Study on the Design of Emergency Entrances for Hospitals Evidence from extremely cold regions -- Urban healing transition space

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Abstract
This paper investigates the design of emergency entrances for hospitals in extremely cold regions. The aim is to achieve the solution to the problem of transitional space for patients from outdoors to indoors. The main research methods used in this paper are behavioral analysis and other research methods. The study of evidence on the existence of potential problems would supply guidance for the improvement of actual emergency entrances, contribute enormously to the development of emergency department of modern hospitals and build up a rescue process with comfort and efficiency, alleviating pain of patients and saving rescue time. The results would also set an example for the design of emergency space in the future and supply theoretical significance and practical guidance. Based on the city, the emergency medical treatment of the "rapid urban lifeline" process, the completion of the "physical space" to "human space" exploration.

Keywords: Extremely Cold Regions; Emergency entrance optimization; Behavior analysis; Medical quality; Humanistic concern

1. Introduction
Population "urbanization" is still one of the themes of today's world. The increase in population density will make the incidence of the violent crime, trauma, traffic accidents, heart and respiratory disease in these areas rise, which makes the pre-hospital care become very important and also boosts the development of the pre-hospital care in the regions without pre-hospital care or where the pre-hospital care is not perfect.

Emergency medical care is often faced with critical patients1; under the conditions that the time is short, the task is urgent and the workload of large cases is small, the emergency medical work must be conducted in accordance with their own characteristics and work norms so as to ensure timely and correct diagnosis and treatment to patients and save the lives of patients to the fullest.

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1 The vital signs are unstable and the disease changes are quick. The functions of more than two organ systems are unstable. Reduction or failure development may endanger the lives of patients.
2. Analysis of the Status Quo Problems in the Emergency Entrance in Cold Region

The extremely cold regions refer to the regions with the average temperature of $\leq -10 \, ^{\circ}\text{C}$ in the coldest month and the number of days of $\geq 145$ days with the annual average temperature of $\leq 5 \, ^{\circ}\text{C}$, with large temperature difference in day and night and in indoor and outdoor. Because of its special social service attributes, emergency department needs to run 24 hours a year. It has efficiently provided space carriers for emergency medical services, which is not isolated, and it should actively use the space in design and gradually adopt the design mode with the combination of internal and external space.

2.1 Adjustment Mechanism Influencing Patients

Especially in winter; the majority of the incidence of patients occurs in the room. Most patients do not have enough time to take adequate warmth measures. Meanwhile, the patient's physical condition is in a non-healthy state and does not have a perfect temperature regulation mechanism. When the outside temperature changes are too large and go beyond the normal human regulatory capacity, it will cause that the body's nervous system and endocrine system lose regulation, thus leading to abnormal activities of life and thereby increasing the incidence of the population and mortality. The direct result of sudden illness leads to loss of temperature of patients (Mild Hypothermia).

2.2 Insufficiency of Space Measure of Emergency Entrance

2.2.1 Defect of Mixed Design Mode

After the actual visit and research three hospitals (Fig.1), it is found that the idiomatic act of the emergency department in Harbin is to integrate the first aid entrance and emergency entrance into an entrance for processing, namely, the design mode of the mixed first aid entrance. It mainly adopts the combination of ramps and steps to meet the needs of pedestrians and ambulance at the same time, which is likely to cause crowded emergency entrance; the ramp set for the ambulance is not conducive to the use of people with inconvenient acts. As the use objects of the two entrances are different, the momentum of the objects is different (different speed, different size), thus affecting the efficiency of emergency work.

A. Harbin Medical University First Affiliated Hospital  
B. Harbin Medical University Second Affiliated Hospital  
C. Harbin Medical University Fourth Affiliated Hospital

2.2.2 Insufficient Exclusive Sense of Space

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Fig.2 warm air curtain in the emergency entrance
The situation where people occupy the emergency entrance is due to the merger of the emergency entrance and the first aid entrance, resulting in the situation where a large number of emergency patients circulate or stay in the emergency entrance; the hot air screen in the top device of the double porches at the entrance (Fig.2) can effectively improve the foyer's thermal environment, so that patients and their families are willing to get close to the hot air curtain.

The situation where the vehicle occupies the emergency entrance includes two types of patients: those served by a private vehicle and those served by an ambulance. The ambulance driver has been professionally trained to quickly drive the ambulance out of the emergency entrance after the patient has been moved to the emergency halls, but most private car drivers may delay the stay at the emergency entrance. Second, with the rapid rise of the food industry and express delivery industry in the country, there will often be a variety of take-away human electric cars appearing in the entrance; if it is at the salesman's delivery stage, or is not fixed delivery time; the manual electric cars are at the unsupervised state. If at this time, there is the emergency situation, the emergency entrance is at the occupied state and or it even cannot quickly deal with the occupied state. (Fig. 3). When the ambulance enters the entrance, there is not enough space for the parking, thus causing chaotic congestion at the entrance.

