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Emergency care system: A systemic analysis

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20231020029, 20231020155

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System's Analysis

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October 5 – 2024

## I. INTRODUCTION

The following document is a compendium of the topics covered throughout the systems analysis classes, applying them to the systemic analysis of the emergency system in Colombia. This analysis aims to understand how the emergency care system operates as a complex, interconnected network of components designed to respond to medical emergencies efficiently. By exploring the system's structure, behavior, and interactions, this study provides insight into the ways it can be improved to better serve the population, especially in times of crisis.

This analysis delves into the main elements of the system, the interactions between them, and the emerging behaviors that result from both predictable and unpredictable factors. Understanding these dynamics is crucial to ensuring that the system can maintain stability, respond quickly to emergencies, and optimize resources, all while handling the challenges of random and chaotic situations that often arise in emergency care.

## II. SYSTEM'S DEFINITION



Image 1. SEM process

The emergency care system serves as a set of interconnected parts to proficiently manage emergency situations and effectively care for all people involved in them. This system is designed to assess, stabilize, treat, and manage patients with urgent medical needs using processes, personnel, facilities, and technology that provide immediate and specialized medical care.

## III. STUDY'S REASON

For the responsibility of the emergency system, and how it needs to be coordinate to take care of people, it is an excellent study topic, which could show a good example of how a system is the addition of its parts, needing see the relations of each part to understand how the emergency system work in all the city achieving its function.

#### IV. ELEMENTS

The emergency care system is made up of some specific elements that are part of the health system in general such as:

- C4 (Command Control, Communications and Computing Center)
- CRUE Operator
- Transport Coordinator
- Hospital Coordinator
- Transport
- Mechanics
- Paramedics
- Doctors
- Medic Equipment
- Nurses
- Data base of medical records
- Data engineers
- CRUE (Centro Regulador de Urgencias y Emergencias)
- EMT (Emergency Medical Technician)
- Administrative

#### V. DEFINITIONS

**C4:** Equipment that allows for effective coordination among emergency response, security, and support agencies, directs the operational and technological integration of these agencies, establishes priorities for emergency response from the perspective of effective coordination, provides support to local authorities and national agencies, and ensures that all actions are carried out within the established priorities

**CRUE operator:** The CRUE operator conducts a more detailed assessment, asking for additional information if necessary. They determine the type of response needed, such as dispatching a basic or medicalized ambulance.

**Transport coordinator:** They determine which ambulance (basic or medicalized) is most suitable for the situation and assign it to the incident. They coordinate the deployment of ambulances and other emergency vehicles, such as helicopters, if necessary.

**Hospital coordinator:** They communicate with the hospital medical staff to inform them about the imminent arrival of a patient. They ensure that the relevant departments (such as emergency, surgery, etc.) are informed and ready to receive the patient. They work with the hospital to ensure that adequate resources are available, such as beds, medical personnel, and necessary equipment to care for the patient.

**Transport:** The transport in an emergency care system consists of all available ambulances and may also include helicopters in cases requiring more extensive assistance.

**Mechanics:** Mechanics are responsible for ensuring that transportation is available at all times, so that there are no delays in emergency situations.

**Paramedics:** Paramedics are medical assistants responsible for providing first aid as quickly and effectively as possible when required.

**Doctors:** Doctors are medical assistants who are in the hospital waiting for the patient to arrive to be diagnosed and treated.

**Medic equipment:** They are all the elements that are used by doctors and nurses to perform medical procedures.

**Nurse:** Nurses are those who are under the supervision of doctors and are in charge of performing the medical procedures required by patients.

**Data base of medical records:** This database stores all of the patient's medical history so that it can be consulted by doctors and with this generate a more accurate diagnosis based on the patient's information.

