Development of Pre-Anesthesia Documentation in Electronic Medical Record Anesthesia (AREME)

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Abstract: Anesthesia Care Nursing Documentation (ASKAN) is a record that contains the actions performed by an anesthesiologist on a patient. In the existing Electronic Medical Record Anesthesia (AREME) application, documentation is limited to intra-anesthesia. This does not align with the guidelines in the Anesthesia Care Nursing Documentation (ASKAN) manual. This study aims to develop the AREME application by adding pre-anesthesia documentation, in accordance with the guidelines outlined in the ASKAN manual. The research method used is Research and Development (R&D) with the Waterfall software development method, which includes the stages of Requirement, Design, Implementation, Verification, and Maintenance. The results of this study produced a new interface and pre-anesthesia documentation in the AREME application, in accordance with the guidelines in the ASKAN manual. System testing was conducted using Black Box Testing with Use Case testing techniques, and the results showed that all system functions operate according to the specified requirements. Therefore, this study successfully developed pre-anesthesia documentation in the web-based Electronic Medical Record Anesthesia (AREME) application.
Keywords: Anesthesia Nursing Care, Development, Documentation, Electronic Medical Record.

INTRODUCTION

Anesthesiology Nursing Care/Anesthesia Care is a series of comprehensive care activities provided to patients during the pre-anesthesia, intra-anesthesia, and post-anesthesia phases [1]. The pre-anesthesia phase is a comprehensive clinical assessment conducted before the administration of anesthesia in patients who will undergo surgical procedures [2]. Complete documentation of the pre-anesthesia assessment is essential for patient safety [3]. Comprehensive documentation also plays an important role in accurate anesthesia planning and improving the quality of clinical services, as well as assisting in planning interventions to prevent complications [4].

Systematic documentation of Anesthesiology Nursing Care includes assessment, identification of problems, interventions, implementation, and evaluation. Documentation of Anesthesiology Nursing Care also forms part of anesthesia healthcare services as a legal aspect for professional responsibility and accountability [1]. In practice, the documentation of anesthesiology nursing care is still commonly performed using conventional methods such as paper and writing tools. Interview results conducted by Abadi et al. (2025) showed that 33% of the reports produced were still incomplete due to the continued use of conventional methods. Recent studies also indicate that Electronic Medical Records are more effective than manual systems in improving the completeness of documentation [6].

The Electronic Medical Record (EMR) system allows healthcare providers to access and update patient information in real time, thereby accelerating the service process and supporting rapid and accurate clinical decision-making [7]. Electronic Medical Records also protect patient data by implementing strong

information security measures [8]. EMR has been recognized as one of the most important technological innovations in modern healthcare services [9]. In anesthesiology nursing, a similar innovation has been developed by Abadi et al. (2025), known as the Anesthesia Electronic Medical Record (AREME).

The Anesthesia Electronic Medical Record (AREME) is an application developed to generate reports for Anesthesiology Nursing Care (ASKAN). This application was designed according to ASKAN documentation standards and aims to assist students in preparing anesthesiology nursing reports more easily. In addition, AREME helps replace the previous manual recording method conducted through handwritten documentation with a more structured and systematic approach. However, the development of the AREME application has so far only focused on the intra-anesthesia phase [5]. This limitation is not fully aligned with anesthesia services, which encompass the pre-anesthesia, intra-anesthesia, and post-anesthesia phases [1].

Therefore, this study proposes an innovation by integrating pre-anesthesia documentation into the AREME application. Pre-anesthesia documentation enables the recording of pre-anesthesia data in a more systematic manner in accordance with anesthesiology nursing services that include pre-anesthesia care. The addition of this feature represents a further development based on recommendations from Abadi et al. (2025), who served as both the researcher and the original developer. This addition is considered important because pre-anesthesia documentation serves as the foundation for planning safe anesthesia and helps mitigate perioperative risks [10].

