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Kazunori Minetaki

Yuji Akematsu

Masatsugu Tsuji

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関西大学ソシオネットワーク戦略研究機構

The Research Institute for Socionetwork Strategies,
Kansai University
Joint Usage / Research Center, MEXT, Japan
Suita, Osaka, 564-8680, Japan
URL: http://www.kansai-u.ac.jp/riss/index.html
e-mail: riss@ml.kandai.jp
tel: 06-6368-1228
fax. 06-6330-3304

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Empirical Study of Medical Safety and Communication among Medical Staffs[1]

Kazunori Minetaki[2], Yuji Akematsu[3] and Masatsugu Tsuji[3,4]

Abstract

The aim of this article is to specify the most important factor which improves the medical safety. Our hypothesis is the good communication and knowledge share among the medical staffs which are categorized by the doctor, the nurse, and the other co-medical staffs are the most important suggested by minetaki, et al. (2010).

We consolidate three factors from our questionnaire conducted at the advanced treatment hospital with the university which has over 1100 beds in Tokyo in 2010, by using factor analysis. Total observations are 2050.

Factor 1 is considered as the supervisor's behavior related with the promotion of medical safety. Factor 2 is the circumstance where medical staffs can discuss about the medical safety freely, so as to say, communication factor. Factor 3 is the factor concerning about the medical safety as a whole of the hospital, so as to say, top management about medical safety. Especially, in this article, we focus on the communication factor where the free and open circumstance of communication among medical staffs exists. We estimate several equations where the dependent variables are the frequency of reporting when the medical errors occur that is called as incident report. The main explanatory variables are above mentioned three factors. To have the robust results, we try to verify several cases concerning about the frequency of reporting when the medical errors occur. Every question is categorical data of five degree. Estimation method is based on the ordered probit model because we handle with the categorical data. Estimation results show that the communication factor is statistically significant and is positively correlated with the frequency of reporting when the medical errors occur in every case. And the coefficient of the communication factor is the largest in every case. It implies that medical staffs would share the knowledge about the accidents by reporting medical errors.

We conclude that the good communication among medical staffs can improve the medical safety.

***Index Terms*—**Medical Safety, Communication, Medical Error, Incident Report

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[2] The Research Institute for Socionetwork Strategies, Kansai University, Japan

[3] Graduate School of Applied Informatics, University of Hyogo, Japan

[4] Department of Urban Studies, National Cheng Kung University, Taiwan

1. INTRODUCTION

Population based research in the United States suggests that between 44 000 and 98 000 patients die each year from preventable errors, making medical error the eighth most common cause of death. Also in Japan, a lot of errors including near errors have occurred in the hospital.

Sexton, et al. (2000) shows that perceptions of stress and fatigue, attitudes to teamwork and hierarchy, and attitudes about error and safety are so important concepts. We also make out the questionnaire from those concepts referring to Singer, et al. (2003) and Baker, et al. (2003). The poor teamwork and communication would be a cause of bring the medical errors.

To verify this hypothesis, we must consider the proxy of the medical safety. But this is difficult, because no one can grasp all of the medical errors including near errors in the hospital. Also it is difficult that we judge what circumstance is safety for the patients. We consider whether or not, the increase of incident reports means the wrong situation for the patients. In the hospital where medical staffs are properly educated about the medical safety, staffs know that serious errors cannot be hidden and knowledge sharing about the reason why errors occurred will improve the wrong situation systematically. The medical staff making errors must not be blamed, and so there is the problem within the organization by itself.

We take the frequency of reporting of medical errors for the proxy of the medical safety, because medical staffs share the knowledge about the accidents by reporting medical errors. We have three types of questions about the frequency of reporting of medical errors. First is the frequency of reporting of medical errors before patients have been influenced. Second is the frequency of reporting of errors which have no effect on patients. Third is the frequency of reporting of errors which could have bad effects on patients but have no effects in this case as a result. First is the lightest case, and third is the most serious case.

