

Emergency Service System Design for General Hospital

—in the case of Tenth People's Hospital of Tongji University

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ABSTRACT

Nowadays, China faces with the challenge of aging society, while there is still much room for improvement of public health care system. Under the current system medical resources are seriously wasted, meanwhile patients' satisfaction is low and physicians work with tremendous pressure. The No.10 People's Hospital is an important hospital in Shanghai which has great willingness to improve its service and offers much help to carry out a deep investigation.

A new concept of service system design built on systematic investigation of the target hospital would be proposed. The research was carried out mainly follow the sequence of the emergency medical care to discover all aspects of design opportunities, including not only the process of service delivery, but also the environment, the medical devices and communication between doctors and patients.

The triage tool kit, the treatment manual and the infusion related design are the main outcome of this research which would for sure help to improve the emergency service of the target hospital.

Key words: Emergency service, Experience, Large general hospital, Service design

Background

China stepped into the aging society since 1999, by the end of 2011 aged 60 and above in China's population has reached to 185 million. It is predicted that almost one out of four aging population would be Chinese in 2020.



nearly 2/14 of Chinese are elder than 60

Figure 1 ageing population of China

Aging has brought many problems, one of which is the increasing of the demand for medical services. It is known that the elderly might face with risk of various diseases, especially cardiovascular and cerebrovascular disease. If not gained timely treatments, they would have the risk of death. In that case, the improvement of emergency service is extremely important.

The aging process of developed countries often experienced hundred years, there has been plenty of time to perfect the relevant medical service system. For China, as the development of emergency medical service is still in the early stage, it needs more attention and investment from society.

On the other hand, with the improvement of people's living level and health awareness, even the ordinary people of China choose going to the hospital more often than before.

Since the beginning of 21st Century, "SARS", "a/h1n1 flu" and other infectious diseases appeared one after another, emergency department of general

hospitals as the main battlefield dealing with these conditions, an efficient service system is necessary to be established.

The development of emergency medical service in China is still in its infancy. It was just been officially acknowledged as an independent discipline in 1987 by the Chinese medical association. There is still a lack of doctor training system and the operation process specifications by far.

Working in emergency department is extremely busy and dangerous and the staffs there are often under tremendous pressures, which would affect their mood, quality of life, and even endanger their physical and mental health. In recent years, there are lots of news about the frequent occurrence of medical disputes and even violence events, most of which happened in the emergency department. It is no doubt that the lack of high level medical service is one of the main reasons. While the lack of communication and understanding in the diagnosis and treatment are also could not be neglected. Shanghai Tenth People's Hospital (also named the Tenth People's Hospital Affiliated to Tongji University) was established in 1910, located in Zhabei district Shanghai, which provides medical service for nearly 2 million residents live around.

Related research and practice

Some doctors and nurses working in emergency department have developed many practical means to improve the service based on the data statistics and analysis from their working experiences. For example, arrange staff scheduling and work time according to the discipline of time of visiting patients. Arrange medical assistances from corresponding departments for the seasonal outbreaks of disease in advance. On the other hand, they thought about solutions to the existing problems found in current emergency service system initiatively, such as the introduction of electronic medical records, re

design the treatment process, improved treatment apparatus etc.. Through practice, these attempts to solve the existing problems in a certain extent, but overall a systematic integration is still needed.

Meanwhile, there has been considerable number of degree thesis from different professional point discussed about the problems and potential solutions of this topic.

Wang Miao from Northeastern University of China, in her Master's thesis "design and implementation of outpatient and emergency management system", started from the perspective of information management, designed the outpatient and emergency service management system, which provided a more convenient and efficient management platform for hospitals. Its main functions include register, recharge, triage, emergency outpatient pharmacy management, system management, data query, database backup, report printing and so on.

In addition, many designers from the perspective of architecture and environmental design did attempts on the construction of hospitals. In general, there are a considerable number of cases could be used as references. But researches from the perspective of service design are difficult to find.

Significance of the study

The main purpose of this research is to improve the design of existing emergency system, to carry out a more rational allocation of resources to promote public health, to provide timely and effective services for patients. To improve the service quality of emergency department of Shanghai Tenth People's Hospital and provide reference for other hospitals for theirs' service improvement.

Summary of the current status of emergency services of China

Compared with other relatively mature departments in hospital, emergency service department is still in its early stage of development. And the developments in different hospital are not balance. Although the norms and standards are increasingly rich, generally speaking, a big gap between people's need and the development of emergency medical service is still existed. There is a long way to go.

So called general hospitals in China are third-grade hospitals, which are comprehensive medical research and education centers, and are also most important places for the provision of health services for the residents. At present, in China there are more than 800 third-grade class-A hospitals, because of their abundant medical resources, they are generally the most trusted selections. And Tenth People's Hospital is one of them.

For the patients, they are seeking for control and healing of their diseases, so the most direct evaluation standard of the emergency service is the result of treatment. Besides, a large number of statistical and research show that, lots of other factors could also outcome of the service and the experience of the stakeholders. Those non-medical technology factors would be mainly studied in this research, which are the process, the environment, the tools and the interactions of people.

The process

Currently there is no specification of the emergency service process in China. Hospitals all around the country have developed their own emergency

process according to the specific circumstances of their own. The exploration of more efficient and reasonable process is continuing.

Although the specific processes are not the same, all patients have to go through triage when starting their journeys in emergency department. So it can be said that, the triage is the official starting point emergency service.

