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Expansion of the System for Collecting Information on Hospital Incidents ～ With the Aim of Revitalizing On-Site Management

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ABSTRACT

In medical facilities and general hospitals, a variety of information regarding incidents in patient care is collected and analysed. However, due to the large differences in knowledge and experience of on-site risk managers, previous studies have shown several problems with the data collected. Underlying these problems is the analyst's limited knowledge of human factors, IT, and management. However, it is very difficult to give more time and cost for safety training to on-site risk managers. Therefore, in this study, we decided to organize the results of past research on human error factor analysis from the perspective of on-site management. As a result, we were able to obtain a set of elements [elements for activation of on-site activities] for improving the ability of on-site risk managers to recognize, the willingness of on-site risk managers to participate in medical safety activities, and the management level of on-site risk managers. Based on the "Elements for Activation of On-Site Activities", we developed a prototype of an incident reporting support system.

Keywords: Incident reports, Risk manager, Human factor, Medical safety

INTRODUCTION

In medical facilities and general hospitals, a variety of information regarding incidents in patient care is collected and analyzed. However, due to the large differences in knowledge and experience of on-site risk managers, previous studies have shown the following problems with the data collected.

- Only information on the act of human error itself is collected. For example, "care lessness," "vagueness," "inattention," "lack of confirmation,"etc.
- Only factors observed only at the time of the incident (factors whose occurrence is rare) are extracted.
- Information is biased.
- The format is to assume the countermeasures first and then investigate the necessary factors.
- Time required for collection is limited.
- Too much emphasis is placed on interviews with the error actor. (In many cases, collection ends with only hearing information.)
- Too much emphasis is placed on recovery actions.

Underlying these problems is the analyst's limited knowledge of human factors, IT, and management. However, it is very difficult to give more time and cost for safety training to on-site risk managers. In particular, it is impossible for small and medium-sized hospitals to provide safety education in their own departments.

Therefore, to solve such issues, we developed a prototype system that support factor analysis by medical risk managers in this study.

BASICS OF SAFETY MANAGEMENT SYSTEM IN MEDICAL INSTITUTIONS

In Japan, specific functional hospitals are required to establish a medical safety committee and have a medical safety manager in accordance with the regulations of the Ministry of Health, Labour and Welfare (MHLW). The medical safety manager is responsible for overseeing safety management activities in each medical institution and appointing a medical risk manager for each department who reports to them. The primary responsibilities of the medical risk manager include:

- Investigating the causes of medical accidents in the workplace and recommending preventive measures
- Analyzing near-miss experience reports
- Communicating the accident prevention and safety measures decided by the Committee to staff members
- Encouraging employees to report near-miss incidents actively
- Undertaking any other necessary tasks for preventing medical accidents

Moreover, those appointed as risk managers are often considered as potential candidates for executive positions in healthcare organizations. Therefore, in addition to their designated duties, department directors expect risk managers to:

- Establish mechanisms and procedures for safety measures
- Demonstrate leadership skills in their work
- Manage department operations
- Have the ability to influence the organization

These findings suggest that department directors have diverse expectations from their risk managers, which go beyond the duties assigned by the medical safety managers. Risk managers are required to perform multiple roles, including promoting and responding to safety activities, exhibiting leadership, and serving as a bridge between departments.

Rating Scale for Incident Factor Analysis

In this study, Table 1 (Okada, 2023) is utilized to classify the ratings of the extracted factors from level 0 to level 5. The number of extracted factors for each level is defined as $z_k (k = 1, 2, 3, 4, 5)$.

To extract factors from multiple perspectives, this study utilized the 4M and SHEL classifications frequently employed in accident factor analysis to

Table 1. Guidelines for factors to be extracted.

