Chapter 1
Introduction

1.1 Overview

A system comprising of individuals (administrative and healthcare staff, patients, and engineers), processes; techniques and equipment (software as well as hardware) connected to formula a network that allows delivery of care to patients immediately is called Emergency Department (ED). For achievement of national goals, the Saudi Vision 2030 stresses upon economic diversification and this can be done through focusing on performance and sustainable strategies which agree with the governance model of Saudi Vision 2030. An important target of the Saudi Vision 2030 is to ensure high quality and efficient healthcare delivery to Saudi citizens through improving quality of the healthcare services, making it more accessible and amplifying the efficiency of the system. With better ED systems, economic stability, improved utilization of resources and delivery of high-quality care is made possible and all these factors affect the organization and the service in the long run.

The second biggest city of the Kingdom of Saudi Arabia was substantially influenced by the 2009 floods. It caused a business loss of one billion and over 350 individuals were missing after the floods. It all occurred 2 days before the Eid AL-Adha holiday. In 2009, 123 individuals were killed by the floods in the Red Sea city. Two years after this, floods killed around ten individuals again. This spurred the need for responsive disaster planning and especially for the aspect of evacuation. Until 2004, the Kingdom of Saudi Arabia offered emergency services through only four organizations. However, 70 emergency departments were delivering emergency services in 2013. Development of improved strategies for EDs is still a challenge faced by the Health Department (Ministry of Health, 2013). At present, the constituents of EDS in Saudi Kingdom are not organized properly, and the network is quite complicated. This study is aimed at minimizing or removing the factors which negatively affect the efficiency of the EDs. Main aspects considered in this study include the unnecessary

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waiting time leading to delay in delivery of care, decision response time and patient's flow in the ED.

In most of the countries especially developing states of the world, the healthcare organizations put great emphasis on emergency services. In this connection, quality analysis is of crucial importance for improving the emergency services. Debate is still in progress about measurement of quality of a service. Researchers are unable to find a method for accurate measurement of quality of a service or operation. Quality of the healthcare delivery can be analyzed in a number of ways including consideration of the degree of satisfaction of the individuals receiving care. In other words, patient's experience speaks a lot about the quality of healthcare delivered in a setting. During this study, not only the patient's experience is analyzed but issues related to key performance indicators (KPIs) in the EDs are also examined. This study can be split in four sections.

A technical aspect is considered in the first step. In particular, the EDs are not utilizing advanced monitoring and operation measurement technologies. This research aims to analyses different factors involved in development and implementation of an e-quality system for the EDs. In the second section, different factors involved in improving efficiency of the emergency service will be analyzed. For this purpose, key performance indicators and key quality indicators are specified for the emergency services. In the third section, the descriptive model is utilized as a platform. The Discrete Event Simulation (DES) modelling platform is capable of managing the complicated and unorganized network that constitutes the EDs. This model facilitates application of various quality measurement models. An innovative strategy is put forward in the last section which focuses on the significance of utilizing operation research methodology in emergency departments.

1.2 Problem Statement

Efficiency of EDs is negatively influenced by the unanticipated admission of a large number of patients. In many emergency situations, resources, and capacity of the EDs become very limited to cope with the situation. Considering the complicated nature of the EDs, it is important to devise a model for improving the efficiency of the EDs. A crucial component of the EDs is the ambulance system. Transference of the patient from the ambulance to the ED is the first step in delivering care at ED and unluckily no strategy is at work which could ensure patient's satisfaction at this particular stage.

1.3 Preliminarily Studies

Before conducting the research, relevant literature was reviewed through selecting a particular topic. The review involved examination of different issues related to

our research problem, suggested solution, and its analysis. Methods of extracting data are discussed in [1]. Ben Zayed et al. [2] discusses EDS in general. Chapter 3 discusses management and operation in EDs. Finally, Chap. 3 discusses the quality of system operations at EDs. In general, the literature review is conducted in three steps. These are planning for the review, executing the review, and reporting the findings. Methods which are used for conducting the systematic review are described in the review protocol. Main aspects of a process under study are analyzed through analytical review.

