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Operational Management in Emergency Healthcare

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"God Doesn't Play Dice with the Universe"
Albert Einstein

To our beloved ones...

"We can't thank you enough"

To all of our friends, faculties, universities and to our countries...

"We thank you kindly"

Preface

Big data, data mining and modelling and simulation play a significant role in today's world specifically in the field of digital health. Digital health is one such application, whereby data is used along with artificial intelligence (AI) by professionals to perform pattern analysis and segmentations with the purpose of improving digital health experience and to lead to better management of risk and emergency by facilitating improved decision-making in normal as well as in emergency conditions. Digital health has become an essential feature of the healthcare sector specifically in present situation of COVID-19 pandemic.

The contribution of digital content in spreading awareness in the current event of global outbreak of COVID-19 has increased its significance. Additionally, numerous amounts of e-Content are being generated everyday including information, facts, figures and statistics pertaining to various fields which is valuable for the government sector besides others. It even allows making prediction on the basis of available data leading to improved decision-making.

It is obvious that the emergency department (ED) is one of the most critical departments of healthcare system and hence requires mathematical models in order to address issues like extensive waiting periods and its adverse impact on EDs and patients. The outcomes of these works are effective for improvement of care delivered to patients in ED. The weaknesses of healthcare system specifically the weaknesses of the EDs have become evident particularly in current scenario when the world is in the grip of the deadly COVID-19. All this implies that analysis is significant for improvement of services in the emergency department. However, there are certain arguments regarding the evaluation of service quality.

This book also presents the systematic review of research pertaining to the processes and systems of the EDs, the issues faced by EDs and their solutions to ensure delivery of proper and ideal healthcare services for patients in ED through superior quality process management in ED. The review assesses the two-decade data from 2000 to 2019 to examine the processes employed for ED operations during this period. The review set special emphasis on emergency system operations. The review involved assessment of the researches and identification of research gaps. Systematic review methodology had been employed to sort the

subject matter of these research works with respect to emergency departments (EDs). Additionally, the book also presented service quality appraisal of the EDs which revealed that the development and adoption of advanced performance appraisal tools and systems enabled EDs in under-developed nations to make great progress in ED services. The assessment was performed by taking data collected from patients. This implies that this part of the book is mainly concerned with development of extremely responsive assessment tool with some specific features to act as a decision support system while designing any application. For this purpose, the assessment tool must be capable of supporting the simulation experiments.

The validation of the evaluation instrument represented a kappa value equal to 0.763 while the attained Cronbach's alpha value was equal to 0.827. Hence, evaluation of healthcare standards through this instrument delivered valid, reliable data. The outcomes of the model experimental data were tested out for accuracy through the use of probability density distribution. It was found that all data sets depicted normal distribution with 90% modelled cases not exceeding the optimal range. The literature review revealed a lack of literary content on bringing about developments in Malaysia and Saudi Arabia through the deployment of simulation model. Moreover, previous research works failed to make comparison between the affectivity of different operational methods that help to reduce the extensive waiting period in EDs and their impact on patient experiences. A reduction of patient waiting time at emergency department specially in Saudi Arabia as 38.57% less than current actual waiting time at medium hazard scenarios for door-to-door service time and with 61.63% of ED possessing time in Malaysia. This subject of deployment of simulation model in Malaysia and Saudi Arabia is being considered for the first time by this book.

Lead Author
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May 2020

Acknowledgements

The first edition of this book had been put together with a great deal of time and efforts from many people. Very special thanks go to all joint authors for guidance, encouragement and academic advices and support during one-year journey to get this book in current look and feel. This book in its first edition is part of Ph.D. thesis of lead author under the supervision of second and fourth co-authors never published before elsewhere.

Comprehensive systematic review was carried out by lead author and the principle of the research is the work of lead author and reviewed by all joint authors. Joint authors helped strengthening the overall development of the research. Validation, verifications and statistical analysis of results were reviewed by joint authors in instrument development and methodology was used. Reviewing of overall development of research was supervised by first and fourth joint author. Data collections were carried out by lead author and analysis was carried out by lead author and second joint author, validated and reviewed by first and fourth joint author. Discussion and conclusion were those of lead author reviewed by all joint authors.

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May 2020

Highlights

- Digital health has become an essential feature of the healthcare sector specifically in present situation of COVID-19 pandemic.
- The contribution of digital content in spreading awareness in the current event of global outbreak of COVID-19 has increased its significance.
- Emergency department is one of the most critical departments of healthcare system that requires mathematical models in order to address issues like extensive waiting periods and its adverse impact on EDs and patients.
- EDs have become evident particularly in current scenario when the world is in the grip of the deadly COVID-19. All this implies that analysis is significant for improvement of services in the emergency department.
- This book presents systematic review of research concerning to the processes and systems of the EDs, the issues faced by EDs and their solutions to ensure delivery of proper and ideal healthcare services for patients in ED through superior quality process management in ED.
- The review evaluates two-decade data from 2000 to 2019 to examine the processes employed for ED operations during this period.
- The literature review revealed a lack of literary content on bringing about developments of EDs in Malaysia and Saudi Arabia through the deployment of simulation model. This subject of deployment of simulation model in Malaysia and Saudi Arabia is being considered for the first time by this book.
- The outcomes of the model experimental data were tested out for accuracy through the use of probability density distribution. It was found that all data sets depicted normal distribution with 90% modelled cases not exceeding the optimal range.
- The validation of the evaluation instrument developed represented a kappa value equal to 0.763 while the achieved Cronbach's Alpha value equal to 0.827. Hence, evaluation of healthcare standards through this instrument delivered valid, reliable result from real world data was collected before COVID-19 pandemic.
- A reduction of patient waiting time at emergency department specially in Saudi Arabia as 38.57% less than current actual waiting time at medium hazard scenarios for door-to-door service time and with 61.63% of ED possessing time in Malaysia.

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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

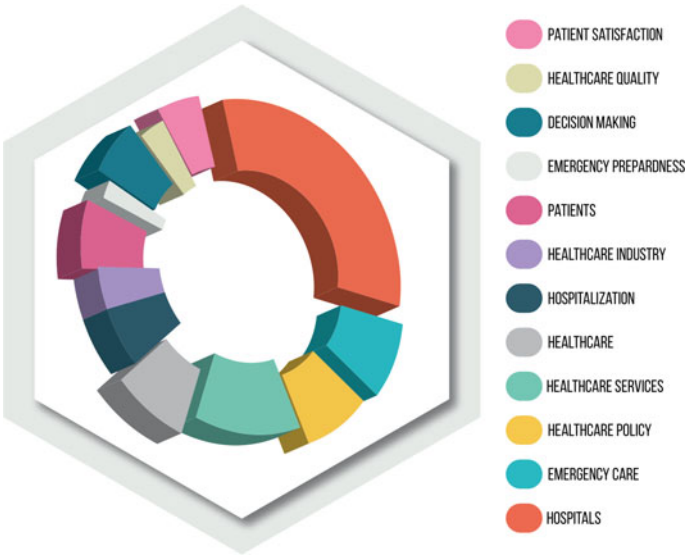

Fig. 1.1 EDs topics gap of knowledge

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.

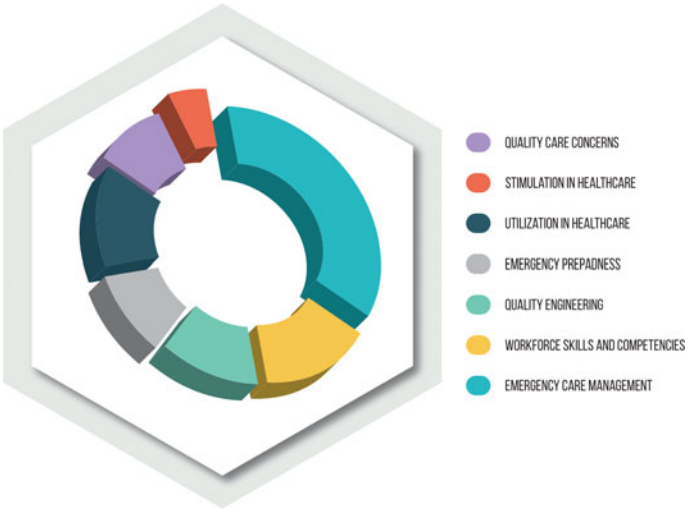

Fig. 1.2 Classification of EDs studies

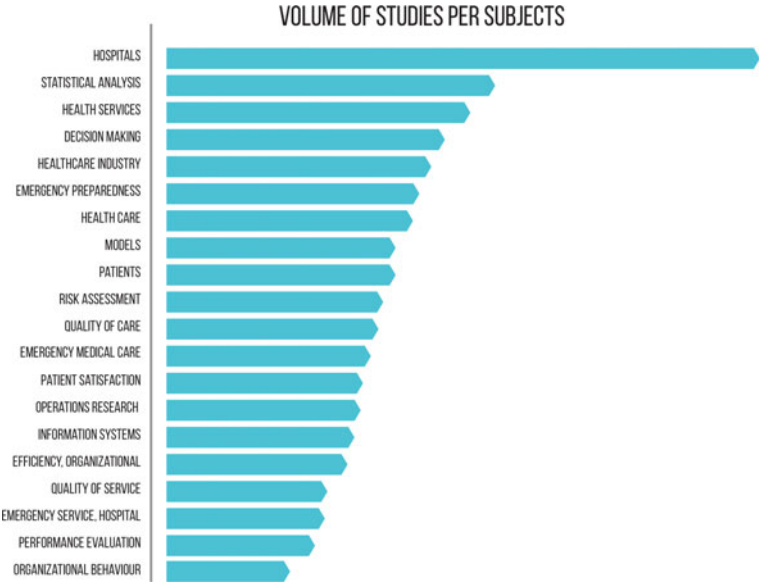

Fig. 1.3 Classifications of EDs studies by themes/subjects before study

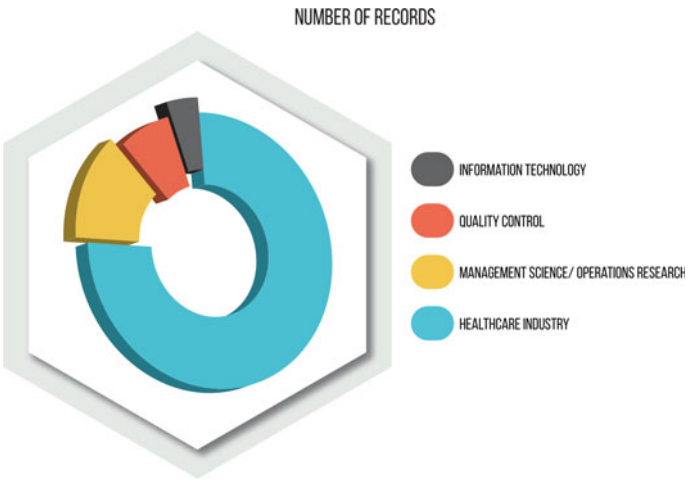

Fig. 1.4 Classifications of EDs studies by themes/subjects after study

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

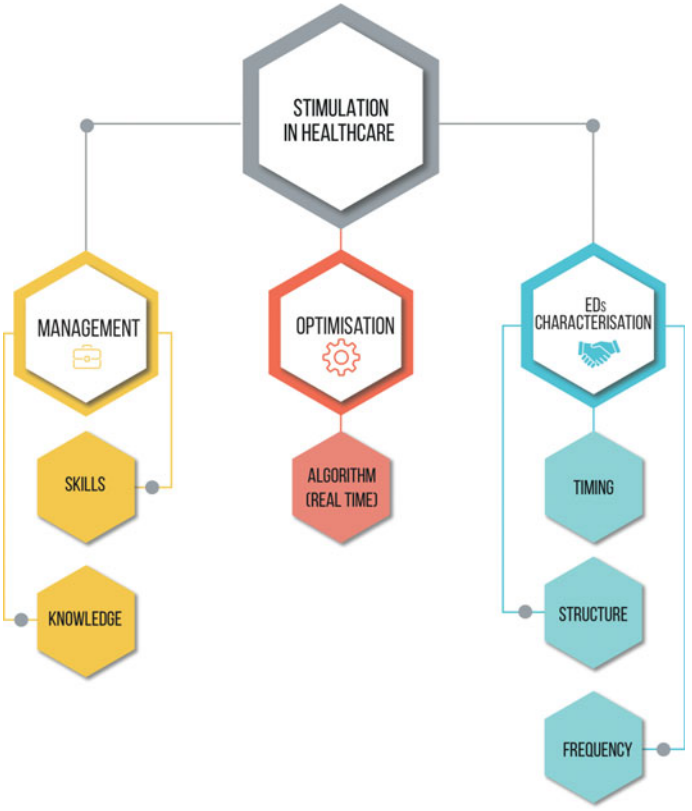

Fig. 1.6 Simulation in healthcare cluster

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

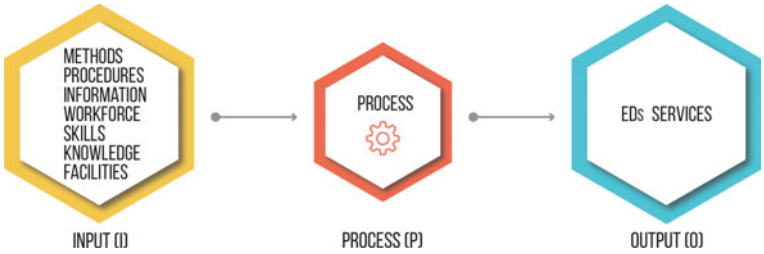

Fig. 1.7 EDs in healthcare flow chart

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.

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Chapter 2
Towards Emergency Systems Engineering: A Background

Salman Ben Zayed, Abdullah Bin Gani, and Mohd Khalit Bin Othman

Abstract The emergency department (ED) setting within the healthcare system is quite complex, and it is necessity to perform mathematical modelling to examine the challenge of long waiting times and the ways in which it can influence EDs and patients experiencing and predict conditions that need to be urgently addressed. In addition, the ways in which certain mathematical models could help in assessing solutions to issues like waiting time and ensure that suitable care is offered to patients at all times based on decision matrix and related big data source is therefore analyzed. Various studies have been carried out in the last decade that examine the challenges faced by EDs to offer research evidence that can help in enhancing the ways in which health providers offer care to their patients and in today worlds with crisis and hazard mode like COVID-19, healthcare systems are barely able to tackle this pandemic.

Keywords Emergency departments · Simulation · Waiting time · Data mining · Overcrowding · Preparedness · And healthcare

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2.1 Introduction

The mathematical modelling techniques employed during the planning stage of industrial engineering and operational processes provide a simple structure for practical implementation. Emergency departments (EDs) do not have indefinite measures; however, they provide critical care to a large number of patients. To evaluate ED systems, resource utilization, volume/number of patients, and waiting times need to be analyzed. A large number of information and data is available on hospitals through emergency department or patient files, which can be reviewed to facilitate management decision-making [1]. Moreover, different applications can be used to further support decision-making processes, with a stress on its application in E-Systems, such as ED systems in the field of healthcare. To specifically manage extensive data in the healthcare domain, data mining methods are essential and include clustering, classifications, sequential patterns, and decision trees. These techniques are supported by the datasets and allow the researcher to use extensive data from the search results in a more effective manner. In general, content mining includes searching for information available within a database. Similarly, there are different uses of search clustering. On the other hand, when there are substantively searched strings, bring together data to group information according to subjects, in which are employed for developing enhanced applications.

2.2 Emergency Departments

A critical element of the healthcare system is EDs [2]. They serve as a setting in which high-quality, instant care and service are offered to patients by care providers. Typically, EDs face challenges like overcrowding and lengthy waiting times [3]. This is due to certain demand- and supply-side factors that have an impact on the ways through which patients are provided care in various settings. A review of previous studies revealed, for example, that problems like overcrowding and extensive waiting times can be managed by hospitals when there is adequate planning, resource allotment, effective patient management, and adequate staffing. Furthermore, the examination and assessment of the effect and cost-effectiveness of different interventions and approaches used to handle the issues experienced at EDs can be facilitated by mathematical frameworks. It is also important to perform additional evaluations to identify the technologies that can be employed by hospitals to decrease waiting times and overcrowding in their emergency departments.

A vital role is played by EDs in the provision of high-quality and well-timed care to patients suffering from various conditions. Typically, these sub-departments are operational 24-hours-a-day so that immediate treatment and care can be offered to patients suffering from extremely critical conditions and illnesses. Patients visit the ED at distinct times with the intention of receiving critical care for life-threatening conditions. Moreover, different kinds of injuries and complications brought about

by accidents and chronic diseases, like cardiovascular disease, are managed by the ED [4]. In addition, all individuals are served in this department, regardless of background, or race. To ensure that the best possible care is provided to patients, various health professionals comprise ED staff, such as nurses, doctors, etc. [5]. Much effort is made to ensure patients are given immediate care after their arrival at the ED [4]. The process may be different for each hospital or each case; however, usually, registration is the first step that is carried out, followed by placing of the patient on an ED bed and performing an examination, including diagnostic and laboratory tests. Following this, the patient is treated [5]. Since this process involves some degree of uncertainty and complexity, various issues can arise, such as medical errors, lengthy waiting times, and resource wastage. Sometimes, due to factors like poor staff scheduling, testing delay, and incorrect results, the ED team is unable to provide effective care to its patients, and, often, the operational models used to perform various procedures can create barriers that inhibit providers from providing high-quality services. This is why efforts are being made to assess the challenges faced by EDs and determine solutions for enhancing the ED process, through which care is provided to patients.

Countries all over the world face different types of disasters, which, in turn, have negative implications on health, including serious injuries and casualties. In various parts of the world, natural calamities like avalanches, landslides, earthquakes, and volcanic eruptions have led to several deaths and loss of life's [4]. In certain situations, the extent to which EDs are reliable and suitable has been examined through the increase in the number of cases of infectious and chronic diseases reported. The ED is usually the primary point of care for patients experiencing complex problems [5] and also serves as the initial point of contact between victims and care providers during natural calamities [4]. Hence, it is important to enhance the ways in which units' function and develop plans that will ensure appropriate care is provided to patients. Training is also being offered to care providers regarding the ways in which patients can be triaged and registered without delay as well as how to communicate with them upon their arrival, analyze their condition, and offer services to ensure they recover quickly. In the past decade, various studies have been carried out that examine the challenges faced by ED departments in order to identify evidence that can help enhance the ways in which health providers offer care to their patients [4]. Lim et al. [5] evidence from three previous studies, which concentrates on the activities occurring in ED settings, was examined.