2.2.3 Over-small Covering Area of Canopy
Among the forms of emergency entrance in the mixed design, it includes the long-distance ramp; meanwhile, the canopy's cover area is too small. In the winter of the extremely cold regions, snow and ice pavement can be seen everywhere; the friction coefficient between road and tires, cotton shoes is reduced and the ability to grip is also decreased, prone to cause the slip phenomenon. Which is very unfavorable for treatment? At the same time, it is found that the area of the existing emergency entrance has been unable to guarantee that the daily routine work is smoothly and normally done.

2.3 Incoherence in Medical Treatment
In the early 70s of last century in China, the main task of the ambulance was still a simple transport function and the use space of ambulance was also very limited, equipped with simple equipment and drug. With the rapid development of the medical process, the main equipment and personnel in the ambulance process have undergone a substantial change in quality and quantity. In terms of hardware, the space of ambulance is increased and the function is diverse, with complete equipment; in terms of software, the professional quality of the staff engaged in emergency is also improved, for they can conduct the initial treatment of the disease in the way of ambulance’s driving and conduct the care treatment of stabilizing the patient's disease, such as helping to stop bleeding, cleaning wounds, fixing limbs and ensuring the supply of oxygen and emergency rescue activities. In the process when the ambulance travels to the front of the emergency center, in the case of occurrence of pre-treatment behavior, the patient's displacement process in the emergency entrance in the extremely cold regions may lead to the disposal of the patient's body and there will be incoherence in the process of medical treatment, so that the patient's lesion is in the exposed state of failed protection.

2.4 Related Social Psychological Problems
Brian Lawson’s Language of Space says that we have greater demands for stability, continuity and predictability of certain degree in daily life. Social norms can give people in social groups a sense of security and enable them to behave in a controlled manner. The former do not have the psychological preparation of receiving psychiatric treatment. Generally speaking, the emergency internal medicine treats diarrhea spit, cold, fever and other abdominal lesions of cavity organ; the clothing of patients is not the whole. Emergency surgery treats bruises, bleeding fractures and other traumatic lesions, which may be caused by accidents such as traffic accidents. Combined with the possible treatment of patients with psychological, on the basis of the patient's suffering from torture and external trauma, the patients will have strong demands for the stability of the space environment, continuity and predictability.

3. Reasonable Design of Emergency Entrance in Extremely Cold Region

3.1. Buffer Space of Climate Making

Spatial levels, because of its different nature, can be divided into: external space-internal and external transition space-internal space. It explores from the climatic creation of the internal and external transition space from the following points.

3.1.1 Temperature Design of Transition Space

Create a climate buffer space and the transition space with indoor and outdoor temperature difference. If it can meet the comfort of the transition value, it is the best. In the extremely cold regions, the indoor and outdoor temperature difference reaches 50 degrees or more. The internal temperature of the emergency entrance should be in the transition interval of the indoor and outdoor temperature, while meeting the bottom line of the comfortable temperature that the human body can accept. Studies have shown that the comfortable temperature should be appropriately lower than the human temperature, with the best range of 24-26 ℃, which should not be lower than 17 ℃ or higher than 33 ℃. At the same time, from the energy point of view, ensure that the bottom temperature line of the transition space can be 17 ℃, to avoid excessive temperature caused by energy waste.

3.1.2 Practice of Heat Preservation

In the winter of the extremely cold regions, the entrance becomes the only opening part of the building, and the entrance should be designed to have reduction of the convective heat loss as the main objective. In the entrance design, avoid the outdoor cold air directly into the building, and also maximize the prevention of indoor heat loss in the building.

1) Entrance Location and Orientation

In the extremely cold regions, the entrance orientation of the building should avoid the dominant wind direction in the local winter. The location should be based on the functional requirements, and the building entrance should be arranged according to the wind speed distribution around the building, thus reducing the cold air infiltration of the building and reducing the building energy consumption. The best orientations are south, south west, east.

2) Entrance Form

From the perspective of energy saving, to set up the foyer and the windshield corridor is the design of the entrance of the extremely cold regions. Pay attention to take measures to prevent cold air infiltration and insulation.

3) Entrance Materials

Buildings in the extremely cold regions, under the premise of ensuring the safety of the envelope, it prefers to choose light weight, thermal conductivity, light and high strength materials as the insulation material of the envelope.

3.1.3 Air Quality Control

After designing the exclusive closed space in the emergency entrance, it is followed by another difficult problem: the car exhaust treatment of the enclosed space. The main fuels used in the automobile are gasoline or diesel oil, which is a mixture of various hydrocarbons, which produce CO and water when
completely burned. The incomplete combustion products are carbon monoxide (CO), nitrogen oxides (NO), hydrocarbons (HC) and other harmful gases, which have a negative impact on the health of the population and the environment. Ventilation in the relatively closed internal space and the surrounding environment is insufficient, with slow diffusion of the contaminants. Therefore, in order to maintain a satisfactory degree of comfort inside the entrance, it should be set with ventilation equipment, which can continuously operate when the ambulances discharges exhaust in a high speed in the time period of the closed space in the entrance, which may not be in continuous operation in other occasions.