Pre-anesthesia assessment is a comprehensive medical evaluation conducted before anesthesia procedures to assess the patient's overall health condition. This evaluation is important because it enables the identification of perioperative risks and hidden medical conditions that may not yet be clinically apparent, allowing these risks to be mitigated prior to surgery. Consequently, the pre-anesthesia phase contributes directly to patient safety by optimizing the anesthesia plan based on preoperative clinical findings. Overall, pre-anesthesia assessment helps improve perioperative outcomes and minimize the possibility of complications during and after surgical procedures [11].

Therefore, this study aims to develop and implement a pre-anesthesia documentation feature in the AREME application. With the addition of this feature, it is expected to improve the completeness of anesthesiology nursing care documentation in a more structured manner. The development of this feature also aims to ensure that the documentation aligns with the guidelines provided in the ASKAN handbook. Thus, the AREME application is expected to contribute positively to improving the quality of anesthesiology nursing care documentation.

RESEARCHMETHOD

This study aims to develop the Anesthesia Electronic Medical Record (AREME) application. The development process of the AREME application employed a Research and Development (R&D) approach. Research and Development (R&D) is a process or set of steps undertaken to develop new products or improve existing ones [12]. In the development of the AREME application system, the Waterfall model was adopted as the system development approach. The Waterfall model is a systematic and sequential software development model [13]. In this method, each development phase must be fully completed before proceeding to the next phase [14]. This model consists of several stages, namely requirement, design, implementation, verification, and maintenance [15]. The development stages of the AREME application include the following steps:

1. Requirement (Needs Analysis)
   At this stage, the researchers conducted an in-depth analysis of the current condition of anesthesia documentation and the requirements for developing a new system. Recommendations from previous researchers served as the foundation for the development of the AREME application.
2. Design
   The researchers designed the system that would operate within the AREME application. At this stage, the system design included the development of a Use Case diagram, the design of a new user interface, and the addition of a new database structure.
3. Implementation
   In this stage, the system design was translated into code that could be understood by the machine. The coding process resulted in the creation of software programs or program units that represent the system functionalities.

4. Verification

    During the verification phase, the AREME application was tested using the Black Box testing method. This testing approach focuses on evaluating the system functions based on outputs generated from specific inputs without examining the internal structure or source code of the system [16].

5. Maintenance

    After the AREME application was successfully implemented and operational, the maintenance phase was conducted. This phase includes fixing bugs or errors that were not detected in the previous stages and making minor adjustments when necessary.

RESULTS AND DISCUSSION

Needs Analysis

At this stage, the researchers conducted an analysis to develop the pre-anesthesia documentation feature in the Anesthesia Electronic Medical Record (AREME) application with the aim of improving the completeness of anesthesiology nursing care documentation based on the needs of relevant system users. The results of this system analysis and design covered two main aspects. First, the existing application only accommodated documentation in the intra-anesthesia phase. Second, the analysis incorporated recommendations from previous researchers to complete the documentation across the three phases of anesthesia care, namely pre-anesthesia, intra-anesthesia, and post-anesthesia.

Use Case Diagram Development

A Use Case Diagram is a diagram consisting of actors, use cases, and the relationships between them, which illustrates various scenarios of interaction between users and the system in a software development context [17]. A use case diagram also represents the results of system analysis and design, with the purpose of describing system requirements. These identified requirements are then implemented by users, enabling the overall system design process to be understood comprehensively [18].

The use case diagram is used as a tool to map Use Case Scenarios and serves as the basis for designing test scenarios, so that testing can be carried out in accordance with the functional flow illustrated in the use cases. Testing is conducted based on use case scenarios to validate the application functions according to the requirements defined in the model [19].

