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Оригинальная статья

РОЛЬ СТАЦИОНАРНОГО ОТДЕЛЕНИЯ СКОРОЙ МЕДИЦИНСКОЙ ПОМОЩИ В УСЛОВИЯХ МАССОВОГО ПОСТУПЛЕНИЯ ПОСТРАДАВШИХ В ТЕХНОГЕННЫХ ЧРЕЗВЫЧАЙНЫХ СИТУАЦИЯХ

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Резюме. *Цель исследования* – планирование работы стационарного отделения скорой медицинской помощи (СтОСМП) в условиях массового поступления пострадавших в техногенных чрезвычайных ситуациях (ЧС).
Материалы и методы исследования. Для создания виртуальной модели СтОСМП было выбрано программное обеспечение Flexsim HealthCare, позволяющее проводить процессное моделирование предполагаемой работы. В программе была воссоздана работа двух стационарных отделений СМП: СтОСМП университетской клиники Первого Санкт-Петербургского государственного медицинского университета (ПСПбГМУ) им. акад. И.П.Павлова Минздрава России (модель-1) со средним потоком (23±2) пациентов в сутки и СтОСМП Городской больницы СМП №25 г.Волгограда (модель-2) со средним потоком (145±3) пациентов в сутки. Кроме того, был выполнен ретроспективный анализ техногенных ЧС, произошедших в 45 регионах России в 2017–2022 гг., на основании которого планировалось прогнозировать работу указанных СтОСМП в условиях массового поступления пострадавших в ЧС.
Результаты исследования и их анализ. По результатам экспериментов определён оптимальный штат сотрудников СтОСМП, оценена его роль в условиях массового поступления пострадавших в техногенных ЧС.

Ключевые слова: *имитационное моделирование, массовое поступление, пострадавшие, стационарное отделение скорой медицинской помощи, техногенные чрезвычайные ситуации*

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Original article

THE ROLE OF URGENT MEDICAL TREATMENT DEPARTMENT IN CONDITIONS OF A MASSIVE INFLUX OF TECHOGENIC EMERGECIES VICTIMS

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Summary. *Investigation purpose* – a planning of stationary department of urgent medical treatment (SDUMT) work in conditions of massive influx of technogenic emergencies (ES) victims.
Methods and materials of the investigation. To make the virtual models of (SDUMT) the Flexsim HealthCare software was chosen. The software allows to conduct a processive modeling of predictable work. A work of two stationary urgent medical treatment departments was recreated. The first was SDUMT of university clinic of the First Saint-Petersburg state medical university (FSPAMU) named after academic I.P. Pavlov of Ministry of Health of Russia (model-1) with average (23±2 patients per day) patient influx. The second was SDUMT of city urgent medical treatment hospital №25 of the city of Volgograd (model 2) with average (145±3 patients per day) patient influx. In addition, a retrospective analysis of technogenic ES happened in 45 Russian subjects in 2017-2022 was conducted. A prognosis of specified SDUMT work in conditions of massive emergency victims influx was planned to conduct basing on the up written analysis.
Investigation results and their analysis. As a result of the experiments an optimal SDUMT staff was defined. The role of this staff in conditions of massive technogenic emergency victims influx was assessed.

Key words: *iimitational modelling, massive influx, stationary urgent medical treatment departments, technogenic emergencies, victims*

Conflict of interest. The authors declare no conflict of interest

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Introduction

The occurrence of a man-made emergency situation (ES) requires a comprehensive algorithmized approach to solving arising problems. The forecasting of different scenarios and the early logistics of emergency medical aid in the in-patient emergency department (IEMD) helps to reduce the waiting time, and reduce the risks of adverse outcomes. Simulation modeling as a new direction in the organization of medical care allows to solve this problem by creating possible scenarios in a simulation model, on which, in a series of experiments, it is possible to identify possible problems in advance, as well as to find ways to solve them [1, 2]. Earlier we considered the possibility of simulation modeling in case of bio-social emergencies during the COVID-19 pandemic [3]. At the present time there is still a need to plan the work of IEMD in conditions of mass influx of victims in man-made emergencies.

The aim of the study is to plan the work of an in-patient emergency department in conditions of mass influx of victims in man-made emergencies.