2.2.1 Non-urgent Visits

It was shown in the study carried out by Hoot and Aronsky [4] that there are several themes related to the reasons behind crowding in emergency care settings. These themes were typically classified as input, throughput, and output factors, with issues relevant to the source and components of patient inflow as some of the input factors. It was shown in an analysis of the data gathered by the researchers that the major factor were non-urgent visits. The researchers asserted that a few patients visited the ED

when suffering from conditions that did not require urgent treatment. Specifically, sometimes, complaints were brought by frequent ED visitors that could probably have been treated in other settings, like inpatient or outpatient facilities. Lastly, patients experienced complex issues during the influenza season that needed to be treated immediately. Furthermore, there was a negative effect of these input factors on the process through which services are provided by healthcare professionals to manage these urgent ED cases. In contrast, the throughput factors were related to ED bottlenecks, and it was determined that its major influencing factor was insufficient staffing that led to negative effects like lengthier waiting times. Furthermore, it was asserted by the authors that due to insufficient staffing, caregivers in certain hospitals were compelled to manage multiple patients at once [4]. Lastly, overcrowding related to bottlenecks observed in other areas of the healthcare system that may influence ED operations were brought about by certain output factors. Inpatient boarding and hospital bed shortages were recognized by Hoot and Aronsky [4] as the main output factors involved in resolving overcrowding issues in EDs.

2.2.2 Overcrowding

Outcomes from previous studies were used by Hoot and Aronsky [4] to demonstrate the ways in which overcrowding affects EDs and summarize the negative health outcomes. Hoot and Aronsky [4], patients visiting the ED experienced several complications that could call for immediate and specialized treatment. When these patients were not offered the urgent care needed due to overcrowding, they faced a greater chance of experiencing negative effects, which could eventually even lead to their demise. Therefore, hospitals need to manage ED overcrowding to decrease the number of deaths they experience. The other issue discussed in the review involved the decreased quality of services.

Overcrowding can compel care providers to treat multiple patients at once and work longer hours, because of which low-quality services are provided that do not fulfil patient requirements. This problem can also lead to less access to critical services since patients must face lengthy waiting times. Sometimes, there is also apprehension that the patients are likely to leave the ED without being examined by doctors because of the large number of patients already present. Because of lengthy waiting times, patients may move to other facilities; however, it is likely that those not checked by an ED doctor or care provider will exhibit worse conditions in comparison to those who were provided emergency care. Overcrowding can also cause financial losses for the hospital and produce a higher cost of care. It has also been shown in previous studies that, because of the large number of patients present at EDs, there may be delays in the provision of care, medical errors, extended pain, death, and the use of irrelevant processes. Relevant methods need to be determined by hospitals to manage issues and ensure that the best possible care is offered to their patients. Further information was obtained by Hoot and Aronsky [4] in regard to the potential solutions to crowding in EDs. three key themes were determined. In the first one,

it was suggested that it is important to enhance ED resources as well as the healthcare system. The authors stated that further physical resources should be offered in hospitals to help employees react to the rising demand for emergency services.

In addition, it has been asserted in other studies that the number of ED staff should increase, and support resources should be offered so they are able to provide treatment to patients in the shortest possible time and achieve positive clinical results. It was also suggested that the strategies, procedures, and techniques used to address the requirement for emergency services in the ED should be enhanced. Specifically, it was suggested by Hoot and Aronsky [4] that the correct use of emergency services should be encouraged by hospitals, which should also reorganize patients in a way that positive health outcomes are attained and the number of patients at the ED at any specific point in time decreases. Finally, it was suggested that operational research should be carried out by hospitals to determine management and process changes required to ensure that patients are provided services just on time.

In this process, partnerships should be established with external organizations, and researchers should formulate methods that make ED units and teams more effective and efficient. Hoot and Aronsky [4] carried out a systematic analysis of studies that examined the degree to which ED operations have been influenced by crowding, leading to unfavorable health outcomes. It was further asserted by the authors that a complex group of factors are responsible for bringing about this problem, which has an impact on patient flow and the tasks of healthcare professionals in these departments. Regardless of the reasons for its occurrence, crowding brings about several unfavorable outcomes that further worsens the health of patients. This is why various targeted solutions, like the recruitment of additional staff, has been carried out in the ED setting. Although important information is offered could bring about enhancements in the health sector, the ways in which overcrowding influences the provision of healthcare services was shown by Hoot and Aronsky [4], and possible solutions that could be used to address this issue were determined.

2.2.3 Waiting Time

Mathematical modelling was used by Lim et al. [5] to analyze the issue of waiting time in EDs. The authors stated that novel opportunities are offered by analytical modelling for examining various healthcare issues, technologies, and interventions that have an impact on the process of providing care to patients. Due to developments in the healthcare setting, there has been an increasing need to establish relevant modelling methods that can offer high-quality data pertaining to care pathways and interactions among patients and healthcare providers in different settings.

An example of assessing processes was put forward by Lim et al. [5], which allowed for identifying the existing and subsequent demands for simulation and the way it affects the provision of high-quality care. System analysis techniques were formulated by the researchers in certain situations, which employed mathematical models to signify and evaluate an extensive variety of queries and factors. In addition,

various hypothetical situations could be simulated by the models to enable care providers identifying areas that require adjustments to enhance patient care [5].

The challenge of ED waiting times has been analyzed by mathematical modelling techniques. Due to lengthy waiting times, EDs become overcrowded and practitioners are unable to manage severe and chronic conditions that have an impact on patients [5]. Since the ED setting within the healthcare system is quite complex, it is imperative to perform mathematical modelling to examine the issue of waiting time and the ways in which it can influence the health and welfare of patients in urgent condition. There are several factors causing lengthy ED waiting times, including, for example, the complicated nature of the care provision process. According to Lim et al. [5], urgent care is required by patients visiting the ED in order for them to regain their health. In contrast, healthcare professionals depend on management systems, care provision techniques, and equipment to manage their patients. Sometimes, lengthy waiting times are caused by demand factors like volume of beds, poor scheduling, hospital capacity, sub-optional management, and variations in the extent of patient acuity.

2.2.4 Preparedness

In some previous studies, the readiness of EDs to manage some of these healthcare issues often experienced by individuals has been examined. In addition, studies have been carried out to examine the issues faced by these departments and the ways in which they influence the provision of healthcare services. For example, a study was carried out by Hoot and Aronsky [4] to assess the problem of overcrowding experienced by EDs.

In this book, the researchers pursued to examine the reasons behind the problem and its consequences and then determine potential solutions for its improvement. It was claimed by the researchers that overcrowding is a critical problem experienced by EDs throughout the world and has an impact on the quality of care offered to patients and their access to critical services. In addition, the authors claimed that, since a unique role was played by the ED in the provision of services, the researchers and practitioners gained encouragement to assess the safety characteristics of the contemporary healthcare system. It was shown that because of the high extent of overcrowding taking place in emergency care units, the quality of care provided to patients has been failing, with a breaking point identified that could cause negative health effects, like medical errors [4].

In previous studies, the ways in which hospital staff comprehend the problem of crowding and the interventions that have been formulated to manage its negative effects were analyzed, revealing evidence that could help in modifying the ways in which ED units work; however, according to Hoot and Aronsky [4], more studies need to be carried out regarding the cause and effects of these issues so that relevant, long-term solutions can be formulated and executed in various care settings. It has been additionally observed that it is vital to comprehend the reasons behind overcrowding

results as well as its impact to enable healthcare professionals in establishing methods for enhancing routine procedures and operations. This would ensure that, in the long-term, facilities are more capable of more rapidly managing the complex healthcare requirements of patients and produce positive health outcomes.

The systematic review method was chosen by Hoot and Aronsky [4] to accomplish their research objectives. A comprehensive review of e-database was carried out to find articles that could present data regarding the required topic. For the purpose of this book, articles that had reviewed the cause, impact, and solutions related to the overcrowding problem in EDs were abstracted. In addition, articles that used unambiguous data collection and analysis techniques were identified by the authors, while concentrating on the typical ED setting. Crowding was explained by Hoot and Aronsky [4] as an issue arising when the requirements of patients in the ED setting become greater than the resources available. The researchers worked alongside two unbiased reviewers to review the articles and identify those that fulfilled the inclusion criteria. In case conflicts arose, consensus was reached on the basis of the pre-established standards for inclusion. After identifying the studies, data extraction was carried out. During this process, information pertaining to the objective, techniques, and findings of each study as collected. In addition, to analyze the methodological nature of the studies included in the review, a 5-level instrument was used [4] with the purpose of collecting data that could help in understanding the issues faced by emergency departments all over the world and determine their solutions. The search process led to the selection of 93 articles that fulfilled the inclusion criteria [4].

2.3 System Engineering

Various types of severe emergencies can be managed by EDs by their offering critical emergency care within and without the hospital. Moreover, the examination of health operations requires a decision-analytical model [3]. It is important for hospitals to update these processes as modelling approaches are applied when carrying out communications among patients and ED staff as well as patient care pathways and supervision. It is vital to examine the system, as EDs are inherently complicated and face specific issues.

Previous studies have employed mathematical healthcare frameworks; however, studies on EDs have quite infrequently used these models. However, a critical role has been performed by such models in decreasing the lengthy waiting times faced by ED patients. It has been found that, in the healthcare sector, especially in EDs in less developed countries, improvements in quality measures and facilities are extremely valuable in assessing the quality and effectiveness of the care provided to the patients. These assessments involve collecting the perspectives of patients. Identifying a conceptual measurement of EDs facilities in EDs is not a simple task, since EDs in these countries do not employ certain existing operation and monitoring approaches to determine service quality. From the technological point of

view, the factors bringing about the successful creation of an e-quality observational mechanism for emergency services can serve as a standard.

2.3.1 Modelling Operations

Efforts have been made throughout the years to develop distinct mathematical models that can help in evaluating healthcare procedures. Nonetheless, there has been limited focus on the issue of ED waiting times. Due to the rising need to decrease the extent of overcrowding and time spent by patients in the ED altogether, a mathematical assessment of emergency department operations was carried out by Lim et al. [5] to obtain information that would enable the enhancement of clinical outcomes. The study essentially sought to determine the latest mathematical modelling techniques that had been employed by researchers to examine the ways in which waiting times can be decreased in emergency departments. In addition, the modelling methods were compared by the authors to determine their impact on the process of offering urgent care to patients.

A well-defined and reliable technique was employed by Lim et al. [5] to examine and produce data that could help in enhancing healthcare outcomes in emergency care divisions. During this process, a systematic search was carried out to identify and determine studies that had employed mathematical models to assess the issue of ED waiting times. Different databases were used these included peer-viewed studies written in English from the years 2000 to 2010. Conference proceedings were also chosen by the researchers if they included information on the given topic. After identifying these studies, an abstraction form was generated by Lim et al. [5] to note all important information. During this process, information was collection regarding the modelling methods employed as well as the aims, techniques, measures, and outcomes of each study. In contrast, the modelling techniques were compared by assessing their performance, ability to perform multiple types of processing, the type of software used, the extent of data abstraction, and memory. Based on the data collected, it was observed by Lim et al. [5] that the discrete event simulation (DES) was used in 20 studies that fulfilled the inclusion standards to examine the problem of lengthy waiting times in EDs. An enhanced version of DES was used in two studies to formulate information pertaining to performance measures relevant to ED operations [5] also studies employed the system dynamics modelling to produce qualitative and quantitative data regarding the processes and systems employed by EDs.

It was shown in the review that DES, optimized DES, and system dynamics modelling were employed in previous studies to examine different performance measures that could increase ED waiting times. The impact of scheduling was one factor that was evaluated. It was asserted by Lim et al. [5] that DES-based studies have assisted in determining scheduling factors like operational hours and staff shifts that had an impact on the number of hours spent by patients at the ED. It was also observed by Lim et al. [5] that, in the studies chosen, appropriate scheduling could considerably

enhance throughput and decrease patient waiting times. It was claimed in this study that, when fast-tracking of ED patients occurred, waiting times could decrease and better resource usage and management could ensue [5]. Other factors that brought about positive clinical outcomes included sufficient staffing, enhanced planning, and bed registration. It was also demonstrated in mathematical model studies that waiting times in emergency care units could be decreased due to resource sharing and process timing [5]. Hospitals with sufficient rooms, staff, beds, and equipment would be more capable of timing and planning their operations in an efficient manner. Consequently, there could be a decrease in ED length of stay and negative outcomes associated with overcrowding, like mortality, could be avoided in the long-term.

Due to pressure to make effective use of resources and enhance the quality of care offered to patients without producing any impact on budget, decision-makers have been compelled to concentrate on the different ways in which time spent in the ED can be decreased. Various supply- and demand-side factors are currently being understood by researchers and decision-makers that can increase waiting times as well as the degree to which care providers will treat patients in emergency departments. It was observed by Lim et al. [5] that critical data has been offered by mathematical models that help decision makers in comprehending the systems and approaches that influence the provision of high-quality ED services in the shortest possible amount of time. It was also demonstrated in the study by Lim et al. [5] that mathematical instruments have been used to illustrate the ways in which to manage the issue of lengthy waiting times through appropriate scheduling, resource usage, and management in addition to process planning. Furthermore, these models have been used to generate simulations that help in testing solutions to waiting times and identifying areas that caregivers should concentrate on in order to attain promising results.

It was stressed in a systematic review carried out by Lim et al. [5] that hospitals need to identify the ways in which the quality of ED services are enhanced by a decrease in waiting times. In addition, the ways in which mathematical models could help in assessing solutions to long waiting times and ensure that suitable care is offered to patients at all times was analyzed [5]. Nonetheless, there were some limitations to the review that should be considered before the results are generalized. First, because of the cross-disciplinary character of mathematical modelling, the researchers were compelled to consider methods that have employed in various fields, such as industrial engineering and healthcare research [5]. Secondly, the review findings may be influenced by biases in the modelling procedure, like temporality. Thirdly, a standard quality assessment instrument for the mathematical modelling methods was not available, which may have affected the validity and quality of the findings presented by Lim et al. [5]. Fourth, non-English studies that analyzed the role of mathematical modelling in addressing problems inherent in EDs, for example, extensive waiting times, were not included in the study. Lastly, the researchers decided to restrict their search to articles issued between 2000 and 2010; because of this, older studies that offered high-quality evidence relevant to the subject of interest may have been excluded. However, despite these limitations, evidence was provided in this study that could bring about improvements in ED operations by highlighting the ways in which the issue of lengthy waiting times can be managed.

2.3.2 Simulations in Healthcare

When performing the operational management of an emergency, it should be noted that various complex features are involved. Specifically, efficient methods should be adopted to make sure that patients are responded to in a rapid manner. An issue that has been extensively observed in EDs is emergency preparedness in respect to lengthy waiting times and overcrowding, especially during calamities. Due to overcrowding, death and re-admission rates increase and there is a greater possibility of patients leaving the ED altogether without ever being checked.

In addition, a greater number of patients are not taken care of in a proper manner due to a lack of prioritizing the offering of care to a large number of patients that could be suffering from minor to major conditions. The patient is first admitted to the hospital, after which, a doctor examines their conditions and offers treatment with appropriate medical care. Due to extended waiting times, EDs become overcrowded, thus increasing the risk of patient mortality. In addition, since patients often leave the ED without being checked, ED re-admission rates could increase.

The organizational, human, and physical features of patient monitoring in ED settings needs to be taken into account; therefore, it is necessary to consider the operational management system, real-time information regarding patients and their families and equipment. The key requirements include waiting areas and other places in which overcrowding is not allowed during times of high strike. The commands below are usually followed when managing patients: triage, registering patient name, examination, blood tests, X-rays, pharmacy, assigning ED bed location, management, ED staff, allocation, and, ultimately, discharge.

The most extensively used method by EDs has been the discrete-event simulation method, particularly within the UK Healthcare system from 2000 to 2009. The purpose of the ED is to attain critical healthcare objectives; hence, they are considered the most important component of hospitals. Thus, logical solutions and procedures should be developed by EDs in normal as well as unlucky situations. Simulation software can also be used to address issues regarding prevention, decreased waiting times, and forecasting variables in normal and critical situations in EDs [5]. Simulation modelling has been used to identify issues experienced in practical settings and those in terms of patient flow and supervising, arrival patterns, and inconsistent removal of optimal methods in emergency response domains [6]. Data collection in the simulation model distinctly occurs in normal and hazard situations. Direct sampling, hospital records, historical data, patient tracking cards, questionnaires, and observations are used for gathering data. To increase resources and decrease waiting times, simulation approaches are used by employing cost monitoring and establishing planned guidelines [6].

2.4 Data Mining

Different applications can be used to further support decision-making processes, with a stress on its application in E-Systems, such as ED systems in the field of healthcare. To particularly manage extensive data in the healthcare domain, data mining methods are needed, which include clustering, classifications, sequential patterns, and decision trees. These techniques are supported by the datasets and allow the researcher to use extensive data from the search results in a more effective manner.

2.4.1 Data Warehousing

To eliminate data duplication that emerges from web mining clustering methods, a cluster-optimizing method that is identical to the inherent capability of ants to identify their nest mates can be employed. The cluster optimization method was considered to eliminate flatterers, there should be accessibility to the graphics in the web log. A cleaned web log was used to carry out the pattern analysis [7]. The algorithms used most often, like Weighted, and PageRank, were evaluated against each other [8]. When an influential web mining tool was used, the information from the traditional user patterns could be examined. In this technique, a vital role is carried out by web structure mining.

Various web structure mining algorithms were used to rank the compatible and relevant pages, with the same treatment was provided by HITs, PageRank, and Weighted PageRank to each link while simultaneously presenting the ranking score [8]. The two levels of the prediction model will be explained by the author to conceptualize achieving enhanced hit ratios. The first level seeks to filter the categories that are highly likely to bring about a visitor hit. The next level is used particularly for achieving the greatest web page probability. Nonetheless, it is not possible to disregard the issues of heterogeneous user behavior [9].

To enhance the customization of web content, data mining instruments were used to examine web logs [10]. The effectiveness of the documents from the perspectives of the users were examined with the search tool by allocating higher ranks to clusters that were similar to the chosen keyword. The systems that just used content-based searching were deemed of lesser value in respect to their specificity [10]. In another study [11], a distinct concept that was presented involved automatically determining landmarks and events in tagged images. When a large volume of user-shared images needs to be aligned, landmark and event detection are critical instruments.

2.4.2 Hyperlinks

Through hyperlinks, various webpages, providing information that can be obtained in an effective manner. The purpose of the majority of e-commerce websites is to endorse and present a given business. The businesses could then gain profits by creating links between the websites because of the increased web traffic that would result in increased revenue for the web developers [12].

The links between websites through the hyperlink was believed to be a representation of the financial and symbolic inter-organizational relationship of these organizations [13]. There was a limited quorum of organizations that developed powerful websites for being linked to other websites. A critical element of data mining is graph mining. Recurring subgraphs in a given mix of graphs and relevant data sets were determined using this method.

A vital role is also competed by this process in forming an efficient methodology directed toward obtaining applicant subgraphs. In addition, it helps in classifying subgroups and ensuring that the sets attained are effective and accurately computed. The different procedures sometimes included in this method were examined in the existing study, which emphasizes and elaborates on the issues involved [14]. Algorithms were considered while assessing the categorization procedures with respect to their search strategies or methods for counting frequencies [15].

2.4.3 Web Mining

Used to obtain a more extensive understanding of the support requirements of web- and programs uses several techniques to identify usage patterns present in web data. It comprises three key phases: pre-processing, pattern identification, and pattern assessment [16]. While being used extensively in web, mining data has also grown its use throughout the web. Through this method, an increased understanding of existing information can be obtained, which can be applied more effectively to end users.

