

Constructing the Evaluation Model for Hospital Wards Fire Safety Mitigation

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Introduction

Chong-Gung Memorial hospital ICU wards got fire in 1991 and causing one person died ; Ren-ai hospital fire in 2000 causing 8 persons died and 19 persons injured. Mennonite Christian hospital underground kitchen fire in 2004 causing three people choking injured and evacuated thousands of patients. Even the public astonished why the hospital gets fire; unfortunately, as long as the hospital gets fire, the damage will be very serious.

After investigation of the hospital fire causes, we find the major groups in hospitals are patients, who are the weak, handicapped, and people hard to evacuate independently. In addition, the hospitals always decorate flammable materials and short of the entire fireproof and smoke barrier compartments. The evacuate equipments depend on the codes are not suitable for the patients. Therefore, the patients always meet a difficult situation when they are evacuating. Moreover, the fire

drills and evacuation for the medical servants are hard to put into practice. Most drill plans just depend on the lowest demand. In fact, the domestic hospitals now always have their own fire prevention plan included fire extinguish team, announce team, evacuate guide team, life safety team, and emergency medical treatment team even hiring the fire prevent manager. Nevertheless, through practical investigation on parts of regional hospitals and medical centers, we discovered most of the fire prevention plans are only the documents and very similar. They did not depend on their realistic configuration design and management system and to make the scenario-based fire prevention plan. As a result, these documents rarely fit the real needs and always lead to the serious damage.

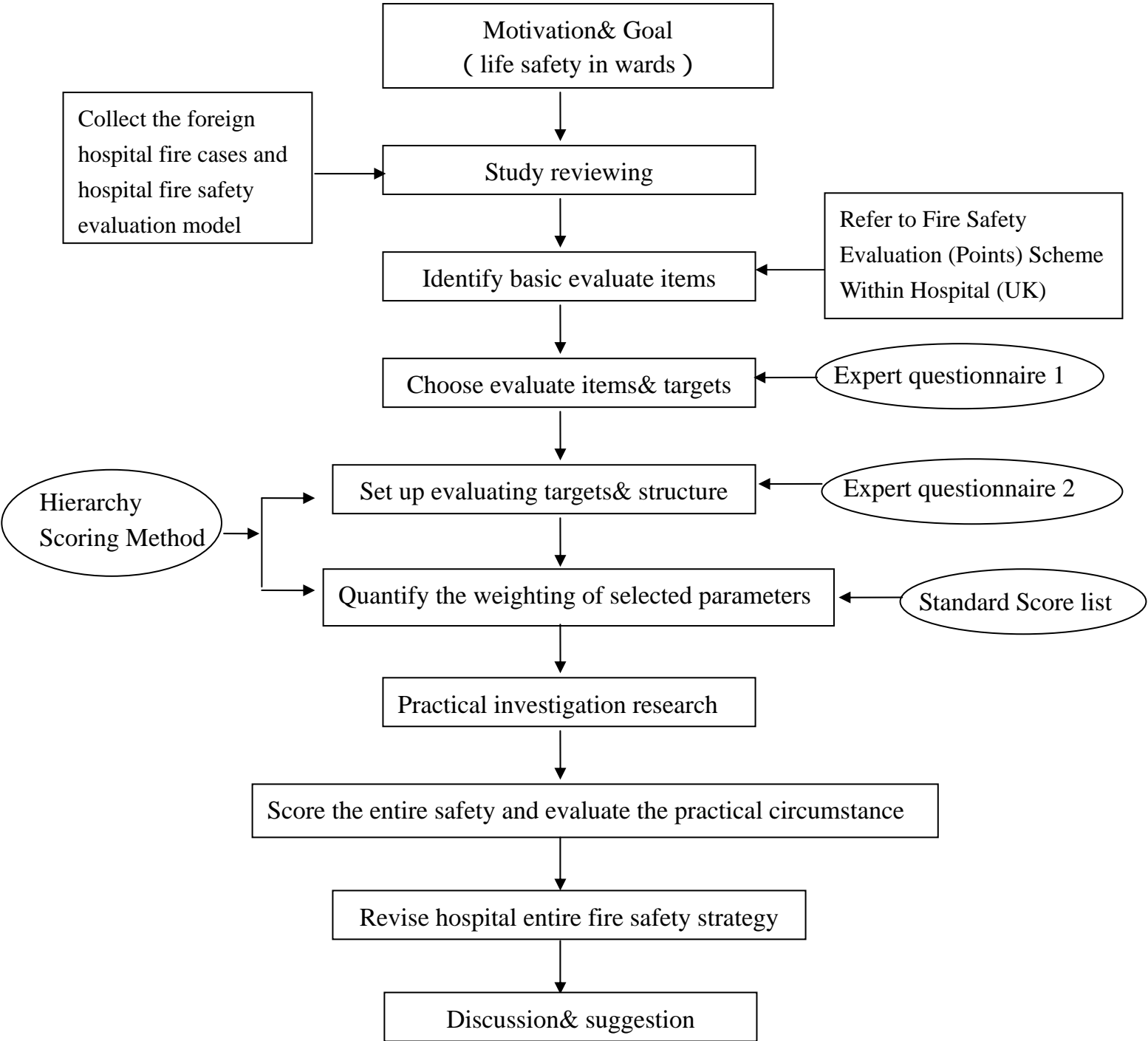
With the time goes by, there are more and more huge scale hospitals in Taiwan. Based on the 1991 statistics, there are 10 medical hospitals providing over 500 wards and most over 1000 wards. As the patients increasing, the outpatient services increase rapidly, comparing to the other occupancies use, the fire safety in hospital confront with critical challenge. Because of the occupational activities, the medical centers and regional hospitals add meals, shopping and the other services. Therefore, those additional facilities raise the rate of fire increasing. Furthermore, there are more and more hospitals begin to extend the range of prohibiting smoke and cook in wards but on the contrary, there are more and more people will cook or smoke on the shadow