After the introductions, and the next section shows methodology. Thirdly results and discussion are stated. The last section is conclusion.

2. DATA AND METHODOGY

We conducted questionnaire survey by interview at the Tokyo Medical University in June, 2009. Total observations are 2050.

We categorize medical staffs by occupation three types which are the doctor, the nurse, and the other co-medical staff. There are 46 questions related with the medical safety in our questionnaire, and we select less subjective 29 questions for analysis. Descriptive statistics of both those questions and 3 dependant variables which are used for estimations after section are shown in Table1.

Table 1 Descriptive Statistics

	median	mean	standard deviation	min	max
Near misses are less at our department than others.	3	2.73	0.94	1	5
Safety is considered as important at our department.	4	4.19	1.05	1	5
There are a few cases that errors of our department are related with patients.	2	1.99	0.99	1	5
There are many cases that errors of our department are very serious.	3	3.15	0.90	1	5
Safety is the top priority in our hospital.	4	3.82	0.92	1	5
Colleagues usually tell us about their errors.	3	3.42	0.86	1	5
Our department deals equally workers compared to others.	3	2.99	1.06	1	5
Executive persons promote that all staff endeavor the safety and keep the rules about the safety.	4	3.74	0.92	1	5
The staffs actively report about the dangerous happenings and situations which violate the safety rule.	4	3.74	0.85	1	5
I have made the serious errors because of the severe fatigue.	3	2.60	1.18	1	5
Many errors of our department are occurred when the staffs treat the patients.	3	3.28	0.95	1	5
Most well-qualified person at optimum level decides about the safety of patients.	4	3.44	0.86	1	5
I tell my overwork situation when it occurs.	4	3.35	1.34	1	5
We check our stress and fatigue each other.	2	2.51	1.05	1	5
It is highly regarded that we take quick response to the serious errors.	4	3.86	0.98	1	5
The staffs who make errors absolutely report them.	4	3.72	1.00	1	5
It is usually difficult to hide their serious errors.	5	4.30	0.90	1	5
In our department there are enough recourses of times, staffs, budgets, and equipments to keep safety.	3	2.82	1.09	1	5
In our hospital, we discuss about the issues about safety.	3	2.99	1.05	1	5
My supervisors promote to work with following the medical safety guideline.	4	3.87	0.86	1	5
My supervisors consider the proposals improving the medical safety by staffs.	4	3.76	0.87	1	5
My supervisors demand us to hurry up even if the regular procedures are omitted.	2	2.21	0.95	1	5
My supervisors do not deal with the problems of medical safety which have occurred at several times.	2	2.16	0.92	1	5
Staffs can tell freely the risk that would violate the medical safety.	4	3.61	0.91	1	5
The errors occurred at the department are reported to the staffs.	4	3.92	0.90	1	5
The staffs can make questions to the person who has the right of decisions making.	3	3.36	0.99	1	5
We discuss about the precautions which can prevent the same accidents.	4	3.78	0.91	1	5
Frequency of reporting of errors before patients are influenced by them	4	3.66	0.96	1	5
Frequency of reporting of errors which have no effect on patients	4	3.47	1.02	1	5
Frequency of reporting of errors which could have had effects on patients but have no effects in this case as a result	4	3.79	0.98	1	5

For 27 selected variables, we practice the factor analysis by maximum-likelihood where a set of loadings created that are more interpretable than those originally produced by promax method, and consolidate three factors because if above three factors are selected, problems occur that the solution is a Heywood case which is invalid or boundary values of uniqueness, and the meaning which factor implies can not be interpreted. For factor analysis STATA version11 is used.