This is why this kind of analysis has been employed by various organizations. In contrast, some challenging questions have surfaced in regard to web mining, and it is imperative to respond to them before formulating robust instruments [16]. There have also been studies on the adoption of data mining with respect to management systems, and adaptive systems. Certain requirements exist with respect to the integration of data mining within systems [17].

2.5 Conclusion

Relevant methods need to be determined by hospitals to manage issues and ensure the best possible care is offered to their patients. Overcrowding can compel care providers to treat multiple patients at once and work longer hours, resulting in low-quality services being provided to patients that do not fulfil their requirements. It has been found that, in the healthcare sector, especially in emergency departments in less developed countries, improvements in quality measures and facilities are extremely valuable in assessing the quality and effectiveness of the treatment provided to patients.

Preparedness in a few studies carried out previously, the readiness of emergency departments to manage a few of the healthcare issues often experienced by researcher were examined. In contrast, healthcare professionals depend on management systems, care provision techniques, and equipment to manage their patients. It was suggested that the correct use of emergency services should be encouraged by hospitals, which could reorganize patients in a way to attain positive health outcomes a decrease in the number of individuals at the ED at any given point in time.

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Chapter 3
Decades Trend of Emergency Department System Operations

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Abstract Emergency services are meant to ensure the timely delivery of essential healthcare services to people using complex systems. If emergency services use real-time patient information to select the most suitable emergency option, it will allow the service provider to more quickly conduct a detailed physical examination to diagnose the problem and to determine a treatment plan that will suit the patient. Emergency departments offer various services and have several components that are conducted under complex management. This study examined previous research on engineering systems and the evaluation of the quality of healthcare systems. These studies considered the level of patient satisfaction and investigated how healthcare is influenced by operational management. The research also indicated that real-time data are very helpful for mangers in emergency departments to help them make appropriate decisions. This finding implies that patient satisfaction can be ensured through the extraction of data about the issues related to proper, operational, and effective management. Patient satisfaction and the quality of services and care delivered can be enhanced to improve the patient's overall experience by using development strategies and quality evaluation in EDs. The previous research conducted on the management and processes of emergency departments was systematically reviewed and classified. This study reviewed research conducted between 2000 and

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2019 to understand how emergency departments used processes, addressed issues, and resolved issues when considering the patient in an ideal healthcare setting with a high standard of operation management. Emergency services are significant for everyone because anyone may need these services at any time. This study uses the data from the last 20 years to investigate the methods employed during that time in emergency department operations.

Keywords Emergency · Management · Preparedness · Quality · Engineering · Healthcare and systematic review

3.1 Introduction

The introduction of new tools and performance evaluation systems in EDs in underdeveloped countries resulted in a positive impact on the measurement of the quality of care and services delivered to patients. In particular, the patient's perspective is considered in this kind of performance evaluation. The process of evaluating the efficiency of the facilities and the services offered by an ED is complex, and there is no specific theoretical formula for this evaluation. The supervising system and functional strategies that serve as criteria for evaluating the efficiency of any ED's facilities are not presently implemented in developing and underdeveloped countries, which makes it difficult to evaluate the performance of ED facilities in these countries. When considering technology, such countries can use factors that ensure a high standard observational system for an emergency department as criteria for evaluating emergency medical services.

The operational management of an emergency department is a complex job and involves various complicated factors. Quick and immediate responses to patient queries must be provided through effective strategies. The main prevailing issue in EDs is the attentiveness of the emergency staff and the readiness of the processes, which allow smooth operations and prevent prolonged waiting and overcrowding in the case of catastrophic events. Overcrowding may also occur with higher casualties, readmissions and when patients cannot see the doctor because of prolonged wait times. Moreover, since all kinds of patients with minor to major illness come to the emergency department, the patients must be categorized on the basis of the severity of their condition so that the more serious patients can be treated first to prevent them from being deprived of the timely services and care they need. The treatment process involves a patient's admission, examination by the doctor and provision of a suitable treatment.

The available research was explored to detect the correspondence between the search systems and data collection [1–3]. Emergency departments (EDs) impart emergency services to patients in urgent need of care by providing acute, out-patient care. The evaluation of the technologies used for care and services must be accompanied by a decision-analytic model. The hospitals must make efforts to introduce and improve this technological analysis because it facilitates effective patient-staff

interaction and regulates the procedures involved in patient care. As EDs operate multiple systems and impart multiple services to patients, they may face numerous issues; therefore, it is imperative to conduct system analyses. Although mathematical models have been investigated by numerous studies in the context of healthcare, no work has been conducted to investigate these models in the context of EDs, although the mathematical models could help reduce prolonged wait times in the EDs.

3.2 Background

A critical element of the healthcare system is the emergency department (EDs). EDs serve as a setting in which high-quality, instant care and services are offered to patients by care providers. Typically, EDs face challenges, such as overcrowding and lengthy wait times. These challenges are due to certain demand and supply-side factors that have an impact on the ways in which patients are provided care in various settings. Problems such as overcrowding and extensive wait times can be managed by hospitals when there is adequate planning, staffing, and resource allotment and effective patient management. Furthermore, the examination and assessment of the effect and cost-effectiveness of different interventions and approaches used to address the issues experienced at EDs can be facilitated by mathematical frameworks. It is also important to perform additional evaluations to identify the technologies that can be employed by hospitals to decrease waiting and overcrowding in their EDs.

A large amount of information and data on hospitals are available through the emergency department or patient files, which can be reviewed to facilitate management decision-making [1]. EDs are a critical element of the healthcare system [2]. Typically, these sub departments operate 24-h-a-day so that immediate treatment and care can be offered to patients suffering from extremely critical conditions and illnesses [3]. It is important to enhance ED resources and those of the entire healthcare system.

3.3 Material and Methods

The systematic review employed the approaches mentioned in [1–3]. The review starts with a systematic analysis of the research to classify the studies and create a thematic assessment. The available literature is discussed in detail in this research. The systematic approach presents the outline of the research area and the drawbacks of the research [3]. The most recent sources of data are employed in this research. This study is quite significant because it is focused on the standard of healthcare and contributes to the present literature by investigating the concept of emergency preparedness, system operations and services reengineering in the context of the ED, which has not been previously explored.

3.3.1 Research Questions (RQs)

The systematic review employed the approach in [1–3] to identify the problems faced by operations of the ED system and gave rise to the following questions:

- RQ1: When and where was the research published?
- RQ2: What problems/objectives were addressed in the research?
- RQ3: Which methods were utilized in the ED operations research?
- RQ4: What measurements and KPIs were used?
- RQ5: What were the findings?
- RQ6: What are the shortcoming and deficiencies that were addressed?
- RQ7: What themes were introduced in the ED operations research?
- RQ8: How was the research categorized?

3.3.2 Search for Strings

Databases were searched with the help of international web trends based on the following keywords: emergency department, emergency medical care, emergency clinics, management, preparedness, quality, reengineering, and health care as shown in Figs. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, and 3.8. The search strings mentioned below were obtained using the search strings:

- Set 1: Search terms related to research on EDs (i.e., emergency department, healthcare).
- Set 2: Search terms related to strings (e.g., emergency medical care and emergency clinics).
- Set 3: Search terms related to themes (e.g., management, preparedness, quality, reengineering).

The keywords were divided into different groups based on the research questions. Table 3.1 shows all of the search strings that were searched in the databases. This

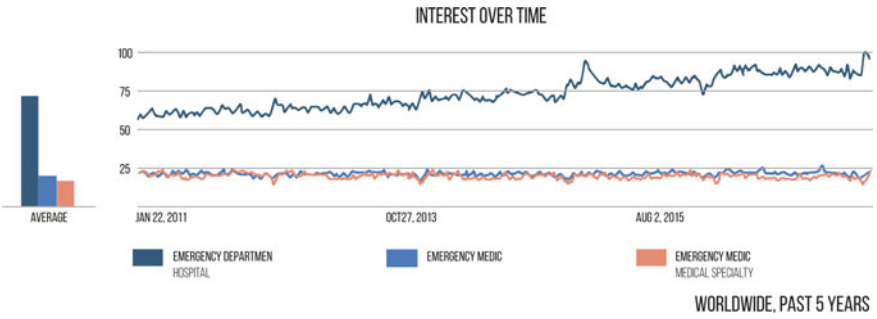


Fig. 3.1 Comparison of EDs three strings worldwide by time

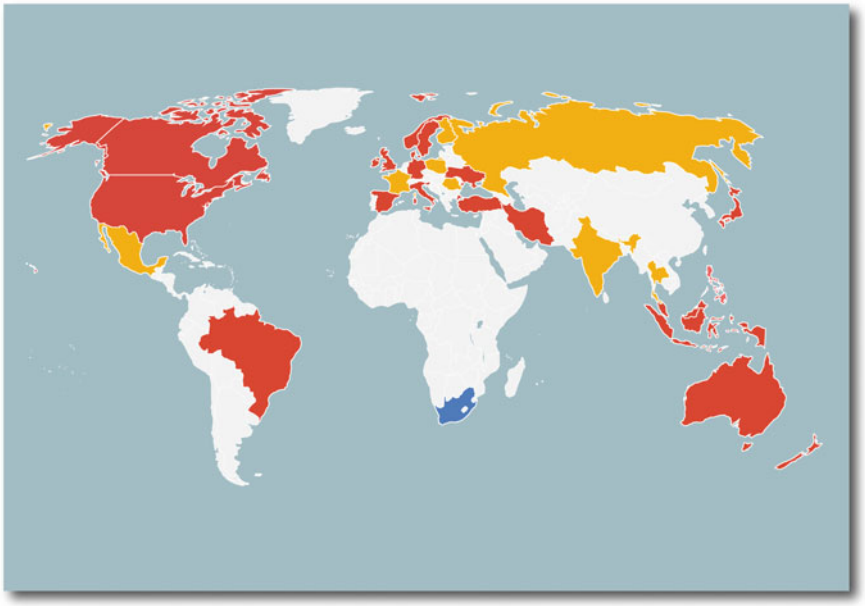


Fig. 3.2 Comparison of EDs three strings worldwide by region

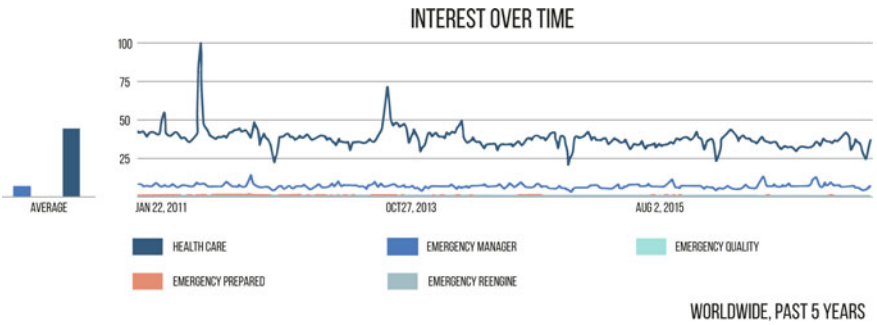


Fig. 3.3 Worldwide trend of EDs other search strings by time

study was classified based on the time it was mined (i.e., from 2018 to 2019). The search results obtained from each database are shown in Table 3.1.

3.3.3 Search for Primary Studies

The search for primary studies was conducted in the following databases. These databases were chosen because they are comprehensive and contain millions of

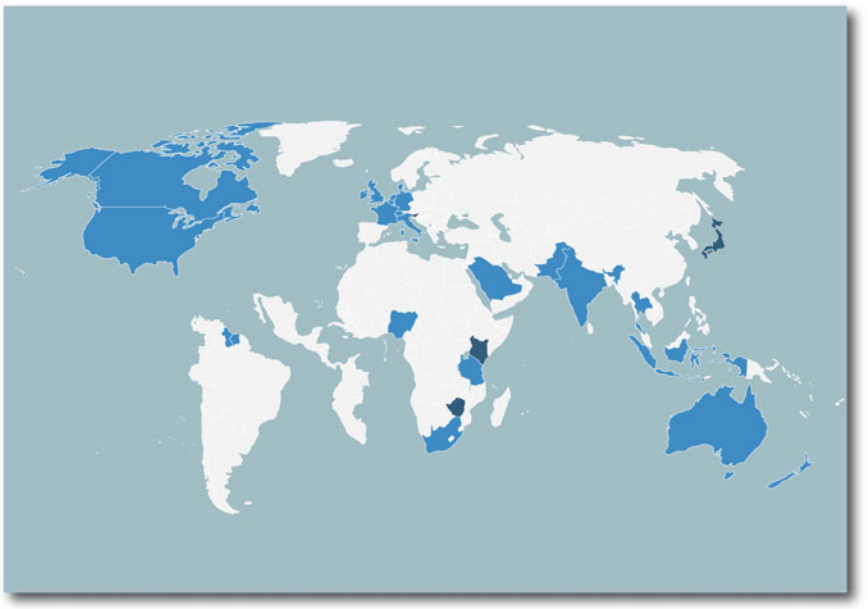


Fig. 3.4 Emergency management worldwide trend by region

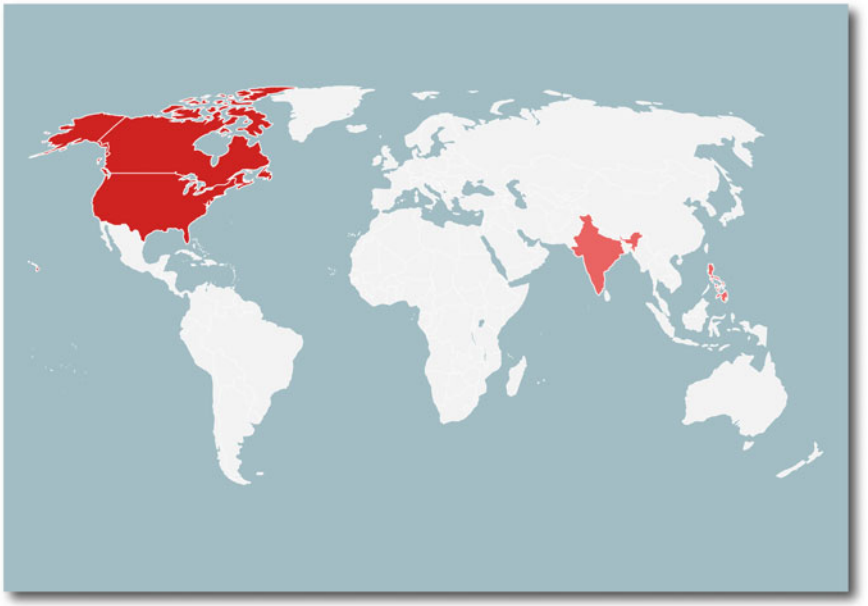


Fig. 3.5 Emergency preparedness worldwide trend by region

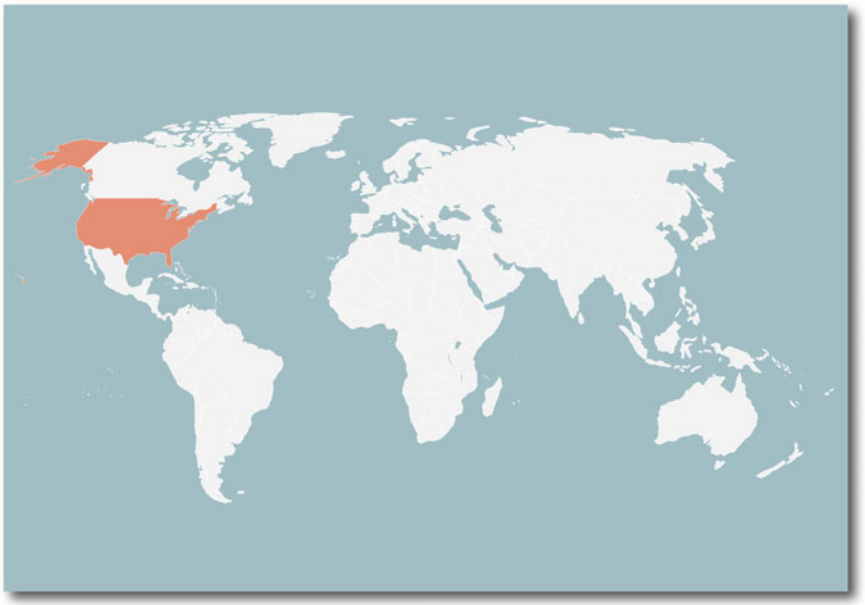


Fig. 3.6 Emergency quality worldwide trend by region

Fig. 3.7 Emergency reengineering worldwide trend by region

publications, especially those related to EDs, engineering, and computer science. Moreover, these databases are user friendly and have advanced search features e.g., IEEE Xplore, ABI Inform, Google Scholar, etc.

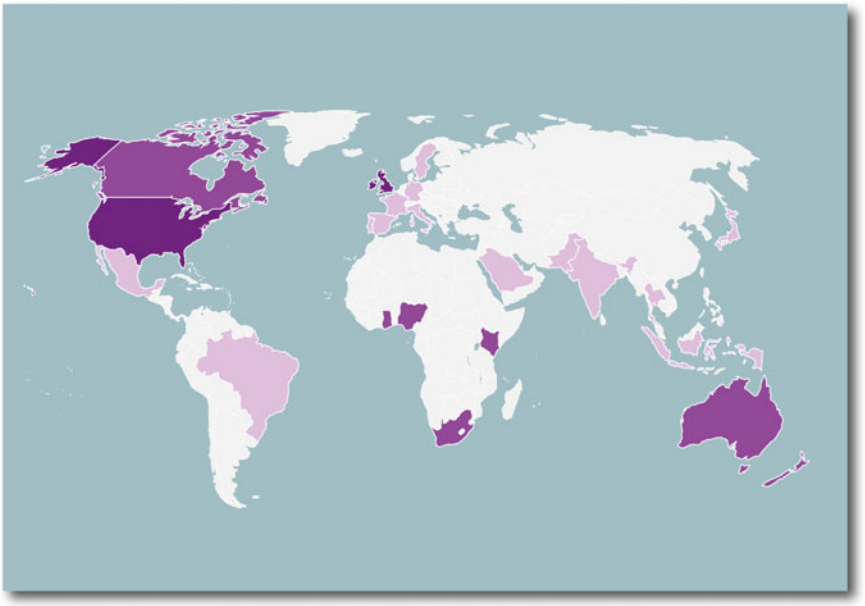


Fig. 3.8 Health care worldwide trend by region

Table 3.1 Search strings

Database	Search strings
1	(Emergency Department OR Emergency Medical Care OR Emergency Clinics) AND (Emergency Management OR healthcare) AND (Emergency Preparedness OR healthcare) AND (Emergency Quality OR healthcare) AND (Emergency Reengineering OR healthcare)
2	(Emergency Department OR Emergency Medical Care OR Emergency Clinics) AND (Emergency Management OR healthcare) AND (Emergency Preparedness OR healthcare) AND (Emergency Quality OR healthcare) AND (Emergency Reengineering OR healthcare)
3	(Emergency Department OR Emergency Medical Care OR Emergency Clinics) AND (Emergency Management OR healthcare) AND (Emergency Preparedness OR healthcare) AND (Emergency Quality OR healthcare) AND (Emergency Reengineering OR healthcare)

Table 3.2 Primary studies

	Search results	Date
Databases	631,957	2000–2019

Fig. 3.9 Study selections process

3.3.4 Study Selections

Figure 3.9 shows that some of the studies were not considered in our study because of certain characteristics of the database. The studies were mainly selected based on their relevance and citations. The studies that did not include proper references or citations were not included. In addition to references, the studies were selected based on the following features: the study must be related to the management, the ED and attentiveness of the ED staff and services, and the quality of healthcare; the study must consider reengineering and healthcare associated with Eds; and the study must have been conducted between 2000 and 2019. Moreover, the selected studies were evaluated and excluded because of the following features: the study did not meet the criteria of full text; the study was not reviewed; the study was a duplicate study, and the study was in a language other than English. Figure 3.9 shows the quantity of the studies that were selected for inclusion and exclusion from the database search. Moreover, Table 3.3 represents the model for studies that required further data extraction for research.