place. In order to attain their smoke goals, many smokers will cover or destroy the smoke detectors especially in the concealed place. For creating a safety environment, we need to draw up an effective fire management strategy.

Owing to no any complete fire safety design and evaluation standard on the hospital wards have been established, the current codes are not set up according to hospital specific characteristics. Therefore, we try to find the influential parameters then map out the effective protection strategies to avoid those tragedy happened; even it happen, we should have the capability to low down the casualties and save the patients and medicals servants for the purpose.

This study is through integrating the opinions in architects; medical science manages, and fire protection professionals, even through the nursing leaders and the expert's questionnaires and interviews. We take medical centers for example and proceed to catch the key parameters and practice all kinds of examinations. Through checking the current codes and the fire prevention management of the weakness, the managers know how to make the reasonable investments on fire prevention, emergency response control and evacuation for lowing down the crisis risk, strengthening effective evacuation, fire spread prevention and early announcement.

Research Methods:



This study is based on the Fire Safety Evaluation System (USA)

, Fire Safety Evaluation(Points) Scheme For Patient Areas Within Hospital (UK) and so on. On the basis of the evaluation sheets, we proceeded to cases analysis and came up with recommendations. We picked up the experts' opinions in architects, medical science, and fire protection professionals and present the important parameters. We are proceeded the first time expert's questionnaire to pick up the evaluation targets and goals. Then, through the second time expert's questionnaire and interviews to make consensus on the influential hospital fire safety parameters and set up the evaluation standard to proceed the weighting of selected parameters.

The result is the emergency response control should reach over 50% on total safety level (acceptable life safety level). Only reach that, it fit in with the acceptable life safety standard.

The main method as followed:

Study reviewing (refer to Fire Safety Evaluation(Points) Scheme) pick up the evaluate goals and objectives set up evaluating targets and structure (through the experts questionnaire) quantify the weighting of selected parameters.(Hierarchy Scoring Method) practical investigation research design the practical score worksheet and pick the two medical centers for evaluation.