1.4 Gap of Knowledge

The EDs outcomes discussed in [2] and [3] and Chap. 3 were used to categorize the topics under the research. Ben Zayed et al. [2] 381,860 articles published during the period between 1864 and 2017 were chosen for the review. Abstracts of these articles were collected. This method has been utilized by Alharethi et al. [1] and Ben Zayed et al. [2]. Basic processes and issues related to EDs were categorized. Information gaps were identified in relation to emergency preparedness, performance measurement and quality of healthcare delivery as indicated by Fig. 1.1.

Review of preliminary studies allowed identification of knowledge gaps and questions which remain unanswered. These gaps were identified through systematic mapping review discussed in [1, 2] and systematic review discussed in third chapter. Identification of such gaps is important before conducting any research study in a

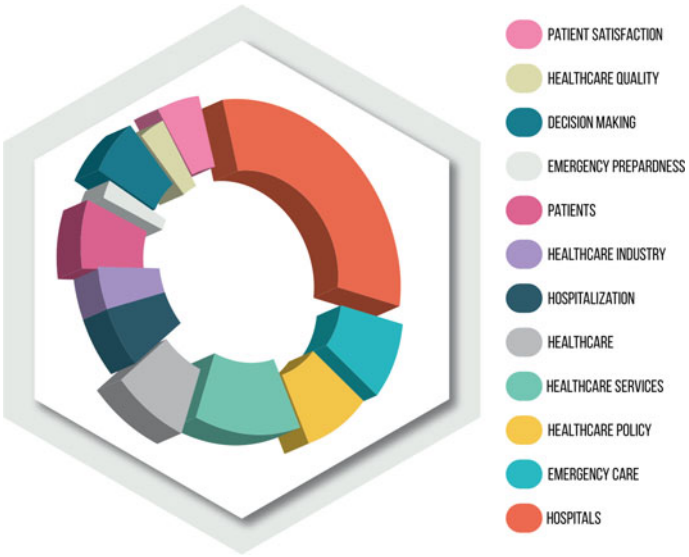

Fig. 1.1 EDs topics gap of knowledge

field of research e.g. healthcare. Figures 1.2 and 1.3 shows the cluster and further gap of knowledge. Figures 1.3 and 1.4 show the result of the systematic review before and after abstraction.