3.3.5 Data Mining

The data obtained was used to present the model given in [1–3]. Table 3.3 shows that the model was customized according to the research requirements. The factors are shown in the table along with their corresponding quantity. One of the experts extracted the data while two others reviewed the data to ensure the validity and

Table 3.3 Data mining table

Item	RQ result	RQ
Study ID	Number	Coding
Author name	Name(s)	Reference
Year of publication	Calendar year	RQ3
Country	Location of research	RQ3
Objective/problem	Problem or objective of research	RQ2
Method	Method used	RQ3
Measurements/KPIs	Items used or measured	RQ4
Findings/conclusions	Result of research	RQ5
Shortcoming/deficiency	Limitation of research	RQ6
Venue	Journal name	RQ7 and RQ8

standard of the mined data. Moreover, another expert evaluated the data for further verification.

3.3.6 Verification and Validation

The data collection procedure followed in this research was highly objective. This data collection method ensures greater validity of the data compared to the quantitative analysis method. The data obtained were recorded in a data-collection Tables 3.1, 3.2 and 3.3 to support the data and to ensure greater validity of data, since tables can be reviewed to evaluating the extracted data. The risk to data validity was reduced to a significant extent due to the involvement of three experts who independently reviewed the data to prevent any risk of invalidation [2]. Therefore, the collected data were found to be accurate and objective with an insignificant degree of risk [1–3].

3.4 Results

In this review, the approaches in [1–3] were used to identify the issues encountered in ED systems operations. Based on these issues, eight research questions were developed.

3.4.1 When and Where Were the Research Published

Several journals that were issued between 2000 and 2019 were included in each database. The earliest study was published in 1998. The importance of this field peaked in 2013 and significantly declined afterwards. The present study considered only peer-reviewed journals, materials, and conferences that answered the research question. The volume of the articles is shown in Fig. 3.10, when researches were published in Fig. 3.11 and where shown in Figs. 3.12 and 3.13. Studies on engi-

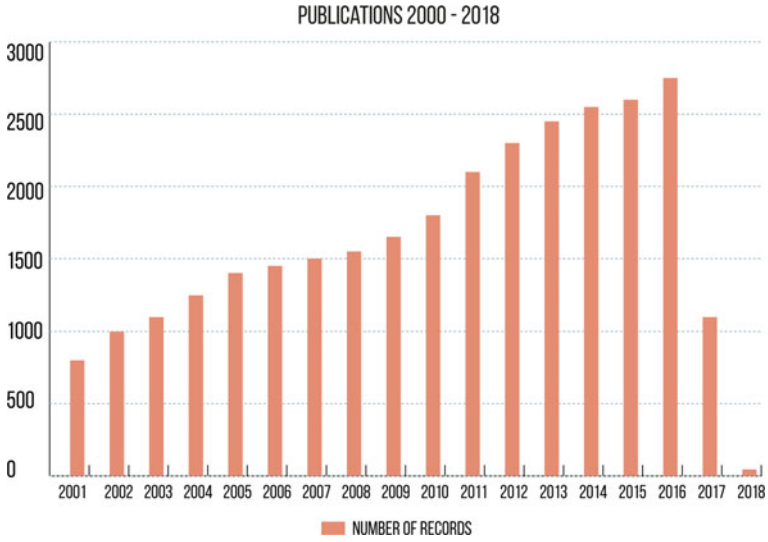


Fig. 3.10 Number of EDs studies per year

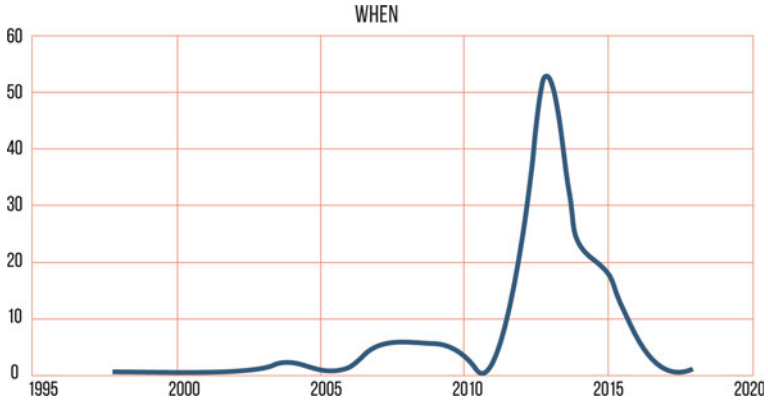


Fig. 3.11 When EDs studies were published

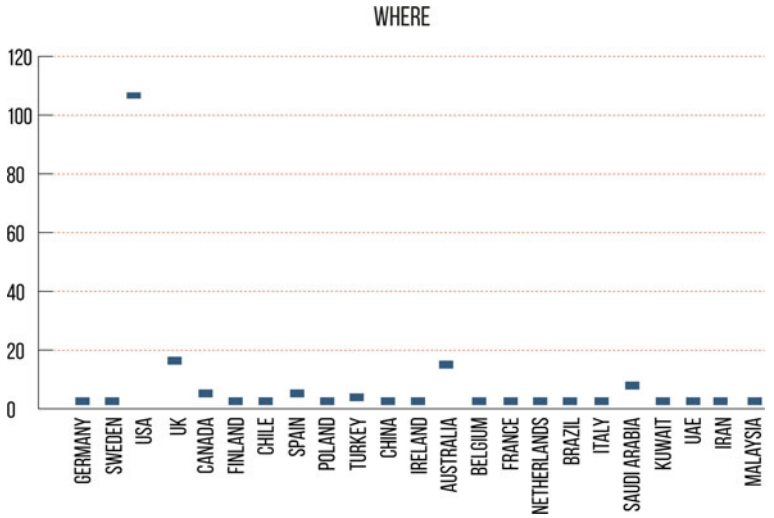


Fig. 3.12 Where EDs studies were published

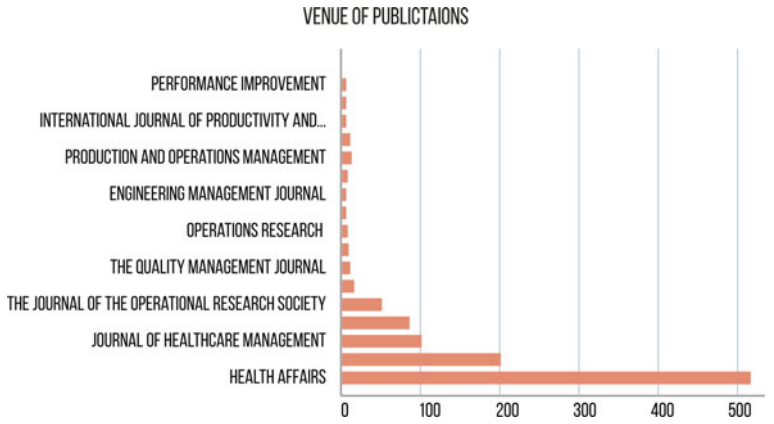


Fig. 3.13 Venue of EDs publications

neering, simulation and process management constituted only 9.92% of the total studies on EDs published from 1998 to 2018.

3.4.2 What Issues Were Addressed in the Research

The current hospital systems need to be removed and replaced with new systems. Not only the systems but also the hospitals themselves, which can be considered systems

Table 3.4 EDs problems

Issue addressed	References
Cost of quality	[41, 83, 87, 109, 111, 112, 133, 137]
Medical data	[41, 44, 51, 67, 89, 126, 130, 139]
Service improvement	[9, 12, 30, 38, 41, 81, 90, 96, 106, 112, 128]
Overcrowding	[26, 27, 51, 57, 58, 125, 144, 145, 148]
Management	[4, 6, 16, 49, 86, 89, 95, 141]
High number of visit	[24, 51, 57, 102, 119, 127, 131, 147]
Waiting time	[5, 9, 12, 19, 27, 48, 113, 126]
Collective skills	[25, 45, 56, 67, 106, 151]

that included separate parts, especially emergency departments, need to be replaced. The issues that arise include the cost of quality, medical data, service improvement, overcrowding, management, high number of visits, wait times and collective skills. Experts are needed to research, explore, and investigate these problems and to improve the processes of service to create a better mechanism and medical reform for each part (Table 3.4).

3.4.3 Methods Were Utilized in ED Operations Research

The data analysis is capable of producing a model that handling services, improves organization, and influences new healthcare. The various number of studies used different approaches that focused not only on patients but also on the healthcare workforce. Various research tools have been utilized mainly including surveys, interviews, observation checklists, questionnaires, and literature reviews. The data used in the studies were either primary or secondary data. The methodologies include analyzing the empirical data, meta-analysis, and simulation. The statistical models utilized include mainly linear regression, logistic regression, correlation, and mean differences.

3.4.4 What Measurements and KPIs Were Used?

Many ED studies tend to measure a wide range of factors in the context of health care within emergency departments. The main key points researchers focus on are health care quality versus the cost of the medical service provided by the system, time spent serving the patient, patient satisfaction, patient length of stay, clinical information, health care services provided to patients, accessibility of the health care system, performance of the health care providers such as physicians.

Table 3.5 EDs data types

Data type	References
Primary	[10, 146]
Secondary	[9, 14, 43, 142, 148, 153]

Table 3.6 EDs studies types

Studies type	References
Empirical	[35, 38, 62]
Observation	[6, 10, 12, 20, 34, 38, 52, 63, 107, 116, 133, 136, 151]
Simulation	[2, 3, 7, 17, 23, 37, 87, 125, 132, 135, 154]
Case study	[9, 89, 151]

3.4.5 What Were the Findings

Quality care is a vital initiative that must be pursued by healthcare providers to affect the high number of visits and the time of services. The implementation of these targeted processes using simulation data to build a significant system will improve services and increase satisfaction for both providers and patients. Therefore, this approach will result in low cost but quality care and an effective emergency system where optimal decisions are made. General findings can be found by looking at Tables 3.5, 3.6, 3.7, 3.8, 3.9, 3.10 and 3.11.

3.4.6 Shortcoming and Deficiencies that Were Addressed

One of the major limitations of ED systems is the availability of accurate data and research. A weak analysis and the wrong tools for analysis will lead to large amounts of incorrect decisions. Errors can be divided into human errors and systems errors. Another issue is data collection during ED research. Very few studies have considered patient characteristics and demographics in their decisions. Observations that are connected and investigations that result in strong evidence provide better information, a strong model and useful information that is exclusive to the ED system. Another deficiency in EDs is traffic including volume, emissions, and noise. A significant number of patients suffer from traffic congestion during their transportation to EDs.

3.4.7 Themes Were Introduced in the ED Operations Research

The classification of themes as shown in Fig. 3.14 shows that there is a general gap

Table 3.7 EDs method types

Method type	References
Interview	[2, 6, 12, 36, 39, 45, 62, 79, 83, 96, 99, 106, 115, 122, 151]
Survey	[3, 13, 31, 37, 68, 72, 80, 82, 83, 92, 96, 105, 106, 108, 116, 118, 126, 128, 141, 143, 146]
Review of literature	[48, 53, 54, 86, 103, 110, 134]
Questionnaire	[6, 38, 45, 46, 104, 120, 146]

Table 3.8 EDs analysis types

Analysis type	References
Meta-analysis	[33, 35, 36, 59, 60, 64, 66, 80, 85, 93–95, 97],
Correlation	[27, 109, 111, 114, 129, 130]
Linear/nonlinear regression	[1, 26, 31, 57, 77, 100, 112, 118]
Logistic/multinomial regression	[32, 34, 132, 152]
Mean differences	[34, 73, 112, 152]

in the knowledge about organizational behavior, performance, and quality of service in healthcare, especially in EDs. A more specific gap is introduced in Fig. 3.15.

3.4.8 How Was the Research Categorized

The volume of all of the studies in this field from 2000–2019 were classified based on venue type, and no dissertations, theses or books were introduced as shown in Figs. 3.16 and 3.17.

3.5 Discussion

The trends of the problems that have existed in healthcare emergency system operations for the past decades include the cost of quality, medical data, service improvement, overcrowding, management, high number of visits, wait times and collective skills.

3.5.1 Emergency System Problems

3.5.1.1 Cost of Quality

The task of improving the efficiency of an elderly patient's treatment is a significant research problem [83]. The Medicare Essential program is presented to improve the effectiveness and efficiency of services [87] and reduce costs. There is a wide variation in admission rates for U.S. hospitalizations due to variations in effectiveness [109]. The Medicare agencies are asked to determine whether for-profit home health agencies are more effective than nonprofit home health agencies [111]. The prices for health care services vary significantly across different hospitals, and experts determine the likelihood of a patients' choice of a lower-price facility based on whether

Table 3.9 EDs KPIs types

KPIs	References
Health care quality	[8, 18, 28, 33, 34, 36, 38, 41, 55, 61, 65, 77, 84, 85, 88, 89, 95, 106, 108, 136, 139]
Medical cost	[3, 33–35, 37, 39, 41, 52, 54, 58, 63, 69, 76, 84, 88, 94, 97, 98, 100, 106–109, 111, 112, 129, 133, 137, 139, 140, 149]
Services' processing time	[7, 15, 17, 19, 20, 24, 27, 44, 51, 116, 117, 120, 122, 126, 144, 145, 148, 149]
Satisfaction	[16, 54, 76, 77, 107, 108, 113, 115]
Length of stay	[6, 24, 49, 52, 78, 114, 145, 148, 154]
Efficiency of ED services	[23, 113, 139, 144]
Access to health care	[106, 114–116, 136]
Performance	[2, 10, 41, 62, 142, 150]
Admission	[6, 34, 52, 102, 107, 109, 119, 124, 125, 133, 140]
Demographic characteristics	[11, 57, 123, 127, 148, 152]

Table 3.10 EDs expected results

Expected result	References
Quality care	[8, 33, 36, 38, 41, 55, 59, 76, 84, 132]
Process simulation	[2, 10, 17, 23, 99, 125, 141]
Good decisions	[43, 58, 65, 69, 80, 98, 108]
Savings	[37, 58, 69, 101]
Improved service	[2, 12, 55, 76]
Better experience	[49, 53, 77, 86, 94, 126, 141]

Table 3.11 EDs shortcoming/deficiency types

Shortcomings and deficiencies	References
Data availability	[11–13, 20, 31, 34, 48, 71, 125]
Errors	[21, 22, 48, 54, 55, 71, 111, 117]
Assumptions e.g., Traffic	[26, 35, 52, 56, 61, 67, 93, 97, 114, 135, 149]
Cost	[37, 41, 69, 111]

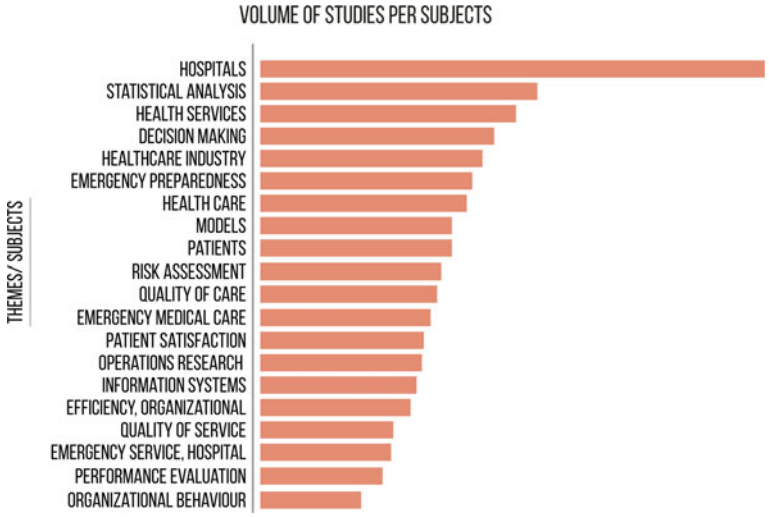


Fig. 3.14 Classifications of EDs studies by themes/subjects before study

or not they are aware of the alternatives [112]. The implementation of a readmission reduction program would cause significant financial penalties for hospitals that do not meet the requirements, and policy makers are considering an expansion and modification of the readmission reduction program [133]. The health care industry is facing increasingly complex challenges, such as new regulatory requirements.

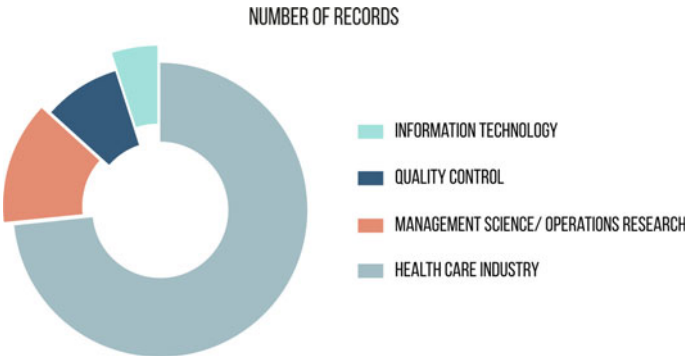


Fig. 3.15 Classifications of EDs studies by themes/subjects after study

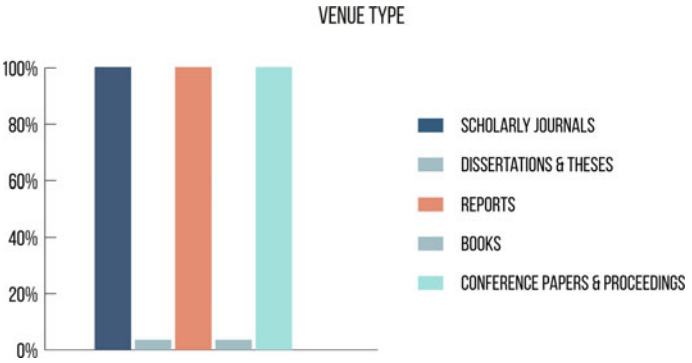
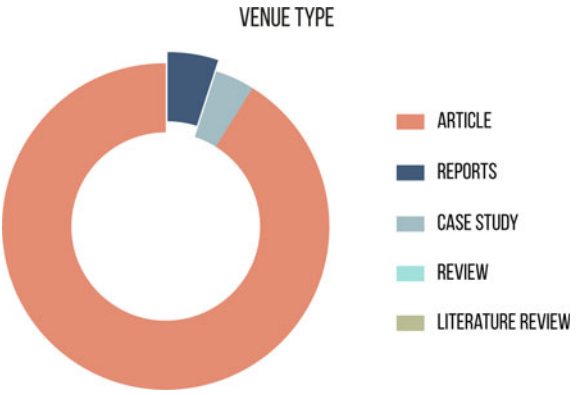


Fig. 3.16 Classifications of EDs studies by source before study

Fig. 3.17 Classifications of EDs studies by source after study



3.5.1.2 Medical Data

The clinical information about patients in a facility is vital to increase the quality of healthcare services, especially in the EDs of hospitals [41]. The major issue that was helpful in the data collection, storage, analysis and near real-time availability of the ED was an improvement in the methods for recording data in health care facilities where technology was lacking [44]. It is necessary to pay more attention to the problem of an administration's effectiveness [89].