Step 1: Refer to Fire Safety Evaluation (Points) Scheme and pick up 20 safety parameters from it.

Step2: Experts questionnaires, through second times questionnaires to decide every influential parameters and weights. Making the worksheet to score through concluding the experts' opinion and interviews result. On the basis of the motivation divides into two ward types, the first type ward is the patients can evacuate by themselves or assisted equipment (wheelchairs). The second ward type is the patients are hard to evacuate independence and need somebody's assistance, cannot interrupt the treatment and have to in the wards where they had been.

Step3: Hierarchy Scoring Method: take advantage of the experts' questionnaire then pick up the targets and goals. The sum is 1 then calculates the weights.

Step4: Practical Investigation: Choosing two medical centers in Taipei then precedes the questionnaire survey and call on. Through the actual case investigation, we can realize the hospital facilities, fire management system, the rate of the nurses and patients during the daytime and night, etc.

The results and analysis

About the evaluation norm structure and weighting as follow Figure 1 and Figure 2:

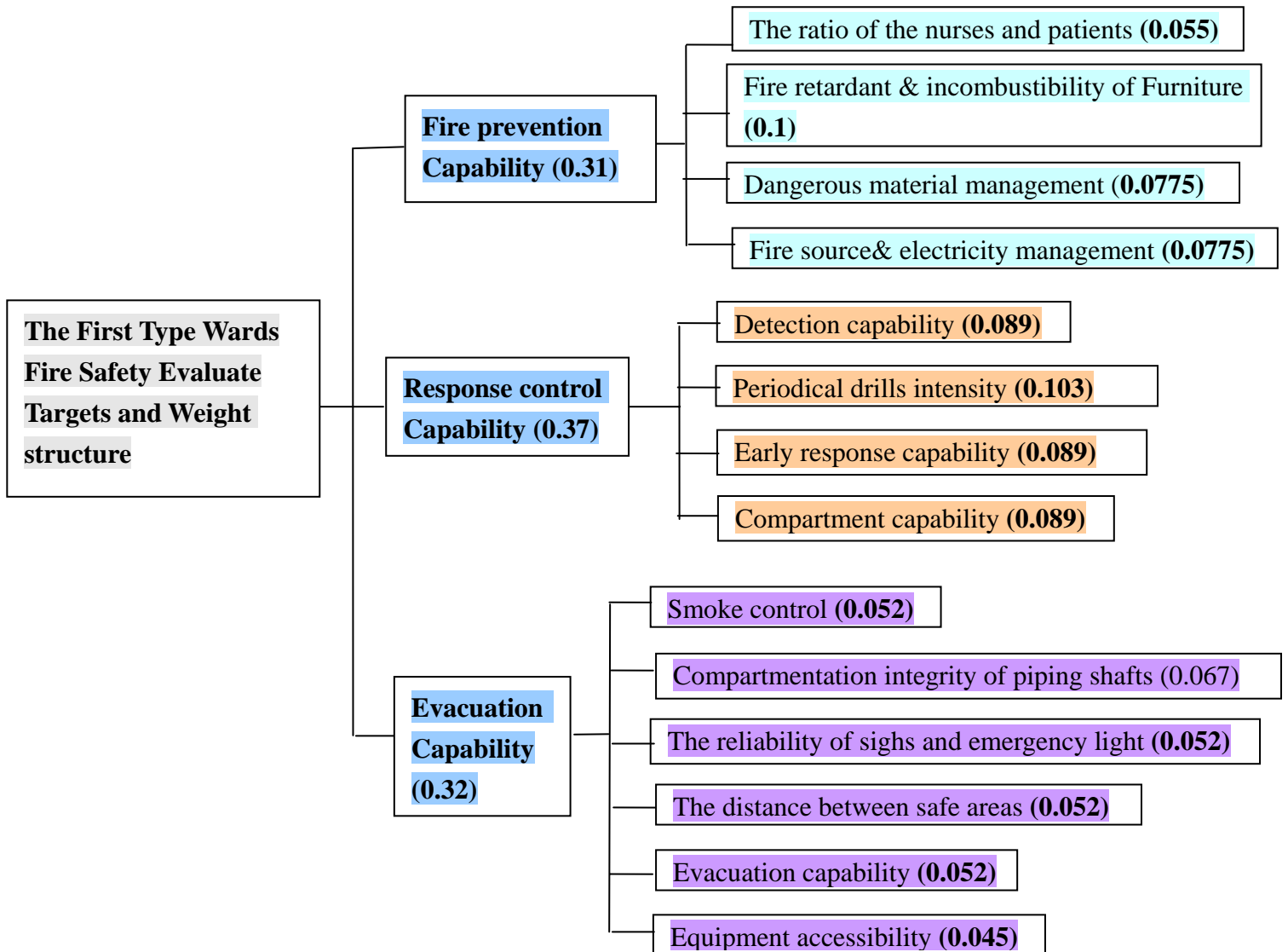


Figure 1 First ward type evaluation norm and weighting structure

On the basis of weight percentage analysis, as far as the first ward type is concerned, the response& control capability is more important then the fire prevention and evacuation capability. At the mean time, through the foreign fire cases and experts opinion, the response control capability items indeed play a critical role on the first ward type.

