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SURGICAL EQUIPMENT PREVENTIVE MAINTENANCE INFORMATION SYSTEM

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ABSTRACT

Medical equipment represents a significant investment in healthcare facilities and requires significant maintenance costs. It is crucial for healthcare facilities to have a planned maintenance program to ensure the safety, quality, and usability of medical equipment. Regular maintenance is also expected to extend the lifespan of medical equipment. However, most preventive maintenance planning and reporting is done manually, resulting in suboptimal and ineffective results.

To facilitate these activities, a tool is needed to create a preventive maintenance information system for surgical equipment. First, a database design is prepared, then the information system model is created using Enterprise Architect, using use case diagrams, activity diagrams, and sequence diagrams. The information system is then created using the PHP programming language and a MySQL database.

From the results The purpose of research on Preventive Equipment Maintenance Information Systems is to ensure equipment continues to function properly and reduce the risk of serious damage that can lead to expensive repair costs. Therefore, this equipment maintenance information system is not only about keeping equipment functioning properly; routine maintenance helps extend the life of the equipment and maintain the safety of patients and medical personnel. Keywords: preventive maintenance, real time, Enterprise Architect, information system, modeling

BACKGROUND

Medical equipment, particularly surgical equipment, plays a crucial role in the success of medical procedures. Optimal equipment availability and performance are crucial for patient safety and the smooth running of medical procedures. Therefore, routine and scheduled maintenance of surgical equipment is essential to ensure proper function, reduce the risk of damage, and prevent equipment failure during use.

However, in practice, surgical equipment maintenance is often neglected or only performed after a breakdown occurs, which can disrupt medical services, increase repair costs, and even threaten patient safety. The lack of a structured monitoring system for preventive maintenance is often a major cause of this problem.

While many hospitals and medical facilities have implemented some aspects of Preventive Maintenance (PM) Information Systems, many still rely on manual systems or poorly integrated technologies. Technological advancements, such as the use of IoT, AI, cloud computing, AR/VR, and blockchain, have brought significant advances in improving the efficiency, reliability, and security of surgical equipment PM systems. These advancements have made PM systems more predictive, proactive, and integrated, ultimately leading to improved patient safety and reduced operational costs in hospitals.

With the increasing number and complexity of medical equipment in hospitals, and the need for more efficient and safe healthcare services, a system that supports preventive surgical equipment maintenance management is crucial. Therefore, the development of a Preventive Surgical Equipment Maintenance Information System is highly relevant to addressing these challenges.

METHOD

A Preventive Maintenance (PM) Information System for surgical equipment is a system designed to ensure that medical equipment, particularly surgical equipment, is always in good condition and ready for use during medical procedures. Using a preventive maintenance approach, this system focuses on routine care and maintenance to prevent breakdowns before they occur, reduce downtime, and improve equipment reliability.

Several methods can be applied in developing and implementing a Preventive Maintenance Information System for surgical equipment by mapping equipment needs, scheduling preventive maintenance, data collection and analysis, condition-based maintenance, documentation and reporting, cloud-based maintenance management system, HR training and management, collaboration with vendors and service providers, evaluation and continuous improvement as well as security and compliance.

RESULTS AND DISCUSSION

The surgical anesthesia equipment maintenance information system that has been designed and prepared includes a system to facilitate the entry of medical equipment data:

1. Login page

On this page, users are asked to enter their registered username and password, verified by the system. This page is a crucial part of the digital system, ensuring the security and privacy of user data. The login page is shown in the image below:

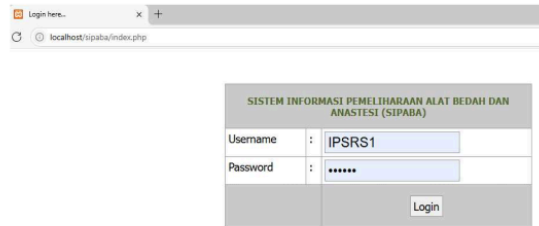
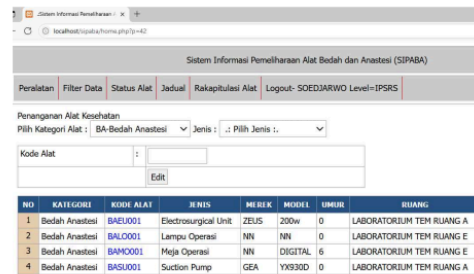