3.5.1.3 Service Improvement

The quality of an ambulance service is related to the wait time as determined by the possibility of all ambulances being busy [9]. It is necessary to address reducing the patient wait times and enhancing the overall system throughput and service delivery at this stage [12]. Bed capacity at hospitals in the U.S. is at a premium and improving of service capacity is more feasible than increasing the physical capacity to respond to increasing patient volumes [30]. The issue of controlling costs under new reforms still has not yet been studied in detail [41]. Problem of measuring the throughput of services is traditionally considered to be a complicated issue [81].

3.5.1.4 Overcrowding

Overcrowding is a challenge for hospitals and requires strategic tools [26]. A contributing factor to the challenge of overcrowding and increased wait times in the ED is created [27]. Overcrowding in some hospitals and longer wait times for minor and major issues has increased by 32% from 1999–2009 [51], with unnecessary visits being one factor [57]. A substantial part of Medicare beneficiaries could have reduced the overcrowding of emergency departments [58]. Overcrowding, particularly in the late afternoon, is made worse by the ED's lack of ability to move patients who need to be admitted due to lack of inpatient beds [125]. Emergency department operations are becoming outdated due to overcrowding, and new communication methods should be used to advance the system [144]. Overcrowding in EDs affects the quality of care [145], and therefore, resolving the issue of overcrowding in the emergency department and the imbalance between the need for emergency care and the available resources requires an evaluation of the triage process [148].

3.5.1.5 Management

The Saudi national guidelines provide a comparison of the recorded management of acute bronchial asthma in the ER [4] for example. The UK is searching for a way to improve operation processes in hospitals, and there is substantial pressure to provide processes to improve the system that will be cost effective [6]. Spanish hospitals

concentrate on shift management [16]. Simulations create a decision support system for EDs that help the heads of EDs establish management guidelines that improve their operations [49]. It is of critical importance to find a way to develop mechanisms of management that would simultaneously focus on effectiveness and efficiency, with more attention being paid to the problem of the administration's effectiveness [89]. It has been proven that patient engagement in decision-making, self-management and prevention activities improves health outcomes [95]. Effective management of health care in the U.S. is critically dependent on effective management [141].

3.5.1.6 High Number of Visits

In the U.S., at the hospital-level, the ED performance on visit length and wait time are major issues [24]. The number of visits to the ED increased by 32% from 1999–2009. Some of these increases in ED visits led to ED overcrowding and longer wait times [51]. Many frequent emergency department users do not have any serious diseases except for mental illness; however, they contribute to ED overcrowding by making unnecessary visits [57]. The New Mexico Health Information Collaborative is a newly invented e-porting project, which will collect a wider array of information about all ED visits in a timely manner in an effort to make changes in authority, mechanisms, design, and approach [102]. Over the past two decades, the number of visits to EDs has increased. However, ED visits for some conditions have decreased while others have demonstrated varying patterns [127], and this presents barriers to assessing primary care [131]. Furthermore, patients return to the ED for more, visits and, hence, there is need to solve this problem [147].

3.5.1.7 Waiting Time

The risk and suffering this are faced by patients while waiting in line needs to be modeled, and changes in the patient's condition while the patient waits need to be considered [5]. Ambulance services have drawn substantial attention in operations research, and a vital aspect of the ambulance service is the wait time [9]. A reduction of patient wait times can enhance the overall system throughput and service delivery [12]. Numerous effects on ED wait time, boarding, and treatment times have been shown across multiple acuity groups and sites [19]. The growing public demand for ED services contributes the challenge of increased wait times in the ED [27]. The ED is considered the front door of the hospital and wait times and inpatient experiences create the perceptions of patients regarding the ED [126].

3.5.1.8 Collective Skills

Expressing collective skills as a mathematical model that can allow emulation of the behavior of the facilities and workforce and its components, shape the optimization

when a problem is faced and satisfy various requirements is required [25]. There is an effort regarding the effectiveness of teaching emergency medicine in terms of skills, knowledge, and attitudes outside the clinical environment [45]. Numerous reports show that emergency departments in the U.S. experience problems concerning behavioral disorders [56]. There is a shortage of studies that evaluate the influence of behavior [67]. A powerful driver of significant improvements in the field of health outcomes is the improvement of behavioral health conditions [106]. One of the most well-known mechanisms of achieving a reliable environment in which all workers look for, and report, small problems or unsafe conditions before those issues pose a substantial risk to the organization is seeking zero defects in outcomes quality and achieving high reliability [140], which are resilience skills [151].

3.5.2 Emergency System Tools

The tools used to research trends in the past decades in healthcare emergency system operations are primary and secondary data in the form of empirical, national, observation, case study and simulation research. Primary data are data that are collected (data that are collected by a researcher from first-hand sources) through observations [6], surveys [146], or other sources. Although most studies did not specifically mention that their source of data was primary, it could be inferred from the research tool used such as those listed in the research tools in the previous paragraph except for the literature reviews. In contrast, some studies used secondary data (data gathered from studies, surveys, or experiments that have been examined by other people or for other research) which include reviewing what other researchers have published about the same issue [9, 14], collecting data from a specific database [43], gathering information about patients who visited the emergency department from health record reviews [148], and collecting data from papers selected using a specific criteria [153].

3.5.3 Emergency System Approaches

The approaches used to track the trends in the past decades in healthcare emergency system operations are interviews, surveys, reviews of literature, and analyses carried out using meta-analysis, correlation, linear/nonlinear regression, logistic/multinomial regression, and mean differences.

In addition to empirical data [35, 38, 62], meta-analysis was used as a methodology for various aims including the calculation of adjusted medical costs [33], determination of the process needed for transformation of the U.S. emergency care system [59], description of the regionalized trauma system, determination of the effectiveness of and provision of recommendations regarding the further development of the emergency health care system [60], or other purposes [93, 94, 97].

Computer simulation is one of the most widely used methods of evaluating, improving, and optimizing many types of processes because it is an imitation of an actual process over time [2]. System simulation is used in estimation of the target function and optimization to calculate and authenticate the optimal configuration of servers [3]. In addition, the simulation model is employed to test various process scenarios, assign resources, and complete activity-based cost analysis [7]. Simulation is also integrated with optimization to establish the optimal number of nurses, lab technicians, and doctors needed to reduce patient time in the system and maximize patient throughput [23].

The simulation model is used to study ED operations [125]. Some studies also simulate an existing ED system after collecting actual data from the system [154]. Finally, the case study methodology was rarely used with a Chilean ambulance firm [9] and with the EDs of two university hospitals in the United States and Brazil [151]. In most cases, various types of regression were used in analyzing the data. Linear regression was mainly used to assess goodness-of-fit [1], to predict a specific outcome [31, 57] [77], to estimate a specific outcome [100], and to assess the influence of a specific factor on the outcome, the influence of an insurer-initiated price transparency program on costs per unit [112], and the influence of comments on patients' intention to recommend the specific hospital and their rating [118].

Moreover, a nonlinear regression model was rarely used [26]. Logistic regression [32, 34, 132] was used when the outcome variable was dichotomous, and multinomial regression [152] was used when the outcome variable was polytomous. A correlational analysis was used to assess the relationship between the variation in admission rates and national health expenditures [109], among the main cost variables of health care services [111], external consultants, system managers and the hospital team [114], between time and cost [129], and between community health centers and the Medicaid program using patient and insurance data [130]. The mean differences using t-tests [73] or other statistical tests [34, 112, 152] were also used in analyzing ED data. The type of factors included wait time, cost, registration process, number of visits and other medicals processes.

3.5.4 Emergency System KPIs

The emergency system KPI trends of the past decades in healthcare emergency system operations are health care quality, medical cost, services' processing time, satisfaction, length of stay, efficiency of ED services, access of heath care, performance, admission, and demographic characteristics.

3.5.4.1 Emergency System Quality

Health care quality was a main theme that researchers intended to measure. Health care quality was operationalized in terms of various variables such as quality and

the type of processes and outputs involved in the health care system [8, 55], quality of the processes of service [18, 28], quality of care [33, 36, 41, 65, 77, 84, 85, 95, 108], clinical quality [34, 89], quality of teamwork [36], changes in health care quality [38], quality of medical services [61], quality of care delivery [88], medication administration quality [89], quality of behavioral health care [106], quality of plans [136], and service quality [139].

3.5.4.2 Emergency Medical Service Cost

The many issues related to cost were the main concern in ED research and included minimum cost configuration of servers that satisfy the user [3], overall medical costs [33, 35, 63, 111, 129], health care costs [98, 106, 107, 109, 139, 140], medical and pharmacy costs [34], cost savings [37, 52, 58], costs of care [41, 54, 69, 84], acute injury costs [69], ED costs [76], cost per beneficiary [88], out-of-pocket costs for health services [97], treatment costs [108], patient costs [100], benefit costs [111], cost per discharged patient [129], healthcare cost and utilization [133], cost of overtime [149], cost of increasing one-unit capacity in hospital [149], and cost of income of accepted patients [149].

3.5.4.3 Emergency Services Processing Time

Researchers were also concerned with measuring the time of medical service delivery including process time [7], time of initial registration at the ED, time until placed into an ED treatment bed, time of hospital bed request, time of discharge from the ED facility [15], cycle time [17], treatment and boarding time [19, 20], wait time [24, 27, 44, 51, 117, 126, 144], time to transfer a patient to a medical facility [116], time of assessment by nurse, time of assessment by doctor, consultation time, time of arrival to a specific area, time of arrival to a consulted specialty, time of laboratory investigation, time of radiological investigation, time of final disposition and time of physical disposition [120], doctor-patient contact time, delay time for lab results and doctor-patient contact, interarrival time and time spent at registration counter [122], processing time [145], time of triage [148], and cost of overtime [149].

3.5.4.4 Emergency Patients Output Feedback

Patient output feedback includes a patient's satisfaction [54, 77, 107, 108, 113, 115], the staff's satisfaction of hard and soft constraints imposed by the monthly schedule [16], and the staff's satisfaction in general [76, 107].

3.5.4.5 Emergency Patients Length of Stay

Researchers were also concerned with the length of stay and queuing times for patients with both minor and major illnesses [6], length of patient stay in the ED [49, 52, 78, 114, 145, 148], length of queues [154], and visit length [24].

3.5.4.6 Emergency Services Efficiency

Measuring the efficiency of ED services provided to patients was an issue for some studies and included the effect of staffing levels on service efficiency [23], the efficiency of heath care services [113], the efficiency that reduces health care costs [139], and the ED efficiency [144].

3.5.4.7 Emergency Access of Services

A few studies aimed to measure a critical variable, such as accessibility of ED health care, which included access to behavioral health care [106, 116], access blocks [114] or barriers [115], and geographic access [136].

3.5.4.8 Emergency Services Performance

Some studies developed measures or indicators of performance in ED service including "output" performance measures such as daily work hours, personnel shifts, and lunch breaks [2], performance monitoring [10], physicians' performance on care quality [41], overall hospital performance [62], and indicators of work performance [142] such as the mean busy period [150].

3.5.4.9 Emergency Admission

Another important issue that attracted the attention of some studies was hospital admission. The studies in ED research were interested in measuring the impact of delayed admission [6], hospital admission [107] and readmission rates [34, 133, 140] and the probability of subsequent inpatient admission [52], ED admission rate [102, 119, 124, 125] and risk-standardized admission rates [109].

3.5.4.10 Demographic Characteristics

Demographic characteristics were also measured in order to test their relationship with factors involved in ED research including demographic characteristics of frequent ED users [11, 57, 127], demographic traits and ages of people who died

from unintentional drowning [123], relationship between demographic characteristics and occupancy ratio, emergency department occupancy, length of stay, time of triage [148], and relation between demographic characteristics and specific vulnerability conditions, such as drug and alcohol abuse, psychological distress and chronic conditions [152].

3.5.5 Emergency System Expected Results

The results of the trends of the past decades in healthcare emergency system operations include quality care, process simulation, well decisions, savings, improved services, and better experience.

3.5.5.1 Quality Care

The use of new technology would improve quality management with regards to processes and would be improved by enhancing staff ownership [8]. A collaborative accountable care initiative may improve the quality of care and decrease medical costs [33]. Teamwork in hospitals and health organizations would be an effective and efficient instrument to improve [36] the time for problem solving [38]. New payment incentives might be useful for ensuring better performance [41]. Integrated networks of emergency care have a potential to significantly increase the level of patient satisfaction and to improve the quality of services [55]. Quality of service and readiness for disasters do not meet the U.S. national requirements [59]. Modeling has a potential to improve service quality and reduce costs [76]. Customized information technology is a promising instrument to improve the quality and costs of care for seniors with multiple conditions [84]. The staff's insufficient knowledge and lack of understanding, along with low-quality training, were the main reasons blocking improvement [99]. Defining standards to promote quality improvement and identifying and removing any existing elements of quality measures that tend to increase the likelihood of patient behavior change could be helpful [132].

3.5.5.2 Process Simulation

Simulation modeling can allow several alternatives to be considered before any resources, especially human, are expended, and a simulation model imitates a system's behavior, which is referred to as "baselining." Simulation modeling evaluates possible changes in the system's structure, environment, or underlying assumptions in the form of a "what-if analysis" [2]. It is clear that a simulation model is a very effective method for identifying solutions to resource levels [10]. A simulation of different scenarios of ED patient flow led to the acknowledgment that ED diversion could result in discharge of patient one hour earlier [17]. The optimization simulation

model yields optimal staffing allocation that would facilitate an average reduction of 40% of patient wait time and a 28% increase in patient throughput [27]. Simulation tools have not been widely implemented [99]. Dynamic behavior in the ED can be acceptably modeled through simulation [125]. A greater use of the processes positively influences patient experience and the quality of health care [141].

3.5.5.3 Optimal Decisions

Real time information can also be used to determine where to build a health care facility and to determine the density of these facilities in each area [43]. Good decisions can reduce expenses by millions of dollars annually [58]. There is universal pattern that would explain the connection between a decision and the analysis of the unique features of each situation in healthcare [65]. It is crucial to develop field triangle guidelines that would prevent EDs from transporting low risk injured patients, and this decision could save millions of dollars annually in the U.S. healthcare system [69]. Other factors influence decisions, such as delays in payments [80], shared decision-making tends to reduce medical costs [98]. A logical decision in the U.S. health care system was developed, and a model demonstrated its extreme effectiveness in ensuring a higher quality of care, in lowering treatment costs and creating a higher level of patient satisfaction [108].

3.5.5.4 Savings

Hospital observation units are very promising when considering how to reduce costs; in all U.S. hospitals the unit has generated $1572 cost savings per patient [37]. The expected savings in Medicare is approximately $283–$560 million annually in the U.S. healthcare system if the guidelines are followed. It has been proven that the decision to prevent EDs from transporting low risk injured patients saves approximately $136.7 million annually in the U.S. healthcare system [69]. Mobile clinics have the potential to lead to significant cost savings [101].

3.5.5.5 Improved Processes

Healthcare is a dynamic service industry with high human involvement [2]. Shorter wait times increase the service level [12]. An increase in the level of patient satisfaction improves the quality of services [55]. Quality assurance has been proven to have the most effective potential to improve service quality and reduce costs [76].

3.5.5.6 Better Experience

The more experienced and the greater number of ED staff, the less the mean length of stay for a patient is [49]. The positive experience of Japan may be useful for the U.S. health response system [53]. A strong commitment to the community implies a high level of patient experience of care [77]. Patient outcomes can be improved by telephone-based coaching services [86]. Patient engagement has a positive impact on both health outcomes and care experiences [94]. There are important relationships that exist between a favorable ED experience and a favorable inpatient experience [126]. The patient experience is positively influenced by greater use of the process analysis [141].

3.5.6 Emergency System Deficiency and Shortcoming

The deficiency and shortcomings of the trends of the past decades in healthcare emergency system operations are data availability, errors, traffic conclusions and cost.

3.5.6.1 Data Availability

The data set did not have a chief diagnosis or complaint, which made it difficult to adequately assess the reasons for patient visits. Nevertheless, it is also impossible to generalize the data from one hospital to other hospitals [11]. The data were collected over the summer which made it difficult to generalize the data to other seasons [12]. The database limited the ability of the researchers to extrapolate national estimates about the subgroups of interest that are reliable [13]. A substantial amount of data was required in order to make a good estimate of the input values [20]. The data were self-reported by patients, [31] and the risk of multiple biases was significant [34]. The searching tools that were used in the business and engineering databases were not as detailed [48]. The data sets do not exclusively contain information about hospitals [71], and there was a limited amount of data available [125].

3.5.6.2 Errors

The inaccurate data that were due to estimation may lead to inaccurate results and, therefore, errors [21]. Software limitations led to problems in weighting the medial wait time results [22]. The databases were not as detailed [48], and there was a risk of transforming the databases' errors and other scholars' biases into the eventual conclusions [54]. There were many errors and limitations from other sources [55]. There was a potential inconsistency between the data sets [71]. Many agencies may

have misreported some of their quality parameters [111]. A single source of data may contain errors [117].

3.5.6.3 Desistance

The conclusions require confirmation, [35] but the conclusions regarding the extreme effectiveness should be verified [52]. Emergency departments can improve their services, but studies that support the conclusions about behavioral disorders and other parameters are required [56].

3.5.6.4 Cost

The costing method was employed for calculating savings [37]. There was a potential correlation between the variation in cost and the quality of physicians' performance that provided higher-quality care [41]. It is necessary to conduct a cost-effectiveness analysis [69], as there are some errors in many of the cost reports [111].

3.6 Conclusion

In conclusion, the issues faced by EDs can be resolved if the cost of quality is controlled and managed effectively, and patient data are recorded appropriately. Moreover, the managers in EDs are expected to prevent overcrowding and prolonged wait times by managing the patient visits and exploiting the skills and expertise of the staff. The managers must obtain primary and secondary data through interviews, surveys, and literature reviews and by conducting research at the clinical and national levels. The managers must interpret and process the data through meta-analysis and must be capable of noting similarities, disparities and weaknesses of the wait time, process of patient registration, costs, patient visits, and other aspects.

