisting of Admission Officers and the treatment room as source and destination entities, the patient entity as a source, medical records as a destination entity, and hospital management as a destination entity.

ERD consists of entities, attributes, and related relationships. ERD serves to describe a more structured database system in the form of a design that presents data relationships (Hidayat & Utomo, 2023).

Admission officers register inpatients with a one-to-one cardinality, then make inpatient bed reservations with a one-to-many cardinality. Room attendants input service data, including all patient mobilizations (room changes, discharges, referrals), which will be recorded in the patient's medical records with a many-to-many cardinality. The input results will appear on the reporting dashboard for management with a many-to-many cardinality.

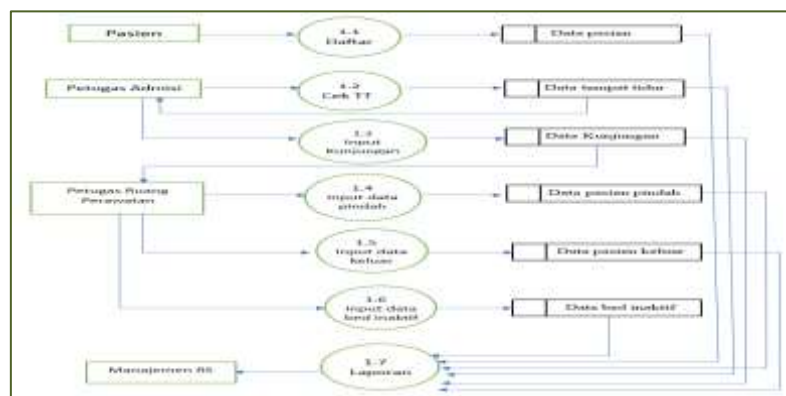


**Figure 3. Entity Relationship Diagram (ERD) for the Design of Inpatient Monitoring and Evaluation System for the Hospital Executive Report**



**Figure 4. Table Relationship Diagram (TRD) for the Design of Inpatient Monitoring and Evaluation System for the Hospital Executive Report**

After designing the ERD, the Table Relational Diagram (TRD) is created to observe the relationships between tables in the database (Kusuma et al., 2023). The TRD illustrates the relationships between tables, where each table has a primary key, and there are foreign keys connecting the tables (Figure 4).

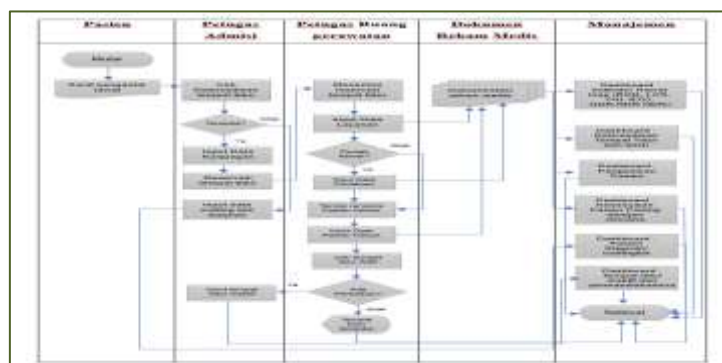


**Figure 5. Data Flow Diagram (DFD) for the Design of Inpatient Monitoring and Evaluation System for the Hospital Executive Report**

The Data Flow Diagram is a model used to illustrate the flow of data undergoing transformations through processes in a system. It provides a comprehensive explanation of data since DFD only shows how data is utilized by processes within the system (Taryanto & Nur Handayani, 2019). DFD is beneficial in system development as it facilitates system analysts in comprehensively understanding the system, including identifying weaknesses and issues within the system (Gunawan et al., 2023). Based on the data flow above, there are 7 activity processes consisting of the registration process, bed checking, inputting visit data, inputting relocation data, inputting discharge data, inputting inactive bed data, and reporting. Then, a Flowchart is created to show the flow or sequence of activities performed in a system (A. F.

