

The Development of A Hospital Risk Management Information System: A Case Study of Somdet Phra Sangkharat (Watsana Maha Thera) Hospital

Alisa Poldach, M.L. Kulthon Kasemsan

College of Information and Communication Technology, Rangsit University, Pathumthani, Thailand

Abstract

This research aims to develop and improve the information system used for risk management in hospitals. The researcher recognizes common problems in the existing system. It is not user-friendly, flexible, and also causes errors in actual usages. For example, if there are mistakes in the recorded data, no corrections can be done. The only way is to make a new record, which causes data redundancy and overestimation of the risks. Additionally, publishing reports is ineffective; it cannot satisfy the needs of its users, and it is difficult to make adjustments to the existing system. Therefore, this research will provide a possible solution to improve the information system used for risk management in hospitals through the application of web applications. The development will be done using the data from the existing system, adjusted according to the standard specified by The Healthcare Accreditation Institute

(Public Organization). It will create a new standard for other healthcare institutes to follow. The system will allow users to publish reports with multiple templates; It is suitable for risk management in hospitals to provide data for planning and decision making, to make adjustments in risk management strategy effectively, and to promptly find solutions should any trouble arises. The system will be developed using Yii2 Framework on MVC architecture since it allows further improvements easier. It will also utilize database in the form of MySQL, which is most widely used among healthcare institutes.

Keywords: Yii2, MVC, web application, hospital, risk management

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Introduction

Hospitals both in public and private sectors have been trying to improve the quality of their service. This is influenced by many factors. For example, the provisions of 2007 Constitution of Thailand, Article 80, which emphasizes on standardized services. The expectation of clients to receive better services from hospitals is reflected through various sources of data. For instant,

complaints filed to the Prime Minister, Deputy Prime Minister, and Minister of the Prime Minister's Office through the 1111, a system that receives and manages complaints. This includes 1) 1111 Hotline 2) P.O. Box/Postal service/Fax 3) Website www.1111.go.th 4) 1111 Service Center.¹ As for the Ministry of Public Health, issues with most complaints filed are: 1) the service of medical staff. Mostly, the clients demand an improvement in service quality. 2) The service system of hospitals and medical treatment. Most of the clients call for an improvement in service quality of the hospitals. Therefore, hospitals should use risk management to guarantee their

Correspondence: Alisa Poldach, College of Information and Communication Technology, Rangsit University, PathumThani, Thailand (Tel.: +66-2997-2200; E-mail address: iamaliz@gmail.com).

service quality and reduce conflicts and complaints about the quality of medical care they provided. This will ensure the safety of both clients and service providers. The Healthcare Accreditation Institute (Public Organization) has ranked risk management as a high priority in issues that need to be raised and discussed among medical staff, and set the Risk, Safety, and Quality Management as follows²:



Figure 1 Risk, Safety, and Quality Management

1. Effectively coordinate risk management-related systems, integrating information system for risk management.

2. Actively search and evaluate clinical and general risks in every organization of every levels, ranking them according to their importance. This is to set safety goals and measures to protect patients or clients who have suffered adverse events caused by patient care process.

3. Set preventive measures and methods. Communicate and educate to encourage successful practice

4. Establish an effective accident and near-miss reporting system. Analyze the data and use them to evaluate, improve, learn, and plan.

5. Analyze the root cause to discover the systematic issue behind it and find appropriate solutions.

6. Constantly evaluate the effectiveness of risk management to further improve it.

A research on risk management of Healthcare Accreditation Institute and an interview with the manager of the risk management team of the hospital

indicate that the current risk management program is not user-friendly. The program sometimes becomes unusable. Recorded data are lost. Also, when there is an error in input, the user cannot edit it. The only solution is to create a new entry, which causes data redundancy, and the system displays more risks than there actually is. Moreover, the user cannot set classification levels or put together a quality team. There are delays in the process of searching and managing. One of the biggest problems of the program is its report publishing function is still incomplete. It cannot satisfy the need of its users, and needs to be improved before actual use. The old program does not allow users to easily edit the details of the risk according to the standards set by Healthcare Accreditation Institute or even make simple changes. Therefore, the researcher would like to develop information system for risk management in hospitals using web application to solve current issues and also to ensure that the program is more user-friendly and supported by more devices. The development will utilize the data in the old system, adapted according to the standards set by Healthcare Accreditation Institute. This will create a new standard, which can be used by other hospitals under the data conditions of Healthcare Accreditation Institute, for the best benefits of the users. It will also present a new way to use the system to improve the service quality of hospitals according the quality evaluation done by Healthcare Accreditation Institute.