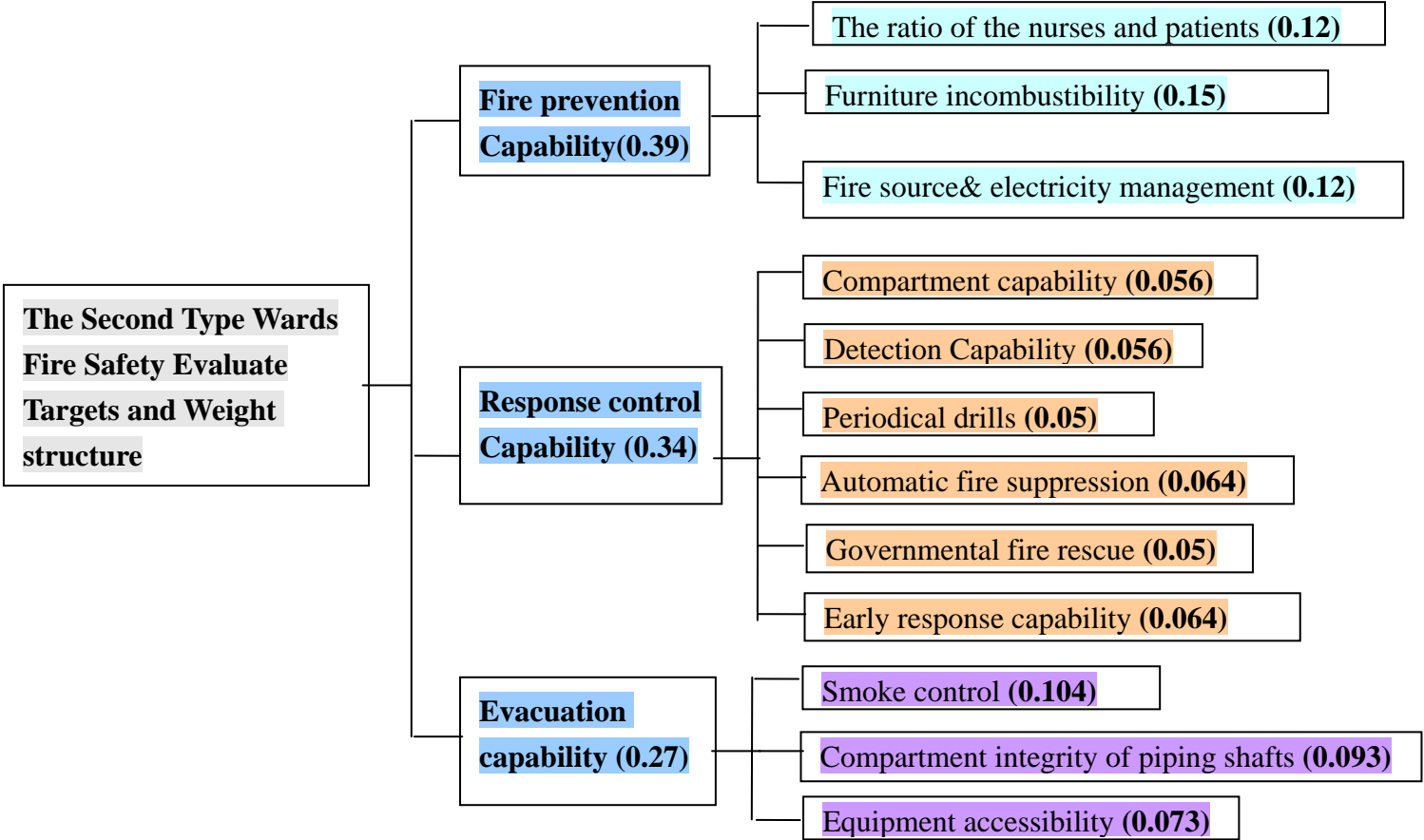


Figure 2 Second ward type evaluation norm and weighting structure

Regarding the entirely safety, we refer the Fire Safety Evaluation (Points) Scheme and set 0%-33% is 「absolutely unacceptable level」, 34%-50% is 「unacceptable level」,

51%-60% is 「acceptable level」, 61%-90% is 「good」, over 91%-100% is 「excellent」.

The empirical survey, we actually score all the hospital every department and investigate the inner hardware equipment, for example the smoke control ability, fire and the integrity of compartments. Although there are some limits on the process, we do our best to interview the staffs from constructor, fire safety, and electrical department and then grade the hospital fire safety.

The score results are listed on Table1 and Table2. We divided into 5 areas (from A to E) on the basis of the space independent characteristic. A is the old area of X hospital; B is the new area of X hospital; C is the front building of the old area of Y hospital; D is the back building of the old area of Y hospital. E is the new building of Y hospital.

Table 1, The First Type of Wards Score (parametersxweighting)

Evaluation Parameters (xweight)		Targets				
		A	B	C	D	E