Putri, 2022). The business process flowchart for the design of the Inpatient Monitoring and Evaluation System for the Hospital Executive Report is as follows:

1. Patients who have an inpatient referral will register with the Admission Officer.
2. The Admission Officer checks the availability of beds; if available, the officer registers the patient and reserves the room. If not available, the officer inputs the patient's waiting list data.
3. The ward attendant receives the patient and inputs the patient's service data during the patient's stay.
4. The ward attendant will update the data when the patient moves to another room or undergoes a relocation.
5. For patients planned to be discharged on D-1, the ward attendant will click on the bed management system to mark that the patient is scheduled to be discharged, which triggers a notification to the relevant profession for discharge preparation.
6. The ward attendant discharges the patient when the patient leaves, declaring the bed empty and ready to be cleaned for subsequent use.
7. Periodically, the ward attendant checks the active beds in the room. If there is any damage, it is reported to Admission, and the reason for the bed's unusability is entered. The Admission officer will then deactivate that bed.
8. All processes that occur from the patient's admission to discharge are documented in the patient's medical records, with the output in the form of a dashboard report.



**Figure 6. Flowchart for the Design of Inpatient Monitoring and Evaluation System for the Hospital Executive Report**

### 3. Prototype Design

The design of this system is an enhancement of the existing information system at X Hospital. Hospital staff will log in with their respective accounts.



Figure 7. Display of Log In



Figure 8. Display of Inpatient Menu

The new addition to this system design is the presence of a Dashboard panel visible in the inpatient menu (Figure 8). Additionally, there is an input for patient waiting lists with a procedure for when rooms are unavailable. If a patient agrees, the patient is "placed" in an available class. Then, the staff clicks the "waiting list" button to input the patient's destination class, as seen in Figure 8. One day before the patient's discharge, the nurse clicks on the marking for D-1 to indicate patients who will be discharged the next day. The aim is to ensure that relevant personnel can make necessary preparations, including Pharmacy, Nutrition, and Cashier, to expedite the patient discharge process (Figure 9). This is to meet one of the hospital's indicators regarding the acceleration of patient discharge preparations.



Figure 9. Display of Patient Waiting List Input and D-1 Patient Discharge



After the patient is discharged, the ward attendant checks the room's status. If there is a bed that cannot be used due to issues like a broken AC or other constraints, the attendant contacts the admission officer to deactivate the bed, informing them of the reason. The Admission officer then deactivates the specified bed. The display of bed deactivation is visible in the following view:



**Figure 10. Display of Inactive Bed Input**

The output of this system design is a dashboard report, as seen in Figure 10. The report is the result of processes performed from the patient's admission to discharge. Hospital service managers can access this dashboard report. Currently, the generated reports related to bed management include daily patient data and room Bed Occupancy Rate (BOR); other data is not yet facilitated. For bed improvement reports, a separate system is currently in use. The Management Dashboard will display data about room beds based on their respective statuses, making it easier for hospital managers to monitor (Siswanto, 2018). In this system design, reports can be accessed daily or weekly, including:

1. Inpatient indicators, including BOR, LOS, TOI, BTO
2. Mortality rate: the percentage of deaths among discharged patients.
3. Waiting List: the number of patients who did not receive a bed according to their entitlement.
4. Discharge Alignment: the number of patients who were discharged on the planned discharge day.
5. Insurance Recapitulation: The number of patients admitted according to their insurance coverage.
6. Patient Demographics: a report based on region and gender.
7. Details of Inactive Beds: the number of inactive beds along with their reasons.

For numbers 1 and 2, detailed information for each room can be displayed when clicking on the details of each indicator. The Waiting List can assess the queue of beds needed by patients (bed demand trends), the alignment of patient discharge with the planned discharge to

assess the causes if there is misalignment, including if the Length of Stay (LOS) is prolonged due to deteriorating conditions or other reasons. For numbers 5-7, they reflect the condition of patients in the room according to the calculated period. For inactive beds, it indicates how many beds are inactive so that the causes can be promptly addressed.



