Evaluation of Guideline System and Sign Design of Public Space in Taiwan Emergency Department

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Abstract. In order to prevent the man-made error under stressful environment in the Emergency Department (ED), it is important to design the clear guidance of the sign. The anticipated goal of this study is to evaluate the emergency service in three major hospitals of southern Taiwan, especially to compare the strengths and weakness of guidance sign and the medical flow. By the focus groups with design professional and twice questionnaires, this study not only indicates the common problem of ED, but also redesigns the guideline system. The researchers consulted the strength in current emergency system and integrated color-coding to signal redesign. Guiding Line, Banner Design and Color Coding Integration were shown in the design stage. In the end, three factors (Guidance, Identification and Comprehension) were estimated the usability by Likert scale in questionnaire II. The design improvement might increase the efficiency and efficacy care of S.O.P in hospital emergency service, as well as quality of patient in future ED.

Keywords: Sign, Emergency Department, Public Area, Color Coding.

1 Introduction

In order to improve the patient safety and comfort, guideline system and sign design in medical field is very important, especially in the high-pressure Emergency Department (ED). In order to estimate and prevent the man-made error under fast and stressful environment in the ED of the hospital [1], the design of clear guidance of the sign to be easily allowing the patients to follow is extraordinarily important. A useful medical guideline system should allow for reliable and accurate interaction between system and the users in ED [2] [3]. Encoding, visualization and decoding is the process of information transmission [4]. According to the recently research [5] are three key points of sign design; (1) Arouse the reading motivation of user, (2) Attract the attention of users, (3) Increase the users' comprehension (See Fig 1). The successful sign design should base on the human-center standard, and stand on the viewpoint of user.

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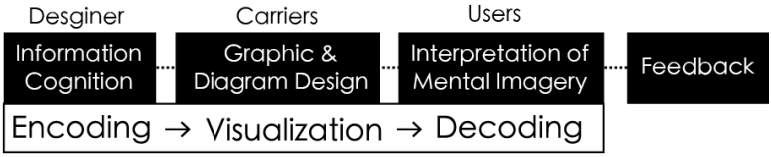

Fig. 1. Information Transmission [4]

Generally speaking, the medical flow of ED in Taiwan is working as Fig 2, when the patients arrive, the nurse or volunteer staff will start to triage the state of illness, and patient will ensure their triage station before the register. Then, the nurse will show the way for the appropriate consulting room and give the treatment. After seeing the doctor to decide receive the surgery, hold for continual observation or hospitalized for further treatment. The final stage is go to cashier and pharmacy and then discharge from the hospital.

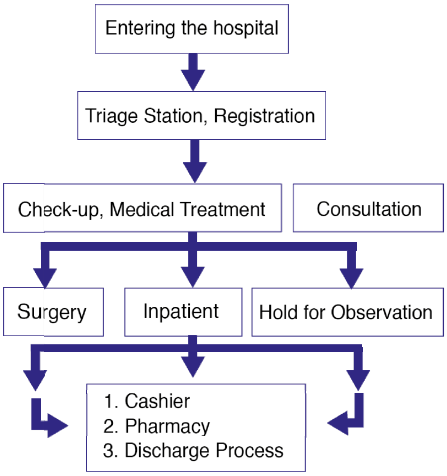

Fig. 2. Flow Chart

This study aims to evaluate the guidance sign of emergency service in three major hospitals of southern Taiwan and compare their strengths and weakness of the working flow. On the other hand, the study points out the common problems found in Taiwan ED, and conclude the opinion from experts and user to redesign the guideline system.

2 Methods and Data Collation

This study aims to evaluate the emergency service in three major hospitals of southern Taiwan; we collect the basic profiles of three hospitals by observing the daily flows in National Cheng Kung University Hospital (NCKUH), Chi Mei Hospital (CMH) and

Sin Lau Hospital (SLH) respectively. Through literature review and observational techniques to verify the key elements of the guidance design; then, the researchers precede the first focus group and questionnaire to integrate the experts' opinion s and the core issue.