The results of the analysis can be seen in the Use Case Diagram of the AREME application shown in Figure 1. The diagram illustrates the interaction between the anesthesia practitioner and the system, in which the anesthesia practitioner, as the user, performs various tasks within the AREME program.
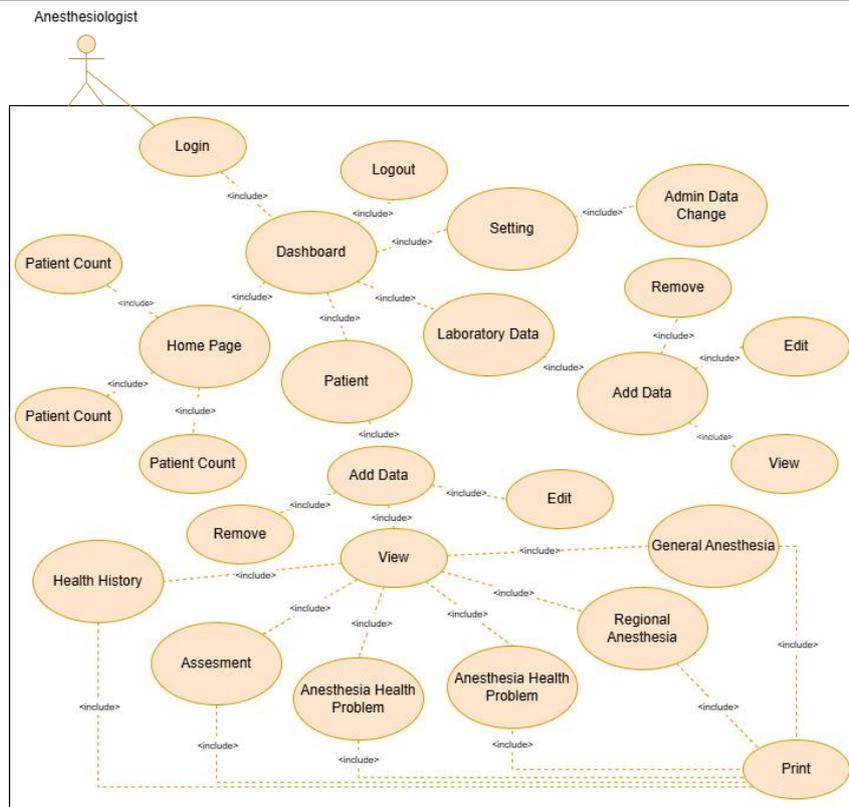
Figure 1. AREME Use Case Diagram

This diagram illustrates the interaction between the user (anesthesia practitioner), which in this context refers to anesthesiology nursing students at Universitas Muhammadiyah Purwokerto. As users, they are able to input patient information data and add medical history, assessments, anesthesia-related health problems, interventions, implementation records, and evaluations of patient care. In addition, users can monitor patients during the intra-anesthesia phase and generate reports of Anesthesiology Nursing Care (ASKAN).

Development of a New Database
The AREME system, which has now incorporated pre-anesthesia documentation, utilizes a MySQL-based database. MySQL, when integrated with PhpMyAdmin as a database management tool, facilitates the creation, modification, and management of database structures efficiently. This integration improves the effectiveness of database administration for AREME users [20].

MySQL is one of the most widely used open-source Relational Database Management Systems (RDBMS) across various industries due to its capability to store, process, and manage large volumes of data with high performance. This capability demonstrates that MySQL is suitable for implementation in the AREME system [21].

The results of implementing the new database within the AREME application are illustrated in Figure 2.
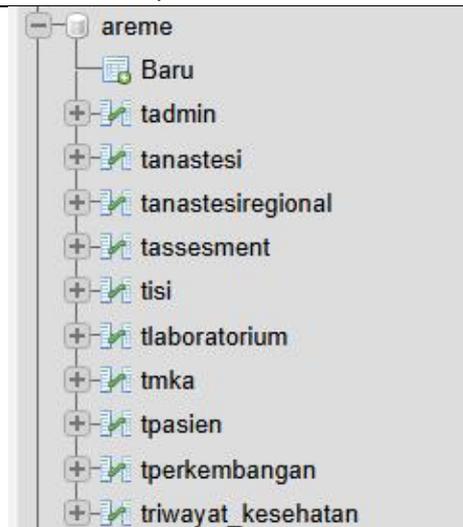
Figure 2. AREME Database

In the implementation of the new database, there are 8 existing tables and 2 newly developed tables. Among the eight tables created by previous researchers, the tadmin table was designed to store user information required to validate access to the application. The tanastesi table is used to store data related to general anesthesia, while the tanastesiregional table stores data related to regional anesthesia. The tisi table functions to monitor patients during the anesthesia process, whereas the tlaboratorium table is used to store patients' laboratory data. The tmka table records patients' health problems that occur during the anesthesia process, and the tpasien table stores patient biodata. Meanwhile, the tperkembangan table is used to record interventions, implementation, and evaluation of anesthesiology nursing care [5].

