Research on the Reserve of Emergency Medical Resources under Natural Disasters

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Abstract. Determining the emergency medical resources reserve is of great significance for the development of rescue work after major natural disasters. The article uses the exponential model to predict the changes of the wounded after the disaster, and then combines the theory of inventory and logistics to establish a model for the emergency medical resources reserve, and optimally configure the emergency medical reserve at the lowest possible cost. In order to fully meet the rescue needs. The results show that this is a feasible emergency medical resource reserve forecasting model.

Introduction

This paper takes emergency medical resources as the core research object, combines the theory of inventory and logistics and fully considers the own attributes of medical resources, and studies the reserve of emergency medical resources.

First of all, a mathematical description of the changes in the condition of individual wounded after the disaster, in order to lay a solid foundation for the study of the overall reserve situation.

Secondly, aiming at various situations that may occur in natural disasters, find out the various influencing factors of medical resource reserves and establish modeling.

Finally, this text is based on the optimization goal of "minimum cost, minimum loss", and establishes a mathematical model with multiple disaster points and multiple inventory. A specific example is designed and solved by Lingo11.0 to verify the correctness of the model.

Disease Change Model of Post-Disaster Victims

In view of the characteristics of the number of incidents and the diversity of hazards, this paper will explore the design of medical emergency plans. It is hoped that the mathematical analysis of the injuries of the affected individuals in the emergency will be carried out, and then the classification will be carried out to find out effective Medical emergency plan.

Depending on the rate of deterioration of the condition, we can classify the disease into three levels: first, second, and third. Among them, the first-grade condition is the most serious, and the condition deteriorates rapidly. It is necessary to take immediate treatment. The second-grade condition is more serious, and the disease begins to deteriorate at a slower rate. Relatively a first-grade disease can delay the treatment of the secondary disease, but if it is not treated for a long time, it will develop into a first-grade. The third-grade condition is relatively lighter than the first and second grades, and the rate of deterioration of the disease begins to slow, and will slowly transition to the secondary and first-grade conditions, and the third-grade condition can be delayed.

By reviewing the data, the time interval for most of the patients after severe injury to deteriorate from a relatively good state of health to a very serious state of health is between 120 minutes and 720 minutes. For most patients, the rate of health deterioration is generally around 0.005 and the time to deterioration is about 180 minutes.

Therefore, for the patients with sudden deterioration, the time range is set within 3 hours; the second level is for patients who do not have sudden deterioration, the time is set at 3-12 hours; the third level is for mild symptoms, and the course remains For longer patients, the time is set at 12-48 hours. The model is solved according to this classification.

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The process of physiological deterioration of patients can be described by exponential growth.

$$y = e^{at+b} + c \tag{1}$$

Where t is the time value of the patient and y is the patient risk index.

This function considers time as a countdown. It can be seen from the function image that when x≥4, the function image is nearly vertical, that is, the patient deterioration rate reaches a high value that cannot exist, so the patient is killed when x=4. . Taking the patient's death time as x=0, taking -x as a function image draws the function line in the first quadrant.

The function is solved by Matlab, and the function formula is obtained.

$$y = e^{\frac{-t}{120}+4} + 1 \tag{2}$$

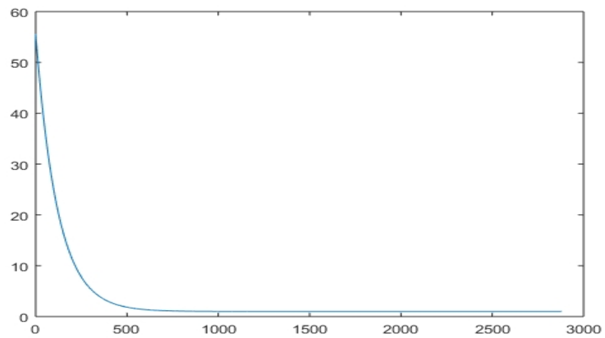

Figure 1. Change trend chart

Construction of Emergency Medical Reserve Model

Description of the Problem

Suppose a certain area is a possible occurrence of an emergency. The number of medical points available for deployment in the plan is n. Each medical point has a certain medical rescue capacity, the rescue capacity of the jth radiation medical point is, and the rescue capacity of the central medical point. After the occurrence of natural disasters, each medical center will give priority to selecting the most convenient disaster-stricken points for rescue, aiming at minimizing the impact of emergencies, and on this basis, pursuing the optimization of disaster-relief costs, and thus obtaining the medical treatment. The effectiveness of the emergency plan is high or low.