So-called triage is the process of determining the priority of patients' treatments based on the severity of their condition. This rations patient treatment efficiently when resources are insufficient for all to be treated immediately. The triage ensures the rational arrangement of the patients' sequence of treatment and effectively improves the success rate of emergency. At the same time, it could effectively control the number of visitors of emergency room and reduce the work burden and pressure of emergency department.

Prof. Zhang Baohua collected and analyzed the triage data from the year 1990 to 2000 of the hospital he worked in and found out that nearly 25% of the patients were actually non-emergency patients. During the interviews with doctors from the Tenth People's Hospital, a universal phenomenon was confirmed as it is. The reason is in many aspects, first of all, patients have not enough knowledge of self-evaluation of the severity of symptoms, at the same time, the pain and anxiety leads to the overestimate of their own diseases. Secondly, the hopes of getting rapid diagnosis and treatment making the patients chose to go to the emergency department rather than the outpatient department.

A large number of non-emergency patients rushed into emergency department, took up valuable medical resources and brought the huge pressure for emergency services. In practice, the main application of triage in Tenth People's Hospital was mainly for critical patients taking by the ambulance. It could not be generally applied to each emergency department patients, which is an important reason causing patients' long time waiting.

Except for triage, traditional emergency process usually includes the registration, waiting, treatment, laboratory, pharmacy, infusion, payment and other steps. The patients always complain about the long waiting time during their experiences along these steps.

The environment

A graceful emergency environment helps to create favorable atmosphere, which would generate positive and optimistic feelings for the patients and staffs. It consists of visual, auditory, olfactory elements which be directly perceived. Positive or negative emotional reactions to medical on medical environment can affect the experiences. Light, color and sound are all important aspects of perceived environmental design.

Emergency service facilities in the environment are used to meet the demands of emergency patients to eliminate their negative emotions. Some other facilities are provided for the medical staff, such as the lounge for resting when they are on the night shift. In addition, the peculiarity of medical service puts forward special requirements of barrier free facilities.

The tools

In the process of emergency service, the patients would be exposed to many tools and materials, such as medical equipment, promotional materials, medical records, registration card and drug packaging, which are the touch points of emergency services. Their usability and desirability affect the patients' experiences.

The staffs and interactions

A lot of work personnel working together to make sure the emergency service can be carried out in an orderly manner, they are the doctor, the nurse, the driver, the cleaning staff and so on. Their working conditions must be improved, and should get paid more abundant. It is also an important measure to disseminate the knowledge of emergency medical treatment to the user to guarantee the quality of emergency service.

The research of the emergency service of the Tenth People's Hospital

The Tenth People's Hospital was established in 1910, located in Zhabei district Shanghai, which provides medical service for nearly 2 million residents live around. It was selected as the first batch of third-grade class-A hospitals by the Ministry of health. The emergency service department is located in a single building with more than 3500 square meters. Now there are 29 doctors, 63 nurses and 8 medical guides and cleaners working there.

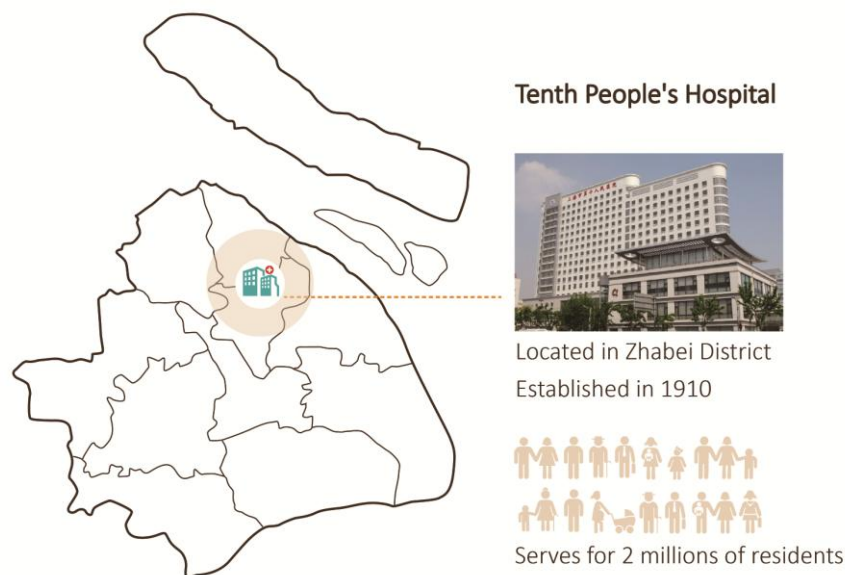







Figure 2 basic information of the hospital

Emergency service department of the hospital



	3500 m ² /2 floors
	29 doctors
	63 nurses
	318,000 patients
	12,678 times

by 2012

Figure 3 basic information of the emergency service department

According to the statistics, in 2012, the amount of emergency treatment was about 318000 times, and the growth rate was more than 50% compared with the previous year. They also received 120 emergency vehicles 12678 times. Daily emergency volume reached to 900 to 1000 times, in holidays it could reach to 1900 times. When the outpatient department closed, for example in holidays, the emergency department has to assume the duties of outpatient department.

The huge visiting number of patients is far more than the designed reception capacity, which would not only affect the quality of service provided to the patient but also would affect the life and work quality of the staffs. At present, the hospital plans to build a new emergency building, along with hardware equipment and personnel inputs, when completed it will greatly improve the emergency medical conditions.