In addition, two new tables were developed, namely the tassessment table, which is used to store patient assessment data, and the triwayat_kesehatan table, which is used to store patients' medical history.

Application Design
This section describes the results of the additional features and modifications implemented in the AREME application.
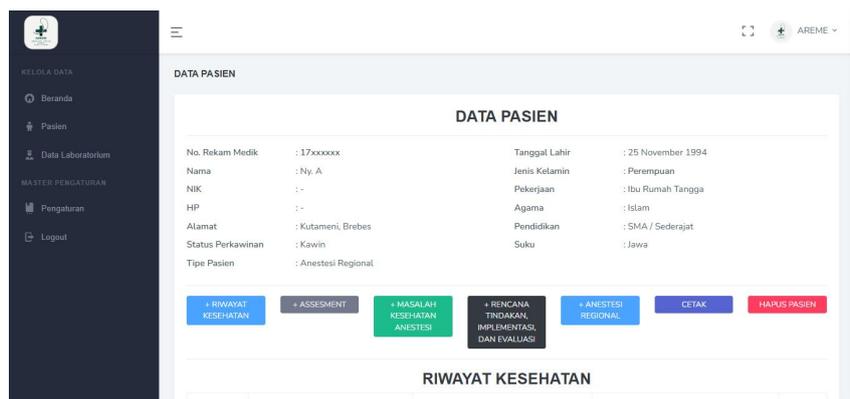

Figure 3. Patient Data Page Interface

Figure 3 shows the patient data page interface. On this page, two new modules have been added, namely medical history documentation and patient assessment, which include data related to the pre-anesthesia phase. Previously, the application did not include these two modules.
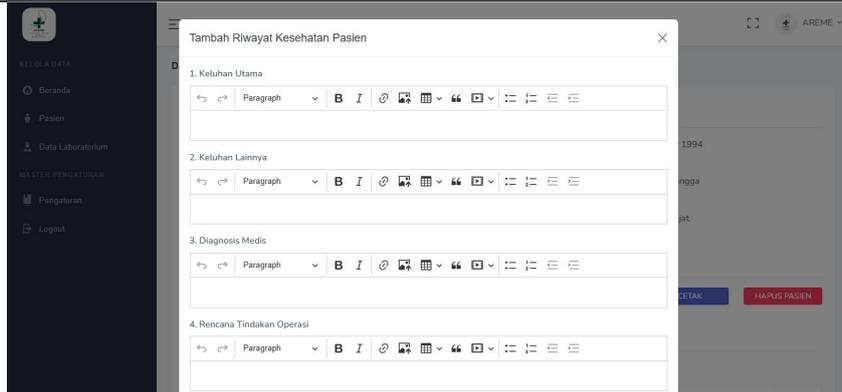
Figure 4. Medical History Table

Figure 4 presents the medical history table interface. This table includes data such as the chief complaint, other complaints, medical diagnosis, planned surgical procedure, and anesthesia-focused data (AMPLE). This page serves as the initial stage for entering patient data at the beginning of anesthesia care services in accordance with ASKAN documentation standards.
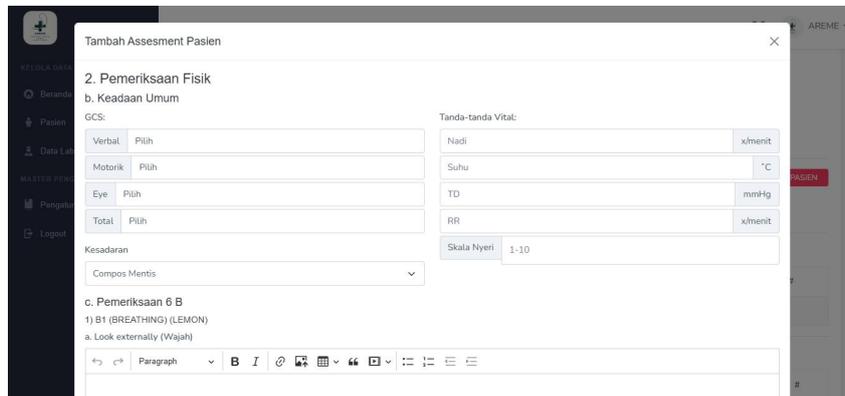