The ED manager is expected to conduct interviews, assessments, literature reviews and meta-analysis, and determine the correlation, various types of regression and average differences in order to investigate aspects such as wait times, the process of patient registration, costs, number of visits and others. The ED manager must pay attention to the standard of healthcare services, cost of treatment, time consumed by services, patient satisfaction, length of stay, quality of performance of the ED, access to health care, patient admission, and demographics. The effectiveness of healthcare services can be ensured if the manager prevents assumptions, biased conclusions, single step data collection, employment of meta-analysis for primary data-analysis, data collection from particular sources of data, employing a costly system and data recording errors as in case of self-reporting patients.

3.7 Future Work

The expertise and skills of the personnel involved in healthcare provision can be explored by conducting multilabel studies [2]. Emergency departments need a management [3] that provides leadership [2] to the employees that facilitates smooth operations in EDs. The management of the ED must ensure that the quality of the care and services is improved and revised with time [3]. Research regarding the performance appraisal of emergency systems and that ensures that the practice of obtaining real-time patient data in EDs is continued is necessary. Future studies must evaluate the performance of emergency departments in the context of a the demographic features of patients, the shift of a patient through the ambulance, the time acquired by the ED to provide for patient needs and evaluation of EDs processing time by simulation.

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Chapter 4
Ambulance Transfer and Emergency Department Processing: Modelling and Simulation

Salman Ben Zayed, Abdullah Bin Gani, Hesham Gadelrab, and Mohd Khalit Bin Othman

Abstract Emergency services aim to use complex systems to ensure the provision of fundamental healthcare services to the patient at the appropriate time. Patients approaching the emergency department are examined in detail by healthcare providers. The care providers aim to obtain real-time data about the patients to detect the issues and quickly decide the appropriate treatment plan. Emergency Departments (EDs) are run by complex management systems and render diverse healthcare services. The assessment of the service quality in the emergency departments has improved significantly with the development of tools and systems of performance assessment in underdeveloped countries. These assessments are based on the views of the patients. In this context, the aim of this study was to formulate a highly sensitive assessment tool that is appropriate for simulation experiments. This assessment tool was validated and had a kappa value of 0.763 and a Cronbach's alpha value of 0.827. The use of this tool for the assessment of healthcare standards resulted in the collection of valid and reliable data. The probability density distribution was used to check the accuracy of the results of the simulation experiment data, and all data adequately followed a normal distribution. Furthermore, 90% of the simulated cases were found to be within the optimal range.

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4.1 Introduction

It is imperative to adopt improvement strategies and to evaluate the quality of services rendered to patients in medical centres or hospitals, particularly in the emergency departments, to enhance the satisfaction of patients and the quality of medical services provided to them. The evaluation of a medical technology must be supported with a logical model. Such a system of technology evaluation must be modified frequently because the association between the patient, the care provider and the systems of care in hospitals are in need of modeling systems. Moreover, the complexity of emergency departments and the diverse issues associated with emergency departments call for system evaluation. The principal objective of the Saudi Vision 2030 program is to ensure the availability of effective and high-standard healthcare to Saudi Arabian citizens. This program aims to enhance the performance and outcomes of healthcare services and to ensure the availability of these healthcare services to all citizens. The ultimate goal behind these activities is the enhancement of the standard of medical services rendered to patients.

These improvements have a direct and long-term impact on the optimization of ED resources and cost savings. Emergency departments can plan the establishment and functioning of such systems by implementing statistical modeling strategies. This also enables the emergency department to practically apply such systems. Emergency departments render healthcare services to the majority of patients despite the limited resources available in the emergency department. The performance of EDs may be evaluated on the basis of resource management, patient arrival and discharge, and waiting period duration. ED management involves a number of complex aspects. The performance assessment of healthcare technology demands a logical decision-making system. Such a system must be modified frequently because the association among the patient, the care provider, and the systems of care in hospitals are in need of modeling systems.

4.2 Background

A simulation model is imperative for the detection of real-life issues related to patient influx and discharge as well as the irregular optimization of resources in emergency departments. The data are obtained through direct sampling, patient history, hospital records, and observation. Resource optimization and waiting period reduction were the basic objectives behind the implementation of the simulation method. This process involved the execution of cost analysis and the adoption of appropriate strategies [1].

The consequences of the alterations in a system or process can be evaluated with the help of simulation models [2]. The basic aims of using these simulation models include testing the system's performance in different circumstances, optimizing resource allocation, and analyzing the entire cost profile. The simulation models provide a thorough explanation and analysis of the problem of overcrowding in emergency departments [3].

The optimization simulation model enables the hospital to make optimum use of its existing resources and staff to enhance the quality of healthcare rendered to patients by reducing the average waiting period of the patients by 40% and improving the patient flow by 28% [4]. The simulations are capable of efficiently modeling the active environment of emergency departments, which involves various procedures and practices specifically related to the emergency departments [5]. The simulation modeling system is imperative for the evaluation and management of the stability of patient care quality [6].

The simulation determines the optimum combination of the healthcare staff and evaluates the impact of this combination by merging field surveys, simulation processes, the optimization of resources and the identification of objectives [7]. Currently, basic simulation systems can be accessed easily from the market and can be directly implemented for basic applications and rearranged for complex applications [7]. The appropriate combinations of simulation, concentration, memory, human resources, power, and other resources at a specific time can help manage a specific crisis [8].

The predictions about the overcrowding in emergency departments and the real results showed high disparity, which declined gradually up to 8 h in the future, while the disparity between the predicted and real ambulance diversion was found to be high and was maintained at this level in the future [9]. The model inputs were identified as the equipment's and facilities, staff allocation, and electronic record of patient information, tracking records, and comprehensive reconsideration of the ED registers [10]. This implies the significance of the simulation model for addressing the issues related to resource allocation and utilization in healthcare institutes to prevent bothersome and tiring waiting periods [11].

The evaluation, enhancement and optimization of healthcare systems are extensively performed with the help of computer simulation since this approach involves the representation of the systems, staff interviews and patient information [12]. In the context of operational research modeling, the highly recognized content available in the literature concerns the modeling of simulations with the help of Scenario Generator [13]. Various factors related to patient care in emergency departments must be considered, which indicates the need to reflect on hospital management, particularly ED management, facilities and equipment in the ED and hospital building, patient data, details about patients' relatives, the areas of the hospital that lead to the emergency department and the waiting areas that must not be overcrowded, particularly in situations when the patient influx is high [14].

4.3 Material and Methods

A questionnaire was adopted from [15] to develop an instrument that was completely modified to fit the simulation experiment. The instrument was logically and statistically validated after modifications; a series of questions to gather data on the characteristics of patients attending the EDs, ED system behaviors, and the required simulation data sheet items were included.

A logical validation, including the assessment of face validity and content validity, was carried out by five different experts; the process was similar to that in Fig. 4.1. The kappa statistic was calculated and equal to 0.763, indicating that the items in the instrument were excellent. Statistical validity was carried out, and the instrument was valid and reliable; the data collected were normally distributed, and the sample size randomly from the United States, Saudi Arabia and Malaysia was over $n = 300$. Simulation data sheet items were included in the instrument questions, and a random sample of 65 was selected to run the simulation experimenting. The instrument is shown in Table 4.1.

A simulation experiment was set to generate new data with new items based on logical model in Fig. 4.2. A series of research questions was developed as follows for both the ambulance transfer process and the ED processing process:

R.Q.1. What is the average wait time for patients waiting an ambulance?

R.Q.2. What is the maximum wait time?

R.Q.3. What is the average time that patients spent in ambulance transfer?

R.Q.4. What is the total number of patients who used an ambulance or arrived in the normal mode?

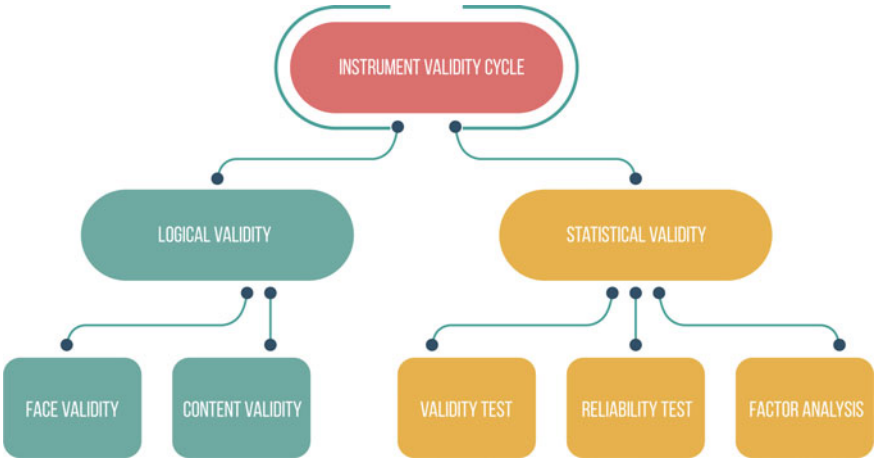


Fig. 4.1 Validation cycle for instrument

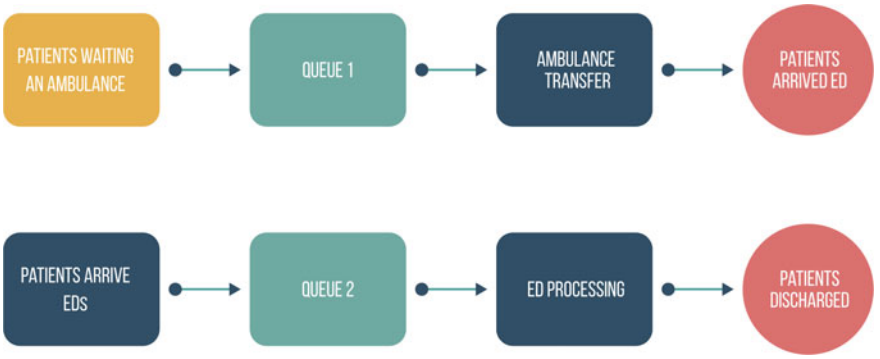


Fig. 4.2 Logical model of patient ambulance transfer and ED processing

R.Q.5. What is the total number of patients serviced by an ambulance in the normal mode?

R.Q.6. What is the number of patients remaining in the system or still in ambulance transfer?

R.Q.7. What is the number of patients waiting in queues for an ambulance?

R.Q.8. What is the utilization percentage for resources?

The patient's urgent care journey requires two different processes. In the first process, the patient feels unwell and then requests an ambulance transfer to the nearest ED, which is the ambulance transfer process. In the second process, the patient arrives at the nearest ED and enters the ED to obtain the necessary healthcare services as show early in Fig. 4.2. This is the ED processing process, which accounts for 10% of the detailing in the simulation experiment [16, 19].

The simulation environment was designed using Arena software [18]. The data generated from the data sheet included in the instrument are shown in Table 4.2 for the ambulance transfer process, and a similar table was designed for ED processing. Both new data sets were tested for their validity, reliability, and normality.

4.3.1 Value of Data

Through a literature review, it was found that no research has been conducted in the past that involved utilization of simulation models to bring improvement in the Kingdom of Saudi Arabia (KSA) or Malaysia. The direct comparison of results from various operational techniques for Minimizing ED wait times and improving the patient experience has also not been considered in the past. Hence, this study is the first to consider the implementation of a simulation model in Malaysia and Saudi Arabia. Key words ["emergency department" OR "emergency medicine" AND "operations" AND "waiting time"] were used to search the relevant peer reviewed

Table 4.1 The validated instrument with key answers and codes

Instrument in English, with Key Answers and Codes											
ID	Item Name	Answer									
1	Sex	Male						Female			
2	Age	18-24	25-34	35-44	45-54	55-64	65-74	75 and above			
3	Education Level	Foundation Degree	Graduate Diploma	BSc	PG Dip	Master	PhD				
4	Field of Education	Engineering	Computing	Health & Social Care	Sports Science	Social Sciences	Mathematics	Law	Information Technology	Business	Art
5	Marital Status	Single	Married	Divorced	Separated	Widowed					
6	Employment Status	Full-time student	Part-time student	Full-time employment	Part-time employment	Self-employed	Retired				
7	Nationality	American	Saudi Arabian	Malaysian							
8	Where do you currently live?	USA	Saudi Arabia	Malaysia							
9	Visited the ED in the past few weeks?	Yes	No	Maybe							
10	How did you arrive to the unit?	By myself	With help								
11	Easy task finding the nearest emergency department?	Yes	No	Maybe							
12	Time between needing emergency care to the time of arrival at your destination	15 min	30 min	45 min	60 Min	90 Min	120 Min	More than 120 Min			
13	How long did the ambulance take to respond to you?	15 Min	30 Min	45 Min	60 Min	90 Min	120 Min	More than 120 Min			
14	Ambulance time from your location to destination	15 Min	30 Min	45 Min	60 Min	90 Min	120 Min	More than 120 Min			
15	Traffic congestion impact?	Yes	No	Maybe							
16	Notice any delay caused by bystanders?	Yes	No	Maybe							

(continued)

Table 4.1 (continued)

Instrument in English, with Key Answers and Codes								
ID	Item Name	Answer						
17	Admission desk or registration area noisy?	Yes			No		Maybe	
18	Admission desk or registration area busy?	Yes			No		Maybe	
19	Patient resistance that cause a delay?	Yes			No		Maybe	
20	Admission or registration process unfavourable?	Yes			No		Maybe	
21	Legal issues impacting admission?	Yes			No		Maybe	
22	Staff at admission or registration desk friendly?	Yes			No		Maybe	
23	Wait time until seen by doctor from the time you entered the ED	Immediately	15 Min	30 Min	45 Min	60 Min	90 Min	120 Min
24	What time did you arrive the ED?	Morning		Afternoon		Night		Midnight
25	Time spend for door-to-door service (in Minutes)?	15 Min	30 Min	45 Min	60 Min	90 Min	120 Min	More than 120 Min
26	Been seen by a doctor and given full service?	Yes			No		Maybe	
27	Was the ED you visited public or private?	Public				Private		
28	How many times do you usually visit ED per year?	1	2	3	4	5	6	More than 6
29	Rate your condition	Nonurgent		Less Urgent		Urgent	Emergent	Severe
30	Area you were transferred to after admission	Waiting Area		Triage Room		Emergency Bed		Doctor's Room
31	How long did you stay in that area?	15 Min	30 Min	45 Min	60 Min	90 Min	120 Min	More than 120 Min
32	Rate your overall experience of visiting the ED	Very Poor		Poor		Acceptable	Good	Very Good

Table 4.2 Data sheet information for the ambulance transfer process

Item number	Item name	Data source
1	Sex	Gathered from survey
2	Age	Gathered from survey
3	Nationality	Gathered from survey
4	Where do you currently live?	Gathered from survey
5	Ambulance response time to patient location (min)	Gathered from survey
6	Ambulance transfer time from patient location to emergency unit (min)	Gathered from survey
7	Ambulance utilization percentage	Simulation data
8	Successful transfer	Simulation data
9	Transfer in the field or stuck in traffic	Simulation data
10	Min number of transfers	Simulation data
11	Max number of transfers	Simulation data
12	Utilization percentage	Simulation data
13	Patient average transfer time (min)	Simulation data
14	Average number of patient calls to request an ambulance (patients picked up)	Simulation data
15	Average number of patients served (patients dropped off)	Simulation data
16	Average number of patients not-served (patients stuck in traffic)	Simulation data
17	Lower ambulance failure range	Simulation data
18	Upper ambulance failure range	Simulation data
19	Ambulance operations (min per week)	Simulation data
20	Patient overall experience	Gathered from survey

articles in the literature published between 1882 and 2018. A total of 1,759,073 articles were identified 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, while this study is original and unique, it can be re-evaluated and validated. The same search results were generated by using the IEEE database.

4.3.2 ED KPIs and Performance Model

Factor analysis was carried out, and items were grouped to draw a unique conceptual model for the patient pathway from the time that they started feeling ill to their discharge time from the ED after receiving the required services, in this case, quality healthcare. The conceptual model incorporates the key performance indicators (KPIs) as shown in Fig. 4.3.

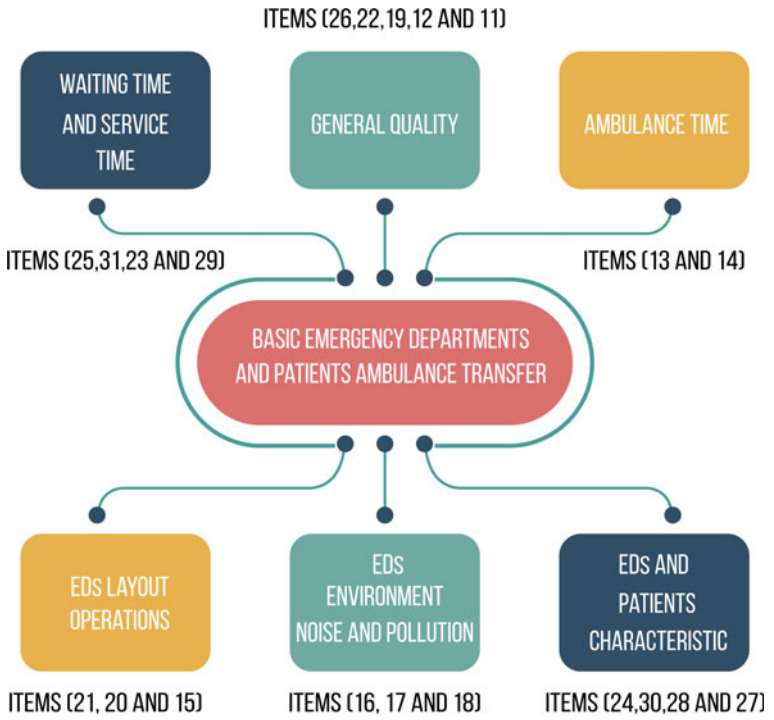


Fig. 4.3 Conceptual model of emergency department and ambulance transfer: a quality KPIs

4.4 Result

The results of this study were divided into three sections. Each section includes intensive analyses (descriptive, diagnostic, predictive and prescriptive analyses). The first section is the survey results. The second and third sections are the simulation experiment results, including ambulance transfer and ED processing simulation experiment results.

4.4.1 The Survey

4.4.1.1 Descriptive Analysis

The characteristics of the respondents in terms of sex, age, education, marital status, employment status, and nationality are presented in Figs. 4.4, 4.5 and 4.6. Figure 4.4 demonstrates the respondent characteristics (n = 348) in terms of education, marital status, employment status, and nationality.