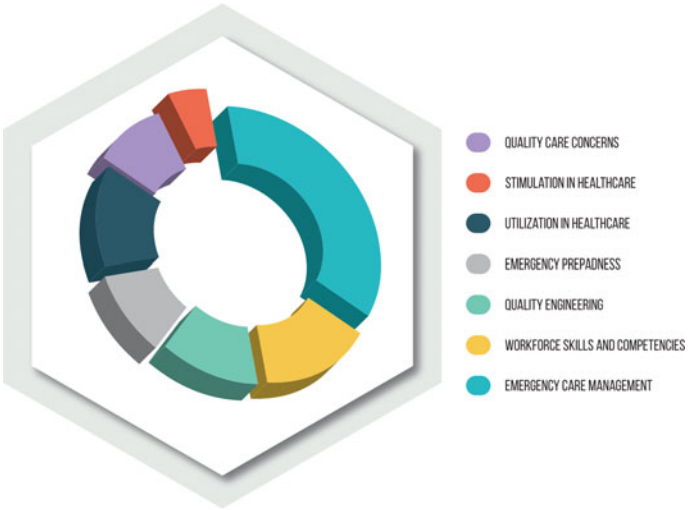

Fig. 1.2 Classification of EDs studies

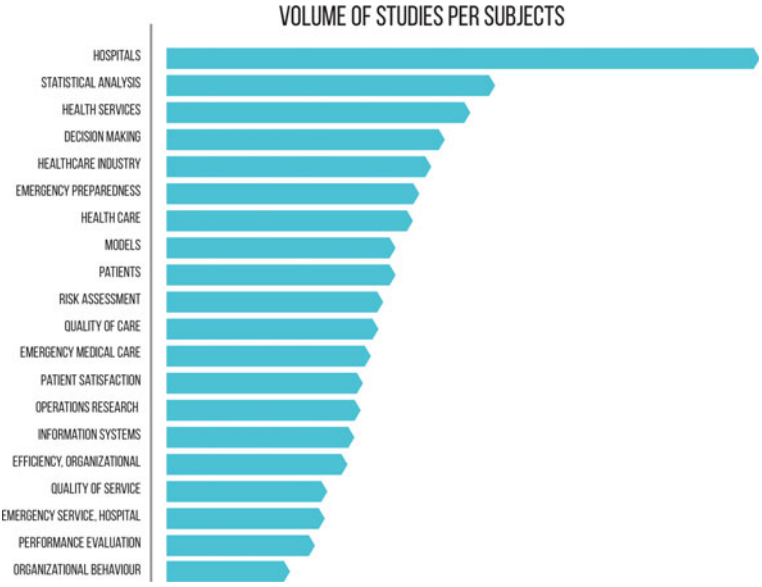

Fig. 1.3 Classifications of EDs studies by themes/subjects before study

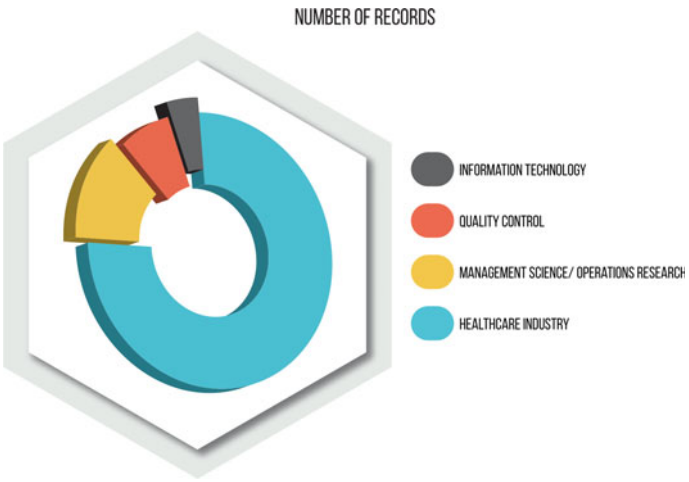

Fig. 1.4 Classifications of EDs studies by themes/subjects after study

1.5 Research Contribution

This book adds to the existing knowledge about the EDs and quality analysis and improvement by providing research-based data and years of track presented in Chap. 3 and Figs. 3.16 and 3.17. Following are the ways through which this research adds to the existing literature.

This research puts forward an innovative framework for the EDs and this framework allows measurement of the efficiency and quality of healthcare delivery at EDs thereby allowing improvement in the ED system. Several knowledge gaps have been identified in this study and were finally removed. Data was collected from well devolved instrument that allows gathering data from actual cases that occurred in developing countries e.g. KSA and MY as well as developed states of the world e.g. USA.

This data was then compared with literature and information provided by the government. The qualitative and quantitative data obtained from questionnaire studies, preliminary studies and questionnaire study were used to develop a model and framework. Development of validated theoretical framework was followed by development of a conceptual framework. Finally, a prototype of a web-based application for ED was developed which makes use of KPIs. Moreover, a research validated tool was developed which allowed measurement of the efficiency of EDs. This tool therefore allows improvement in ED using two different languages i.e. Arabic and English. Lastly, an innovative toolkit is developed for ED managers which presents a summary of the best operation management in the field of healthcare reported during the period between 2000 and 2019.