Fire prevention Capability	1. The ratio of the nurses and patients	0.3	0.3	0.3	0.3	0.3
	2. Fire retardant & incombustibility of Furniture	0.63	0.63	0.63	0.63	0.63
	3. Dangerous materials management	0.42	0.42	0.42	0.42	0.42
	4. Fire source& electricity management	0.35	0.35	0.35	0.35	0.35
	Percentage in all Fire prevention	60.71%	60.71%	60.71%	60.71%	60.71%
Response Control Capability	5. Compartment capability	0.42	0.42	0.35	0.35	0.35
	6. Detection Capability	0.48	0.48	0.64	0.64	0.64
	7. Periodical drills intensity	0.14	0.14	0.49	0.49	0.49
	8. Early response capability	0.28	0.28	0.42	0.42	0.42
	Percentage in all Response Control	45.52%	45.52%	65.52%	65.52%	65.52%
Evacuation Capability	9. Smoke control	0.14	0.42	0.21	0.21	0.42
	10. Compartment integrity of piping shafts	0.54	0.36	0.36	0.36	0.36
	11. The reliability of sighs and emergency light	0.42	0.42	0.42	0.42	0.42
	12. The distance between safe areas	0.24	0.42	0.3	0.3	0.3
	13. Evacuation capability	0.21	0.21	0.28	0.28	0.28
	14. Equipment accessibility	0.25	0.25	0.25	0.25	0.25
	Percentage in all Evacuation	43.90%	50.73%	44.39%	44.39%	49.51%
Total score		4.82	5.10	5.42	5.42	5.63
Percentage in all (%)		51.83	54.84	58.28	58.28	60.54

Table 2、 The Second Type of Wards Score (parametersxweighting)