**Figure 11. Dashboard Display of the Design of the Inpatient Monitoring and Evaluation System for the Hospital Executive Report**

The information generated from inpatient transactions has access limitations. For visitors or patients, access is limited to information related to the availability of beds per class, occupied beds, total beds per class, and room facilities. Meanwhile, hospital staff, in addition to bed availability, can also access information on inactive beds and patients planned for discharge. Hospital management has access to the generated dashboard reports. The hospital management referred to includes the Head of the unit, Head of the Ward, and relevant Structural Officials involved in services, as well as the Directorate.

It is hoped that this system design can also expedite the service reporting process, accelerate follow-up actions for the causes of inactive beds, detail the waiting list of patients, facilitate the achievement of established indicators, and be useful as one of the considerations in the hospital leadership's policy-making.

## DISCUSSION

Several previous studies on the design of inpatient systems:

1. Analysis and Design of the Hospital Service Indicator System (Niska Ramadani and Nisa Ullatifa) in 2020. This study designs a computerized system for the daily census of inpatients that will generate reports on Bed Occupancy Rate (BOR), Length Of Stay (LOS), Turn Over Interval (TOI), and Bed Turn Over (BTO).

2. Design of the Interface System for Inpatient Bed Management Information at Airlangga University Hospital in Surabaya (Ahmad Shofi Nur Kholili, Novita Nuraini, Rosita Prananingtias) in 2022. This study designs an interface displaying room details with facilities and room images that patients will obtain. It also prints reports on inpatient visits, categorized by payment type, Barber Johnson indicator reports, and graphs of patient visits per room, per payment type.
3. Design of the Daily Inpatient Patient Reporting System Application at Citra Medika Hospital in Depok (Diana, Za'imatun Niswati, and Rendi Prasetya) in 2023. This study designs an application for the daily inpatient patient reporting system that includes patient data, doctor data, and room data.

Based on the above studies, the design focuses on inpatient indicator reports, including BOR, LOS, TOI, BTO, and patient visits, along with room displays and the facilities that will be occupied by the patient. Meanwhile, the Hospital Inpatient Monitoring and Evaluation System design for the Executive Report not only generates inpatient indicators (BOR, LOS, TOI, BTO) but also produces other information that has not been automatically generated before, such as the percentage of deaths, demographic and insurance data, inpatient waiting lists, inactive rooms due to damaged supporting facilities, and monitoring of patient discharge preparations. The generated information includes both summarized and detailed room-wise breakdowns, along with a warning system for discrepancies with standard values.

The information system manages inpatient data from registration, room changes, input of all service data in the medical record, payment, until the patient is discharged. (N. S. Putri et al., 2013)

This system design combines all transactions or activities during the inpatient service process with a more comprehensive output by adding several functions that have not been accommodated yet. It produces useful reporting output for monitoring and evaluating inpatient services and achieving hospital indicators, both related to statistical reports and hospital quality. This ensures that field constraints can be addressed promptly.

The system design is carried out according to the SDLC stages up to the prototype development phase. The constraints faced are in the process of collecting data through interviews, which must represent all users from both the hospital and patients or visitors. Additionally, document review involves examining the Standard Operational Procedures for all stages of inpatient care, where some activities still lack procedures.

## CONCLUSIONS

The design of the Inpatient Care Monitoring and Evaluation System for the Executive Report is an enhancement of the existing inpatient information system in the hospital. It involves adding several functions that are currently unavailable. This system design generates a dashboard report containing a summary of inpatient transactions from registration to patient discharge. This helps illustrate the inpatient conditions over a specific period, including details about patients and supporting facilities.

The design of this system aims to produce reports within one integrated system quickly and accurately. This is intended to assist in achieving services according to established standards or indicators, allowing for effective monitoring and evaluation of inpatient care. The system also serves as a "warning" mechanism in case there are results that do not meet the standards, prompting immediate action. The expected benefits of this system design include aiding decision-making processes and facilitating planning.

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