1.6 Research Advantage

Through literature review it was found that no research has been conducted in the past for utilization of simulation model in the Kingdom of Saudi Arabia (KSA) and Malaysia for bringing improvement. Direct comparison of results from various operational techniques for minimizing waiting time in EDs and improving patient's experience has not been considered in the past as well. Hence, this study is considered to be the first to consider implementation of simulation model in Malaysia and KSA. Key words ["emergency department" OR "emergency medicine" AND "operations" AND "waiting time"] were used for searching the relevant peer reviewed articles in the literature published during the period between 1882 and 2018. 1,759,073 articles were generated through this search and only 2994 publications were from the Middle East. Only ten articles were excluded from the study because they were found to be irrelevant. Hence this study can be considered to be original and unique; however, it can be re-evaluated and validated. Same search results were generated by using the IEEE database.

1.7 Research Framework

In this research, different gaps present in the literature have been identified and illustrated. It also elaborates why the issues addressed in this study do exist. Further gap and modified model with steps of constructing a conceptual framework is presented in Chap. 3. Previous gaps and model that contains SMR and SLR started showed in Fig. 1.5 and Table 1.1. This research links different studies conducted in this context and enlists different variables investigated by different studies. Research questions which have been specified in Chap. 3 have been developed accordingly. The entire framework is developed for investigating and analyzing different phenomena related to and system behaviors and events relating to ED. This type of research has been conducted for the first time in connection to developing states like Malaysia and Saudi Arabia and implementing E-Systems for healthcare in developing states.

An Over 50,000 research papers published in peer reviewed journals during the period between 1915 and 2017 have been investigated previously. Alharethi et al. [1] and Ben Zayed et al. [2] outlines the conceptual model and summarized working structure is given in Table 1.1.

1.8 Research Roadmap

Building a research roadmap is the first step for approaching an investigation and for conducting research planning. Research management involves collection of evidences and its utilization for improving outcomes. Certain research articles were

Fig. 1.5 Research conceptual model

Table 1.1 Research theoretical framework

Elements of framework	Issue identified
Quality care	Patient Record
EDs operational management	EDs capacity and layout
	Waiting time
	Crowding and flow
	Efficiency
Healthcare workforce	Skills
	Knowledge
	Effectiveness
Emergency preparedness	Radiation/virus/chemical exposure
	Disaster response
Quality engineering	Automatic segmentation
Simulation/utilization in healthcare	Structure and frequencies
	Reduction of length-of-stay (LOS)

extracted based on the time period of publication. Research road map presents an extensive overview of the research framework and different issues linked with the research conceptual model.

Classification and abstractions of simulation in healthcare is presented in Table 1.1 and Fig. 1.5. It is clear from the SMR and SLR conducted and as showed in Fig. 1.6 that a simulation is categorized into groups and subgroups. Simulation is

