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Design of a Birth Certificate Information System (Neonatal) Using the Waterfall Method at Santosa Hospital Bandung Kopo

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Abstract: A Birth Certificate is an essential document that confirms the birth of a child, issued by a hospital. This document is crucial for registering a child's birth and obtaining an official birth certificate. At Santosa Hospital Bandung Kopo, the process of creating Birth Certificates is currently done manually using Microsoft Excel, with data input based on handwritten forms filled out by the patient's family. This method is prone to data entry errors, leading to delays and inaccuracies in information. This study aims to design a Birth Certificate Information System that can improve the efficiency and accuracy of data processing. The system is developed using Microsoft Visual Studio 2010 with the Waterfall software development method. The research employs a qualitative method with a descriptive approach. Data was collected through interviews, observations, and literature reviews. The research instrument is a questionnaire consisting of five questions related to the process and challenges in creating Birth Certificates. The results of the study indicate that the designed system can minimize data entry errors and enhance the efficiency and accuracy in the creation of Birth Certificates at Santosa Hospital Bandung Kopo.

Keywords: Design; Information System; Birth Certificate; Neonatal; Microsoft Visual Studio; Medical Records.

1. Introduction

Digital technology has become an integral component of daily life, influencing various sectors, including healthcare. The World Health Organization (WHO) actively harnesses digital technology and health innovation to accelerate global health and well-being objectives. The WHO's Global Strategy on Digital Health aims to support countries in strengthening their health systems through the implementation of advanced health technologies [1]. In Indonesia, the adoption of health technologies has seen significant progress in recent years, enabling healthcare professionals to work more efficiently and effectively. The application of information technology in healthcare is believed to offer numerous benefits to healthcare providers, particularly within hospitals. According to the Regulation of the Minister of Health No. 3 of 2020, hospitals are defined as healthcare facilities that provide comprehensive personal health services, including inpatient, outpatient, and emergency care. To enhance medical services, hospitals must deliver optimal performance, particularly in the management of medical records. As the population grows and technology advances, the need for systems that can efficiently store and retrieve patient data becomes increasingly critical. To address this need, Electronic Medical Records (EMR) have been introduced, offering secure and confidential data management solutions.

The implementation of the Ministry of Health Regulation No. 24 of 2022 on medical records, which replaces the previous regulation No. 269 of 2008, mandates that all healthcare facilities adopt EMRs. Arief Kurniawan Nur Prasetyo (2021) explains that the implementation of EMRs offers several advantages, including ease of information retrieval, efficient data storage, and streamlined information transfer [2]. These benefits are particularly relevant to maternal and neonatal healthcare services, where accurate and accessible medical data is essential. The regulation defines medical records as documents containing critical information about a patient, such as personal data, medical history, examinations, treatments, and other related healthcare services. Electronic medical records, therefore, represent a shift from physical documentation to the use of information technology in managing patient health data.

In healthcare delivery, one of the essential documents provided by hospitals is the Birth Certificate, which serves as the official record of a child's birth. This document includes basic information such as the baby's name, date, and place of birth, as well as the parents' names. Rinda Nurul Karimah (2018) emphasizes that implementing healthcare policies for maternal and child services requires robust information systems that ensure data integrity and generate accurate information [3]. Birth Certificates are crucial for registering a child's birth and obtaining an official birth certificate, which serves as legal proof of identity and provides access to various public services.

In Indonesia, birth registration must be based on a Birth Certificate issued by medical personnel or health institutions involved in the delivery process. Syaqil Ahmad (2019), in his study, concludes that the digitalization of Birth Certificates can accelerate the acquisition of birth certificates for children in Indonesia [4]. According to data from the Central Statistics Agency, in 2023, the percentage of children with birth certificates reached 91.79%, with a national target of 98%. Despite significant progress, additional efforts are needed to achieve the 100% target. One approach to increasing birth certificate ownership is the development of information technology platforms that facilitate the issuance of Birth Certificates, which is the primary requirement for obtaining an official birth certificate.