Materials and research methods. To create a virtual model of the emergency department, the Flexsim HealthCare software was chosen, which allows you to conduct process simulation of the proposed work [4, 5]. The program recreated the work of two IEMDs: IEMD of the University Hospital of the First St. Petersburg State Medical University named after I.P. Pavlov (hereafter Model-1) with an average daily flow (23±2) of patients and the IEMD of Volgograd City Hospital No.25 (hereafter Model-2) with an average daily flow of 145±3 patients. In addition, a retrospective analysis of man-made emergencies that occurred in 45 regions of Russia in 2017-2022 was carried out, on the basis of which it was planned to forecast the work of the above mentioned IEMDs in conditions of mass arrival of victims in an emergency.

Results of the study and their analysis. During the analysis of the obtained data, emergencies with the number of victims less than 10 were excluded. In addition, regions with hard-to-reach territories were not included in the analysis because the average time from the event to the hospitalization of the victims in the ES exceeded 2 hours, which requires a separate consideration in connection with the territorial features mentioned. In the studied subjects of the Russian Federation (hereinafter referred to as subjects) there was a tendency to form the maximum flow of patients within the first hour of an emergency, which indicates the need not only to involve the maximum number of surgical and intensive care specialists to provide care to victims in an emergency, but also to maintain the constant readiness of the hospital for such situations (Fig. 1). The latter requires not only the existence of clear instructions, but also the creation of algorithms of action in the relevant medical treatment organizations (LMOs).

In the first hour, the main load will fall on the doctors of the IEMD, since they are the first-contact doctors and have experience in the multidisciplinary approach to the examination and treatment of patients. Thus, in the event of an emergency, IEMDs play a key role in emergency medical care

A retrospective analysis of the incoming patient flow during their mass admission revealed the following patterns: in 20.8% of cases patients were delivered in a severe condition; 45.8% — in a moderate condition; in 33.4% of cases — in a mild condition. In 19% of cases surgical treatment was required for emergency indications during the first day.

Most of the man-made emergencies were road traffic accidents (RTAs). The percentage of victims brought to LMO by ambulance crews was 87%, and 13% of victims went to hospitals on their own. According to the data for a number of years, the average number of victims was (24±2) people, the maximum number was 137 people. In the latter case several medical institutions were involved in providing medical care to the patients. With the help of computer modeling using model-1 and model-2, an experiment was carried out on the one-stage admission of 24 victims to IEMD with no patients for one hour.

In model-1, there are 2 ambulance doctors, 4 nurses, and 2 registrars in real life (Figure 2). It was assumed that real life would include the immediate transfer of patients from the IEMD department to other units in order to free up beds and staff

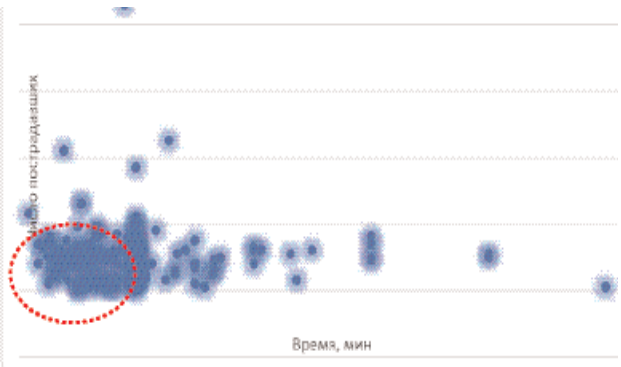

Рис. 1. Продолжительность (мин) проведения медицинской эвакуации пострадавших в ЧС
Fig. 1. Duration (min) of medical evacuation of injured in case of emergency situation