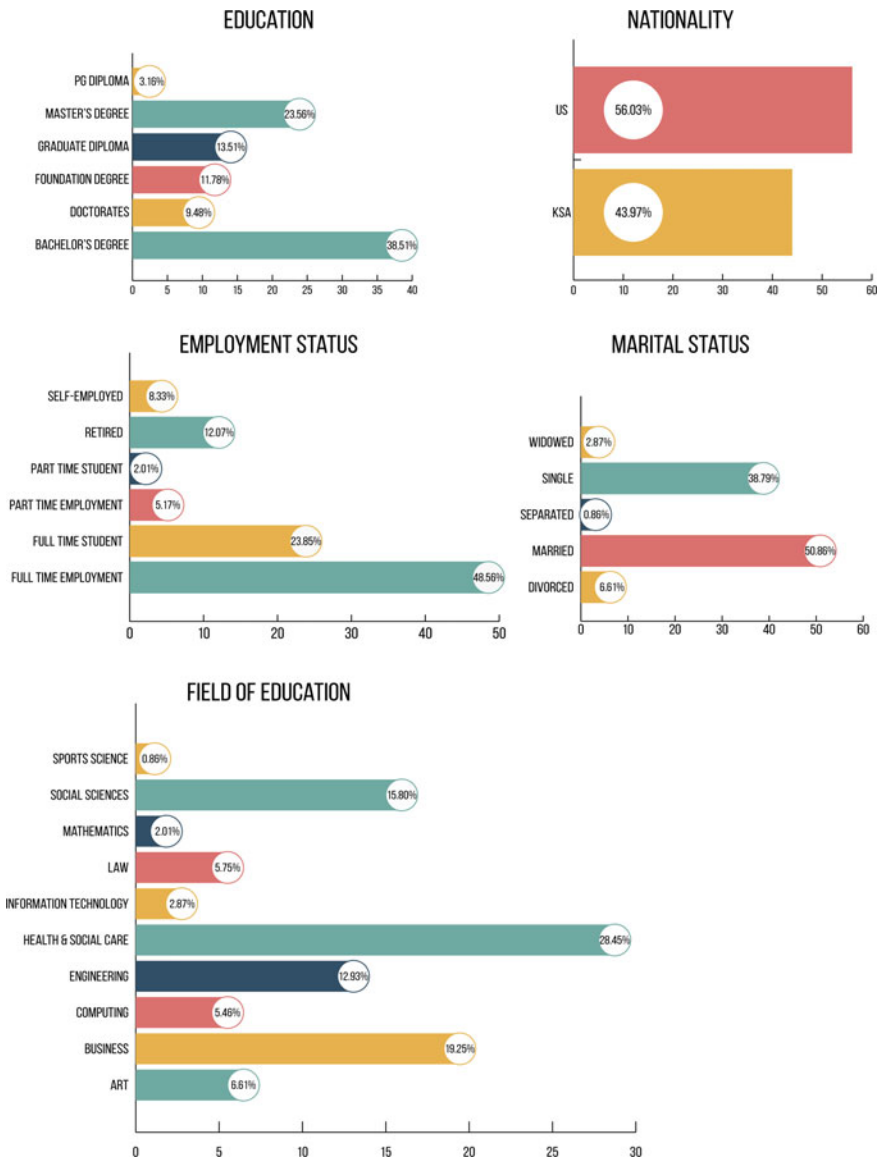


Fig. 4.4 Characteristics of patient attended an ED

Figure 4.5 represents the sex distribution of the respondents. As shown in Fig. 4.5, 54.9% of respondents were male. Figure 4.6 represents the age distribution of the respondents. As shown in Fig. 4.5, 28.7% of respondents were between 25 and 34 years old. Table 4.3 details the distribution of the respondents according to ED

Fig. 4.5 Sex distribution

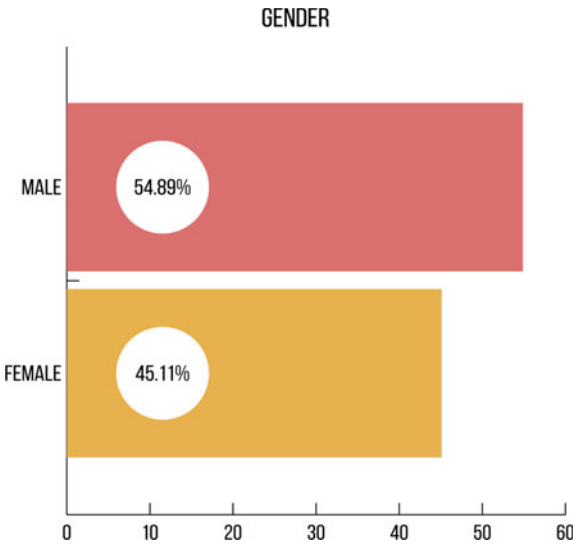
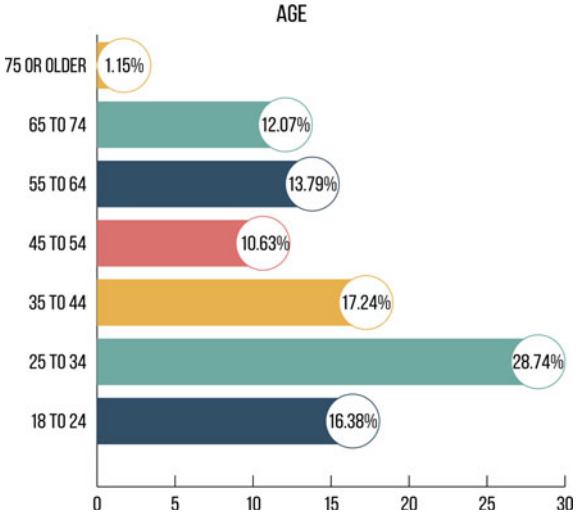


Fig. 4.6 Age distribution



type, patient arrival time, patient severity level, area after admission, and patient overall experience.

A total of 58.5% of emergency departments visited by patients were public, and 41.5% were private. A total of 29.2% of patients visited the ED in the morning, 24.6% in the afternoon, 32.3% at night, and 13.8% at midnight. A total of 12.3% of patients visited the ED with a nonurgent severity level, 16.9% with a low severity level, 38.5% with an urgent severity level, 26.5% with an emergent severity level, and 6.2% with a high severity level. After admission, 33.8% of patients stayed in

Table 4.3 ED profile distribution

ED type	Public 58.5%				Private 41.5%					
Patient arrival time	Morning 29.2%		Afternoon 24.6%		Night 32.3%		Midnight 13.8%			
Patient severity level	Nonurgent 12.3%		Less Urgent 16.9%		Urgent 38.5%		Emergent 26.5%		Severe 6.2%	
Area after admission	Waiting Area 33.8%		Triage Room 23.1%		Emergency Bed 36.9%		Doctor's Room 6.2%			
Patient overall experience	Very Poor 7.7%		Poor 20.0%	Acceptable 30.8%		Good 24.6%		Very Good 16.9%		

the waiting area, 23.1% went to the triage room, 36.9% stayed in an emergency bed, and 6.2% of patients went to a doctor's room. Overall, 7.7% of patients rated their ED visit as very poor, 20% rated their ED visit as poor, 30.8% rated their ED visit as acceptable, 24.6% rated their ED visit as good, and 16.9% rated their ED visit as very good.

4.4.1.2 Diagnostic Analysis

To investigate the factorial structure of the survey, factor analysis was performed using principal component analysis estimation methods with orthogonal rotation (varimax) and Kaiser normalization. The rotation converged in 14 iterations. Table 4.4 shows the results of the factor analysis for the final survey with kappa values and corrected item-total correlations. The items accumulated in six factors (Fig. 4.3): general quality, wait time and service time, ED layout and operations, ED and patient characteristics, ambulance time and ED environment. All items showed high and significant correlations ($p < 0.01$) with the total instrument score. Five experts assessed the instrument items, and according to their evaluation of each item, kappa statistics were calculated (see Formula 4.1). The kappa statistics showed excellent to fair content validation of the instrument. The factor analysis (principal components) of the instrument items showed moderate to high loading, as shown in Table 4.4. In addition, the instrument items showed high internal consistency, with a Cronbach's alpha of 0.827.

The kappa statistic calculation is presented in Eq. 4.1, where Po is the relative observed agreement among raters, and pe is the hypothetical probability of chance agreement. The reliability calculation is presented in Eq. 4.2, where n is the number of items, Vt is the variance of the total scores and Vt is the variance of the item scores.

Kappa Theorem:

$$K = \frac{Po - Pe}{1 - Pe} \tag{4.1}$$

Reliability Theorem:

$$\propto = \frac{n}{n-1}\left(1 - \frac{\sum_i Vi}{Vt}\right) \tag{4.2}$$

Figure 4.3 represents a conceptual model operationalized from the factor analysis results. As shown in Fig. 4.3, six factors were extracted from the patient responses: general quality (represented by items 11, 12, 19, 22, and 26), wait time and service time (represented by items 23, 25, 29, and 31), ambulance time (represented by items 13 and 14), emergency department layout and operations (represented by items 15, 20 and 21), emergency department environment noise and pollution (represented

Table 4.4 Factor analysis

Item number	Item content	Corrected item total correlation	Kappa	Loading
Item 8	How long did it take from the time of feeling ill/needing emergency care to the time of arriving at your final destination (entering the emergency department; in minutes)?	0.580**	0.763	0.448
Item 9	How long does an ambulance usually take to respond to you at your location (in minutes)?	0.668**	0.763	0.452
Item 10	How long did the ambulance take traveling from your location to your final destination (entering the emergency department; in minutes)?	0.657**	0.763	0.885
Item 11	Traffic congestion impact	0.750**	0.763	0.843
Item 12	When you enter the emergency unit and before you seen by a doctor, did you notice any delay caused by bystanders or family members?	0.716**	0.763	0.445
Item 13	Were the admission desk or registration areas noisy?	0.501**	0.763	0.746
Item 14	Were the admission desk or registration areas busy?	0.551**	0.763	0.636
Item 15	Did you notice any patient resistance that caused a delay?	0.704**	0.763	0.464
Item 16	Was the impression of patients and their family about the admission or registration process unfavourable?	0.742**	0.763	0.529
Item 17	Did legal issues or litigation proceedings interfere with the efficiency of admission?	0.683**	0.763	0.641
Item 18	Was the staff at admission or registration desk friendly, and did they have trust and confidence when working with you?	0.628**	0.763	0.839
Item 19	How long did you wait until you saw the doctor from the time you entered the emergency department?	0.486**	0.763	0.751

(continued)

Table 4.4 (continued)

Item number	Item content	Corrected item total correlation	Kappa	Loading
Item 20	How long did you spend (in minutes) for door-to-door service?	0.492**	0.763	0.622
Item 21	Were you seen by a doctor and given full service?	0.470**	0.763	0.784
Item 22	How many times do you usually visit an ED per year?	0.478**	0.418	0.799
Item 23	Severity level	0.333**	0.418	0.819
Item 24	Area after admission	0.695**	0.418	0.322
Item 25	How long did you stay in the admission area?	0.647**	0.418	0.333
Item 26	Overall Experience	0.599**	0.418	0.411

**$p < 0.01$

by items 16, 17, and 18), and emergency department and patient characteristics (represented by items 24, 27, 28, 30).

A structural equation analysis model was specified using emergency department and patient characteristics as exogenous variables, general quality as mediating variables and wait time and service time as endogenous variables.

RMSEA Model fit:

$$\text{RMSEA} = \sqrt{\max\left(\left[\left(\left(\chi^2/\text{df}\right) - 1\right)/(\text{N} - 1)\right], 0\right)} \tag{4.3}$$

The RMSEA calculation is presented in Eq. 4.3, where N is the sample size, and df is the degrees of freedom.

$$CFI = if\ D = X^2 - df, then: \frac{D(Null\ Model) - D(Proposed\ Model)}{D(Null\ Model)} \tag{4.4}$$

$$\text{TLI} = \frac{X^2/df(Null\ Model) - X^2/df(Proposed\ Model)}{X^2/df(Null\ Model) - 1} \tag{4.5}$$

The model was adequate with RMSEA = 0.07, TLI = 0.95, and CFI = 0.95. The equations for RMSEA, TLI, and CFI are presented above.

4.4.1.3 Predictive Analysis

A multiple regression analysis was performed, where the overall patient experience was used as an outcome variable, and all the other instrument variables were used as independent variables to explore which variables were highly related to the patients' emergency department experience. Only one variable showed a significant relationship with the outcome (patient experience), which was "How long did you wait until you saw the doctor from the time you entered the emergency department? "($\beta = -0.48$, $t = 3.13$, $p < 0.01$). The coefficient of determination (R2) was equal to 0.52 ($F = 2.07$, $p < 0.05$). This indicated that as the time that the patient spent before seeing the doctor increased, the impression that patients had about their emergency department visit was less positive.

4.4.1.4 Prescriptive Analysis

Table 4.5 shows significant sex differences using the independent samples t-test for the equality of means. Five variables showed significant differences in favor of females: traffic congestion impact, noisy admission desk or registration area, patient resistance that caused a delay, seen by a doctor and given full service, and length of stay in the area following admission.

Table 4.5 Independent samples T-test for the equality of means by sex

	t	df	Significance (2-tailed)	Mean difference	95% confidence interval of the difference	
					Lower	Upper
Traffic congestion impact	−2.500	63	0.015	−0.435	−0.783	−0.087
Were the admission desk or registration areas noisy?	−2.884	63	0.005	−0.440	−0.745	−0.135
Did you notice any patient resistance that caused a delay?	−2.658	63	0.010	−0.385	−0.674	−0.096
Were you been seen by a doctor and given full service?	−2.169	63	0.034	−0.375	−0.721	−0.029
How long did you stay in that area?	−2.980	63	0.004	−1.300	−2.172	−0.428

Table 4.6 shows significant differences related to nationality (US versus KSA) using the independent samples t-test for the equality of means. Three variables showed significant differences in favor of US nationality: noisy admission desk or registration area, patient resistance that caused a delay, and length of stay in the area following admission.

Table 4.7 shows differences among the participants' responses for 9 selected

Table 4.6 Independent samples T-test for the equality of means by nationality

	t	df	Significance (2-tailed)	Mean difference	95% confidence Interval of the difference	
					Lower	Upper
Were the admission desk or registration areas noisy?	2.616	63	0.011	0.414	0.097	0.731
Did you notice any patient resistance that caused a delay?	2.703	63	0.009	0.409	0.106	0.712
How long did you stay in that area?	3.928	63	<0.001	1.685	0.826	2.544

Table 4.7 Responses of the participants for variables with statistically significant differences (n = 65)

Item number	Item content	Rarely (%)	Most of the time (%)	Always (%)	Chi-square
11	Traffic congestion Impact	20 (30.8)	32 (49.2)	13 (20.0)	8.52*
12	When you enter the emergency unit and before you were seen by a doctor, did you notice any delay caused by bystanders or family members?	11 (16.9)	39 (60.0)	15 (23.1)	21.17**
13	Were the admission desk or registration areas noisy?	22 (33.8)	36 (55.4)	7 (10.8)	19.42**
14	Were the admission desk or registration areas busy?	27 (41.5)	27 (41.5)	11 (16.9)	7.88*
15	Did you notice any patient resistance that caused a delay?	14 (21.5)	42 (64.6)	9 (13.8)	29.20**
16	Was the impression of patients and their family about the admission or registration process unfavourable?	14 (21.5)	32 (39.2)	19 (29.2)	7.97*
17	Did legal issues or litigation proceedings interfere with the efficiency of admission?	15 (23.1)	36 (55.4)	14 (21.5)	14.25**
18	Were the staff at the admission or registration desk friendly, and did they have trust and confidence when working with you?	45 (69.2)	9 (13.8)	11 (16.9)	37.79**
21	Were you seen by a doctor and given full service?	49 (75.4)	8 (12.3)	8 (12.3)	51.72**

*$p < 0.05$, **$p < 0.01$

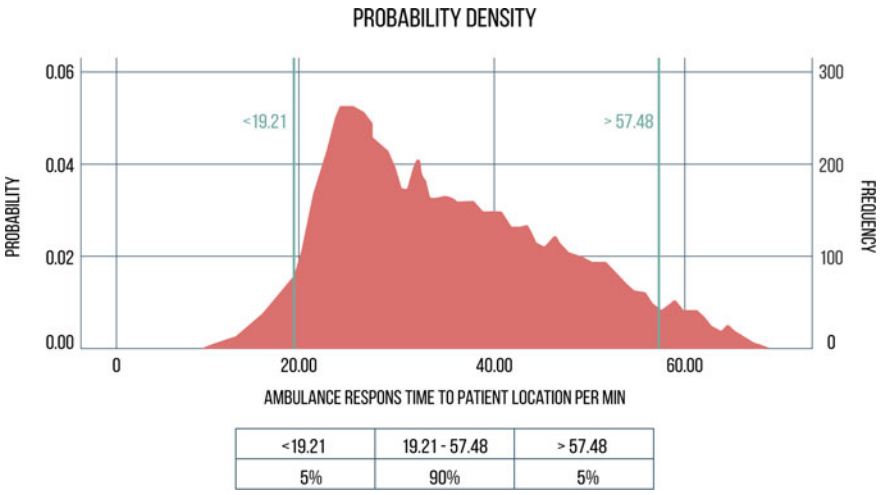


Fig. 4.7 Probability density of the ambulance transfer variable 1

variables using the chi-Square test of homogeneity.

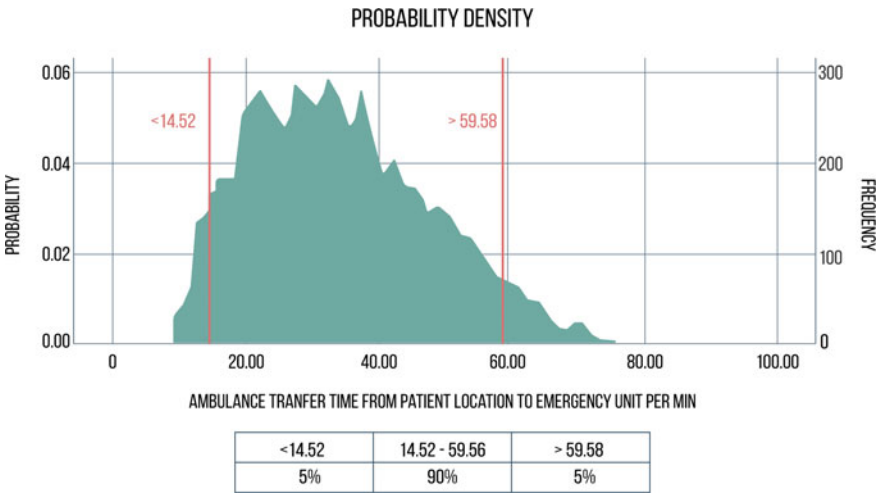
4.4.2 Ambulance Transfer

4.4.2.1 Descriptive Analysis

Figures 4.7, 4.8, 4.9, 4.10, 4.11, 4.12 and 4.13 show the probability distributions of the ambulance transfer simulated data. As shown in Figs. 4.7, 4.8, 4.9, 4.10, 4.11, 4.12 and 4.13, most variables tended to be normally distributed. A typical normal probability distribution was found for the transfer failed or stuck in traffic variables. Ninety percent of the simulations had an ambulance response time to the patient location between 19.2 and 57.5 min. Ninety percent of the simulations indicated successful transfer of between 130 and 355 patients. Ninety percent of the simulations had ambulance operations of between 256 and 388 cases per minute per week.