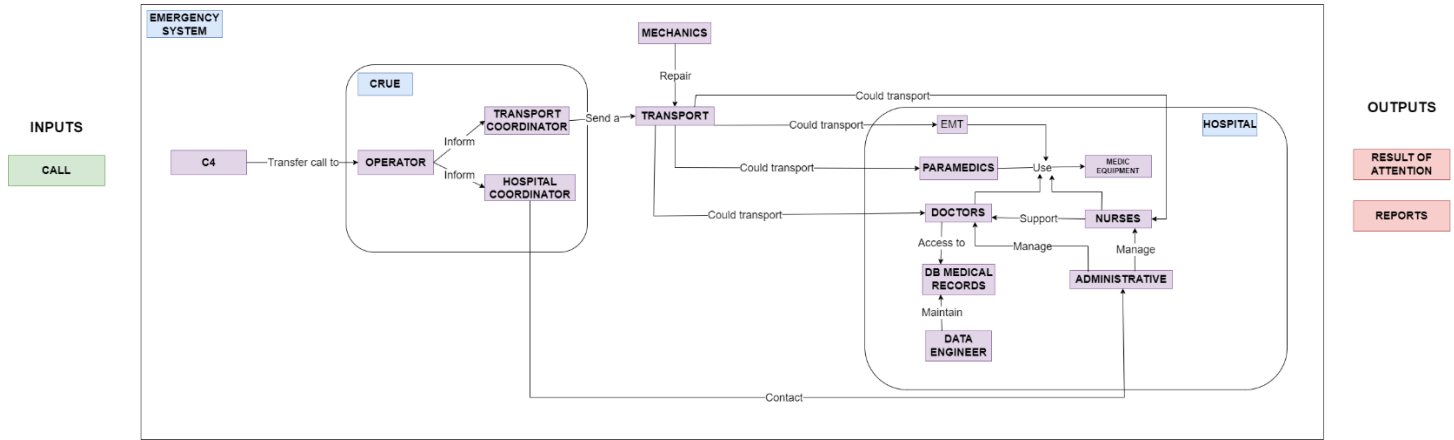
**Data engineer:** The data engineer is responsible for designing and keeping the databases available at all times for consultation.

**CRUE:** Is the health agency that receives requests, cases and incidents from the Single Security and Emergency Number – Line 123.

**EMT:** It is a specially trained medical technician certified to provide basic emergency services before and during transportation to a hospital.

**Administrative:** The administrative staff is in charge of managing the number of available personnel.

## VI. RELATIONS



### ***C4 – Operator***

If the C4 determine that the patient needs an ambulance, they transfer to the operator the call

### ***Transport Coordinator – Transport***

The transport coordinator sends an ambulance to pick up the patient.

### ***Hospital Coordinator – Administrative***

The hospital coordinator contacts the administrative in the hospital to report the situation of the patient.

### ***Mechanics – Transport***

The mechanics ensure that the means of transport used are ready for any emergency.

### ***Transport – EMT***

If it is a basic emergency, the ambulance carries EMT to do basic assistance.

### ***Transport – Paramedics***

If it is an advance emergency, the ambulance carries paramedics to do assistance more complex.

### ***Transport – Nurses***

If it is a critical emergency or a medicalized ambulance, the ambulance carries nurses to treat the patient.

### ***Transport – Doctors***

If it is a critical emergency, the ambulance carries doctors to treat the patient.

#### ***EMT – Medic equipment***

The paramedics use the medic equipment to perform first aid techniques to patients who require it.

#### ***Paramedics – Medic equipment***

The paramedics use the medic equipment to perform techniques to patients who require it.

#### ***Nurse - Medic Equipment***

The nurse uses the medic equipment to help the patient.

#### ***Doctors – Medic equipment***

The doctor uses the medic equipment to perform medical procedures when it is required.

#### ***Doctors – DB Medical records***

The doctor access to the Database that stores the Medical Record of the patient to generate a diagnosis.

#### ***Data engineer – DB Medical records***

The data engineer oversees designing and managing the database so that it is always available.

#### ***Nurse - Doctor***

The Nurse supports the doctor to perform the respective medical procedures.

#### ***Administrative – Nurses***

The administrative manage the doctors according to the emergencies.

#### ***Administrative – Doctors***

The administrative manage the doctors according to the emergencies.

## **VII. INPUTS**

The main inputs of our system are essentially the key characteristics of the patient being reported in emergencies, the most important ones are:

- Medical conditions reported
- Location of the patient

These characteristics are sent directly to the main element, which is the call center, and from there the entire process is generated to provide the most efficient and effective care.

## **VIII. OUTPUTS**

The main outputs of the emergency system are based on two fundamental aspects:

- Result of attention
- Reports

First, the outcome of the care reflects the patient's satisfaction with the service provided and clearly indicates whether their medical condition could be treated or not.

On the other hand, the reports, whether they are the statistics collected or the report generated with the patient's information and the treatments performed, are essential for evaluating the performance of the emergency care system.

Both elements are fundamental for a feedback exercise for the system as they allow us to understand its strengths and weaknesses, thus seeking possible solutions.