Literature reviews

Risk Management in Hospitals

A risk³ is a chance to encounter a loss or an adverse effect. An adverse effect in hospitals could be danger or injury to body and mind, mishap, threatening situation, uncertainty, and leak of classified information. The effect could be physical, emotional, social, or mental in nature. Risk management is therefore necessary to identify, prevent, and eliminate risks, danger and loss that might occur. The hospital should also raise awareness in those involved and create a culture of safety to make hospitals a safe place for its patients and their relatives

and its staff. It should monitor, search, and set measures for the prevention and control of risks, and effectively handle any risk that has occurred.

Risks in hospital can be divided into 2 categories and various levels of severity, as follows (Table 1 and 2)

Table 1 Levels of severity of clinical risks

Priority Level	Severity
1 (Near-miss)	Level A - an incident that has not occurred, but might occur, and has not affected the clients. Level B - an incident that has occurred, but has not affected the clients.
2 (Low severity)	Level C - an incident that has occurred and affected the clients, but has not put them in danger. Level D - an incident that has occurred and affected the clients, where the clients are not in danger but the situation requires additional monitoring.
3 (High severity)	Level E - an incident that has affected the clients, causing temporary danger or requiring medical care. Level F - an incident that has affected the clients, causing temporary danger and requiring additional medical care or additional recovery in a hospital.
4 (Very high severity)	Level G - an incident that has affected the clients, causing permanent danger or rendering them disabled. Level H - an incident that has endangered the clients, nearly causing death and requiring resuscitation. Level I - an incident that has endangered the clients, causing death or is the cause of death, or damages to the organization and leads to legal proceedings.

Table 2 Levels of severity of general risks

Priority Level	Severity
1 (Near-miss)	An incident that has not occurred, but could occur, and has not affected the clients or organization
2 (Low severity)	An incident that has occurred, but has not put the clients or organization in danger.
3 (High severity)	An incident that has affected the clients or organization, causing temporary danger, or damages of between 1,000 Baht to 10,000 Baht.
4 (Very high severity)	An incident that has caused temporary danger/damage to the clients or organization, affecting its creditability, image, reputation, assets, and calls for legal proceedings, or damages of 10,001 Baht and up.

Risk Evaluation

Risk evaluation⁴ can be divided into 4 levels. There are a total of 16 points of Level of Risk, using the results from possibility and effects

evaluation to create a Risk Assessment Matrix for the managers and the organization to see the risk dispersion more clearly (Table 3).

Table 3 Map of Risk Evaluation

Risk Assessment Matrix Chance of occurring	score	Effects of severity			
		1	2	3	4
Low/Every 2-5 years	1	1	2	3	4
Medium/Every year	2	2	4	6	8
High/Every month	3	3	6	9	12
Very high/Every day	4	4	8	12	16

From the Map of Risk Evaluation, we can use the list of each risk ranking to analyze and compare

the capacity to accept risks and find an effective way to manage them (Table 4).

Table 4 Risk management according to risk ranking.

Risk Ranking	Score Ranking	Color	Meaning
Near miss	1-2	Green	Acceptable without risk control and requires no additional management.
Low severity	3-4	Yellow	Reasonably acceptable, but requires monitoring to ensure it will not escalate.
High severity	5-8	Orange	Unacceptable. Must be controlled and managed to a more acceptable level.
Very high severity	9-16	Red	Unacceptable. Must be managed and controlled to a more acceptable level immediately.