Figure 5. Assessment Table

Figure 5 shows the assessment table interface. This table includes physical examination data such as the Glasgow Coma Scale (GCS) score, the patient's general condition, and vital signs. In addition, the table contains the 6B examination, which includes breathing, blood, brain, bladder, bowel, and bone.

The table also records information regarding current therapy, complicating factors, the ASA physical status classification, and anesthesia considerations in accordance with ASKAN documentation standards.
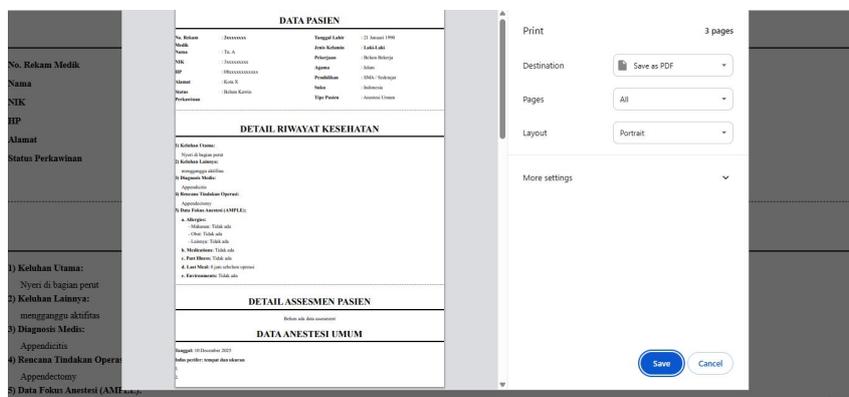

Figure 6. Print Interface in AREME After the Addition of the Pre-Anesthesia Module

Figure 6 shows the print output generated by the AREME documentation program after the addition of the pre-anesthesia module. This page contains the ASKAN documentation generated from the AREME program, including patient medical history data, patient assessment, patient monitoring, anesthesia-related health problems, as well as intervention, implementation, and evaluation records.

Users can also customize the print settings, such as adjusting the paper size, selecting the pages to be printed, and choosing the preferred print layout.

System Testing
The testing of the AREME application shows that the system successfully performs the functions defined during the planning stage. The testing process covered several aspects, including admin login testing, dashboard button functionality, patient data page buttons, medical history input, assessment input, buttons for entering anesthesia-related health problems, input of care plans, implementation and evaluation records, anesthesia data input, print button functionality, and delete button functionality.

Black Box Testing is a software testing technique that focuses on evaluating system functionality based on specified requirements without considering the internal structure or program code logic. This testing is conducted by examining inputs and outputs to ensure that each implemented feature functions according to the predetermined requirements [22].

The AREME application was tested using the black-box testing method with a Use Case testing approach. This testing focused on validating system features, interface navigation, and system outputs in accordance with user expectations [16].

