

Computerized Medical Device Management System

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Abstract— This research aims to design and create a computerized medical device management system (CMDMS) which based on the principle of computerized maintenance management system (CMMS) This system operated by web application and database system on the server as well as management system maintenance of medical devices in the hospital. The design and construction of CMDMS composed of 3 main parts: 1) preventive maintenance (PM) system 2) corrective maintenance (CM) system and 3) pooling system. Recently This system has implemented at Pathum Thani hospital. The system tests found that it works perfectly according to the primary purpose of every user’s aspects.

Keywords—Maintenance; Medical Equipment; CMDMS; PM; CM; CMMS

I. INTRODUCTION

Many hospitals in Thailand are facing the difficulties of medical device management because of the numbers of medical devices and the lack of biomedical engineers who take responsibility on this task. This problem can reach to the quality of diagnosis and treatment which affect to patients. For this reason, the smart system of CMDMS has been developed to solve the problem by using the computer based and IT knowledges. Basically, the CMDMS composed of aspects the PM, CM and pooling system. Moreover, this system can generate automatic reports according to JCI requirement, HA standard or others. [2]

II. CMMS

Computerized Maintenance Management Systems (CMMS) are vital for the coordination of all activities related to the availability, productivity and maintainability of complex systems. Modern computational facilities have offered a dramatic scope for improved effectiveness and efficiency in, for example, maintenance. Computerized maintenance management systems (CMMS) have existed, in one form or another, for several decades. [1]

The benefits of CMMS are resources control, cost management, scheduling, integration and reduction of breakdowns.

Nowadays, the CMMS applications can make decision and analyze the maintenance data such as downtime and frequency of failures. The Decision-Making Grid (DMG) then proposes different maintenance policies based on the state in the grid. Each system in the grid is further analyzed in terms of

prioritizations and characterization of different failure types and main contributing components. The maintenance system based on decision making grid process is shown in Fig.1

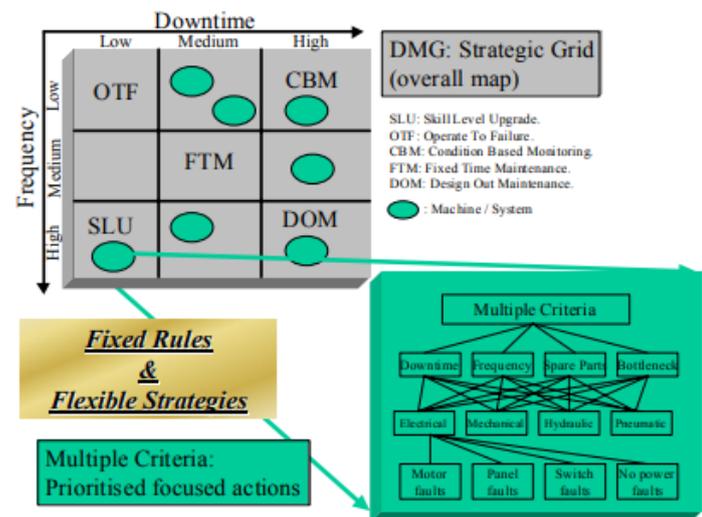


Fig. 1 Decision analysis maintenance system or Decision-making grid (DMG) process [1]

III. CMDMS

For medical devices management, we focus on the maintenance schedules of medical devices which confirms that all devices work correctly and effectively. Computerized medical device management system (CMDMS) from CMMS for using in medical devices management has been developed which purpose to confirm the effectiveness and efficiency of medical devices usage.

Basically, CMDMS consists of two categories. The first is medical device management and the second one is personal management. In medical management part consist of medical device registration system, preventive maintenance (PM), corrective maintenance (CM), pooling system and medical device disposal.

While the personal management system consists of personal work load and working performance measurement for biomedical engineer. Both parts of CMDMS is demonstrated in Fig 2. The main page of this CMDMS is in Fig 3.

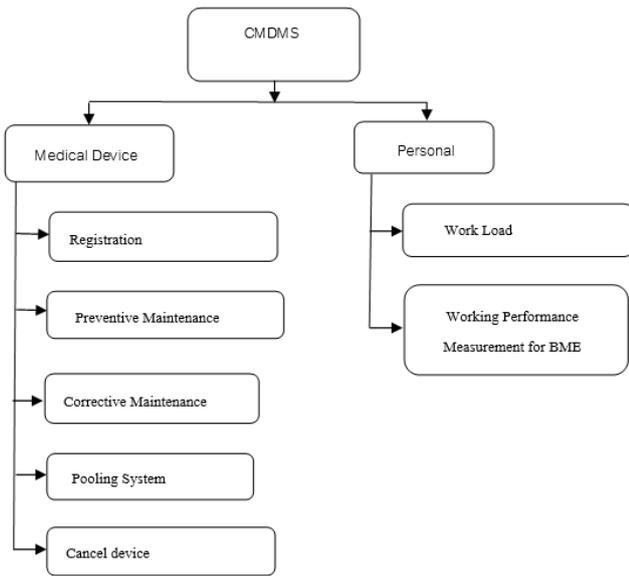
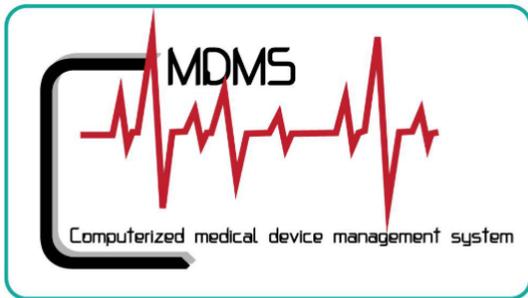