Next, we estimate several frequencies of incident reports with controlling other individual attributions. First is the lightest emergency case of frequency of reporting of errors before patients are influenced by them. Second is the middle level of emergency case of frequency of reporting of errors which have no effect on patients. Third is the most serious emergency case of frequency of reporting of errors which could have had effects on patients but have no effects in this case as a result. Every question is the categorical data of five degree, and so estimation method is ordered probit model. Formation is defined as followings.

$$Y_i^* = \sum_{j=1}^{3} \beta_{j,i} X_i + \sum_{h=1}^{n} \gamma_{h,i} Z_i + \mu_i \left(i = 1,2,\cdots n\right)$$

where Y_i^* is the continuous potential variable which can not be observed.

X is the factor above mentioned, and Z is the control variable of attributions of each person. μ_i is error term. In this equation, control variables are as follows: (1) whether the medical staff is manager or not; (2) the facilities where the medical staff works because Tokyo Medical University has three facilities and each facility has original characteristics; and (3) the degree of the risk aversion which is made by principal component analysis from subjective preference to the general concept of safety that are food, water, medical treatment, and air, among the other 17 questions. Those subjective preference variables are not included in variables in Table1 which are more objective, so it is no problem statistically to use subjective preference for this model.

Above mentioned, Because Y_i^* is the continuous potential variable which can not be observed, we must transfer Y_i^* into Y_i which can be observed as dependant variables as follows.

$$Y_i = k \Leftrightarrow \kappa_{k-1} < Y_i^* < \kappa_k \left(k = 1,2,\cdots K\right)$$

This relationship is called as threshold mechanism.

The probability that Y_i has a certain value is expressed as follows.

$$\pi_{i,k} = P\left(Y_i \setminus X_{i,} Z_i\right) = F\left(\kappa_k - X'_i \beta - Z'_i \gamma\right) - F\left(\kappa_{k-1} - X'_i \beta - Z'_i \gamma\right)$$

Ordered probit model is defined as probability function as follows.

$$\pi_{i,k} = \Phi\left(\frac{\kappa_k - X'_i \beta - Z'_i \gamma}{\sigma}\right) - \Phi\left(\frac{\kappa_{k-1} - X'_i \beta - Z'_i \gamma}{\sigma}\right)$$

3. RESULTS AND DISCCUSION

Table2 shows the result of factor analysis. Factor 1 is strongly correlated with the questions, “My supervisors consider the proposals improving the medical safety by staffs,” and “My supervisors promote to work with following the medical safety guideline.” Thus factor 1 is considered as the supervisor’s behavior related with the promotion of medical safety, so factor1 is called as supervisor’s concerning factor.

Factor 2 is strongly correlated with the questions, “Staffs can tell freely the risk that would violate the medical safety,” and “The staffs can make questions to the person who has the right of decisions making.” Factor 2 is considered as the circumstance where medical staffs can discuss about the medical safety freely, and so called as communication factor. Factor 3 is strongly correlated with the questions, “Executive persons promote that all staff endeavor the safety and keep

the rules about the safety," and "Safety is the top priority in our hospital." Thus factor 3 is concerning about the medical safety as a whole of the hospital, and so called as top priority as a whole hospital factor.