No.	Testing Description	Testing Procedure	Expected Result	Test Result
1	Admin Login Testing	Entering the username and password, then logging in	The system displays the Dashboard page	Valid
2	Dashboard Button Testing	a. Clicking the Home button b. Clicking the Patient button c. Clicking the Laboratory Data button d. Clicking the Settings button e. Clicking the Logout button	a. The function displays the Home page b. The function displays the Add Patient and Patient Data pages c. The function displays the Settings page d. The function returns to the Login page	Valid
3	Patient Data Page Button Testing	a. Testing the Add Patient Data input b. Testing the View, Edit, and Remove buttons	a. The function displays the page for entering patient data b. The function displays, edits, and deletes patient data, and then saves the changes	Valid
4	Medical History Input Testing	Entering the patient's medical history data and then saving it	The save function works successfully, and the entered medical history data is displayed in the Medical History section	Valid
5	Assessment Input Testing	Entering the patient assessment data and then saving it	The save function works successfully, and the entered assessment data is displayed in the Assessment section	Valid
6	Anesthesia-Related Health Problem Input Button Testing	a. Testing the input button and entering pre-anesthesia data, then saving it b. Testing the input button and entering intra-anesthesia data, then saving it c. Testing the input button and entering post-anesthesia data, then saving it	a. The button function displays the input page for anesthesia-related health problems, and the save function successfully displays the entered pre-anesthesia health problem data in the Anesthesia Health Problems section b. The button function displays the input page for anesthesia-related health problems, and the save function successfully displays the entered intra-anesthesia health problem data in the	Valid

No.	Testing Description	Testing Procedure	Expected Result	Test Result
			Anesthesia Health Problems section c. The button function displays the input page for anesthesia-related health problems, and the save function successfully displays the entered post-anesthesia health problem data in the Anesthesia Health Problems section	
7	Care Plan, Implementation, and Evaluation Data Input Testing	Entering the Care Plan, Implementation, and Evaluation data, then saving it	The save function works successfully, and the entered Care Plan, Implementation, and Evaluation data is displayed in the corresponding section	Valid
8	General Anesthesia/Regional Anesthesia Data Input Testing	Entering General Anesthesia/Regional Anesthesia data, then saving it	The save function works successfully, and the entered General Anesthesia/Regional Anesthesia data is displayed in the corresponding section	Valid
9	Print Button Testing	Clicking the Print button	The function displays the print page	Valid
10	Delete Patient Button Testing	Clicking the Delete Patient button	The function displays the delete option	Valid

The results of AREME testing using the Use Case testing technique showed that all 10 test scenarios conducted were valid. These findings indicate that the AREME application, which was developed with the addition of the pre-anesthesia module, successfully passed the validity testing.

CONCLUSION

This study successfully developed the Anesthesia Electronic Medical Record (AREME) application by adding a documentation feature for the pre-anesthesia phase through the medical history and assessment modules. Based on the results of the study, the development of the AREME application demonstrates that the existing documentation has become closer to the ASKAN documentation standards. The application, which previously only recorded data during the intra-anesthesia phase, now also includes documentation for the pre-anesthesia phase. However, several limitations remain, such as the interface design that still requires improvement and the data entry process across all modules that is still performed manually.

These limitations can serve as an evaluation for future application development in order to improve system performance. For future researchers, it is recommended to further develop the application by adding automatic input features, allowing the documentation process to be conducted more quickly and accurately. In addition, it is also recommended to host the application online so that it can be more easily accessed by users.

REFERENCES

[1] I. K. Setiabudi *et al*., *Asuhan Keperawatan Anestesiologi/Asuhan Kepenataan Anestesi (ASKAN)*. Purwokerto, Indonesia, 2023. [Online]. Available: http://eprints.uhb.ac.id/id/eprint/2324

[2] O. B. Omole, M. Torlutter, A. J. Akii, S. Africa, and O. Omole, "Preanaesthetic assessment and management in the context of the district hospital," 2021, pp. 1–7, doi: 10.4102/safp.v63i1.5357.

[3] Y. B. Woldegerima and S. D. Kemal, "Clinical audit on the practice of documentation at preanesthetic evaluation in a specialized university hospital," 2018, pp. 819–824, doi: 10.4103/aer.AER.

[4] A. Mumtaz, R. Zahid, R. Sherazi, N. Aslam, K. Shakoor, and W. B. Waris, "Improving preoperative care in Pakistan: An evaluation of pre-anesthetic record completeness and documentation practices," vol. 17, no. 2, 2025, doi: 10.7759/cureus.79761.

[5]   B. W. Abadi, M. Tania, G. Ching, T. Hardiyani, and R. Annisa, "Pengembangan anestesi rekam medis elektronik (AREME) untuk dokumentasi asuhan keperawatan anestesiologi," vol. 6, no. 2, pp. 126–136, 2025, doi: 10.25047/j-remi.v6i2.5715.