Observations conducted at Santosa Hospital Bandung Kopo revealed that the process of creating Birth Certificates is currently manual, using Microsoft Excel for data entry, with information taken from handwritten forms completed by the patient's family. This method is prone to data entry errors, which can lead to delays and inaccuracies in information processing. The manual process also tends to be time-consuming, reducing the overall efficiency of hospital services. To address these challenges, this study focuses on designing an information system for Birth Certificates that is expected to streamline the data processing workflow, making the creation of these documents faster, more effective, and accurate. The objective of this research is to design an information system that automates the Birth Certificate creation process at Santosa Hospital Bandung Kopo, thereby minimizing the potential for human error and enhancing the efficiency and accuracy of data management. This system is anticipated to support the improvement of healthcare service quality, particularly in the area of birth registration, by leveraging the latest information technology advancements.

2. Research Method

In academic research, methodology is a critical component, as highlighted by Gatot Wijayanto *et al.* (2022), who emphasize the importance of a systematic approach in conducting research, particularly in the post-pandemic era where digital methods have become increasingly relevant [5]. This study adopts a

qualitative methodology with a descriptive approach. Data collection techniques include interviews, observations, and literature reviews. The research instrument is a questionnaire consisting of five questions, which were adapted and modified by the researchers to address issues and challenges related to the process of creating Birth Certificates. Additionally, the design of the Birth Certificate Information System in this study utilizes the Waterfall method, which provides a systematic and sequential approach to software development.
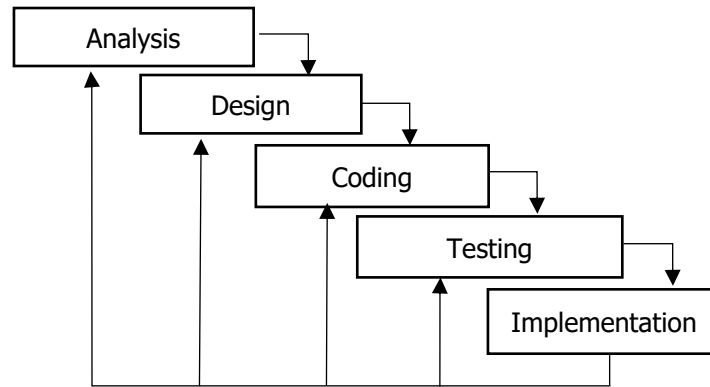

Figure 1. Waterfall Method

The first stage of this methodology is analysis. Analysis involves the process of observing an object and breaking down the data into more manageable components. In this study, the researchers conducted an analysis by observing and communicating with hospital staff regarding the process of Birth Certificate creation. This step aims to gain a comprehensive understanding of the ongoing procedures and identify any inefficiencies or areas for improvement. The next stage is design. After completing the analysis, the researchers proceeded to the design phase, where they began developing the forms and user interfaces required for the Birth Certificate Information System. The system design was carried out using Microsoft Visual Studio 2010, tailored to the specific needs identified during the analysis phase. This design phase is crucial as it translates the findings from the analysis into a functional system architecture. The third stage is coding. During this phase, the researchers undertook the task of writing the program code, which involves creating the necessary algorithms and combining numeric and alphanumeric codes to enable the system to function as intended. The coding process was applied to the various forms and interfaces designed earlier, ensuring that the system could be effectively operated using Microsoft Visual Studio 2010. Following the coding phase, the next step is testing. Testing is a critical stage where the functionality of the designed information system is thoroughly evaluated. The objective of testing is to verify that the program code works as expected and to identify and rectify any errors or issues that may arise. This ensures that the system is reliable and meets the specified requirements before it is implemented. The final stage in the Waterfall methodology is implementation. Implementation involves deploying the developed system in a real-world environment. At this stage, the system must meet all predefined requirements to ensure that it functions correctly and delivers the anticipated benefits to its users. This phase marks the transition from development to practical application, where the system is put to use in the intended operational setting. The methodology employed in this research encompasses the critical phases of analysis, design, coding, testing, and implementation. These steps are essential in developing an effective and efficient information system, ensuring that it not only meets the immediate needs of the hospital staff but also contributes to the broader goal of improving healthcare service delivery through the use of advanced digital technologies.