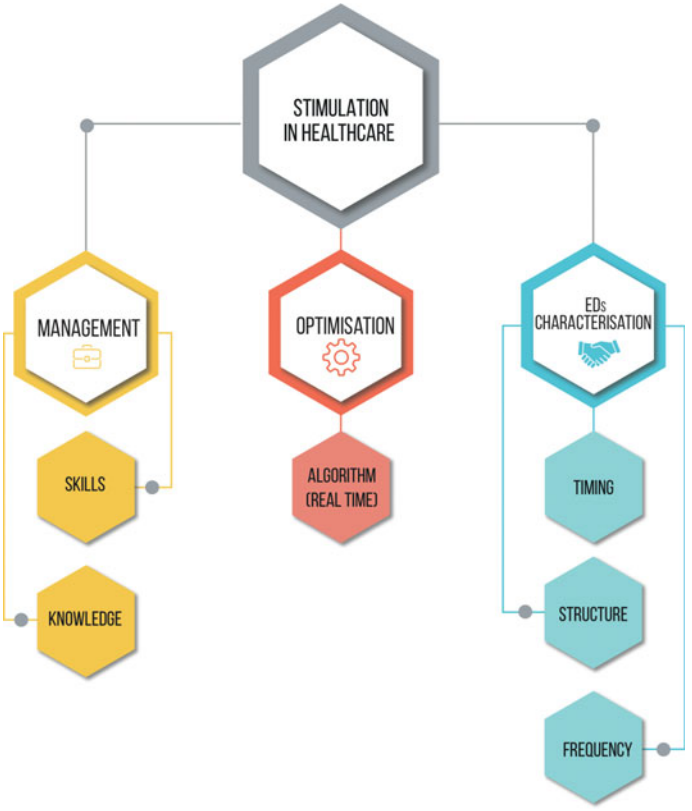

Fig. 1.6 Simulation in healthcare cluster

first categorized into management, optimization, and characterization of EDs. EDs are characterized by structure, patient flow i.e. frequency of patients and timing of various processes occurring at ED. These processes include admission, LOS, and discharge of patients. Management involves skills and expertise for implementation of the simulation and optimization involves utilization of real-time algorithm. Ben Zayed et al. [2] presents detailed roadmap of the research.

1.9 Research Scope

Scope of this study covers the topics related to e-Quality in the EDs of the healthcare sites particularly with indication to the utilization of simulation model. Different aspects identified by SMR and SLR for improving quality of the emergency services will be considered with the aim to improve level of satisfaction of patients as well as

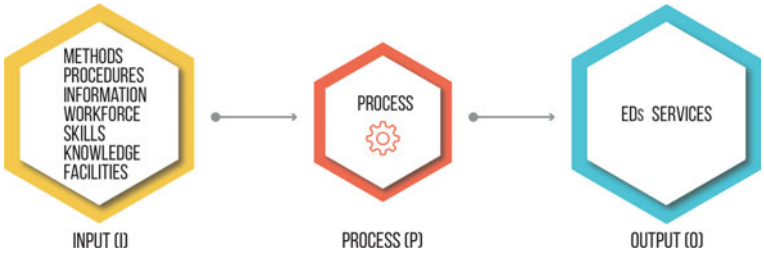

Fig. 1.7 EDs in healthcare flow chart

staff members in the healthcare sites thereby improving the efficiency of the entire EDs system if I-P-O model as shown in Fig. 1.7 is deliberated.

1.10 Research Questions

Research question was developed as part of research objectives of this book to solve the research problem and divided into three research questions:

R.Q.1. What are the main and current problems of Emergency Department?

R.Q.2. What type of current method available and common to solve and overcome those problems?

R.Q.3. How can we better harness our knowledge to execute tasks and missions to improve the overall process and outcomes of emergency department systems experiences and patient's satisfaction?

All three research questions were answered either within the discussion chapter or conclusion and recommendations of this book and each chapter.

1.11 Research Objectives

Confident research objectives were achieved through this book and answering to above mentioned questions are found. In other words, this book is basically conducted to:

- To analyze the quality of services and patient's experience at EDs in a healthcare setting. (RQ1)
- To formulate an innovative model which addresses the complicated nature of ED and relevant process. (RQ1) and (RQ2)
- To test the designed model in EDs of various countries. (RQ2)
- To verify the results with the help of real-world data and simulation data of ED. (RQ3)

1.12 Significance of the Results

The statistical analysis of the results is important so that it can be validated that the results are correct. For instance, when two variables are found to be connected, it is tested statistically to make sure that they are actually connected, and the relationship is not caused by some other factors.

Only statistically significant results are worth reporting. Results are first validated through instrumental validation that involves logical and statistical methods. In terms of the reliability of the instrument/tool designed in this study, Cronbach's Alpha was found to be 0.827. As per the findings of normality test, sample size was normally distributed.

Strong and significant correlation ($p < 0.01$) was detected between items and instrument score. The instrument items were evaluated by five experts and as per their analysis that involved determination of Kappa statistics, fair to excellent content validation is demonstrated by the instrument. A moderate to high loading was found through the factor analysis of various items of the instrument. This research is unique in terms of originality, collection of real-world data and introduction of an innovative model which is discussed in [1, 2] and Chap. 3 and as a result in Chap. 4 in detail.

References

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