## **IX. CONTEXT**

### ***Demographic conditions***

Some aspects as the number of habitants in a region determines the demand for emergency services. In heavily populated areas, the emergency system must be prepared for a higher volume of patients, which can lead to overcrowding, longer waiting times, and the need for more staff and resources.

### ***Regulation Institutions***

Institutions like the OMS, “La Cruz Roja” and the department of health oversee regulating the procedures performed to ensure that healthcare services are delivered according to international standards.

### ***Availability of medicines***

According to the number of medicines available for distribution, so will be the capacity that can be supplied to the patients who require it.

### ***Current health conditions***

The current issues determinate how frequent people need medical assistance. Factors such as the prevalence of chronic diseases, infectious diseases, and mental health disorders all contribute to the demand for healthcare services.

## **X. EMERGING BEHAVIORS**

### ***Traffic Jam***

The transport might be affected by the availability of the streets and avenues.

### ***Severity***

The health people are aleatory and could change unexpectedly.

### ***Prank Calls***

The transport might be affected by those calls that seems to be truth but are just pranks.

### ***Common mistakes when ordering ambulances***

Few people know what type of ambulance to ask in the event of an accident, so an ambulance may arrive that was not needed or was not qualified.

### ***Mechanic Problems***

The operation of ambulances might fail, and it could be get stopped, causing that the speed of the attention decrease.

### ***Saturation of telephone lines***

In the case that the telephone lines are saturated or present any failure, it may result in affecting the entire system.

### ***Database Disconnection***

It may happen that due to a cyber-attack or loss of electricity the database is disconnected, which would mean that it could not be consulted by the doctors, leaving them uninformed about the patients.

## **XI. EFFECTS**

### ***Domino***

- If the ambulance crashes, it would spend a lot of time, generating that the patient could not arrive on time to the hospital and the patient would be on risk, causing a domino effect.

### ***Butterfly***

- If the patient omits information about his or her condition, in other part of the system, the patient could have complications.

### ***Snowball***

- If any of the medical staff becomes overwhelmed due to a high volume of emergencies, it may result in the required procedures not being performed correctly, putting patients' lives at risk.

## **XII. CHAOS THEORY**

- The ambulances have the objective of carry patients to the hospital, but the time that the ambulance spend carrying the patient to the hospital has too much aleatorily, for traffic jams, accidents and different situations, therefore, the chaos increment.
- Initially the hospital has a protocol for handling emergency calls, according to the seriousness of the situation, one or another possible route is taken to attend all requests in the most effective and efficient way possible, but there is always the probability that one of the calls is a joke, which could result in a waste of time by the staff or that decisions are made are not really necessary.



- In the context of a serious emergency that has just occurred, it may happen that the emergency lines become overloaded and not all operators are able to answer all calls, causing many people to be unattended.
- Under normal circumstances doctors can access the hospital's databases to review, for example, the medical records of the patient they are treating at the time, but it may happen that for any reason the database stops working, leaving the doctor uninformed about the patient's previous situation.

### **XIII. ENTROPY**

The medic environment has a lot of aleatory things, because you do not know what will happen with the patients, how they will advance or if complications will arise, for this reason, the emergency system has many entropy in each part of the system, taking into account the conditions of the patient, the speed of the transport and the doctor's skills, all are aleatory aspects that are difficult to counteract.

### **XIV. SYNERGY**

Synergy in a hospital emergency care system is evident when the various elements, such as call operator, medical teams, medical equipment and communication networks, work together in a coordinated manner to improve the efficiency and effectiveness of the response. It is important to keep in mind that any error or failure within any of these elements can cause the system to slow down and collapse. For example, if the communications networks are faulty, requests will not be able to reach ambulances dedicated to picking up patients in medical need, putting their lives at risk.

### **XV. HOMEOSTASIS**

Homeostasis applied to an emergency care system refers to how this system maintains its internal balance and functionality despite pressures or changes in external demands. In general, this system maintains a very good balance as it is able to adapt easily to the different adverse conditions that may occur in its environment, the clearest example of how this system maintains its balance is with the use of triage protocols. Triage is a system of selection and classification of patients in emergency services, based on their needs and the resources available to attend them.

### **XVI. STOCHASTIC AND DETERMINISTIC**

In general, the emergency system is a stochastic system, elements such as the arrival of patients, the nature of emergencies and the recovery time of patients are random and cannot be predicted exactly, however, this system also presents deterministic characteristics such as medical protocols for which clearly defined procedures are followed according to the patient's information.