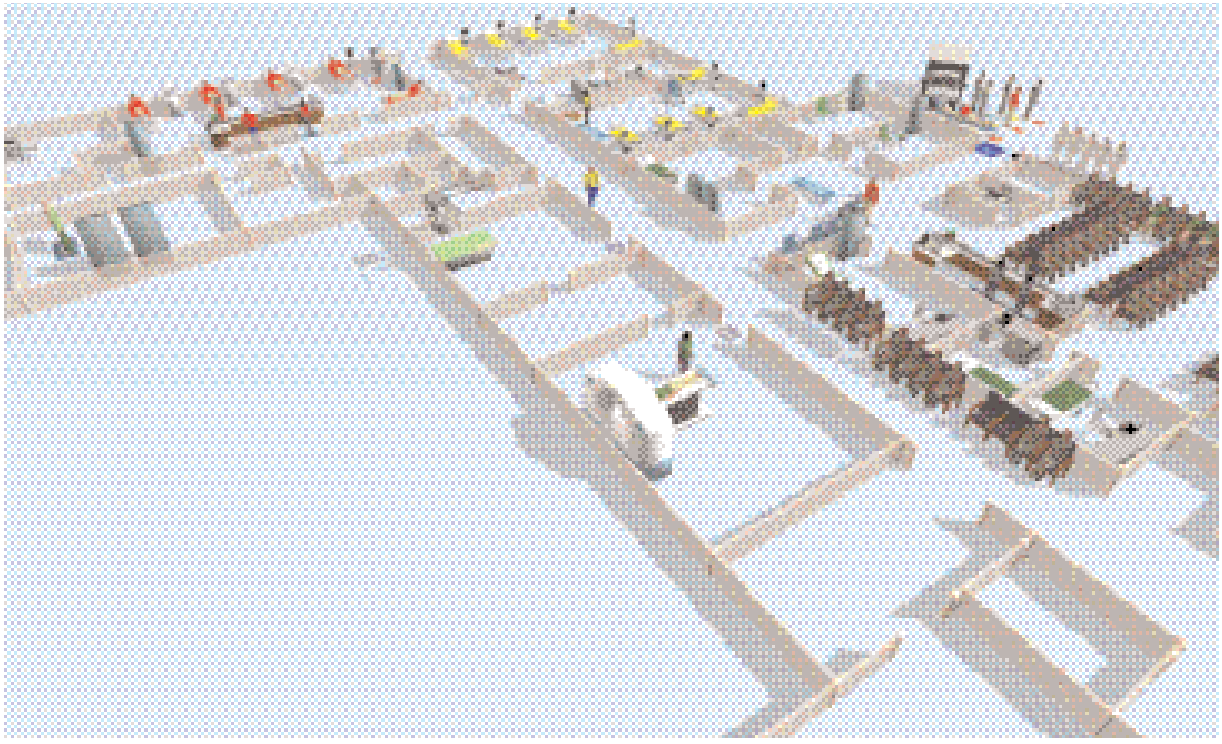

Рис. 2. .Модель-1 – стационарное отделение скорой медицинской помощи Первого Санкт-Петербургского государственного медицинского университета им. И.П. Павлова Минздрава России
Fig. 2. Model-1 – stationary ambulance unit of Saint Petersburg state medical university named after I.P. Pavlov of Ministry if Health of Russia