Figure 1. Login page

2. Registration of equipment for maintenance process by electromedical technicians

This refers to the process of recording and recording medical devices that will be maintained, including detailed information about the device, including the category, device code, device type, brand, and location. Registration is important to keep device data well-managed and facilitate tracking of maintenance history. The next step is to select the device code and the handling status "MAINTENANCE". First, select the device code that matches the device type, then in the handling status menu select the option "MAINTENANCE", this indicates that the device is undergoing maintenance. The display looks like the image below:



NO	KATEGORI	KODE ALAT	JENIS	MERK	MODEL	UMUR	RUANG
1	Bedah Anestesi	BAEL001	Electrosurgical Unit	ZELUS	200w	0	LABORATORIUM TEM RUANG A
2	Bedah Anestesi	BAL0001	Lampu Operasi	NN	NN	0	LABORATORIUM TEM RUANG E
3	Bedah Anestesi	BAM0001	Meja Operasi	NN	DIGITAL	6	LABORATORIUM TEM RUANG E
4	Bedah Anestesi	BASU001	Suction Pump	GEA	Y930D	0	LABORATORIUM TEM RUANG A

Figure 2. Tool registration for maintenance process

Sistem Informasi Pemeliharaan Alat Bedah dan Anestesi (SIPABA)

Perawatan | Filter Data | Status Alat | Judul | Rakapitulasi Alat | Logout: SOEDJARWO Level=IPSR

Penanganan Alat

Kode Alat : BAEU001
 Nama Alat : Electrosurgical Unit
 Merek Alat : ZEUS
 Model Alat : 200w
 Ruang : LABORATORIUM TEM RIJAU
 Tanggal Update : 2025-07-07
 Status Alat : PEMELIHARAAN
 PERBAIKAN
 KALIBRASI

Simpan

Figure 3. Tool code selection

3. Equipment Maintenance List

In order to carry out maintenance, the previously registered tool will be entered into the tool maintenance list. Select or type the tool code for which the maintenance process will be carried out.

Sistem Informasi Pemeliharaan Alat Bedah dan Anestesi (SIPABA)

Perawatan | Filter Data | Status Alat | Judul | Rakapitulasi Alat | Logout: SOEDJARWO Level=IPSR

Status Pemeliharaan Alat

Kode Alat :
 Input

Tampilkan Data Pemeliharaan Alat

NOMOR	KODE ALAT	NAMA ALAT	MERK	MODEL	TGL BELI	NAMA RUANG	TANGGAL	KET
1	BAL002	Lampu Operasi	SERENITY	LED30M	2025-06-20	LABORATORIUM TEM RIJANG A	20-06-2025	
2	BAN002	Meja Operasi	SGA	Universal Manual 3000-A	2025-06-20	LABORATORIUM TEM RIJANG A	20-06-2025	
3	BAEU001	Electrosurgical Unit	ZEUS	200w	2025-06-20	LABORATORIUM TEM RIJANG A	07-07-2025	

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Figure 4. Equipment Maintenance Status

4. Fill in Planned Preventive Maintenance

A proactive maintenance strategy to prevent equipment or machinery breakdowns by performing scheduled inspections, servicing, and repairs. The goal is to ensure equipment is functioning properly and avoid unexpected breakdowns and costly repairs.