3. Result and Discussion

3.1 Results

Based on the Regulation of the Minister of Health No. 24 of 2022, all healthcare facilities, including clinics, are required to support and maintain electronic medical records (EMR). This regulation underscores the necessity of developing an integrated information system for Birth Certificates (Surat Keterangan Lahir, SKL) at Santosa Hospital Bandung Kopo. The implementation of such a system is expected to make the birth registration process more efficient, accurate, and secure. In designing the Birth Certificate Information System, the researchers utilized Microsoft Visual Studio 2010, a robust and comprehensive software development tool capable of creating various applications in console, Windows, or web formats.

The first step in the system development process was the analysis phase. During this phase, the researchers conducted a detailed examination of the existing process for creating Birth Certificates at Santosa Hospital Bandung Kopo. The findings revealed that the current process is manually performed using Microsoft Excel, with data entry based on handwritten forms filled out by the patient's family. This manual process is prone to errors, such as illegible handwriting or data entry mistakes, which can lead to delays and inaccuracies. Therefore, the need for specialized software or an application to automate the Birth Certificate creation process was identified. The proposed solution involved using Microsoft Visual Studio 2010, coupled with a Microsoft Access database, to streamline data processing, reduce human errors, and enhance the efficiency and accuracy of the system. This approach aims to provide convenience for both staff and patients by saving time and ensuring data precision. Following the analysis, the design phase was initiated. Based on the observations and analysis, the researchers designed an information system tailored to the identified needs. The system design included the creation of flowmaps, context diagrams, data flow diagrams (DFD), and entity relationship diagrams (ERD). The flowmap, as proposed by Jogiyanto (2015), combines the elements of a map and flowchart to illustrate the movement of objects from one location to another. This tool is instrumental in helping analysts and programmers break down problems into smaller segments and explore alternative solutions [6]. The flowmap designed by the researchers detailed the movement of data within the hospital's Birth Certificate process, including interactions between patients, admission officers, nurses, and the medical records department.

Next, the context diagram was developed. The context diagram represents one of the highest levels of data flow diagrams and is used to define the boundaries and interactions of the system within its environment (Bagir & Putro, 2018). It provides a broad overview of the system's interaction with external entities, such as patients and hospital staff, and illustrates how data flows between these entities and the system [7]. The Data Flow Diagram (DFD), presented in the subsequent stage, is a critical tool in system analysis and design. The DFD helps in understanding and documenting how data moves through the system, how it is processed, stored, and how different components of the system interact. This clear visualization of data flow is crucial for the development and maintenance of the information system, ensuring that all processes are mapped out and understood before implementation. The final diagram created was the Entity Relationship Diagram (ERD), which models the data relationships within the system. According to Edhy Sutanta (2015), an ERD is developed based on objects and is used to logically explain the relationships between different data entities within a database [17]. The ERD designed by the researchers helped visualize the structure and interrelationships of data, facilitating a more effective design and management of the database that supports the Birth Certificate Information System.
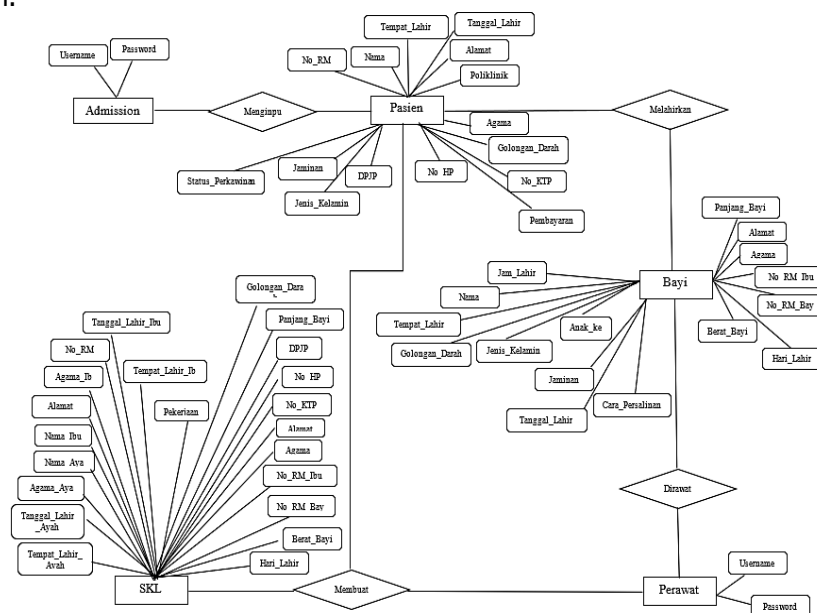