[6]   F. Wurster *et al.*, "Differences in changes of data completeness after the implementation of an electronic medical record in three surgical departments of a German hospital: A longitudinal comparative document analysis," *BMC Medical Informatics and Decision Making*, vol. 24, no. 1, 2024, doi: 10.1186/s12911-024-02667-0.

[7]   D. W. Sutha, L. Masyfufah, E. W. Faida, and T. Wahyuni, "The impact of use of electronic medical records on the quality of health services and patient safety: Review," vol. 3, no. 1, pp. 1–11, 2025.

[8]   D. Puteri, A. Pramesti, D. Ayuningtyas, and R. Verdi, "Keamanan dan kerahasiaan data medis pasien dalam implementasi rekam medis elektronik," vol. 8, pp. 7691–7702, 2024.

[9]   Y. W. Putri *et al.*, "Implementasi dan dampak penggunaan sistem rekam medis elektronik (RME) pada pelayanan kesehatan," vol. 3, no. 4, pp. 255–264, 2024, doi: 10.54259/sehatrakyat.v3i4.3449.

[10] M. G. Taye, E. Fenta, T. Tamire, and Y. Fentie, "Assessment of perioperative anesthesia record sheet completeness: A multi-center observational study," *Annals of Medicine and Surgery*, vol. 79, p. 104103, 2022, doi: 10.1016/j.amsu.2022.104103.

[11] S. S. Maroufi, B. S. Zilan, P. Moradimajd, and J. Abolghasemi, "The importance of pre-anesthetic evaluation in patient safety: A systematic review," *Archives of Anesthesiology and Critical Care*, vol. 10, no. Autumn, pp. 622–630, 2024, doi: 10.18502/aacc.v10is2.17225.

[12] L. Judijanto, M. Muhammadiah, R. N. Utami, and L. Suhirman, *Metodologi Research and Development (Teori dan Penerapan Metodologi RnD)*. Jambi, Indonesia: PT Sonpedia Publishing Indonesia, 2024.

[13] U. Achlison, J. T. Santoso, K. Rozikin, and F. Diapoldo, "Analisis model implementasi tracking pengiriman barang menggunakan Waterfall dan Rapid Application Development," vol. 5, pp. 90–97, 2025.

[14] N. Hidayati, A. Priandi, Y. Sembiring, D. Sirait, and I. Fachry, "Sistem informasi di Apotek Whitney menggunakan metode Waterfall," vol. 7, no. 1, pp. 50–60, 2025.

[15] A. A. Wahid, "Analisis metode Waterfall untuk pengembangan sistem informasi," pp. 1–5, 2020.

[16] Y. D. Cahyono, L. W. Widianti, S. I. Pramuningsih, P. A. Darat, and A. W. Development, "Pengujian black box pada website sistem informasi pengolahan data teritorial menggunakan metode use case testing untuk operasi militer," vol. 9, no. 2, pp. 2250–2256, 2025.

[17] B. Alturas, "Connection between UML use case diagrams and UML class diagrams: A matrix proposal," vol. 72, no. 3, 2023.

[18] S. W. Ramdany, S. A. Kaidar, B. Aguchino, C. Amelia, and A. Putri, "Penerapan UML class diagram dalam perancangan sistem informasi perpustakaan berbasis web," vol. 5, no. 1, 2024.

[19] G. F. Fitriana, "Pengujian aplikasi pengenalan tulisan tangan menggunakan model behaviour use case," vol. 7, no. 2, 2020.

[20] M. C. Wibowo, T. Wijanarko, and A. Putra, "Utilizing phpMyAdmin for system design in enterprise administration," vol. 3, no. 2, pp. 217–234, 2024, doi: 10.51903/jtie.v3i2.193.

[21] I. Šušter and T. Ranisavljević, "Optimization of MySQL database," vol. 11, no. 1, pp. 141–151, 2023.

[22] P. K. Ayuningtyas and P. Rachmadi, "Performance and functional testing with the black box testing method," vol. 39, no. 2, pp. 212–218, 2023.