Table2 Factor Analysis

Variable	factor 1	factor 2	factor 3
Near misses are less at our department than others.	-0.015	-0.011	0.138
Safety is considered as important at our department.	0.207	0.057	0.305
There are a few cases that errors of our department are related with patients.	-0.069	-0.079	0.030
There are many cases that errors of our department are very serious.	0.010	0.053	0.121
Safety is the top priority in our hospital.	0.202	0.100	0.507
Colleagues usually tell us about their errors.	0.092	0.229	0.234
Our department deals equally workers compared to others.	0.064	0.090	0.145
Executive persons promote that all staff endeavor the safety and keep the rules about the safety.	0.315	0.149	0.558
The staffs actively report about the dangerous happenings and situations which violate the safety rule.	0.209	0.213	0.485
I have made the serious errors because of the severe fatigue.	-0.027	-0.229	-0.132
Many errors of our department are occurred when the staffs treat the patients.	0.075	0.144	0.034
Most well-qualified person at optimum level decides about the safety of patients.	0.282	0.233	0.342
I tell my overwork situation when it occurs.	0.089	0.231	0.134
We check our stress and fatigue each other.	0.194	0.226	0.157
It is highly regarded that we take quick response to the serious errors.	0.181	0.199	0.252
The staffs who make errors absolutely report them.	0.278	0.250	0.284
It is usually difficult to hide their serious errors.	0.128	0.244	0.111
In our department there are enough recourses of times, staffs, budgets, and equipments to keep safety.	0.158	0.119	0.157
In our hospital, we discuss about the issues about safety.	0.214	0.276	0.152
My supervisors promote to work with following the medical safety guideline.	0.849	0.165	0.109
My supervisors consider the proposals improving the medical safety by staffs.	0.854	0.162	0.096
My supervisors demand us to hurry up even if the regular procedures are omitted.	-0.324	-0.203	0.000
My supervisors do not deal with the problems of medical safety which have occurred at several times.	-0.540	-0.188	-0.058
Staffs can tell freely the risk that would violate the medical safety.	0.285	0.643	0.122
The errors occurred at the department are reported to the staffs.	0.321	0.576	0.096
The staffs can make questions to the person who has the right of decisions making.	0.280	0.601	0.085
We discuss about the precautions which can prevent the same accidents.	0.407	0.539	0.091

We use those three factors for estimating the ordered probit model. We estimate equations where the dependent variables are the frequency of reporting when the medical errors occur which are proxies for the medical safety. Because of number of observations constrain, we can not estimate by each occupation. We categorize as doctor, nurse, and others from view points of the degree of the total medical knowledge, and the frequency of seeing patients.

In Table 3-11, the estimation results are shown. In Table 3-5, the dependent variable is the frequency of reporting of medical errors before patients have been influenced. This is the lightest case of medical errors. Table 3 is the case of doctor, Table 4 is the case of nurse, and Table 5 is the case of other co-medical staffs as the same following Table 6-8, and Table 9-11. In Table 6-8, the dependent variable is the frequency of reporting of errors which have no effect on patients. In Table 9-11, the dependent variable is the frequency of reporting of errors which could have bad effects on patients but have no effects in this case as a result. This is the most serious case of medical errors.

Table 3 Estimation result of incident report at the light level of emergency: Doctor

Dependent variable: Frequency of reporting of errors before patients are influenced by them

	Marginal effect	S.E.	Z	P>|z|	
Factor 1	0.043	0.010	4.42	0.000	***
Factor 2	0.072	0.013	5.40	0.000	***
Factor 3	0.019	0.010	1.84	0.066	*
Dummy for manager	-0.001	0.017	-0.03	0.976	
Dummy for facility 2	0.032	0.024	1.33	0.185	
Dummy for facility 3	0.068	0.050	1.35	0.177	
Risk aversion	-0.014	0.005	-2.90	0.004	***
Number of obs.			347		
LR chi2(7)			111.25		
Prob > chi2			0.000		
Pseudo R2			0.1226		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

Table 4 Estimation result of incident report at the light level of emergency: Nurse

Dependent variable: Frequency of reporting of errors before patients are influenced by them					
	Marginal effect	S.E.	z	P>|z|	
Factor 1	0.066	0.012	5.44	0.000	***
Factor 2	0.132	0.013	9.97	0.000	***
Factor 3	0.043	0.013	3.21	0.001	***
Dummy for manager	-0.033	0.036	-0.91	0.365	
Dummy for facility 2	0.036	0.021	-1.69	0.090	*
Dummy for facility 3	0.008	0.027	0.30	0.767	
Risk aversion	-0.009	0.006	-1.45	0.146	***
Number of obs.			1115		
LR chi2(7)			168.12		
Prob > chi2			0.000		
Pseudo R2			0.0567		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

Table 5 Estimation result of incident report at the light level of emergency: Others