The emergency process of the Tenth People's Hospital

The emergency process of the Tenth People's Hospital started with triage. The emergency triage station is located in the left corner in hall of the first floor,

which also take the duty of general consulting service. Although there are signs telling the patients to take the triage first, but it always be ignored by most of them. The second step is to register, while the registration office is located opposite the main gate. When registration completed the patients would go to the emergency consulting rooms, such as department of internal medicine, department of ENT and so on. Then they need to take the medical tests suggested by the doctors. When finished the tests they need to bring the results to the doctors to ask for diagnoses and prescriptions. Some of the patients would go to buy medicine and go home after wise, while some would take the medicine to the infusion room to have further treatment. A large number of patients would spend a lot of time waiting in queues outside the infusion room, during peak periods some patients might need to wait for nearly two hours because of the lack of nurses.

In a word, the emergency process of the Tenth People's Hospital is a combination of industry standards, practices and the specific conditions. The most prominent and initial problem is in the triage step, many non emergency patients get into the emergency service process resulting in a large number of medical resources are occupied, so that patients who are in truly critical condition cannot get timely and effective treatment. It also makes serious impact on the experiences of both doctors and patients. Besides, as the last service step for most patients, too much time was wasted in the queues outside of the infusion room. These also are the chances for improving.

The environment of the Tenth People's Hospital

The building of emergency department is within 5 minutes walking distance from both the underground station and bus stop, so it is quite convenient to get to. There are several convenience stores, fruit shops and fast food in the block.

The traffic is busy and a little noisy nearby, during the peak hour there would be congestion in front of the hospital. Because the space in front of the main gate always been occupied by the stalls, sometimes the ambulance even cannot enter.

Inside the building, the space is limited and the number of ward beds can hardly meet the demand of patients. Sometimes temporarily beds are needed to be placed in the corridor. There are only two windows for registration, which result in the serious queuing phenomenon in peak time. Sound, light, color and other aspects in the environment are also need to be designed. Besides, more green plants are needed to make the environment cozier and warmer for users.

Facilities, tools and materials of the Tenth People's Hospital

The public service facilities in emergency department are seats, public telephones, self-help registration machines, vending machines, TV, sphygmomanometer, microwave ovens, hand sanitizers, garbage cans and water heaters etc.

As there is always a long waiting time, seats are quite important facilities for patients. At present, the seats using in the waiting area are made of metals, which are cold especially in winters, and the height is too low for the elderly and the disabled to use.

There are many printing materials used in the service, which are the receipts, medical records, prescription, medicine packaging and bills for infusion. These are important documents for each step and should be properly kept. Sometimes they are quite confusing for the patients.

Staffs, patients and interactions

29 doctors, 63 nurses and 8 medical guides and cleaners are working in the department of emergency service. Through the questionnaire and the interview, their evaluations on their jobs and the work environment are collected. Most of them held the opinion that they were suffering the intensity of work and poor working environment. And from the points of staffs, most thought that the doctor-patient communication was not enough and the relationship between them was quite tense.

The patients coming to the emergency department were mainly residents living nearby. Through interviews with them, some serious problems were found. First of all, they said the emergency space is limited especially in the infusion room the number of seats was far more less than it should be. Another problem they complaint a lot was the long waiting time. The patients almost needed to queue up for every step of the service. While waiting their demands cannot be handled in time. And even the elderly and disabled needed to wait in queue, there was no special measures to help them.

Persona and journey map

In order to have further knowledge of the experiences of the patients, in-depth observations were taken. The first approach was chose the individual patient as the target, tracking the whole experiences they had in emergency department. The second approach was staying in the key scenes of the process observing their behaviors and interactions in order to find out some common and unique problems of the service.

The queuing phenomenon of the infusion room was complained most by the patients. Data collection and analysis were carried out to this problem. The number of the waiting patients was counted at different time of a day. It is found out that the number would reach to 50 during the peak hour. Time for

handling each queuing patient was also counted. Normally it would take around 1 minute and 20 seconds for each of them finishing infusion registration. The operations of infusion registration including finding a available seat, giving the medicine to the infusion nurse, getting the bill of infusion from the nurse and then going to the chosen seat to wait. In several minutes, the other nurses who take the responsibility would go the seat and do the infusion. The patients should away take an eye on their amount of medicine, when the medicine is close to be finished they need to call a nurse help to pull the needle out and finish the infusion.

In practical, sometimes the infusion nurse need to help the patients to find them seats and sometimes she would even be asked by some patients to pull their needle out, so that lots of time might be wasted. The handling time for the waiting patients would often get much longer than it should be. During the research the average times was more than 2 minutes and 10 seconds, which means if there are 40 people waiting the queue the total waiting time for each of them would be nearly 1.5 hours. While, if the infusion nurse could only focus on her own duty the waiting time would reduce to 50 minutes. That could be an idea for improving the service.

Base on the findings of the researches above, personas and journey maps were developed for deeper understanding of the design opportunities.

78 years old Mr. Zhang is retired and lives in the neighborhood. He is quite familiar with emergency service procedures. One morning he felt headache and dizzy and went to the emergency department alone at 9 Am. In hospital he took the routine test of blood. At end the doctor told he to take oral medicine and have good rest at home. Followed is his journey map.

17 years old Xiaoming is middle school student whose school is nearby. He is unfamiliar with emergency procedures. Because of abdominal pain he went the hospital at 11 Am with his classmate Xiaoma, who helped him a lot during the service. Xiaoming took B-mode ultrasonography as the doctor told him to. At end he was asked to take infusion. Followed are the journey maps of them.