Targets		Evaluation Parameters (xweight)				
		A	B	C	D	E
Fire prevention Capability	1. The ratio of the nurses and patients	0.48	0.48	0.48	0.48	0.48
	2. Fire retardant & incombustibility of Furniture	0.70	0.70	0.70	0.70	0.70
	3. Fire source& electricity management	0.40	0.40	0.40	0.40	0.40
	Percentage in all Fire prevention	60.77%	60.77%	60.77%	60.77%	60.77%
Response Control Capability	4. Compartment capability	0.48	0.48	0.40	0.40	0.40
	5. Detection Capability	0.48	0.48	0.64	0.64	0.64
	6. Periodical drills intensity	0.14	0.14	0.49	0.49	0.49
	7. Automatic fire suppression	0	0.63	0.63	0.45	0.63
	8. Governmental fire rescue	0.14	0.42	0.42	0.14	0.42
	9. Early response capability	0.36	0.36	0.54	0.54	0.54
	Percentage in all Response Control	33.33%	52.29%	65%	55.42%	65%
Evacuation Capability	10. Smoke control	0.2	0.6	0.3	0.3	0.6
	11. Compartment integrity of piping shafts	0.54	0.36	0.36	0.36	0.36
	12. Equipment accessibility	0.5	0.5	0.5	0.5	0.5
	Percentage in all Evacuation	42.76%	50.34%	40%	40%	50.34%
Total score		4.42	5.55	5.86	5.4	6.16
Percentage in all (%)		42.91	53.88	56.89	52.43	59.81

For the second type of wards, the score result is listed as Table 2. The Fire prevention Capability, A-E all reach 60.77% 「good」 level; the Response& Control except A is lower than 40%, B and D are over 50% 「acceptable」 level; C and E reach 65% 「good」 level; the Evacuation capability, except B and E, all others are lower than 50%. For the entirely fire safety, A reaches 42.91%, B is 53.88%, C is 56.89%, D is

52.43%, and E is 59.81%. As far as the total scores are concerned, B, C, D, E reach 「acceptable level」, but on Evacuation capability, C and D is obviously lower than 50% 「acceptable level」. For the second type of ward, the patients are hard to evacuate by themselves. Based on the fire case investigation reports and experts meeting results, because those patients are taken as the delay evacuators during the fire early period. Therefore, the 「smoke control」 and 「Compartment Integrity of piping shafts of the hospitals」 are the key points. As a result, our study consider the two parameters should get over necessary scores then can be taken as 「acceptable level」.

Discussion

The study is to protect wards fire safety. From the foreign hospital document collections, case investigation analyses, experts questionnaires, empirical investigations then proceed to pick up the evaluate items and establish the level structure and case analysis. The objective is to set up the local hospital wards fire safety evaluation model and choose the critical parameters depending on the separate patients. On the basis of the result, through the expert questionnaire and Hierarchy Scoring Method, we define the first and second type of wards and give them the weightings.

Conclusion

- 1、 According to the questionnaire and investigation, **to the first type wards** (*the patients can evacuate by themselves or assisted equipment (wheelchairs)*), The result is 「**Response Control Capability**」 is much more important than 「**Fire Prevention Capability**」. The importance order list is

「**Response Control Capability**」 > 「**Evacuation capability**」 > 「**Fire Prevention Capability**」.

- 2、 On the contrary, **to the second type wards** (*the patients are hard to evacuate independence and need somebody's assistance, cannot interrupt the treatment and have to in the wards where they had been.*), The result is 「**Fire Prevention Capability**」 is much more important than 「**Response Control Capability**」. The importance order list is

「**Fire Prevention Capability**」 > 「**Response Control Capability**」 > 「**Evacuation capability**」.

- 3、 We recommend the follower can try to take the Region hospitals as evaluation objects and set up another basic materials and comparing the weightings of selected parameters. And then the conclusions can be referred to improve priority.

4、 From many serious fire case investigation reports, it is not hard to find the major reasons are a series of chairman errors, for instance, the ignorance, training not completeness, incorrect management, etc.