Dependent variable: Frequency of reporting of errors before patients are influenced by them					
	Marginal effect	S.E.	z	P>|z|	
Factor 1	0.084	0.011	7.31	0.000	***
Factor 2	0.107	0.013	8.07	0.000	***
Factor 3	0.040	0.013	3.00	0.003	***
Dummy for manager	0.003	0.026	0.12	0.907	
Dummy for facility 2	-0.032	0.023	-1.43	0.154	*
Dummy for facility 3	-0.013	0.028	-0.45	0.652	
Risk aversion	0.006	0.006	0.97	0.330	***
Number of obs.			588		
LR chi2(7)			180.17		
Prob > chi2			0.000		
Pseudo R2			0.1119		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

Table 6 Estimation result of incident report at the middle level of emergency: Doctor

Dependent variable: Frequency of reporting of errors which have no effect on patients					
	Marginal effect	S.E.	z	P>|z|	
Factor 1	0.025	0.007	3.67	0.000	***
Factor 2	0.040	0.009	4.24	0.000	***
Factor 3	0.014	0.007	2.00	0.046	**
Dummy for manager	-0.018	0.012	1.51	0.130	
Dummy for facility 2	0.008	0.014	0.57	0.567	
Dummy for acility 3	0.012	0.025	0.49	0.624	
Risk aversion	-0.007	0.003	-2.38	0.018	**
Number of obs.			347		
LR chi2(7)			82.22		
Prob > chi2			0.000		
Pseudo R2			0.0875		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

Table 7 Estimation result of incident report at the middle level of emergency: Nurse

Dependent variable: Frequency of reporting of errors which have no effect on patients					
	Marginal effect	S.E.	z	P>|z|	
Factor 1	0.071	0.011	6.44	0.000	***
Factor 2	0.093	0.012	7.93	0.000	***
Factor 3	0.034	0.012	2.85	0.004	***
Dummy for manager	-0.045	0.032	-1.39	0.166	
Dummy for facility 2	-0.035	0.019	-1.84	0.066	
Dummy for facility 3	-0.021	0.023	-0.90	0.368	
Risk aversion	-0.005	0.005	-1.02	0.306	
Number of obs.			1114		
LR chi2(7)			139.40		
Prob > chi2			0.000		
Pseudo R2			0.0453		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

Table 8 Estimation result of incident report at the middle level of emergency: Others

Dependent variable: Frequency of reporting of errors which have no effect on patients

	Marginal effect	S.E.	z	P>|z|	
Factor 1	0.06	0.01	6.06	0.00	***
Factor 2	0.07	0.01	6.33	0.00	***
Factor 3	0.02	0.01	1.83	0.07	**
Dummy for manager	0.00	0.02	0.21	0.83	
Dummy for Facility 2	0.00	0.02	-0.22	0.82	
Dummy for Facility 3	0.00	0.03	-0.15	0.88	
Risk aversion	0.01	0.01	0.37	0.71	
Number of obs.			588		
LR chi2(7)			114.56		
Prob > chi2			0.000		
Pseudo R2			0.0668		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

Table 9 Estimation result of incident report at the serious level of emergency: Doctor

Dependent variable: Frequency of reporting of errors which could have had effects on patients but have no effects in this case as a result

	Marginal effect	S.E.	z	P>|z|	
Factor 1	0.051	0.011	4.60	0.000	***
Factor 2	0.085	0.015	5.80	0.000	***
Factor 3	0.018	0.012	1.54	0.125	
Dummy for manager	-0.003	0.020	-0.17	0.862	
Dummy for facility 2	-0.019	0.021	-0.87	0.383	
Dummy for facility 3	0.035	0.046	0.75	0.455	
Risk aversion	-0.011	0.005	-2.09	0.036	**
Number of obs.			346		
LR chi2(7)			98.31		
Prob > chi2			0.000		
Pseudo R2			0.1086		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

Table 10 Estimation result of incident report at the serious level of emergency: Nurse

Dependent variable: Frequency of reporting of errors which could have had effects on patients but have no effects in this case as a result