System analysis and design

For the architecture of designing and developing the information system for risk management in hospitals, this research will be using MVC⁵ architecture, which is a popular design pattern for designing and applying to web application. MVC will adapt according to the Roles of Objects, which can be divided into 3 roles:

Model - represents the data to change it into an object and manage it

View - displays results through web browsers, also known as User Interface.

Controller - receives orders and call other objects to work together and defines work paths of those orders.

Structure Design

1) Yii2 Framework⁶ or Yii PHP Framework Version 2 is an open source software that can be used to create web application for PHP5-supported websites, and allows users to write web applications quickly. In most cases, it will be designed using MVC architecture, which is the accepted architectural pattern used in software engineering. MVC is used to divide software and separate Domain logic, i.e. user's understanding of the system and GUI used in development, testing, and software maintenance from each other.

From this research, Yii2 Framework to design the structure since it is convenient for further development,

and also because it can be used, studied, improved, and published with no costs.

2) MySQL⁷ is a Database Management System that stores data to be used in data collection from the work system that the programmer has created through SQL language. MySQL will act as the middleman between the users and the data base. MySQL is a Database Management System (DBMS) for relational database. We can interact with MySQL by writing programs in languages such as PHP, Perl, Java, C#, C, Ruby and C++.

From the research, the researcher decides to use MySQL for database management to ensure the database is compatible with most databases used in most hospitals within the public health system.

3) Responsive Design⁸ is designing a web page to display appropriately for current devices which has different display resolutions. For example, computers, mobile phones, and tablets.

System Analysis

The researcher has chosen UML technique for analysis, which mainly includes the following:

Risk management layout for hospitals

From Figure 2, this layout shows the process in risk management for hospitals. When there is a risk, incident, or complaint, the staff who encountered it would provide an elementary solution and record the risk data in the program, or write an incident report (IR) for their superiors. Then, they would evaluate the severity of the risk and plan a solution, and also find a way to prevent and inform to risk managers in hospitals. After that, they would coordinate with a quality team and the organization where the risk has occurred to help plan systematic risk solution. A risk management team would evaluate, follow up, and analyze the results of the risk management to inform the director board or managing team of the hospitals to plan the management/prevention of possible risks. The duration of the reporting and working on risk will depend on the severity of the risk that occurred.