Figure 2. Entity Relationship Diagram (ERD) Proposed by Researchers

With the design phase completed, the researchers proceeded to the coding phase. During this phase, the program code was written, which included creating the necessary algorithms and logic to ensure the system functions as intended. The coding was applied to the various forms and user interfaces that had been designed in the previous phase, using Microsoft Visual Studio 2010. The database operations were managed using

Microsoft Access, ensuring that data entry, storage, and retrieval processes were optimized for accuracy and efficiency. Once the coding was completed, the testing phase began. In this research, blackbox testing was employed, focusing on the system's functional aspects to identify any errors or defects that could be rectified before the system's deployment. Blackbox testing involved inputting various scenarios to see how the system responded and whether it met the expected outcomes. The testing process ensured that the program functioned correctly, with all specified features operating as intended. The final phase of the system development process was implementation. During this phase, the fully developed and tested Birth Certificate Information System was deployed for use at Santosa Hospital Bandung Kopo. The implementation involved setting up the system, configuring it according to the hospital's operational needs, and training the staff to use the new system effectively. The system's interface included several key features, such as a user login form, which acts as the entry point to the application. Users are required to input their username and password to access the system, ensuring that only authorized personnel can operate it.

Figure 3. Main Menu Form
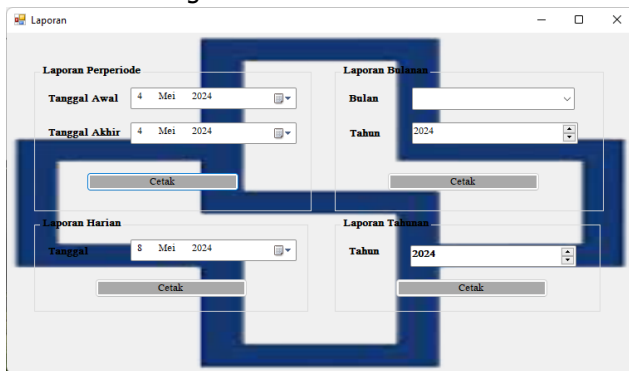

Figure 4. Patient Data Form Mother
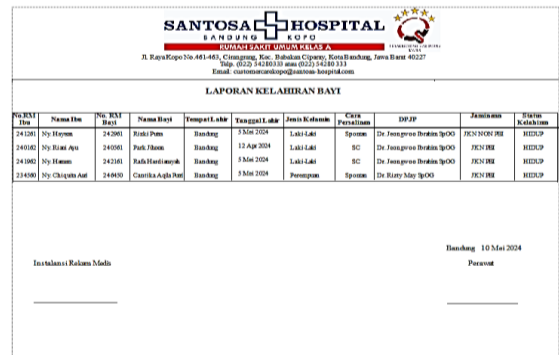

Figure 5. Report Form View

Figure 6. Display of Report Output Results

The main menu of the system, displayed upon successful login, includes options for managing patient and newborn data, as well as generating birth reports. The system is designed to allow hospital staff or the patient's family to print the Birth Certificate as soon as all required data is entered and verified. The form for entering patient data, particularly the mother's information, is structured to ensure that all relevant details are accurately captured and stored in the system's database. For newborns, the data entry form is designed to capture detailed information immediately after birth, ensuring that the records are complete and accurate. The form for printing the Birth Certificate is linked to the patient's medical record number (RM No.), which automatically retrieves and populates the necessary details from the database, streamlining the process and reducing the likelihood of errors. The system also includes a reporting module, which allows users to generate and view birth reports based on different time periods, such as days, months, or years. This feature provides valuable insights into birth trends at the hospital and supports better decision-making. The output of the Birth Certificate, as generated by the system, includes both front and back sections, formatted according to the hospital's standards. The final report includes a detailed listing of all newborns recorded in the hospital's system, providing a comprehensive overview of the data captured by the Birth Certificate Information System.