2.1 Observational Techniques

Observational techniques are one of the important aspects of action research and case studies whether undertaken by participants or outsiders. This study took the unstructured-participant observation [6] to data collection. The main idea is that researchers only do observation but not attend any activities of target. We use photography to collect the floor plan, path of the patient, sign and guideline system in three major hospitals in Tainan, the city of southern Taiwan.

2.2 Focus Group and Questionnaires

The focus group held in this study for twice, one took place after the observation to differentiate the study goal. The second focus group aims for the possible design directions. The participants who join the focus group have the professional background of medical or design. During the discussion, the researcher will asked the participants to share their personal experience of visiting the ED, introduced our observation outcomes and discussing the possibility of redesign the sign and guideline system.

Questionnaire I expects to confirm the problems found form first focus group applicable or not. Next, the second focus group will aim to refine the design concepts. When the researchers achieve the probable guideline system and sign design in ED by previous data collection, Questionnaire II will purpose the evaluation of new types of sign.

3 Results

3.1 Observation

Compare the three floor plans and the observation in NCKUH, CMH and SLH. We found that SLH has the smallest ED, as the result, the whole medical flow is easily understood by the patients. On the other hand, NCKUH is the largest among all EDs, in which had the most patients, and it was under the process of rebuild construction.

In term of the sign design and guideline system, there are only few guiding signs hang on NCKUH, but many temporary icons. The type of guideline system in CMH is really simple and clear, which won the good comments by users. Its medical flow collocated with number marks and single color-coding. SLH used two colors (light green and skin tone) to differentiate different use, one for index the road sign and other is target the destination in their pubic area of ED.

3.2 Focus Group I

Six participants were asked to join the Focus Group I, one has medical background, and others are industrial design experts. Based on previous observation, the main purpose of Focus Group I is to aid the inadequate information of ED and share the medical experiences as well.

There are some viewpoints found in the first Focus Group;

1. Many kinds of problem happened in ED, usually cause by the error that nursing staff didn't hand over the patients' condition completely.
2. Triage station is not clear that makes patient to ignore, and sometime nurse didn't ask patient's condition actively; therefore, the patient will miss the triage desk and jump to the registration stage.
3. Patient's family or accompanier paid more attention on problem of the sign seeking and guideline system.
4. Recently, the design concept of caring center often applied the "Central Island ".
5. It needs to be considered the other livelihood service; such as public telephone, convenient store, restroom, and ATM.

3.3 Questionnaire Survey I

Questionnaire I confirmed the result and problem of Focus Group I. The participants of Questionnaire I required to have the medical experience in ED or had accompanied other to use the emergency service. There is 70.91% of participants face the neglect of nurse in the ED, and 60% of participants didn't know where to register. The reason is that 58% of them couldn't find the guiding sign.

According to the Questionnaire I, more than half of the participants (56%) used the assistant sign to find their way; however, interfering with many other signs or couldn't find the right sign were the major issues of confusion. The patients and their families often use the sign of restroom, information counter, registration desk and pharmacy. It was found that more than 80% of participants think the hospital should propagate the serious injury patient's priority while they on waiting list of emergency medical service.

3.4 Focus Group II

Seven participants attended Focus Group II, there are two major in nursing and three have design professional. Focus Group II aims to share the existing sign design to experts and discussing the potential design ideas to refine the concepts.

The researcher noted that the guiding system marked with numerical reminders made the whole proceeding easier. In addition, to encourage user's comprehension, the guiding line on the ground, which pilots different functions, was adopted. Nevertheless, these lines stick on ground will cause attrition problem. Besides, the arrowhead pattern probably caused the direction misunderstanding. The experts agreed that sign should overlook systematic design, and the concept of "Color-Coding" could be

a direction of farther approach. The experts also mentioned that it should shift the color of information to avoid causing visual tiredness on the long banner. Different purpose of use also addressed as a great ideas to distinguish the guideline system.

3.5 Design Stage

After reformulating the rough design concepts, the research team consulted the strength in current emergency system and experts' point of views. Then integrated color-coding to redesign guideline system. Guiding Line, Banner Design & Color Coding Integration was following the discussing session, and we separated them to two categories, "Line" and "Banner". (Table 1)

Guiding Line provided guiding information and direction on the ground of ED. Banner included more then three information or icons on the long board suspend from ceiling. Color Coding Integration, based on different colors and different uses to display the sign; for example, using colors to differentiate the medical or administrative signs.