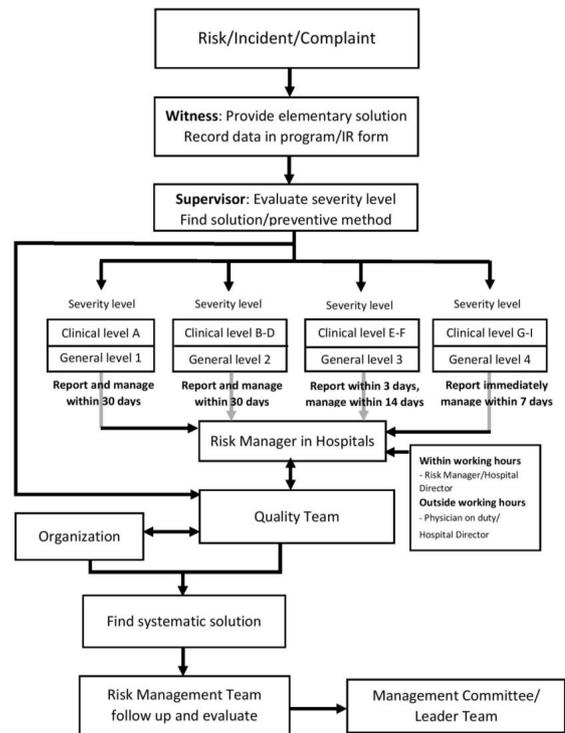


Figure 2 Risk management layouts for hospitals

Use Case Diagram

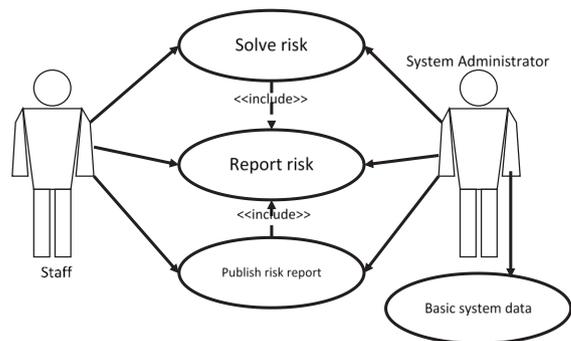


Figure 3 Use Case Diagrams

The development of information system to manage risks in this hospital consists of 4 main parts, which are: risk reporting system, risk solving system, risk report publishing system, and basic data management system. It also consists of 2 groups factors: hospital staff (hospital director, risk manager, head of department, and common staff) and system manager.

Results

We have developed an information system to manage risks in hospitals using web application to display user interface in each page, as follows (Figure 4)

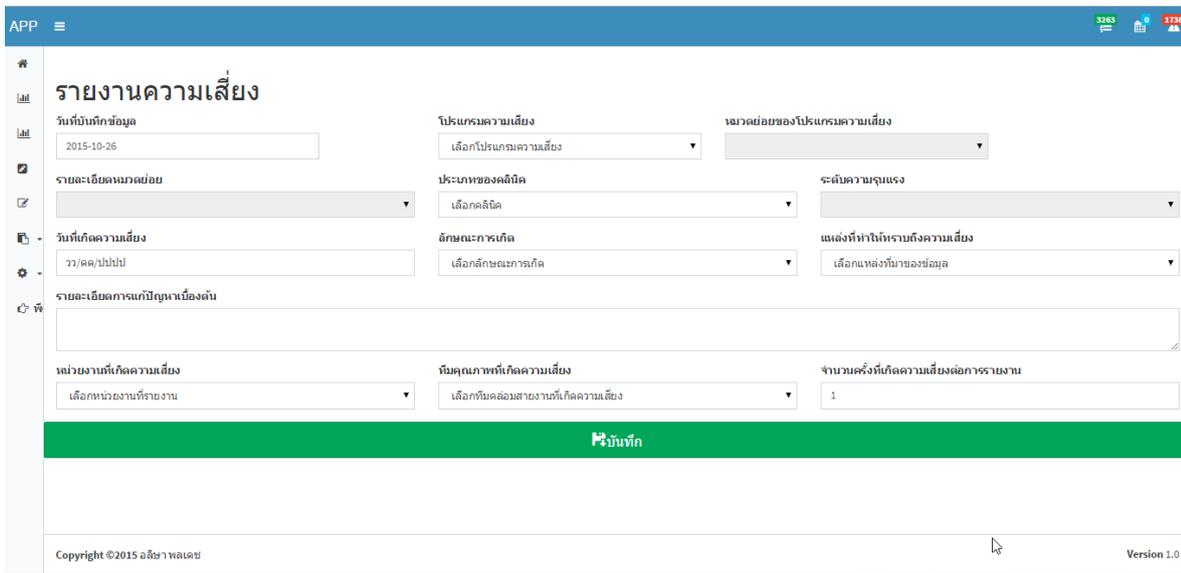


Figure 4 Risk management page

This is the page where the staff in the incident recording the data. If not every data field is chosen/filled, the data cannot be recorded (Figure 5). The staff must choose/fill every data field before