Personas



Mr Zhang
Age:78

Retired, lives in the neighborhood
Familiar with emergency procedures
High blood pressure, headaches and dizziness,
Goes to the hospital alone at 9 Am
Inspection item: routine test of blood
Doctor: Oral medicine, rest



Xiaoming
Age:17

Middle school student
Unfamiliar with emergency procedures
Abdominal pain
Goes to the hospital at 11 Am with classmate
Inspection item: B-mode ultrasonography
Doctor: Oral medicine, Infusion

Figure 4 Personas

Journey Map

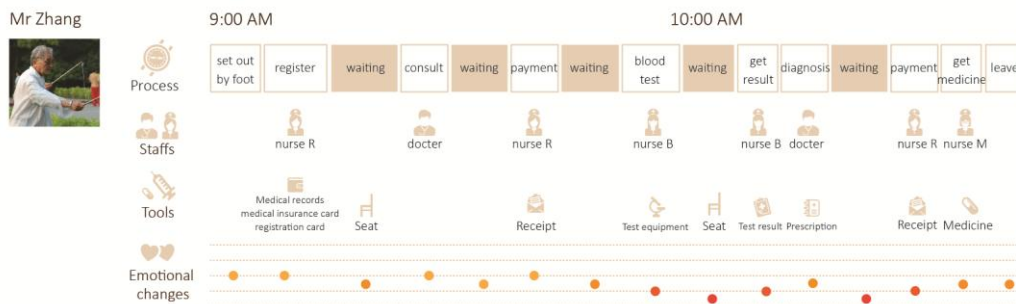


Figure 5 journey map of MR. Zhang

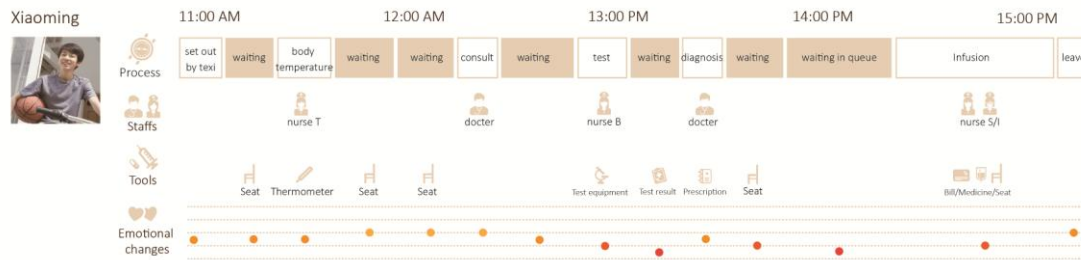


Figure 6 journey map of Xiaoming

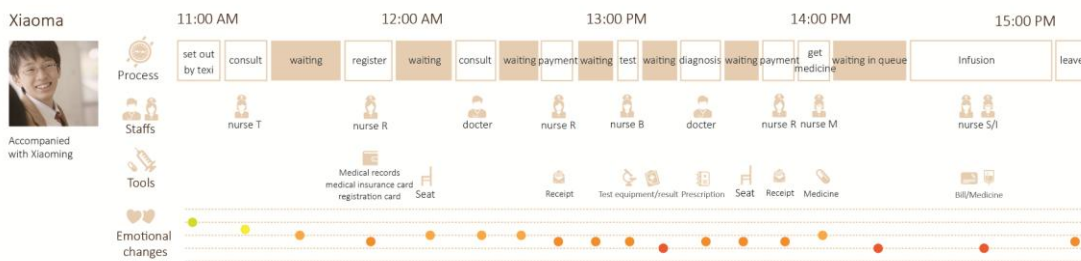


Figure 7 journey map of Xiaoma

In summary, the problems which have greatest impact on the experiences are process's complicated, queuing process's too much, waiting time's too long, the needs of accompanying persons are not been considered.

System map of the service

The stakeholders of the service are the hospital, the staffs, the patient and the other patients and accompanying. The Secondary stakeholders are the

Medical equipment provider, the medicine provider, social security department and the medical waste management sector.

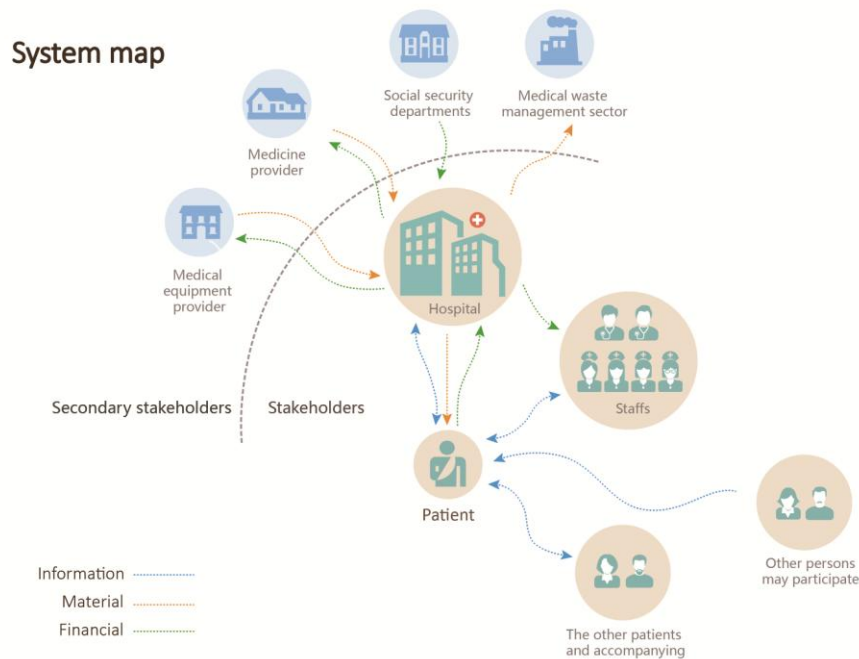


Figure 8 system map

Besides tangible medical treatment, the content of the service is actually information. So the service design of emergency medical care is about communication design. The tangible medical treatment can hardly be improved by design approaches. While from the perspective of communication the problems of emergency service could be re-thought.