Fig. 2 CMDMS algorithm



| คู่มือการใช้งาน | คณะวิศวกรรมชีวการแพทย์ | มหาวิทยาลัยศรีรังสิต |

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พบปัญหาเกี่ยวกับการใช้งานกรุณาติดต่อ คณะวิศวกรรมชีวการแพทย์

Fig. 3 The main page of CMDMS

A. Registration

This function is used for registration of new medical devices in to the CMDMS. The format of recording data was designed based on JCI standard and ECRI provision [3]. The registration page of this system as shown in Fig.4 such as standard name, medical device id, risk level and other data.

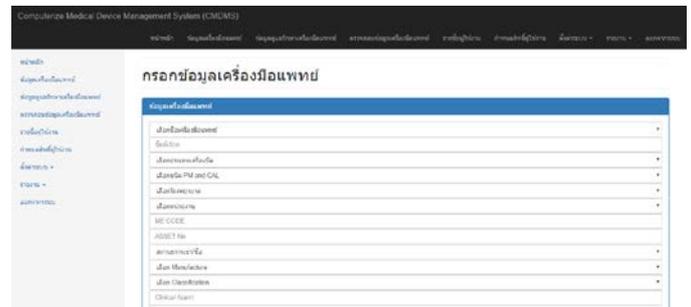


Fig. 4 CMDMS Registration page

B. Preventive Maintenance

Preventive maintenance (PM) is the strategy for medical devices failure prevention. Regularly, medical devices have different periods of PM which depend on types and risk levels. In this system, the preventive maintenance was designed in the planning and scheduling of PM on as shown in Fig 5 and 6.

Moreover, in this page can demonstrate the medical status in term of "PASS" or "FAIL" by using the decision-making system.

อุปกรณ์	PM No.	สถานะ	วันที่เริ่มดำเนินการ	ECRI No.	วันที่เริ่ม PM	กำหนดการ PM	แจ้งเตือน PM
Start	2802	2802					12-04-2019
อุปกรณ์เดิม	2884	2801					12-04-2019
อุปกรณ์เดิม	2880	2808					12-04-2019
อุปกรณ์เดิม	2875	2819					12-04-2019
อุปกรณ์เดิม	2878	2808					12-04-2019
PM and OIL	2877	2807					12-04-2019
อุปกรณ์	2876	2816					12-04-2019
อุปกรณ์	2875	2816					12-04-2019
อุปกรณ์	2874	2814					12-04-2019
อุปกรณ์	2873	2813					12-04-2019
อุปกรณ์	2872	2812					12-04-2019

Fig. 5 The planning and scheduling page of CMDMS

กรอกข้อมูล Preventive Maintenance Action Report (Physiological Monitor)

Safety Analyzer
 Safety Analyzer
 Pulse Oximeter Analyzer
 Pulse Oximeter Analyzer
 EKG Simulator
 EKG Simulator
 MRP Simulator
 MRP Simulator
 Pass Fail CheckProving (นิ้ว)
 Pass Fail MountFastener (นิ้ว)
 Pass Fail Cables/Straps (จุดเชื่อมต่อ)
 Pass Fail AC Plug (ปลั๊กไฟ)
 Pass Fail Lim Cord (สายไฟ)
 Pass Fail Strap Relief (สายรัด)
 Pass Fail Circuit Breaker/Fuse (เบรกเกอร์/ฟิวส์)
 Pass Fail Tubes/Process/Probe (สาย/ท่อ/โพรบ)
 Pass Fail Labeling (ฉลาก)
 Pass Fail Transducer (หัววัด)
 Pass Fail Control Switch (สวิตช์)

Fig. 6 The checklist for PM of CMDMS

C. Corrective Maintenance

The Corrective Maintenance (CM) is any maintenance which performed due to a breakdown of equipment. The CM steps start from identify, isolate and rectify a failure, respectively. Then, the fixed equipment, machine or system can restore to an operational condition within the tolerances or some limits some in-service operations. [4]

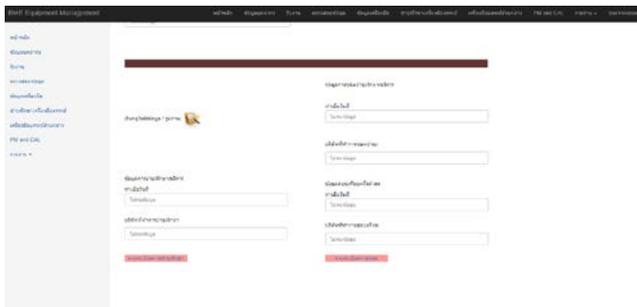


Fig. 7 The page of CM form

D. Pooling system

Pooling system is the medical device management, that other departments can borrow the devices from central one. Recently, big hospitals in Thailand establish this system because of the numbers of expensive medical devices. Normally, it demonstrates of the borrowing and returning status of medical devices as shown in Fig 8.