	Marginal effect	S.E.	z	P>|z|	
Factor 1	0.096	0.015	6.54	0.000	***
Factor 2	0.176	0.016	11.04	0.000	***
Factor 3	0.039	0.016	2.43	0.015	**
Dummy for manager	-0.080	0.045	-1.80	0.072	*
Dummy for facility 2	-0.031	0.026	-1.17	0.244	
Dummy for facility 3	-0.063	0.030	-2.06	0.039	**
Risk aversion	-0.012	0.007	-1.64	0.100	*
Number of obs.			1116		
LR chi2(7)			205.27		
Prob > chi2			0.000		
Pseudo R2			0.0722		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

Table 11 Estimation result of incident report at the serious level of emergency: Others

Dependent variable: Frequency of reporting of errors which could have had effects on patients but have no effects in this case as a result

	Marginal effect	S.E.	z	P>|z|	
Factor 1	0.108	0.014	7.83	0.000	***
Factor 2	0.139	0.016	8.66	0.000	***
Factor 3	0.034	0.017	2.03	0.042	**
Dummy for manager	0.001	0.033	0.04	0.970	
Dummy for facility 2	-0.015	0.030	-0.49	0.625	
Dummy for facility 3	0.021	0.039	0.54	0.588	
Risk aversion	0.007	0.007	0.94	0.346	
Number of obs.			588		
LR chi2(7)			185.92		
Prob > chi2			0.000		
Pseudo R2			0.1127		

***, **, and * indicate the 1%, 5%, and 10% level of significance, respectively.

In every estimation results, factor 2 which is the communication factor is statistically significant ($p<0.01$) and the marginal effect is the largest. It means that the existence of free and open circumstance of communication among medical staffs can increase the number of incident reports. It can bring the good effect on the medical safety to communicate and share the knowledge about medical errors either its degree is light or serious. The marginal effect of communication factor is the largest in the case of nurse and it is the smallest in the case of doctor. It may suggest that nurses works together more flatly, and the team play is done easier compared to doctors.

4. CONCLUSION AND POLICY IMPLICATION

The communications among medical staff can increase the knowledge why and how the medical errors happen. The accumulation of those communications about medical errors will contribute to the medical safety. For this purpose, the good team work is needed. Nurses are accustomed with working style of rotation. They can easily form the team work.

And nurses usually contact with patients frequently every day. They could find the symptom from frequent face to face communication with patients. The accumulation of such awareness can improve the medical safety. Thus the communication factor is the most important shown by the estimation results.

When medical errors occur, each staff should not be blamed in usual case, because the circumstance of free and open communication will diminish and the number of incident reports will decrease. The possibility of happening of medical errors will higher. Reconsideration of the system as a whole is more important.

Many medical errors occur on hospitals in Japan every day. Serious medical malpractices that patients unfortunately died also have occurred in Japan. There is a tendency that the hospitals in which serious medical malpractice occurred in the past have induced serious medical malpractice repeatedly. Those hospitals are considered to lack the medical safety culture.

It takes long times to make up the medical safety culture. The commission external experts must be held as soon as possible after serious medical malpractice occurred. The commission external experts must verify the reason why serious medical malpractice occurred, and present the plan of recurrence prevention. The possibility is low that the internal verification system can work well. The external audit is needed for those hospitals regularly. Needless to say, internal staff’s efforts must be practiced.

According to our empirical study, it is important to breed the supervisor’s behavior related with the promotion of medical safety, the circumstance where medical staffs can discuss about the medical safety freely, and concerning about the medical safety as a whole of the hospital.

Tasks to reduce serious medical malpractices for policy makers are to eliminate the condition of doctor shortage, especially in surgery and the stress from overwork. This problem is more serious in rural area. Other policies on this problem are to enlarge the field of task which nurses can practice, for example, anesthesia, and to promote the cooperation among hospitals, especially between advanced treatment hospital and other hospitals.

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