Sistem Informasi Pemeliharaan Alat Bedah dan Anestesi (SIPABA)

Perawatan | Filter Data | Status Alat | Judul | Rakapitulasi Alat | Logout: SOEDJARWO Level=IPSR

PLANNED PREVENTIVE MAINTENANCE

Nama Alat : Electrosurgical Unit | Kode Alat : BAEU001
 Merek Alat : ZEUS | No Inventaris : rset24BAEU
 Model Alat : 200w | Ruang : LABORATORIUM TEM RIJANG A
 Tanggal Masuk : 2025-07-07 | Periode Pemeliharaan : 2 Bulan
 Tanggal Selesai : 2025-07-07 | Status : PEMELIHARAAN
 SELESAI

CHECK LIST

A. VISUAL CHECK

1. Cek kondisi fisik alat dari kerusakan OK Not OK
 2. Cek kabel power dan koneksi OK Not OK
 3. Cek tombol on-off dan fuse power OK Not OK
 4. Cek semua accessories dalam kondisi baik OK Not OK

B. SAFETY CHECK

1. Cek tabaran ground dan koneksi elektrik lain	<input type="radio"/> OK <input type="radio"/> Not OK
2. Cek kebocoran arus ground pada kondisi normal	<input type="radio"/> OK <input type="radio"/> Not OK
C. MAINTENANCE	
1. Bersihkan unit dari kotoran	<input type="radio"/> OK <input type="radio"/> Not OK
2. Test fungsi elektroda	<input type="radio"/> OK <input type="radio"/> Not OK
3. Test fungsi elektroda Pasive	<input type="radio"/> OK <input type="radio"/> Not OK
4. Test fungsi mode operasi CJIT	<input type="radio"/> OK <input type="radio"/> Not OK
5. Test fungsi mode operasi COAGULATE	<input type="radio"/> OK <input type="radio"/> Not OK
6. Uji fungsi alat	<input type="radio"/> OK <input type="radio"/> Not OK
D. MEASURE STEP	
1. Main Voltage (220+/-10%) Volt	<input type="text"/>
2. Power (VA)	<input type="text"/>
3. Ground Leakage Current (<=500 mikro Ampere)	<input type="text"/>
4. Single fault condition (Open feed line) <=1000 mikro ampere	<input type="text"/>
5. Insulated Resistance between line conductor to ground (>=2 MOhm)	<input type="text"/>
6. Ground Resistance (<=0.2 Ohm)	<input type="text"/>
E. RECOMMENDATION	
Peralatan tidak memiliki masalah. Hasil uji keamanan menunjukkan ada penyimpangan dari nilai referensi yang dibuktikan.	<input type="radio"/>
Peralatan memiliki masalah kecil yang melakukan membuat penggunaannya. Namun mereka harus diperbaiki sebagai tindakan pencegahan. Hasil uji keamanan menunjukkan ada penyimpangan dari nilai referensi yang dibuktikan.	<input type="radio"/>
Peralatan memiliki masalah besar. Untuk alasan keamanan, peralatan tersebut tidak dapat digunakan sampai masalah telah diatasi.	<input type="radio"/>
<input type="button" value="Simpan"/>	

Figure 5. Planned Preventive Maintenance

- If the Planned Preventive Maintenance sheet is still incomplete (continuing), the electromedical technician must select MAINTENANCE in the status field. If it is already complete (not continuing), select COMPLETE. The entry history will be automatically saved.
- If you want to see the history of Planned Preventive Maintenance implementation, you can select the Tool Recapitulation menu, select Tool History then select the tool code you want to display.

Figure 7. Tool history list

- Select the maintenance history number and the details of the Planned Preventive Maintenance will be displayed.

Figure 8. Equipment maintenance history list

The purpose of research on Preventive Equipment Maintenance Information Systems is to ensure equipment continues to function properly and reduce the risk of serious damage that can lead to expensive repair costs. Therefore, this equipment maintenance information system is not only about keeping equipment functioning properly; routine maintenance helps extend the life of the equipment and maintain the safety of patients and medical personnel.

CONCLUSION AND SUGGESTION

Conclusion

A medical device maintenance information system is a crucial component of modern healthcare facility management. This system makes medical device management more structured, efficient, and transparent. This ultimately improves the quality of healthcare services, costs, and patient safety. This system also makes it easier to ensure the availability and address issues with medical devices.

Suggestion

It is hoped that future researchers will be able to conduct more extensive research by adding an online system and providing notifications to remind users of upcoming maintenance schedules.

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