The testing phase included rigorous checks to ensure that all forms and functionalities operated correctly. For example, the login form was tested under various conditions, such as empty fields, incorrect usernames, and passwords, to verify that the system appropriately handled each scenario. Similarly, the data entry forms were tested to ensure that incomplete or incorrect data entries were flagged by the system, prompting the user to correct the information before proceeding. The printing function was also tested to confirm that the Birth Certificate could be generated accurately and that the system provided clear prompts and confirmations throughout the process.

Table 1. Blackbox Testing System Testing

No	Test Description	Test Scenario	Expected Outcome	Test Result	Conclusion
1	Login Form	Leaving the username and password fields empty, then clicking the login button	The system should reject the login attempt and display the message: "Username and password cannot be empty!"	The system rejects and displays the message: "Username and password cannot be empty!"	As Expected
		Entering a correct username and incorrect password, then clicking the login button	The system should reject the login attempt and display the message: "Check username and password. Incorrect username and password combination!"	The system rejects and displays the message: "Check username and password. Incorrect username and password combination!"	As Expected
		Entering an incorrect username and correct password, then clicking the login button	The system should reject the login attempt and display the message: "Check username and password. Incorrect username and password combination!"	The system rejects and displays the message: "Check username and password. Incorrect username and password combination!"	As Expected
		Entering both incorrect username and password, then clicking the login button	The system should reject the login attempt and display the message: "Check username and password. Incorrect username and password combination!"	The system rejects and displays the message: "Check username and password. Incorrect username and password combination!"	As Expected
		Entering both correct username and password, then clicking the login button	The system should accept the login and display the message: "Login successful!"	The system accepts and displays the message: "Login successful!"	As Expected
2	Patient Data Form and Baby Data Form	Leaving all fields empty, then clicking the save button	The data addition should not be saved, and the user is prompted to input the data again.	The data addition is not saved, and the user is prompted to input the data again.	As Expected
		Filling all fields except the full name, then clicking the save button	The data addition should be rejected, and the system should display the message: "Ensure all fields are filled!"	The data addition is rejected, and the system displays the message: "Ensure all fields are filled!"	As Expected
		Filling in all fields completely, then clicking the save button	The data should be saved, and the system should display a confirmation message: "Are you sure you want to save?" If 'No' is selected, the system does not save and returns to the form. If 'Yes' is selected, the system displays the message: "Data successfully saved!"	The data is saved, and the system displays the appropriate messages as expected.	As Expected
3	SKL Print Form	Entering the correct mother's medical record number (No. RM Ibu)	The system should retrieve and display the mother's data.	The system retrieves and displays the mother's data.	As Expected
		Entering an incorrect mother's medical record number (No. RM Ibu)	The system should reject the input and display the message: "Data not found!"	The system rejects the input and displays the message: "Data not found!"	As Expected