The patients thought process's complicated, that might also because the guidelines are not clear enough for them. For the other problems, does each patient need to line up? Is accompany really needed? The answers of these questions could help to develop design concepts.

The design of emergency service

At present, the patients and their accompanying spent reasonable money and quite long waiting time to get high quality diagnosis and treatment. For the future, the waiting time is needed to get shorten and more value would be added by design methods. These include intimate services, medical and health care knowledge, and eventually a lasting mutual trust relationship.

At the same time, through the establishment of new service system, the burdens and pressure of the medical staffs can be effectively relieved, at meantime their work environment and conditions would be improved. What is more, the strained doctor-patient relationship could be alleviated at the end.

Followed are the offering maps for both current and future service.

Offering Map

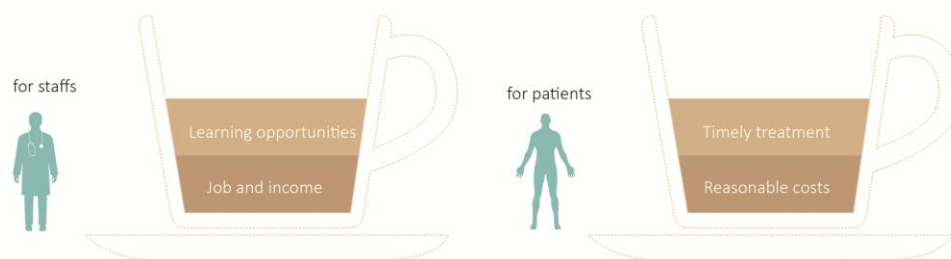


Figure 9 offering map for the current service

Offering Map

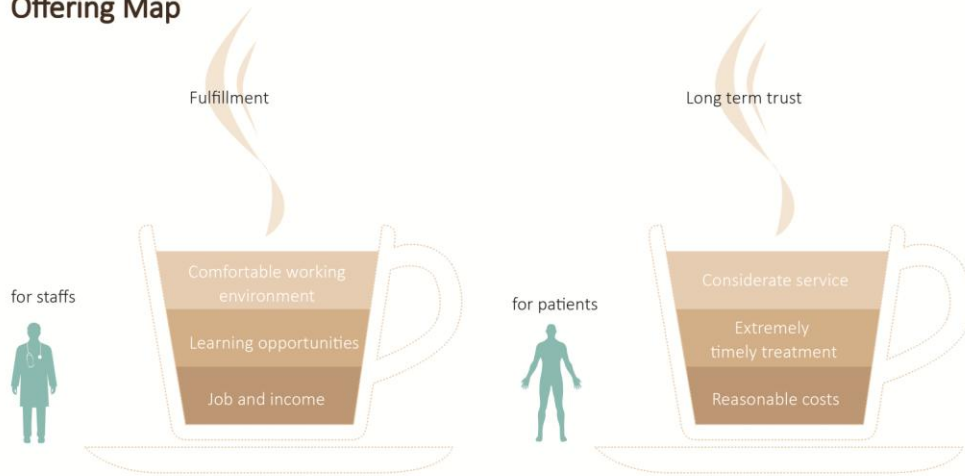


Figure 10 offering map for the future service



Figure 11 mood board for the future service

The emergency service is quite complicated system which could be divided into sub-services as followed.