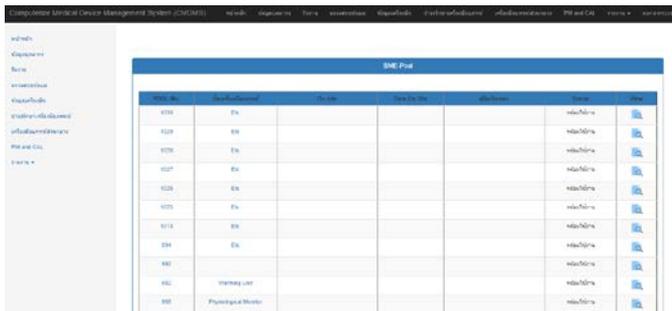


Fig. 8 CMDMS Pooling system page

E. Disposal

This function is used for the medical device's expiration. In our CMDMS, we change the status of expired devices in to "disposal" status. However, the data of each devices still be recorded in this system for the future data analysis.

F. Work load

In case of working including PM and CM, user prefers to know how many works that is on operation. Also, the length of working time for calculating the key performance indicator (KPI) score. In CMDMS that we developed, the KPIs are automatically calculated and demonstrate on the work load page as in Fig. 9

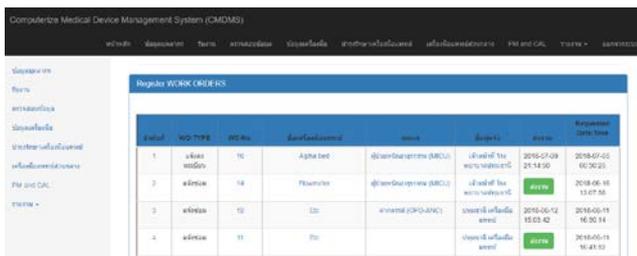


Fig. 9 CMDMS Work load page

IV. SYSTEM ARCHITECTURE

All functions in CMDMS that we previously described are synchronizing work based on web application. PHP language and MySQL database were used to develop the system. User can easily use computer, laptop or mobile phone which can access internet. This system can be operated on widows, Linux, IOS as well as android. The system architecture of CMDMS is demonstrated in Fig 10.

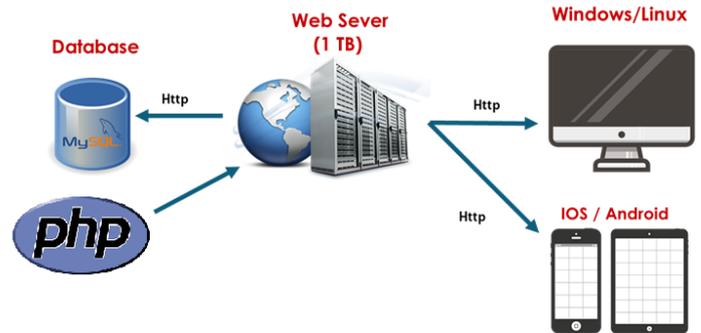


Fig. 10 CMDMS System Architecture

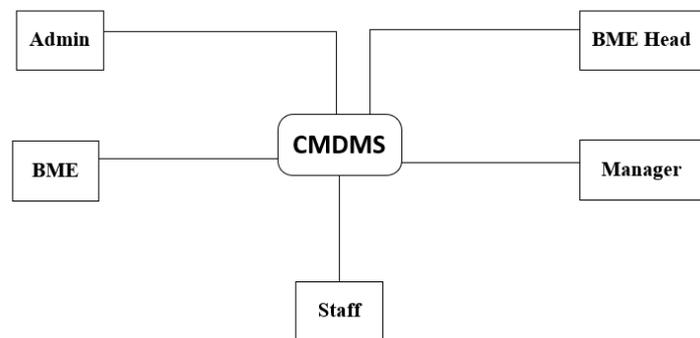


Fig. 11 CMDMS User level design

The CMDMS assessment can be categorized in 5 levels which are admin, head of biomedical engineering (BME head), biomedical engineer (BME), staff and manager as shown in fig 11.

V. DISCUSSION

This development system, CMDMS, is an adaption of CMMS which specifically used for medical devices management. Previous system which established at Srisawan hospital [2] is only having PM function module. However, the users required more functional uses such as CM and pooling that we added. In the new version of CMDMS.

VI. CONCLUSION

Medical devices management system directly affects to patients for having good quality of healthcare including diagnosis and treatment. In this work, we develop an effective management system, CMDMS to support devices, workload

and KPI calculation. Staff in term of PM, CM, pooling, disposal. This system is recently operated at Patumthani Hospital. The feedback of satisfaction from the operating staff is 4.8 from 5 which indicator the system effectiveness.

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