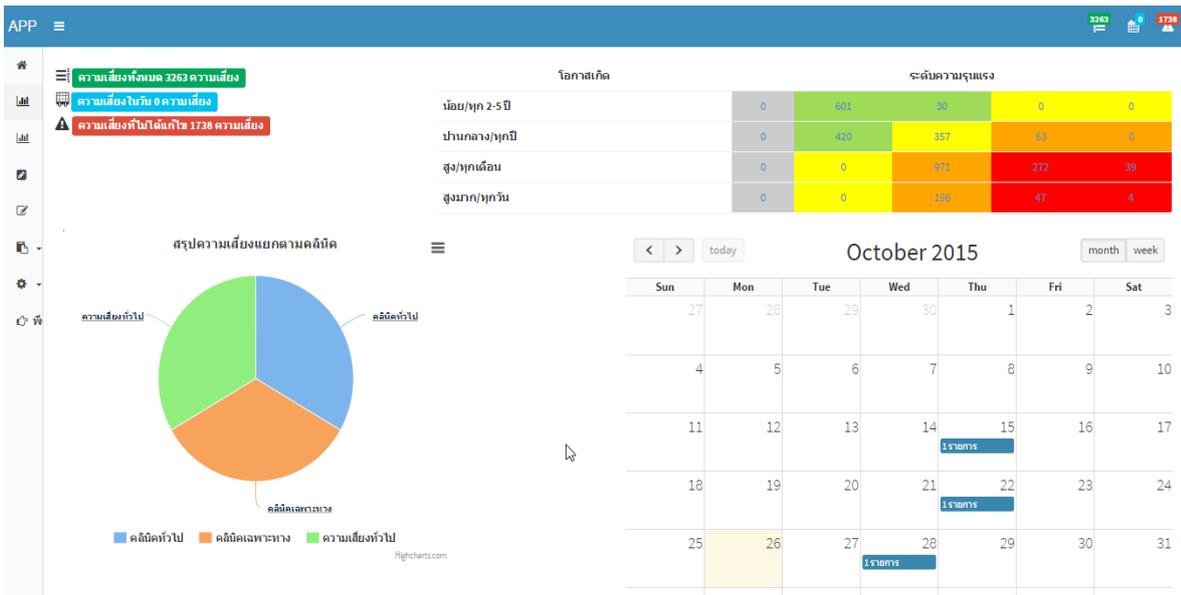


Figure 5 Risk dispersion reports page

This page shows the number of risks, which includes Risk Assessment Matrix that shows the total number of risks for the hospital. Users can click to view the details of different levels of severity, the risks that occur each day are displayed in a calendar that can be clicked to browse details for the selected date, and

conclude the number of risks categorized by their type in a pie chart. This is a page that displays the summary of number of risks. It will display all of the risks, both resolved and unresolved. The report can be exported in multiple formats. For example, excel and PDF (Figures 6-8).