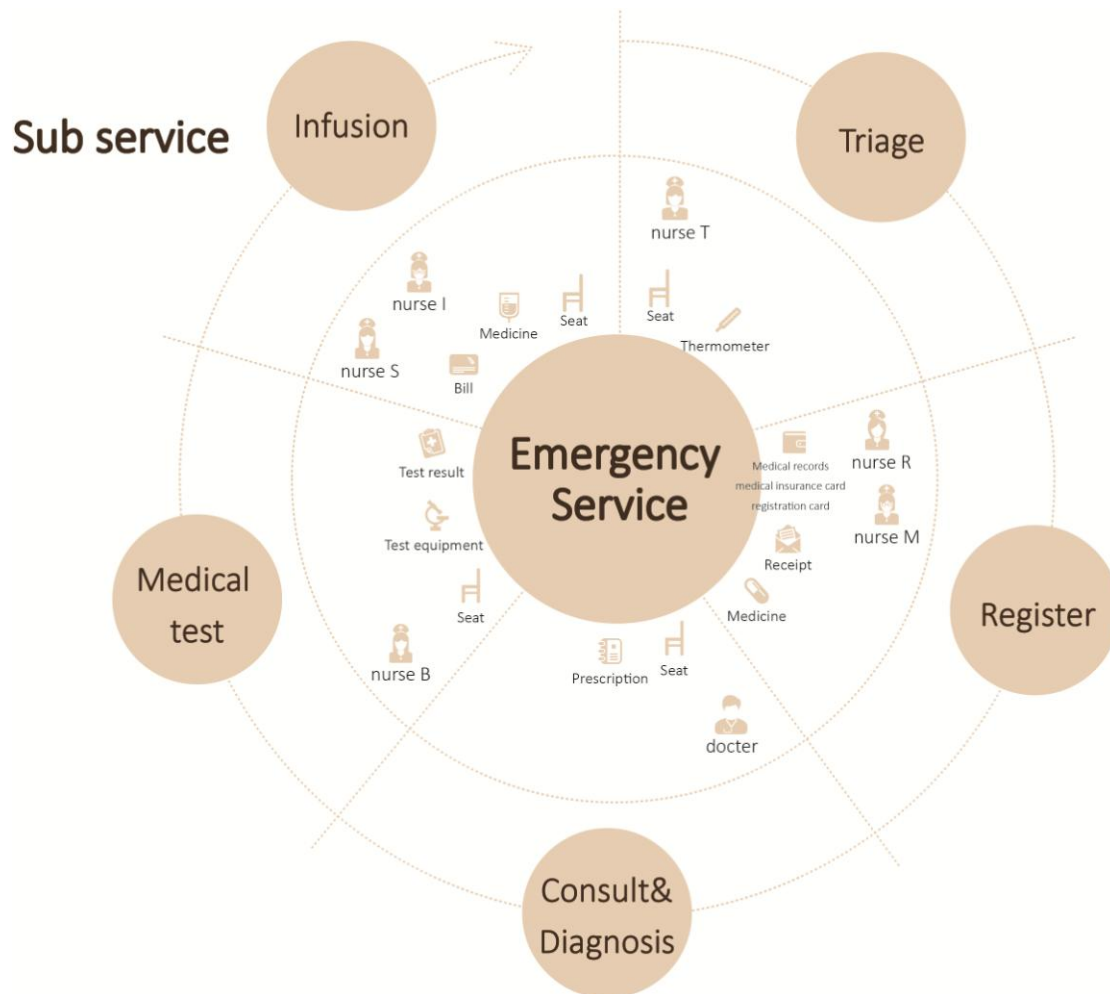


Figure 12 sub services of emergency service

The design would be in the following three aspects:

Triage tool kit Design

The triage is the operation of fast data collection of patients and treatment order arrangement according to the severity of their illnesses.

The aim of triage tool kit design is to help the nurse to perform triage quickly and accurately and to make sure all the patients get timely treatment. Shunt non-emergency patients and reduce the pressure of subsequent emergency

service. Reduce the waiting time of patients and improve the environment of the service.

The SOPA formula is widely used to carry out triage. S stands for subjective, which means collecting the patient's subjective feelings, including complaints and symptoms associated with. O stands for objective, which means objective data collected from the patients, including body temperature, blood pressure and so on. A stands for assess, which means analyze the collected data to make preliminary judgments. P stands for plan, which means arrange treatment order according the severity of illness.

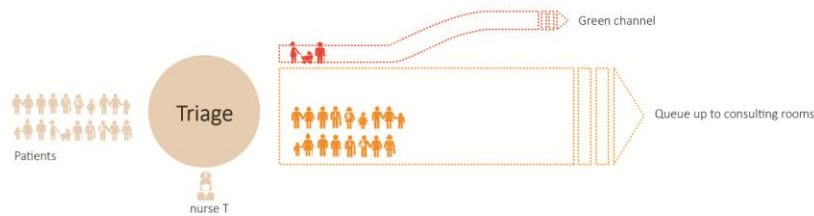


Figure 13 triage result of current service

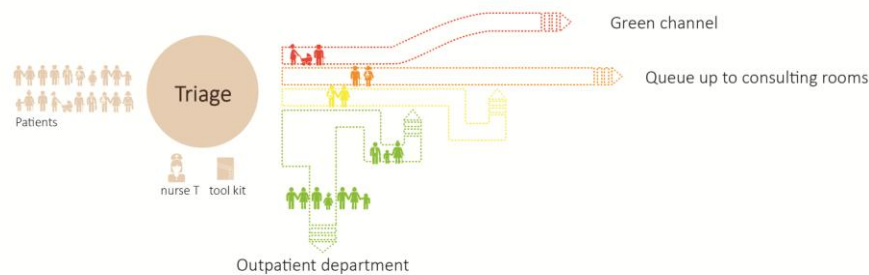


Figure 14 ideal triage results

The result of triage would be in four categories, which are the Critical, urgent, less urgent and not urgent. If the result is critical, that means the patient has life risk and should be treated immediately. If the result is urgent, that means there is a potential danger for the patient and the condition could dramatically change. The patient is in need of emergency treatment and close observation. Less Urgent means the patient's vital signs are stable and there is no serious

complication. Not Urgent means the patient could wait or go to outpatient department. If the patients who are not urgent could be picked out and go to the outpatient department, the pressure of the service could be effectively released.