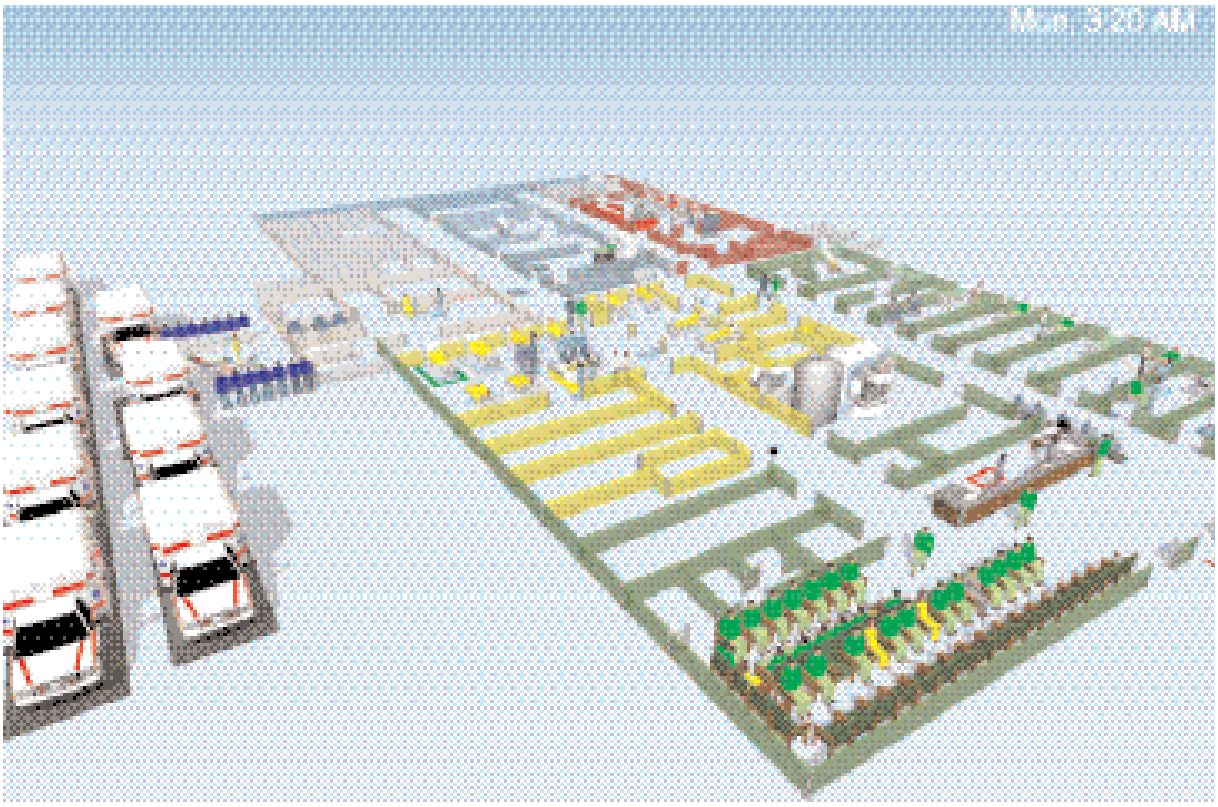

Рис. 3. .Модель-2 – стационарное отделение скорой медицинской помощи Городской клинической больницы СМП №25, Волгоград
Fig. 3. Model-2 – stationary ambulance unit of City clinical hospital of ambulance No.25, Volgograd

and the deployment of a triage area for patients outside the department.

After the model was launched, there was a significant increase in the workload of the medical staff, but the available bed capacity was sufficient to accommodate this patient flow. To optimize the work of the medical staff and reduce waiting times for medical care, a triage doctor and a nurse for primary medical triage were added to the staff. In model-1, primary medical triage was performed on the START scale and required no more than one minute for expedited patient admission. Thereafter, the triage physician performed dynamic observation and treatment of patients of mild severity — when the condition of such patients changed, they were routed to an appropriate LMO. In model 1, 7 to 10 minutes were allotted for the initial examination of one patient and the preparation of medical records for him, provided that a primary medical card (Form 100) was prepared for him.

Based on the results of the experiment, the necessary staffing of the department was determined — 3 doctors, 5 nurses, 2 orderlies and 2 medical registrars. After adopting this staffing schedule, normalization of the work process and equal distribution of workload on the staff were noted.

A similar experiment was conducted with Model-2 (Figure 3). In reality, there are 8 doctors, 9 nurses, 2 orderlies, and 2 medical registrars working 24 hours a day in this department. Taking into account the staff schedule, there were no significant failures in model-2 when 24 patients were admitted within one hour to the IEMD of a multidisciplinary hospital.

In both model-1 and model-2, the admission of 137 patients to IEMD caused certain difficulties, led to the formation of queues and slowed the work process due to the insufficient number of beds and the number of staff. Obviously, in such situations it is necessary to use the capacities of several LMOs, which have in their structure in-patient ambulance departments.

Conclusion

The analysis of liquidation of medical and sanitary consequences of technogenic emergencies has shown that in the subjects it is necessary to have clinics of permanent readiness, as in most cases the period of time from the moment of emergencies till the moment of admittance of the first victim to a hospital is minimal. Only if there is a structural subdivision of IEMD, LMO can be considered ready to work in conditions of man-made emergencies.

Simulation modeling proved that the presence of IEMD in the university clinic and in the multidisciplinary hospital provides an advantage over the emergency departments — in such cases, the bed fund and space was sufficient, which simplified the task of receiving patients and providing them with medical care. At the same time, there was a need for immediate transfer of patients who were in IEMD at the time of the emergency to another LMO, as well as the creation of additional staffing and staff notification system, especially in the departments with a small number of emergency daily admissions. In addition, provision should be made for the deployment of triage areas outside the inpatient emergency department areas.

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