3.2 Constructing the Moderate Behavior Dimension

The scale of the transitional space of the emergency entrance is closely related to the size of the emergency department in the hospital, and it is also affected by the internal function flow and spatial demand of the hospital. Emergency entrance is often combined with the internal space of the emergency entrance, namely hall. It gives comprehensive consideration of the hospital function streamline and keeps more in line with the requirements and the concept of hospital emergency functions. To a certain extent, inside and outside transition space of the emergency entrance has a certain proportional relationship with the size of the emergency department. Many of the recently built emergency departments begin to focus on the creation of barrier-free environment in the entrance off the emergency department. It does not set the indoor and outdoor height difference in the emergency entrance, and the emergency entrance also sets a more spacious site, easy for rotation and parking of emergency vehicle.

3.2.1 Related Size of Closed Entrance

There should be a clear orientation near the entrance, and the patients at the entrance are delivered primarily through an ambulance. The ambulance is generally based on the main line of the bus, much larger than most of the private cars, so the size of the closed special entrance to the ambulance is often 6m long and 3.5m wide. The entrance height should not be less than 3m and the road slope is \( \leq \frac{1}{10} \). In order to facilitate access to emergency vehicles, outdoor should have enough return to the venue.

3.2.2 Mode Selection of Door of Closed Entrance

Combined with the creation of the climate buffer space in the emergency entrance, factors like closeness, constant temperature and easy control should be considered. Therefore, the emergency entrance is suggested to adopt the automatic door. In the absence of emergency situation, it is in a closed state and keeps the room temperature so as to avoid the heat scatter and meanwhile prevent the occurrence of random occupancy; in the event of emergency transport, it can be automatically closed after the ambulance fully enters, to again ensure that the indoor temperature is constant. It also eliminates the manual switch throttle procedures and facilitates the passage.

3.2.3 Shunt Design of Closed Entrance

The drawbacks of the mixed design (Fig.5a) should be addressed in the entrance design, and the following two ways are found to mitigate or solve the problems caused by the man-machine crossing.

1) Vertical type. When ambulance enters the emergency department, its direction is mostly parallel to the emergency entrance and ambulance enters fast. After the completion of the patient transfer to the emergency hall, the evacuation rate is relatively slow in the emergency process. So direction of the flow should be avoided to the entry direction; it can be arranged vertically in the direction of departure (Fig.5b).
2) Parallel type. On the basis of the vertical arrangement, consider the more optimized arrangement and conduct parallel organization of the flow direction. In the direction of the ambulance, the man-machine flow line is parallel (Fig. 5c).

3.3 Accessibility Integration of Emergency Process

In general, in the medical field, the classification of critically ill patients is mainly based on the severity of the patient's condition, but from the architectural design point of view of this research, classification will be conducted from the perspective of treatment efficiency. In terms of space, it facilitates contact and wins the time for the comprehensive consultation and quick rescue. There are professional admissions who deal with the patients according to the degree of treatment and the order. In addition to the general departments, it should combine the regional and climatic different emergency conditions to consider and improve. For example, the leading logo in the emergency hall of the Jilin University Bethune First Hospital, which is the green channel of the frequent stroke thrombolysis in the hospital?

3.4 Privacy Design of Space

3.4.1 Control of Social Form

Control of social form is mainly considered from two aspects. First of all, control social influence and avoid negative impact. Second, consider whether the overload test in the admissions of the emergency ambulance area can calmly deal with. It adopts the closed emergency entrance and can play a good control role in social control. The dedicated transport channels of the closed ambulance avoid the full open transport in the traditional mode; patients are directly transferred to the operating room or disposal room in the closed entrance through the closed and controllable professional space, thus avoiding over contact with the outside and effectively controlling the scene. To avoid unnecessary interference can also be understood as to reduce the delay and the impact in the first aid and relatively improve the first aid efficiency.

3.4.2 Satisfaction of Psychological Demands

Privacy is a complex social reality; privacy embodies human personality, freedom, human rights and value and has the profound philosophical and cultural origins. As everyone's attention to personal privacy continues to improve, in the design and processing of the emergency entrance, it mainly starts from the perspective of visual privacy. In order to enhance the building heating and insulation performance, the interface of the emergency entrance also uses composite wall and double hollow glass and uses "greenhouse effect" to improve the indoor air temperature and reduce radiation loss. For the above design considerations, the glass material should be replaced with ground glass, both to meet the basic requirements of light transmission and protect the purpose of privacy.

4. Conclusion

To sum up, through the analysis of the emergency entrance in the extremely cold regions, it aims to achieve the higher design standards of emergency entrance. In the design, take full account of the particularity of the emergency department; improve the healing process of the better experience of comfort of body mechanism in the rescue process and perfect patient's psychological experience in the treatment process. Medical staff is relieved from a large number of simple and repetitive labors and rescue patient's lives to the fullest. The information processing process of hospitals is simplified, accurate, timely, improving the quality of hospital services; establish the rescue process of the integrated seamless connection; management improves the standardization and standardization of work and is the decisive factor to save the lives of patients. It also provides a guiding outline for the new and expanded projects.

References