Level	z_k	Evaluation	Characteristics of Terminal Extraction Factors	Measures to be planned
Level0	z_1	Not allowed	"Carelessness," "Vagueness"	"Strengthening of consciousness"
			"Inattention," "Lack of confirmation"	"Reinforcement of attention," "Daring to check"
Level1	z_2	Undesirable	"Lack of skills or experience"	"Thorough training and implementation"
Level2	z_3		"Insufficient materials," "Inadequate manuals," "Insufficient instructions," "Poor communication"	"Review of materials," "Review of manuals," "Clear instructions, and thorough reporting"
Level3	z_4	Appropriate	"Specific problems in the workplace"	"Establishment of rules or prohibitions"
Level4	z_5	Ideal	"Specific and detailed problems involved in the work"	"Work improvement," "Business improvement," "Environmental improvement," "System improvement"
Level5	z_6		"Specific and detailed issues involved in the work"	"Cross-departmental measures," "Measures that improve employee satisfaction"

Based on Yusaku Okada, "Human Error to keieisenryaku"(Okada, 2023)
(Adapted from (Okada, 2023) and translate for this study.)

identify seven categories for factor classification. (Table 2) Each category was assigned a score, defined as $x_i\,(i = 1, 2, 3, 4, 5, 6, 7)$.

Using the classifications presented in Tables 1 and 2, a list was created to evaluate the extracted factors. The list is utilized to determine the categories and levels of the extracted factors. Factors were collected from Yukimachi and Nagata (2004) and Swain and Guttmann (1983) and keywords associated with them, which were then compiled into the list. The presence or absence of relevant keywords is used to determine whether the extracted factors are consistent with the listed factors.

Characteristics Required of Healthcare Professionals

Analyzing incidents in healthcare facilities necessitates proficiency in analytical methods, medical information, and healthcare safety practices. On the

Table 2. Classification of factors.

Name		x_i	Meaning
Liveware		x_1	Factors related to individual characteristics of field workers
Software		x_2	Factors related to software such as procedures, manuals, etc.
Hardware		x_3	Factors related to machine and human-machine interface
Environment		x_4	Factors related to the work and work environment
	Team* Management	x_5	Factors related to team leader
Organizational Design	Organizational Management	x_6	Factors related to organizational structure and systems
	Regulations	x_7	Factors related to company and social regulations and rules

*Team performing routine tasks

other hand, the World Health Organization (WHO) recommends that healthcare professionals have competencies (Sako et al., 2007). In particular, competencies are increasingly required of personnel who play a central role in medical safety. Risk managers, who are the subject of this study, will also be required to acquire such competencies in the future. Therefore, a competency map was created as shown in Table 3. The three axes of the competency map in this study are awareness, willingness to participate, and management skills (Hollnagel, 1998; Dekker, 2019). In creating the detailed competency map, we made sure to fully reflect the information from interviews with the safety managers and management of the medical institutions (Table 3).

The competency map presented in Table 3 demonstrates that "awareness" encompasses "imagination" and "insight," "willingness to participate" comprises "initiative" and "ability to act," and "management" includes "power of expression," "power of judgment," and "communication skills" as factors.

Table 3. Competency map on risk managers proposed in this study.

Key axis	Characteristics	y_i	Contents
awareness	imagination	y_1	Ability to assume imaginary people and things
	insight	y_2	Ability to understand the situation and circumstances around you
willingness to participate	initiative	y_3	Ability to take initiative in carrying out tasks
	the ability to take action	y_4	Ability to set your own goals and take action
	expression	y_5	Ability to communicate one's feelings and thoughts clearly to others
management skills	judgment	y_6	Ability to respond prudently to unexpected situations
	communication skills	y_7	Ability to accurately share information with others

As "awareness," "willingness to participate," and "management" are critical abilities required for factor analysis, developing these abilities would enhance the analysis results. Therefore, increasing y_j, which constitutes "awareness," "imagination," and "management ability," will also improve the factor analysis results. Consequently, we assume that assessing the current value of y_j, using x_i and providing advice on how to increase y_j,would enhance "awareness," "willingness to participate," and "management ability," leading to improved factor analysis results.