Triage standard





-  **Critical** have life risk
-  **Urgent** the condition could dramatically changed
-  **Less Urgent** no serious complications
-  **Not Urgent** could wait or go to outpatient department

Figure 15 triage standard

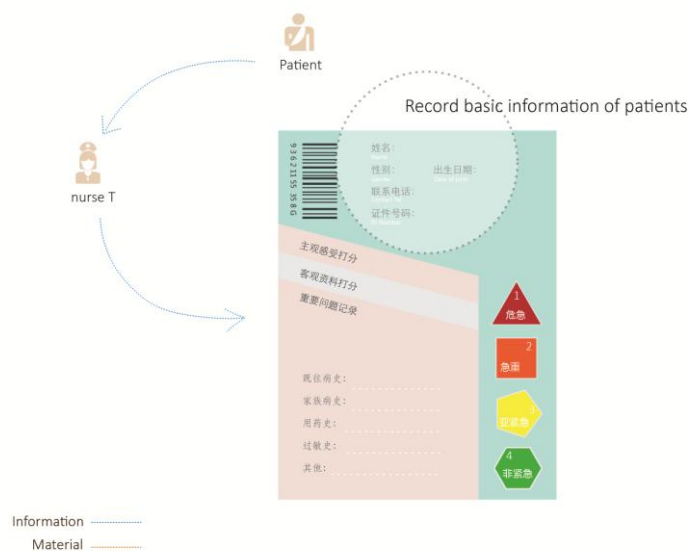


Figure 16 first step of using the tool kit

The first step of using the tool kit, the triage nurse would need to record the basic information of the patient, such as name, gender, age, cell phone

number and so on.

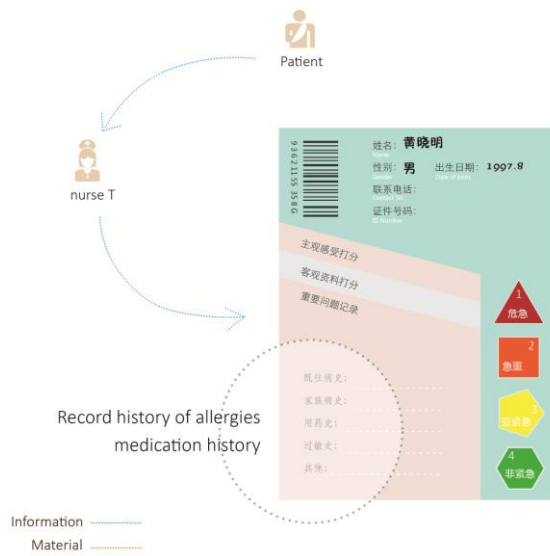


Figure 17 second step of using the tool kit

For the second step, the nurse needs to record the answers of some important questions, for example, if the patient has history of allergy.

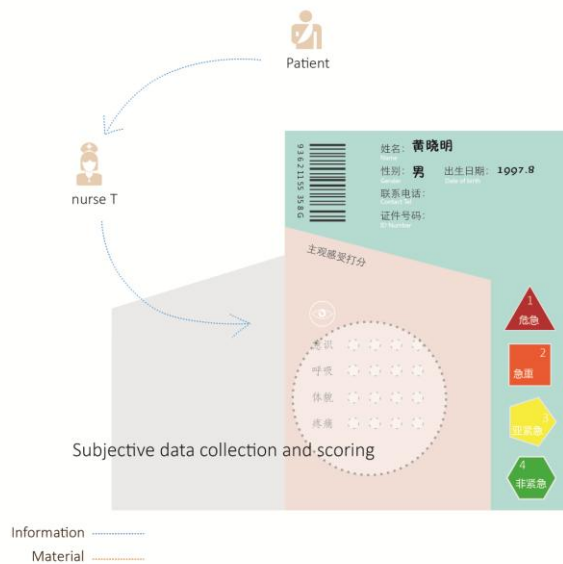


Figure 18 third step of using the tool kit

For the third step, the nurse needs to open the small pages on the left of the

tool kit to collect subjective data of the patient and to make a score of it. The score needs to be put on top of this small page for making the final judgment.

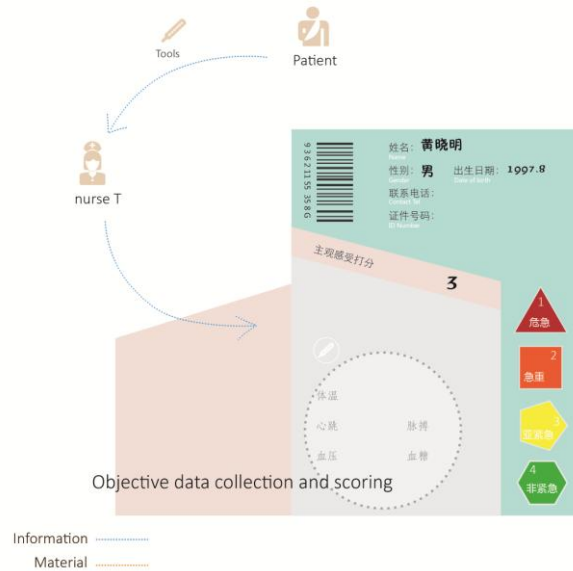


Figure 19 forth step of using the tool kit

For the forth step, the nurse needs to open the small pages on the left of the tool kit to collect objective data of the patient and to make a score of it. The score needs to be put on top of this small page for making the final judgment.