Table 1. Design Items and Category

Category	Sign Design
Line 1	
Line 2	
Line 3	
Banner 1	
Banner 2	
Banner 3	
Banner 4	
Banner 5	

3.6 Questionnaire II and Usability Evaluation

In the last stage, the researchers appraised the potential designs' usability by the Questionnaire II. 55 questionnaires were done by the participants who have the experience visiting ED. Three factors: Guidance, Identification and Comprehension were estimated the usability by Likert Scale [7] in Questionnaire II.

Guidance is the factor that brings the definite guiding effect to the users. Identification aims for users to see the sign clearly or not. The third factor is Comprehension, which determines the understanding of information given. Questionnaire II was compiled statistics by repeated measure ANOVA, the comparison of different design items are given in Fig 3.1 & Fig 3.2.

Through repeated measures ANOVA, it was discovered that all the factors of three lines had significant differences. Guidance ($F_{2, 108} = 48.106$, $p < 0.001$); Comprehension ($F_{2, 108} = 14.928$, $p < 0.001$); Identification ($F_{2, 108} = 3.609$, $p < 0.05$).

It's feasible to use the ground line of guiding ways; yet, the pattern types should be choosing carefully. To figure the means of different items from Fig3.1, Line 1 gained the best Usability. Although monochromatic and solid Line2 got the good performance of Identification and Comprehension, its Guidance is weaker among others.

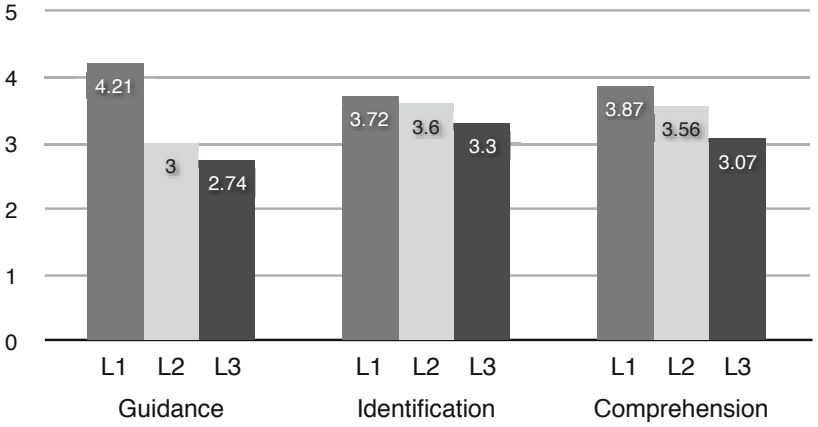

Fig. 3.1. Comparison of Usability of different Lines

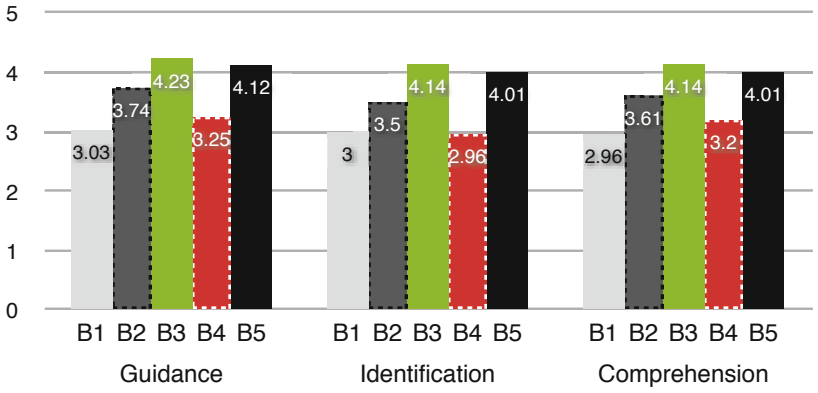

Fig. 3.2. Comparison of usability of different Banners

According to ANOVA, all the factors of five banners showed the significant differences. Comprehension ($F_{4, 216}$= 23.737, p< 0.001); Identification ($F_{4, 216}$= 28.704, p< 0.001), Guidance ($F_{4, 216}$= 28.156, p< 0.001).