We thus rated y_j, on a scale of 0 to 5 points and developed advice data based on each score (Table 4).

Incident Reporting Support System Specifications

A prototype incident analysis support system was developed by utilizing the factor evaluation method and advisory data proposed in the previous section. The advisory data and the factor analysis support system were linked to complement the skills of the analysis method, knowledge of medical information, and experience in medical safety activities (see Figure 1).

The four functions that support incident analysis are as follows

Function α: This function counts the number of factors in each of the seven categories listed in Table 2. It informs the analyst about the categories where the factors have not been fully extracted.

Function β: This function displays the list of factors extracted. It helps the analyst identify the factors that have not been extracted.

Function γ: This function separates and lists the incidents based on person-action. It organizes the flow of information leading up to the trouble and facilitates the collection of relevant information.

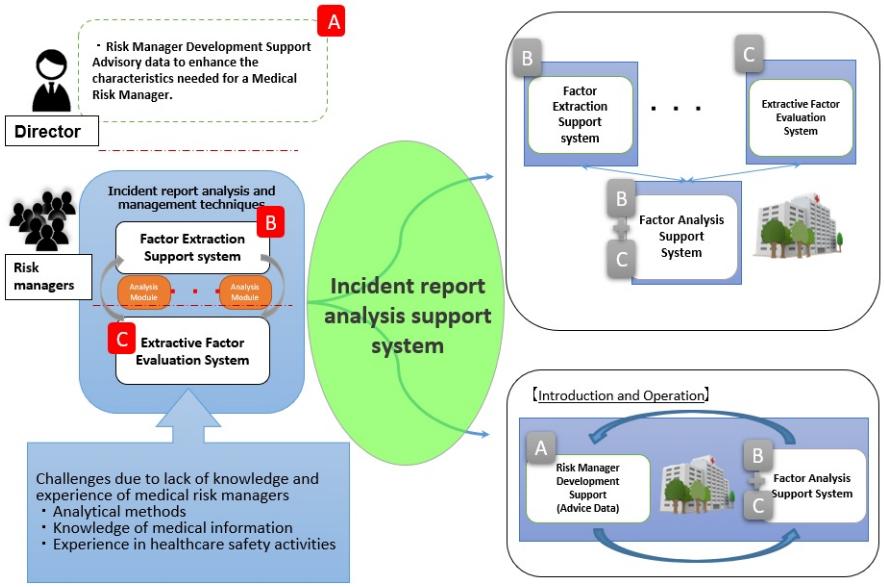

Figure 1: Overview of the in-hospital incident factor analysis support system developed in this study.

Table 4. Advice data by score.

Characteristics	0	1	2	3	4	5
imagination	Assumptions regarding fictitious work have not been made.	There is a description for the fictitious work, but no description of anyone other than the subject of the work.	In addition to the fictitious work, there is a description of the people around him, but no detailed information about them.	In addition to the fictitious work, the description of one's surroundings is also detailed.	In addition to the fictitious work, information about the people around you is also written from their point of view. However, it lacks detail.	In addition to the fictional work, information about the people around you is also detailed from their point of view.
insight	You are not aware of your surroundings.	You have an understanding of the situation concerning yourself. but no description of the situation concerning those around you.	There is a description of the situation for you and the people around you.	In addition to the description of themselves and their surroundings, there are some descriptions about the equipment. However, many of the description relate to conditions at the time of the accident.	In addition to descriptions of themselves, their surroundings, and their equipment, there are also descriptions of their daily work situations. However, it lacks detail.	In addition to a description of yourself, your surroundings, and the equipment, there is a detailed description of the conditions related to your daily life.
initiative	You are working with a sense of being made to do a job that is all predetermined and given to you.	In some tasks, they work with a sense of significance.	You understand the significance of the work you have been given and are focused on it.	You are interested and proactive in the work assigned to you.	You are working independently with some of their own ideas for the work that is given to them.	You are aware of the problems involved in the work and are able to make new suggestions regarding the work.
the ability to take action	You can't set goals for myself.	You have vague goals but lack detail.	Detailed goals are in place, but you are not linked to the work,so you have not been translated into action.	You are taking action based on detailed goals, but it doesn't last long.	Under detailed goals, they continue to take action to achieve their objectives.	Based on actions and current results, they are modifying their goals as they go along.