	Entering the correct baby's medical record number (No. RM Bayi)	The system should retrieve and display the baby's data.	The system retrieves and displays the baby's data.	As Expected
	Entering an incorrect baby's medical record number (No. RM Bayi)	The system should reject the input and display the message: "Data not found!"	The system rejects the input and displays the message: "Data not found!"	As Expected
	Filling all required fields and clicking the print button	The system should accept, display, and print the SKL form.	The system accepts, displays, and prints the SKL form.	As Expected
4 Report Form	Generating reports based on year	The system should accept, process, and display the report based on the year.	The system accepts, processes, and displays the report based on the year.	As Expected
	Generating reports based on month	The system should accept, process, and display the report based on the month.	The system accepts, processes, and displays the report based on the month.	As Expected
	Generating reports based on day	The system should accept, process, and display the report based on the day.	The system accepts, processes, and displays the report based on the day.	As Expected
	Generating reports based on period	The system should accept, process, and display the report based on the period.	The system accepts, processes, and displays the report based on the period.	As Expected

The reporting feature was tested to ensure that it could handle different queries and generate accurate reports based on various criteria, such as specific dates or time periods. The overall testing results showed that the system met the expected outcomes, with all functionalities performing as required. The development and implementation of the Birth Certificate Information System at Santosa Hospital Bandung Kopo represent a significant advancement in the hospital's ability to manage birth records efficiently and accurately. The system's design, which was meticulously crafted through stages of analysis, design, coding, testing, and implementation, ensures that the process of creating Birth Certificates is streamlined, reducing the potential for errors and improving overall operational efficiency. By leveraging the capabilities of Microsoft Visual Studio 2010 and Microsoft Access, the system provides a robust solution that supports the hospital's commitment to delivering high-quality healthcare services. The successful deployment of this system demonstrates the potential of digital solutions in transforming healthcare administration and enhancing service delivery, aligning with the broader goals of national healthcare policy.

3.2 Discussion

This study aimed to design and implement a Birth Certificate Information System (SKL) at Santosa Hospital Bandung Kopo, in line with the Indonesian Ministry of Health Regulation No. 24 of 2022, which mandates all healthcare facilities to support and maintain electronic medical records. The integrated information system is expected to enhance the efficiency, accuracy, and security of birth registration and SKL issuance processes. The analysis revealed that the current SKL creation process at Santosa Hospital Bandung Kopo is manual, relying on Microsoft Excel for data entry based on handwritten forms filled out by the patient's family. This method is prone to errors due to illegible or unclear handwriting. Therefore, there is a need for a system that can process data electronically, minimizing human errors and improving both time efficiency and data accuracy. The choice of Microsoft Visual Studio 2010 with Microsoft Access as the database for this study was appropriate, as it provides a robust development environment capable of effectively managing data processing. This study involved the design of various diagrams to illustrate the data flow and entity relationships within the system. A flowmap was used to depict the movement of data from one point to another within the system, while the Data Flow Diagram (DFD) provided a detailed visualization of how data is processed, stored, and interacts within the system. The Entity Relationship Diagram (ERD) was employed to logically represent the relationships between data in the database, facilitating more effective database design and management. During the coding phase, the study implemented codes for each form designed using Microsoft Visual Studio

2010, ensuring that the system functions according to the intended design. This process ensured that each component of the system operates as required, supporting automated data input and processing. The designed system was then tested using black-box testing to evaluate its functionality. This testing aimed to identify any errors or defects in the system and to verify that the program functions as expected. The testing results indicated that the system successfully m*et al* the testing scenarios, delivering outcomes as anticipated. The tests included validation of the login form, patient and baby data input, SKL printing, and report generation. In the implementation phase, the developed information system was trialed and deployed with satisfactory results. The system effectively managed all processes related to birth registration and SKL issuance. From the login page to the generation of birth reports, the system demonstrated strong performance in supporting administrative tasks at Santosa Hospital Bandung Kopo. This implementation is expected to facilitate the work of healthcare staff and improve the quality of services provided to patients.