The rescue capacity problem studied in this paper mainly considers the call and employment costs, delay costs and sudden costs of medical assistance. In order to facilitate the construction and solution of the model, it is not too complicated and as realistic as possible, so the following assumptions are made:

(1)The research in this paper is mainly aimed at major emergencies, and the small-scale emergencies adopt the national natural disaster general rescue policy, which is no longer considered;

(2) Treat medical assistance as the same type of emergency services;

(3) The medical point has only a certain rescue capacity;

(4) After a natural disaster occurs, each radiation medical point provides rescue services according to the principle of proximity. If it is insufficient, it is directly supplemented by the central medical point, and there is no contact between the radiation medical points;

(5) The following information before the disaster occurred: the total number of people, the number and type of buildings, the proportion of each type, the road network information of each disaster area, etc.

(6) After the disaster, emergency medical transportation has road priority and is not affected by road traffic;

(7) If all roads leading to a disaster site are completely blocked and cannot be used, we assume that the needs of such disaster areas can be met by other means of transportation, such as air

transportation;

(8) The probability distribution of demand for emergency medical services in all disaster areas is known.

Model Construction

The model built in this paper mainly includes three influencing factors: plan call and employment cost index, delay index and burst index.

(1) Plan hiring and calling costs

The salvage capacity of each medical point is that a, b, c, and d are the proportion of experts, doctors, nurses, and materials. K is the unit call cost, which is the cost of hiring experts, doctors, nurses and materials.

Hiring and calling costs:

$$TC = \sum_{j=0}^{n} S_J (ak_1 + bk_2 + ck_3 + dk_4) + K(a+b+c)S_J \quad (3)$$

(2)Delay cost

The patient's condition deterioration function is known, combined with the excess call time to construct the total delay cost:

$$H_C = \sum_{i=1}^{n} g_i y_i P_i + \sum_{i=1}^{n} \sum_{j=1}^{m} g_i e^{\frac{t_{ij}}{120}} P_{ij} \quad (4)$$

If there is no excess condition, the value of the index of each summation part e in the second item in the equation is 1, which can be understood as the necessary cost for normal transportation time. A unified base value.

(3)Sudden cost index

Also know that when the planned rescue capacity in the plan cannot meet the demand, it will be delivered to the disaster site on time from other places, and the cost of the unit emergency medical assistance will be increased. Then, when the available available resources cannot meet the demand, the additional increase will be made. Expected value of total cost:

$$C_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} (D_{ij} - S_j) C_{add} \frac{y_i}{y_0} p_{ij} \quad (5)$$

Based on the description of the problem, an emergency medical rescue system model with multiple rescue points and multiple disaster points can be established. The goal is to minimize the emergency rescue cost based on timely meeting the demand. The above three models can be obtained as follows:

$$MinC = (TC + H_c + C_0) \quad (6)$$

$$C = \sum_{j=0}^{n} S_J (K(ak_1 + bk_2 + ck_3) + dk_4) + \sum_{i=1}^{n} g_i y_i P_i + \sum_{i=1}^{n} \sum_{j=1}^{m} g_i e^{\frac{t_{ij}}{120}} P_{ij} + \sum_{i=1}^{n} \sum_{j=1}^{n} (D_{ij} - S_j) C_{add} \frac{y_i}{y_0} p_{ij} \quad (7)$$

Conclusion

The research on emergency medical resource logistics is of great significance for ensuring the life safety and property safety of the people affected by the disaster after the occurrence of natural disasters. After the occurrence of natural disasters, timely and sufficient supply of medical resources is not only a prerequisite for emergency rescue activities, but also a guarantee for post-disaster reconstruction. This paper gives the disease change process of the affected patients and uses the knowledge and inventory control theory of emergency logistics to explore how to minimize the disaster relief cost based on the needs of the disaster area as much as possible, so as to establish a corresponding inventory control model and give reasonable resource allocation. . In the follow-up study, case analysis should be made for specific types of natural disasters in specific regions, and then the layout of medical rescue points in a certain area should be considered to make the model closer to reality.

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