Continued

Table 4. Continued.

Characteristics	0	1	2	3	4	5
expression	You are unable to organize your thoughts and feelings and express your emotions and thoughts.	You can explain to those directly involved in your work.	You can explain your situation to others in the same environment as you.	You can give people in other departments a picture of your situation.	You can explain your situation in a way that is easy to understand for people in other departments.	You can explain your situation in a way that all can easy to understand.
judgment	You are incapable of responding to actions outside of the manual.	Able to make decisions from his/her own point of view on a situation he/she had anticipated.	You can make judgments from others' perspectives regarding the situation you envisioned.	Able to make decisions from their own point of view regarding unexpected situations.	You are able to make judgments about unexpected situations from the perspective of others.	You are able to make decisions regarding unexpected situations from a variety of perspectives.
communication skills	You have no one to share information with.	You do not understand the communication you need and the information is biased.	You are able to share information with some people who are directly involved in your work.	You are able to share information with those who are involved in your work.	You are able to share information with others in your department.	You can share information with people in other departments.

Function δ: This function provides factor analysis support. By entering the extracted factors in the given format, it evaluates the current characteristics (y_j) of the risk manager and displays advice according to the value of y_j. The analyst examines and scrutinizes the extracted factors based on this advice.

The algorithm for inputting, evaluating, and displaying advice data for factors is as follows.

(1) Extraction and input of factors

This system uses "why-why analysis" to identify the root causes of failure events by repeatedly asking "why"(Hitoshi, 1997). The analyst can extract and input the factors by following a displayed format when analyzing a specific action from the extracted error actions.

(2) Factors are classified by category.

(3) Calculation of x_i

For each level, level 0 was weighted 0, level 1 0.2, level 2 0.4, level 3 0.6, level 4 0.8, and level 5 1.0. The number of points x_i for each category is calculated by summing the product of the number of pieces extracted z_j for each level and the weights.

(4) Evaluation of y_j

The score y_j for each force is evaluated by the score x_i for each category. y_j is calculated by the following formula.

$$y_j = \sum_{i=1} \alpha_{ij} x_i \tag{1}$$

(5) Display of Advisory Data

Display the advice data corresponding to Table 4 for the item with the lowest score among the calculated characteristic values y_j (Figure. 2).

Evaluation

The system described above was evaluated using actual test data. Specifically, one participant was given one hour to perform an incident factor analysis

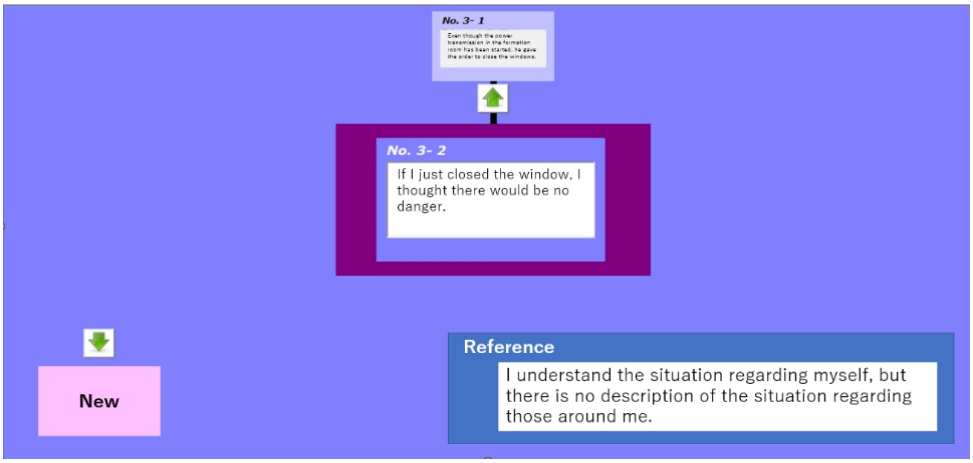

Figure 2: Factor analysis execution screen.