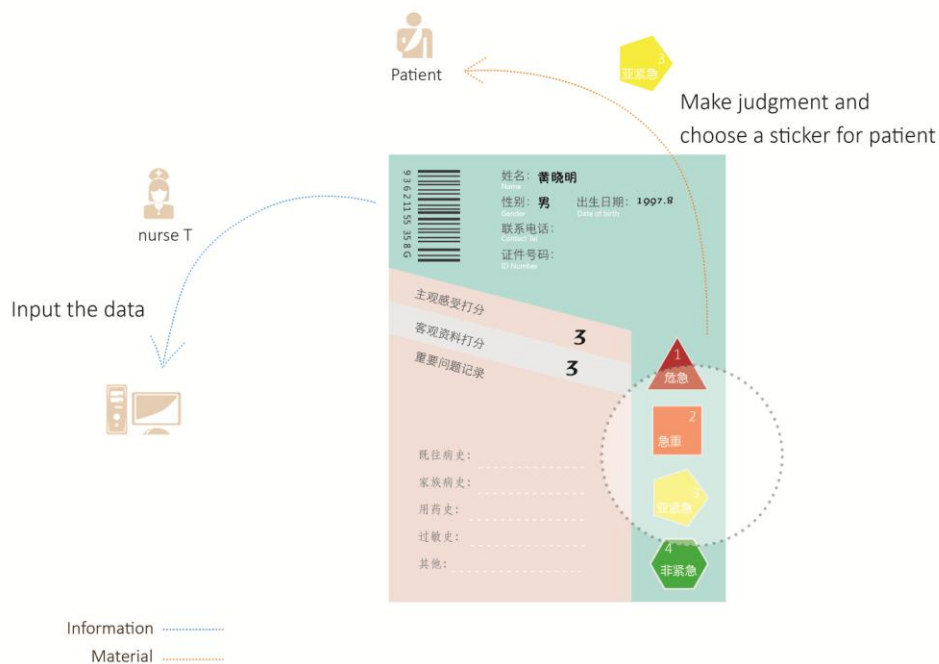


Figure 20 fifth step of using the tool kit

For the final step, the nurse needs to make a judgment of the patient's severity and choose a sticker from the tool kit for the patient. There are 4 stickers on the right side of the tool kit with different colors and shape, which stand for the Critical, urgent, less urgent and not urgent. The sticker should be put on a certain position of the treatment manual so that the doctors and nurses could easily follow it during the other emergency service steps. After the triage, the data would be input into computers.

Treatment manual Design

Many receipts and prescriptions would be used along the timeline of emergency service. They could provide tips for the patients of emergency procedures and needed to be better preserved. The aim of the treatment manual design is to help patients to better understand the emergency

procedures and to manage the receipts of emergency process

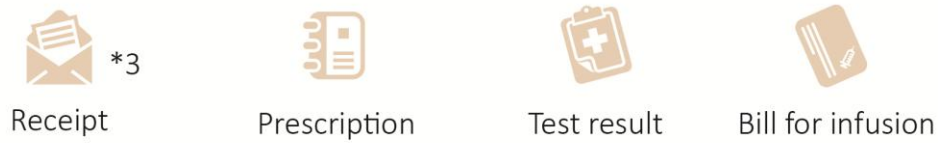


Figure 21 paper materials of the service



Figure 22 mood board for treatment manual

The emergency process can be considered like stamp collecting, once the last piece was gathered it means a perfect ending is reached. Inside the manual transparent pockets were made by the side of the instructions of each service step. The patients could put all the paper materials into the manual step by step.

The triage tool kit was on the top of the manual and they shared the same bar code, so the data of the patients would be easily tracked all along their emergency service process. On the second page of the manual, there is instruction for the meanings of all the stickers in order to help the patients to understand what kind of priority level they would have.



Figure 23 cover of the treatment manual



Figure 24 pages of the treatment manual

Infusion service related design

The infusion is the last step of the service and it is also the step that was been complained the most. The aim of infusion service related design is to reduce work burden of the nurse and reduce the waiting time of the patients.



Figure 25 waiting patients out of the infusion room

As is discussed in previous chapter one of the main reasons that making the penitents have such long waiting time is the nurse cannot focus on her own duty. A seat choosing system is therefore designed to help patients to find available seats. The nurse could also use the system to monitor infusion process and to disposal of the needs of patients timely.

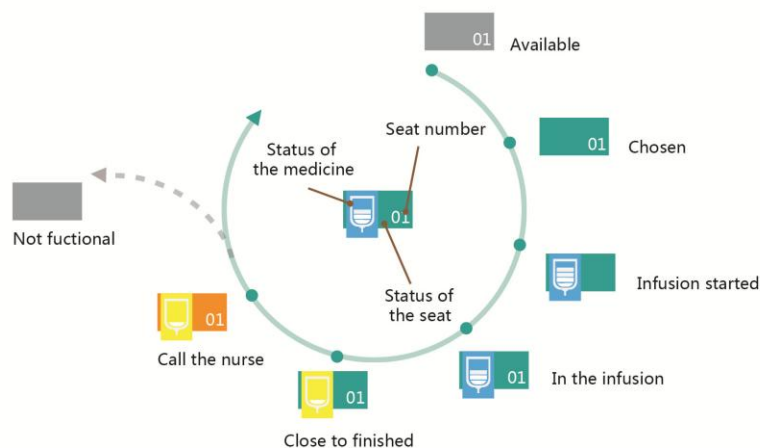


Figure 26 the implications of icons on the screen



Figure 27 the layout of the screen of seat choosing system



Figure 28 facilities for hanging medicine

A new concept of facilities for hanging medicine also was developed in this system. In which there are weigh sensor and battery so that the amount of the medicine could be tracked and shown on the screen.

Summary

The emergency service is a very complex system, especially in large general hospitals of China. The development of emergency medical service in China is still in its infancy. As a result, there are plenty of problems of this service need to be solved. But many of the problems are actually rooted in the condition of the country and could not be eliminated without the development of the whole society.

At end the triage tool kit, the treatment manual and the infusion related design are the main outcome of this research, which have the potential to be put into practice soon and make Significant effect to the service.