4. Related Work

Abdussalaam and Oktaviani (2020) focused on developing a web-based grading information system using the prototyping method, which allowed for iterative refinement of system features based on user feedback. This approach is similar to the work by Afyenni (2015), who emphasized the importance of structured data representation through the creation of Data Flow Diagrams (DFD) for a school information system. Both studies share a common focus on enhancing the efficiency of data management through tailored information system designs that address specific user needs [8][9]. Fajar, Kurniawati, and Herianto (2019) explored the use of Microsoft Visual Studio 2015 to develop a simulation model for approach lighting systems in airports, highlighting the adaptability of Visual Studio for specialized applications. This research aligns with the study by Fahmi *et al*. (2023), who utilized Microsoft Visual Studio 2012 to create a medical records release information system at a regional hospital. Both studies demonstrate the flexibility of Visual Studio as a development tool, though they apply it in distinct sectors—aviation and healthcare—underscoring its versatility in handling complex data and operational requirements [10][11]. Handiwidjojo (2015) investigated the implementation of electronic medical records (EMR) to enhance healthcare service delivery, a focus that is in line with the Indonesian Ministry of Health Regulation No. 24 of 2022, which mandates the adoption of EMR across all healthcare facilities. This regulatory framework is further explored by Yunisca, Chalimah, and Sitanggang (2022), who examined its application in monitoring the health of radiation workers in the Serpong Nuclear Area. These studies are united by their emphasis on improving healthcare management through the adoption of digital records, yet they differ in their specific applications—one focusing on general healthcare delivery and the other on occupational health in a specialized environment [12][13][19].

Nurjanah *et al*. (2021) developed a web-based mail management information system using the CodeIgniter framework, aimed at improving administrative processes. Similarly, Nurqalam *et al*. designed an accounting payroll information system using Microsoft Visual Studio. While both studies aim to enhance administrative efficiency through the use of information systems, they are applied in different contexts—mail management and payroll systems—demonstrating the broad applicability of these tools in various administrative tasks [14][15]. Rizkita, Herfiyanti, and Abdussalaam (2021) designed a death certificate information system for Bhayangkara Sartika Asih Hospital, focusing on improving the efficiency of critical administrative tasks in the healthcare sector. This study parallels other healthcare-focused research in its use of Microsoft Visual Studio but is distinct in its specific application to the management of death certificates, a crucial aspect of hospital administration [16]. Wahid (2020) analyzed the Waterfall methodology in the development of information systems, emphasizing a structured and sequential approach to system design. This contrasts with the iterative prototyping method used by Abdussalaam and Oktaviani (2020), reflecting different methodologies suited to different types of projects—where the Waterfall method is ideal for projects with well-defined requirements from the start, while prototyping allows for more flexibility and ongoing adjustments [8][18]. While these studies are aligned in their objective to improve system efficiency and data management through tailored information systems, they diverge in their methodologies, application areas, and specific objectives. From education and aviation to healthcare and finance, each study contributes unique insights into how specialized systems can be effectively designed and implemented to address the distinct needs of various sectors.

5. Conclusion

Based on observations conducted over a two-month period, from February to April, it can be concluded that the birth certificate creation process at Santosa Hospital Bandung Kopo is currently performed manually using Microsoft Excel. Data entry is based on handwritten forms filled out by the patient's family, a method prone to errors due to the potential for illegible or unclear handwriting. This manual process introduces significant risks of data entry mistakes, which could impact the accuracy and reliability of the birth certificates issued. The findings highlight the need for the development of an information system specifically designed for birth certificate creation. Such a system would minimize the occurrence of human errors during data entry and improve the overall efficiency of the process. By automating the process, the proposed system is expected to enhance the speed, accuracy, and convenience of data management for healthcare providers and patients alike. This study emphasizes the importance of implementing a dedicated information system to ensure that the birth certificate creation process at Santosa Hospital Bandung Kopo is both reliable and efficient, ultimately contributing to better healthcare service delivery.

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