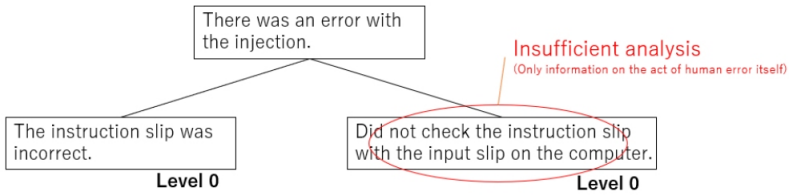

Figure 3: Factor analysis results for no support.

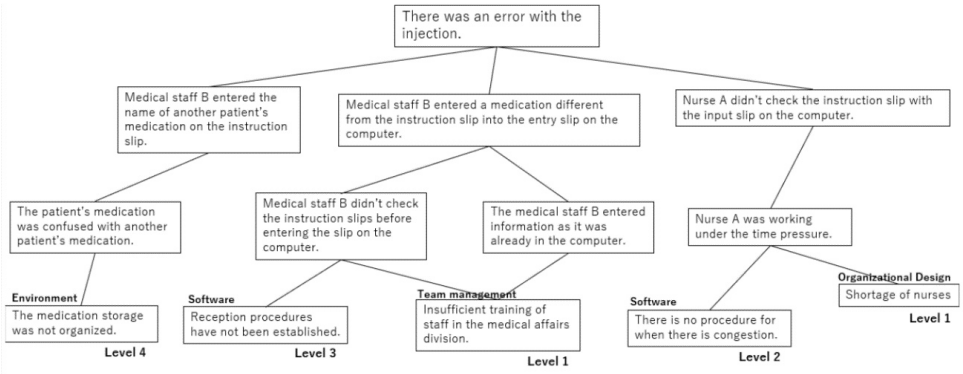

Figure 4: Results of factor analysis with support.

using the system. The results of the factor analysis conducted before utilizing the system, as well as the results of the analysis using the system, are presented in Figures 3 and 4, respectively.

After comparing the results obtained before and after the use of the system, it was found that the number of extracted factors increased significantly from 2 to 12, with a more detailed content for each factor. Moreover, the average factor level was also improved from 0 to 2.2 points, indicating that the post-assistance results presented a higher quality and more diverse set of factors compared to the pre-assistance results.

However, it was observed that not all categories of factors were extracted in the post-assist results, revealing a bias that needs to be addressed. The diversity of the results still needs improvement, and several factors may have contributed to this outcome. The following factors may have contributed to these results.

- The display for function alpha shows category balance, but the factor extraction screen lacks information on factor categories, resulting in a loss of awareness regarding the extraction of factors in missing categories.
- The variable x_i, which determines y_j, is determined by the weight of the factor level and the number of factors extracted. This means that a higher level of extracted factor may result in a larger value of x_i, which may incorrectly determine a missing category as less important despite a small number of extracted factors.
- There is insufficient data from past factor analysis to calculate α_{ij}.

CONCLUSION

In this study, a prototype of a factor analysis support system was developed to aid medical risk managers in extracting a diverse set of factors. Results from applying test data to the system confirmed its potential for improving the quality and quantity of factors. However, the diversity of factors extracted was not satisfactory. In future research, we aim to expand the target population and enhance the advice data and evaluation method to make the system more practical for on-site management. Our ultimate goal is to improve the awareness, participation, and management skills of medical risk managers, enhance the necessary qualities, and invigorate on-site management through the use of this system.

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