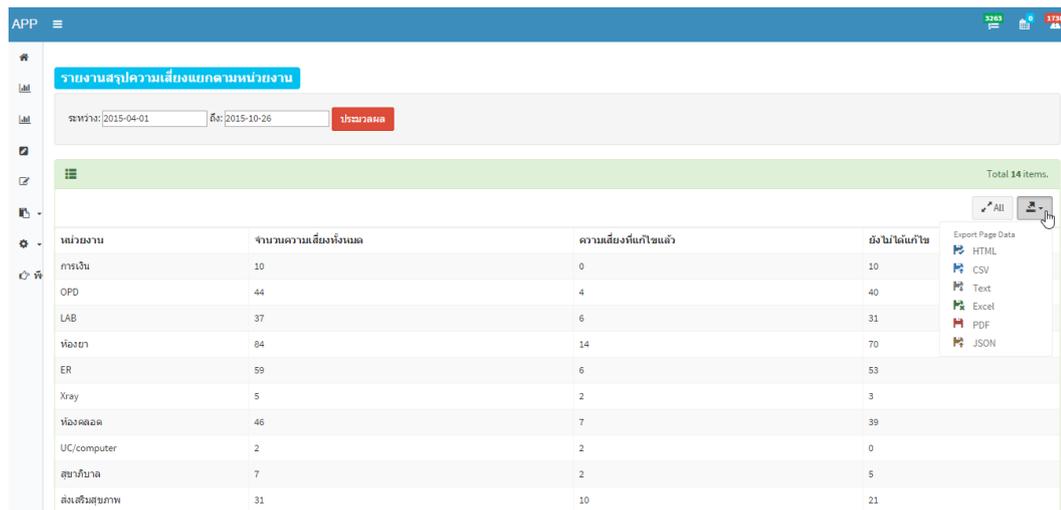


Figure 6 Number of risks summary page

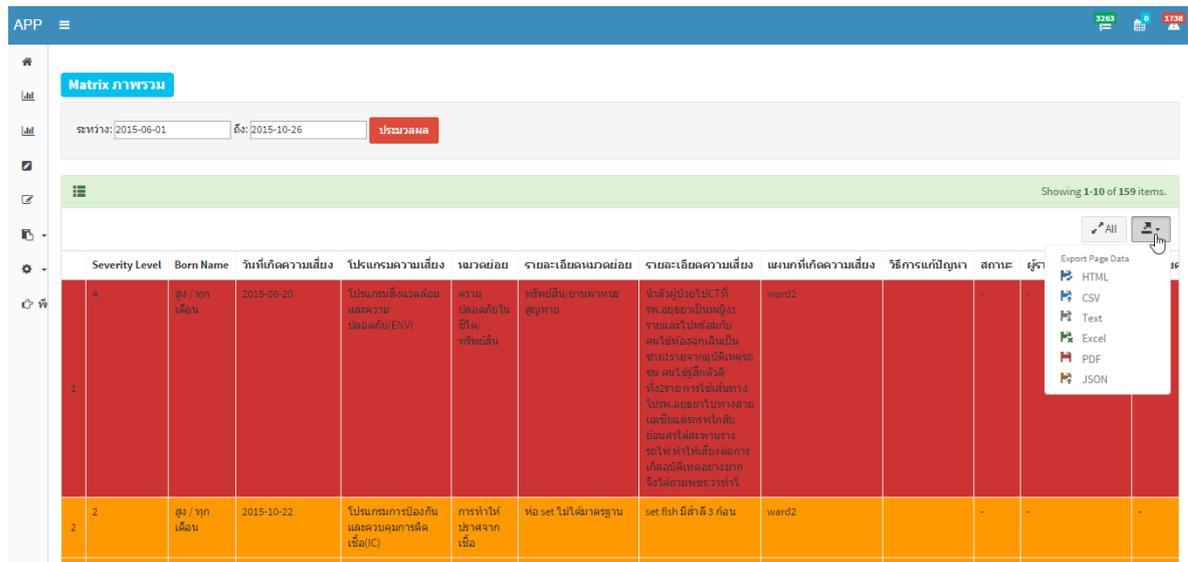


Figure 7 Risk details page

This page displays the risk details as colors calculated from risk evaluation layout. The report

can be exported in multiple formats such as excel and PDF.



Figure 8 Example of a Responsive Design page in a mobile device.

Evaluation of the system usage

As for the evaluation of the actual use of the system in Somdet Phra Sangkharat (Watsana Maha Thera) Hospital,

questionnaires were distributed among 27 users who work at the hospital, the results are as follow (Table 5)

Table 5 Conclusion of the System Use Evaluation

Satisfaction	Average (\bar{X})	Standard Deviation (S.D.)	Level of Satisfaction
Satisfy user's need	4.03	0.41	High
System function	4.00	0.45	High
User-friendliness	4.13	0.55	High
System data security	4.29	0.58	High

Satisfaction level of ability to satisfy user's need is high ($\bar{X} = 4.03$). Satisfaction level of system function is High ($\bar{X} = 4.00$). Satisfaction level for user-friendliness is High ($\bar{X} = 4.13$), and Satisfaction level for security of system data is High ($\bar{X} = 4.29$).

From the development of information system for risk management in hospitals in the case study of Somdet Phra Sangkharat (Watsana Maha Thera) Hospital, the researcher has tried to match user's need, provide convenience in use, and give users more flexibility in their work. The development utilizes data in the old system, adapted according to standard set by Healthcare Accreditation Institute. It will create a new standard for other healthcare institutes to follow. The system has been developed to allow users to export summary report in various templates as chosen by the users. It is convenient to use the data for planning in risk management in hospitals, to adjust strategies in risk management effectively and allow for a prompt and immediate solution.

If other hospitals wish to adopt the system, there should be further examinations on the details of the risk and the report conditions to match the terms and conditions of each hospital.

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