Chapter 19
Emergency Department Logistic Optimization Using Design of Experiments:
From Triage to High Quality of Service

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ABSTRACT

Public healthcare services face a growing demand and Emergency department is the main entrance to these services. Waiting times at Emergency departments are increasing at risky levels, causing that people die in wait rooms due to a lack of staff to serve timely every patient. Present chapter describes one research project conducted in a mexican public hospital which was in the process of adopting a triage systems in order to reach the goal of a maximum wait time in department. Design of experiments is the tool proposed to analyze waiting time factors and define the best levels to reduce the response variable value.

INTRODUCTION

Public healthcare services have around the globe an ever-growing demand along with a shrinking budget (Brandeau, Sainfort & Pierskalla, 2004).

Recently healthcare service providers are adopting operations research techniques in order to improve logistics of services reducing costs and enhancing medical facilities capacities. These research efforts are classified as patient flow improvement. Metaphors use to be useful thinking tools and conceiving

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patients going from one service point to another as a flow, helps to model its dynamic as a flow and build and abstract model with mathematics and logic.

The main research categories on patient flow improvement are the following (Medina, 2010a):

1. Operations changes to increase patient flow;
2. Lean thinking in hospitals;
3. Queueing theory application on healthcare;
4. Discrete event simulation and design of experiments;
5. Integration of Systems Dynamics and Discrete event simulation;
6. Agent Based Modeling in healthcare;
7. Analytical methods to define required beds, rooms capacity and required staff;
8. Hospital design methodology; and
9. Mathematical modeling of patient flow in hospitals.

It is common to define the Emergency Department as the access gate to hospitals. The outpatient department capacity cannot provide timely service to patients so they look for an access point to medical services and they usually find it at Emergency Department.

This chapter presents one applied research in an Emergency Department (ED) designed to identify and quantify the main factors in waiting time using Design of Experiments in order to improve the quality of Mexican public healthcare services.

BACKGROUND

Healthcare access is a constitutional guarantee for all citizens in Mexico; most of healthcare services are delivered by public institutions. Work regulation demands employers to pay for healthcare service for his employees and their families. Healthcare delivery is the responsibility of both, the federal and the state governments. Federal health care delivery is achieved through IMSS (Mexican Institute of Social Security) or ISSSTE (Institute of Social Security and Services for State [government] Workers), for most of Mexican employees in private and public offices. Some government employees (oil industry, army and navy) are covered by PEMEX or SEDENA healthcare delivery subsystems (see Figure 1). A set of Mexican workers had no access to any of the previous agencies (mostly small business owners, freelancers) so *Seguro Popular* (SPSS, Popular healthcare insurance) was created to help those persons and its families to have access to health care services, which are delivered through SSA (state governments' health ministry, SSA is the acronym to agency's name in Spanish).

Mexican Health System is aimed to reach universal coverage. Every single Mexican must have access to health services. In ten years the percentage of people with social security grew more than 50% as is shown in Figure 2.

Due to this tendency on public healthcare services demand, it is mandatory to understand the dynamic of that system and design viable solutions to the challenge of provide quality services to general public.

Mathematical modeler has to deal with a trade-off between model attributes and resources available to develop the model. Model attributes are fidelity, resolution and scale. Fidelity defines how closely the model matches or behaves like the real system it is representing. Resolution is the degree of detail with which the real world is simulated. A high resolution model includes a more detailed description of the