By inference of paired comparisons, Banner 2, 3 & 5 are in the high-performance group, while Banner 1 & 4 are in the lower one. Banner 3 with monochromatic obvious contrast got the highest Guidance. The color differentiate Banner 5 took the second place. Monochromatic Banner4 and Banner 1, which are low contrast, achieved poor Identification among five items. The outcomes demonstrated that color separate with strong contrast or with different colors is a better choice for signs provided multi-information.

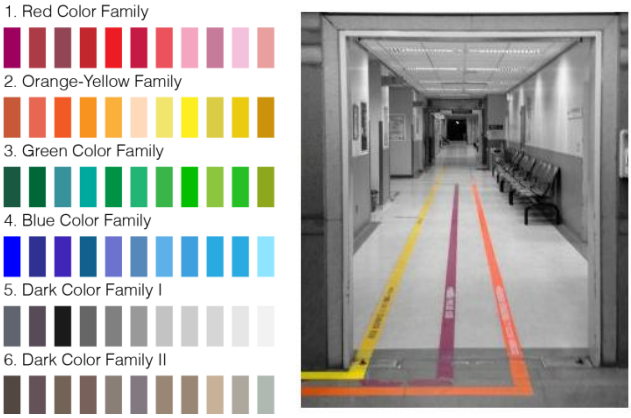

Fig. 3.3. Example of Color-Coding families and ground lining

Questionnaire II investigated the subjective preference of color-coding at the same time, most of participants (47.46%) prefer the analogous blue colors to use of administrative relevant signs, the green family (28.81%) stood on the secondary support level. On the other hand, preferences of medical relevant signs tend to the orange-yellow family (45%), and then the analogous red colors (28.33%). It was found that using the colorful lining guide-system practicable.

4 Discussion

Although the medical flow is completed in ED, but due to the specific status in the hospital, there were a few differences from other departments. For instance, the individual triage station, and variation of the registration. In addition, the interior configuration affects whole flow most. Some problems, such as containing the huge amount of patients or hospital beds obstructed the public area, caused by the interior design. It is discovered that visual guideline designs give few influence. The core-guiding problem is the crowded and disorder situation when lots of patients suddenly appeared in ED. Hence, the further study might focus on the guideline system of whole hospital environment and combined interior configuration.

Questionnaire Survey II demonstrated that colorful indicator sign and guiding line, which point out destination, are easier accepted by general. However, the patters

designed of Guiding Line should not be too complicated; and the color separation is the better choice for the banner provided multi-information.

The arrowhead emphasized the direction of Line 1, which won the higher Identification of users. In spite of other Lines also use stripe pattern to increase the degree of identify, they didn't obtain the users' confidence. The result confirmed that using color-coding to differentiate the medical or administrative relevant sign had high feasibility. Furthermore, colorful Guiding Lines on the ground are more obvious and directly for its usability, which could catch patients' attention. The items of lining also showed the higher degree of preference form Questionnaire II.

The study only evaluation the subjective preference, and it was limited by online survey. Studying in practical field of ED should be thinking about in the further research, the results might be different. In addition, graphic layout is the other important variables of sign design; for instance, the direction of the word or information on the banner might also affect the user' attitude.

5 Conclusion

The study found that it's hard for patients to seek the specific sign in ED; the identification might be confused if there are many icons provided. The researchers consulted the advantages and color plan of guideline system in public area of Taiwan hospitals, and redesign two main types of sign form experts' advices.

Line 1, with the pattern of arrowhead, got the good performance of Identification in questionnaire evaluation; the researchers discovered that banner with strong contrast or with different colors is the better choice of guide system of ED.

We anticipate our study to be a starting point for more sophisticated for efficacy care of S.O.P in hospital emergency service, as well as quality of patient in future ED. The other relevant studies will be benefit from such design developments.

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