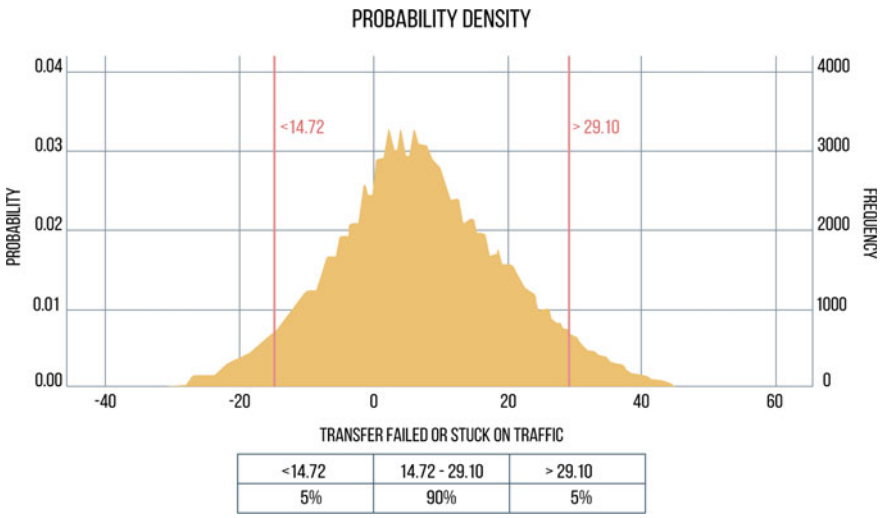
4.4.2.2 Diagnostic Analysis

Table 4.8 shows the minimum values, maximum values, means, and standard deviations for the ambulance transfer variables. In addition, Table 4.8 shows the bias statistics and bootstrap 95% confidence intervals for each variable. The bootstrap results are based on 1000 stratified bootstrap samples selected from the simulated dataset. The bias statistics showed small mean values and small standard deviations, indicating the accuracy of the simulated data. According to the bootstrap results,



<14.52	14.52 - 59.56	> 59.58
5%	90%	5%

Fig. 4.8 Probability density of the ambulance transfer variable 2



<14.72	14.72 - 29.10	> 29.10
5%	90%	5%

Fig. 4.9 Probability density of the ambulance transfer variable 3

95% of the time, ambulance response times to the patient location were between 18.9 (SD = 8.0) and 24.92 (SD = 19.7) minutes; 95% of the time, between 234 (SD = 71) and 280 (SD = 106) patients were successfully transferred, and ambulance operation was between 282 (SD = 64.4) and 321 (SD = 96.7) patients per minute per week.

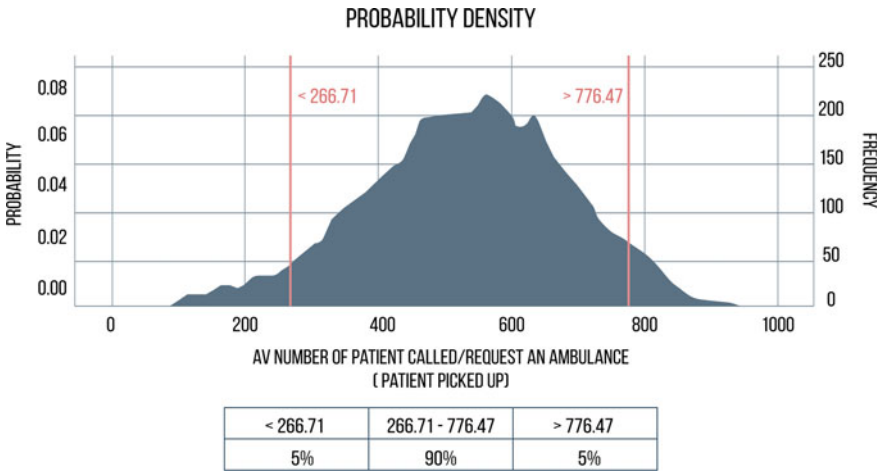


Fig. 4.10 Probability density of the ambulance transfer variable 4

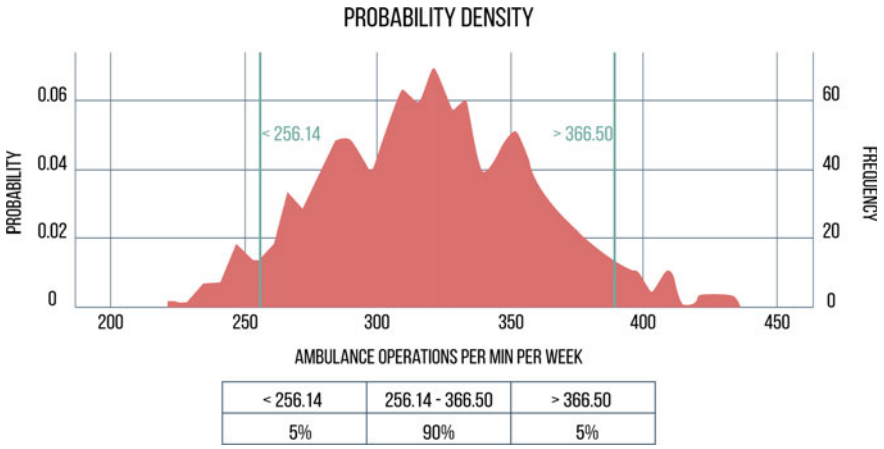
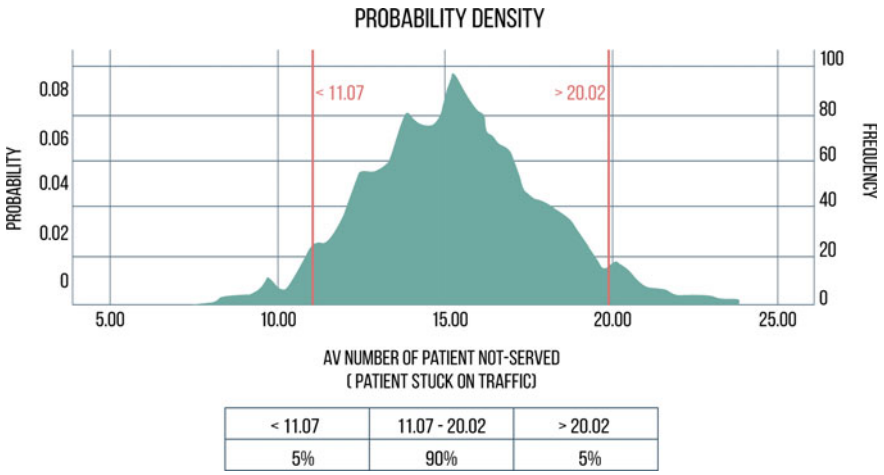


Fig. 4.11 Probability density of the ambulance transfer variable 5

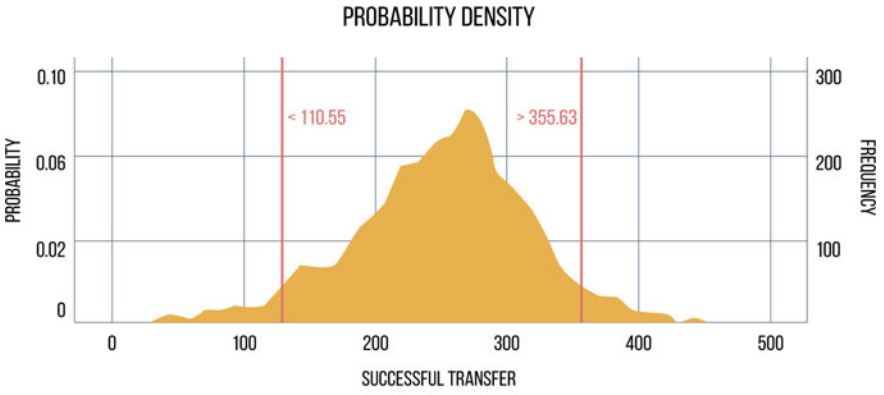
4.4.2.3 Predictive Analysis

Multiple regression analysis was performed shown in Table 4.9 with ambulance operations per minute per week used as the outcome variable and all the other simulation variables used as the independent variables. Four variables showed significant prediction: ambulance transfer time from patient location to emergency department (minute) ($\beta = 0.92$, $t = 10.93$, $p < 0.001$), number of successful transfers ($\beta = 0.92$, $t = 8.28$, $p < 0.001$), transfer failed or stuck in traffic ($\beta = 0.86$, $t = 7.82$, $p < 0.001$), and utilization percentage ($\beta = -0.33$, $t = 3.90$, $p < 0.001$).



< 11.07	11.07 - 20.02	> 20.02
5%	90%	5%

Fig. 4.12 Probability density of the ambulance transfer variable 6



< 110.55	266.71 - 355.63	> 355.63
5%	90%	5%

Fig. 4.13 Probability density of the ambulance transfer variable 7

4.4.2.4 Prescriptive Analysis

Table 4.10 shows the analysis of sex differences using the independent samples t-test for the equality of means. As shown in Table 4.10, no variable showed significant differences. Table 4.11 shows the analysis of differences among US, KSA, and Malaysia with regard to ambulance transfer variables.

According to Table 4.11, there were differences in favor of US with regard to ambulance response time to the patient location (minutes), average number of patients served (patients dropped off), and utilization percentage.

Table 4.8 Bootstrap statistics for the ambulance transfer simulated variables

Items	Statistic				Bootstrap					
					Bias		95% confidence interval			
							Lower		Upper	
	Min	Max	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Ambulance response time to patient location (min)	15	105	21.69	14.28	−0.14	−0.82	18.92	7.99	24.92	19.67
Ambulance transfer time from patient location to emergency department (min)	15	75	21.23	12.96	−0.11	−0.42	18.69	8.77	24.00	15.91
Ambulance utilization percentage	33.80	99.80	89.08	16.14	0.0755	−0.34	84.83	12.15	92.89	19.08
Successful transfer	31	403	259.43	90.65	0.36	−1.42	234.4	71.33	280.47	105.7
Transfer failed or stuck in traffic	1	76	18.54	16.24	0.06	−0.35	15.18	10.49	22.43	20.64
Min number of transfers	2	607	433.08	236.6	1.47	−2.17	379.2	211.51	486.53	254.23
Max number of transfers	15	1042	610.60	274.4	1.98	−3.92	542.3	234.11	677.71	306.34
Utilization percentage	40.40	95.30	81.63	12.69	0.0413	−0.25	78.61	9.24	84.62	15.05
Patient average transfer time (min)	13.30	199.0	22.68	24.43	−0.1797	−2.84	18.36	8.62	28.05	38.755

(continued)

Table 4.8 (continued)

Items	Statistic				Bootstrap					
					Bias		95% confidence interval			
							Lower		Upper	
	Min	Max	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Average number of patient calls/requests for an ambulance (patients picked up)	46	675	516.17	220.0	1.58	−2.60	462.1	191.09	569.65	241.95
Average number of patients served (patients dropped off)	26	645	490.03	218.5	1.52	−2.67	438.1	185.53	542.57	244.23
Average number of patients not served (patient stuck in traffic)	1	35	16.28	7.63	0.04	−0.12	14.47	6.23	18.18	8.685
Lower bound of ambulance failure range	0.7	24.0	5.214	4.20	0.008	−0.12	4.327	2.70	6.24	5.34
Upper bound ambulance failure range	1.0	50.0	37.89	16.54	0.110	−0.27	33.82	13.06	41.90	18.89
Ambulance operations (patients per min per week)	58.56	585.0	301.52	81.70	−0.2113	−2.05	282.0	64.40	321.00	96.69

Bootstrap results are based on 1000 stratified bootstrap samples

Table 4.9 Regression analysis for ambulance transfer data

Variable	Standardized coefficients (beta)	t	Significance
Ambulance transfer time from patient location to emergency unit (min)	0.923	10.928	>0.001
Number of successful transfers	0.915	8.283	>0.001
Transfer failed or stuck in traffic	0.862	7.820	>0.001
Utilization percentage	−0.328	3.900	>0.001

4.4.3 ED Processing

4.4.3.1 Descriptive Analysis

Figures 4.14, 4.15, 4.16, 4.17, 4.18, 4.19, 4.20 and 4.21 show the probability distributions of the simulated ED processing data. As shown in Figs. 4.14, 4.15, 4.16, 4.17, 4.18, 4.19, 4.20 and 4.21, the variable distributions tended to be almost perfectly normal. For example, wait time was normally distributed, with 90% of simulations having a wait time from emergency department admission to the first contact with a doctor between 5.99 and 279.08 min in the most extreme cases.

4.4.3.2 Diagnostic Analysis

Table 4.12 shows the minimum values, maximum values, means, and standard deviations for the emergency department variables. In addition, Table 4.12 shows the bias statistics and the bootstrap 95% confidence intervals for each variable. The bootstrap results are based on 1000 stratified bootstrap samples selected from the simulated dataset.

The bias statistics showed small mean values and small standard deviations, indicating the accuracy of the simulated data. According to the bootstrap results, the wait time after admission ranged from 2.5 (SD = 1.3) to 3.2 (SD = 1.8) 95% of the time, the wait time from emergency department admission to the first contact with a doctor was between 4 (SD = 1.3) and 4.8 (SD = 1.6) minutes 95% of the time, the emergency department processing time ranged between 2.6 (SD = 1.2) and 3.3 (SD = 1.6) 95% of time, the estimated number of patients in the admission area ranged from 18 (SD = 12) to 25 (SD = 15) 95% of the time, and the average door-to-door service time was estimated to be between 297.6 (SD = 189.8) and 404.3 (SD = 235.4) minutes 95% of the time.

Table 4.10 Sex differences for the ambulance transfer variables

Ambulance response time to patient location (min)									
				15	30	45	60	More than 60	Chi-square	Significance
Sex	Male		Count	26	11	3	0	0	7.28	0.122
	Female		Count	20	3	0	1	1		
Ambulance transfer time from patient location to emergency unit (min)										
Sex	Male	Count		28	7	4	1	0	5.62	0.230
	Female	Count		21	2	0	1	1		
Variable				Sex	N	Mean		SD	t	Significance
Average patient transfer time per min				Male	40	21.15		9.71	0.639	0.525
				Female	25	25.14		37.78		
Successful transfers				Male	40	260.90		101.20	0.164	0.870
				Female	25	257.08		72.54		
AV number of patient served (patient dropped off)				Male	40	458.03		226.71	1.51	0.136
				Female	25	541.24		198.52		
Transfer failed or stuck in traffic				Male	40	18.98		17.96	0.272	0.786
				Female	25	17.84		13.34		

(continued)

Table 4.10 (continued)

Ambulance response time to patient location (min)							
	15	30	45	60	More than 60	Chi-square	Significance
Average number of patients not-served (patient stuck in traffic)	Male	40	16.03		8.426	0.334	0.739
	Female	25	16.68		6.310		
Ambulance utilization percentage	Male	40	87.93		17.83	0.727	0.470
	Female	25	90.93		13.11		
Utilization percentage	Male	40	81.24		14.27	0.315	0.754
	Female	25	82.26		9.88		
Patient overall experience	Male	40	3.15		1.07	0.694	0.491
	Female	25	3.36		1.35		

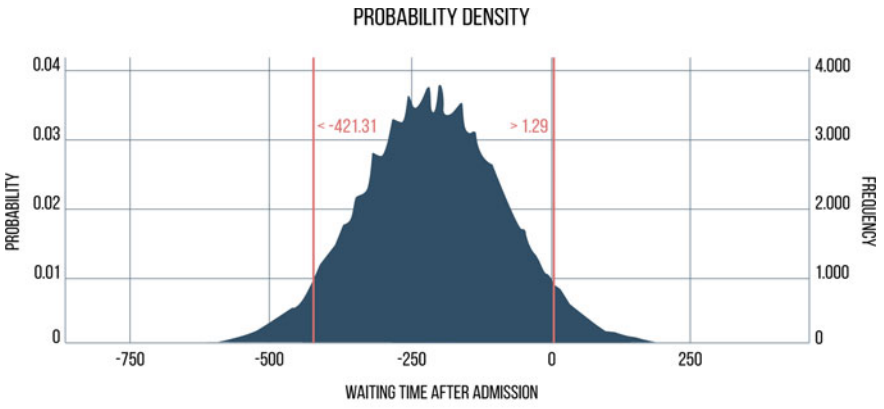
Table 4.11 Difference among countries for the ambulance transfer variables

Ambulance Response Time to the Patient Location (Min)									
			15	30	45	60	More than 60	Chi-square	Sig
Country	US	Count	27	1	0	1	1	21.05	0.007
	KSA	Count	10	10	1	0	0		
	MY	Count	9	3	2	0	0		
Ambulance transfer time from patient location to the emergency department (min)									
			15	30	45	60	75	Chi-square	Significance
Country	US	Count	26	1	0	2	1	13.15	0.107
	KSA	Count	13	5	3	0	0		
	MY	Count	10	3	1	0	0		
Variable	Country	N		Mean		Std. deviation		F	Significance
Average patient transfer time (min)	US	30		22.77		34.73		0.098	0.907
	KSA	21		24.12		9.06			
	MY	14		20.34		10.54			
Successful transfers	US	30		243.60		69.95		1.05	0.358
	KSA	21		265.19		127.17			
	MY	14		284.71		57.82			
Average number of patients served (patients dropped off)	US	30		558.90		201.47		5.12	0.009
	KSA	21		374.29		225.11			
	MY	14		516.07		182.53			
Transfer failed or stuck in traffic	US	30		20.50		15.55		0.676	0.512
	KSA	21		18.52		21.22			

(continued)

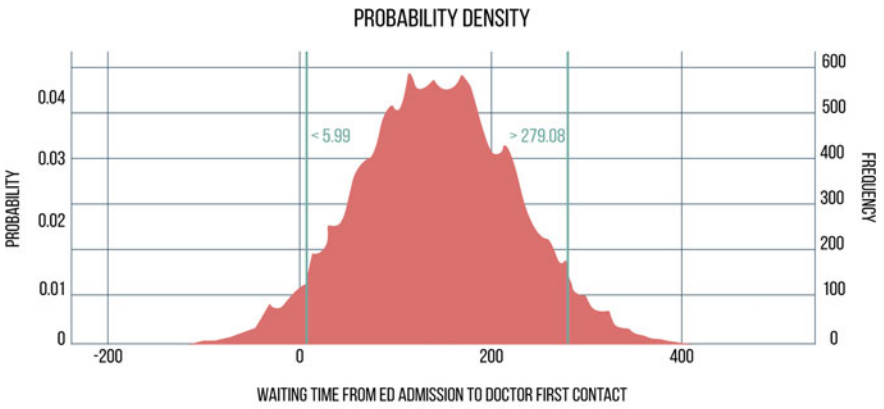
Table 4.11 (continued)

Ambulance Response Time to the Patient Location (Min)								
		15	30	45	60	More than 60	Chi-square	Sig
	MY	14	14.36		6.14			
Average number of patients not-served (patient stuck in traffic)	US	30	18.37		5.82		2.332	0.106
	KSA	21	13.90		9.92			
	MY	14	15.36		6.28			
Ambulance utilization percentage	US	30	83.91		6.87		2.003	0.144
	KSA	21	77.15		18.78			
	MY	14	83.46		9.81			
Utilization percentage	US	30	93.33		9.29		3.152	0.050
	KSA	21	82.25		22.69			
	MY	14	90.22		13.38			
Patient overall experience	US	30	3.47		1.30		1.414	0.251
	KSA	21	2.90		1.13			
	MY	14	3.21		0.89			



< -421.31	-421.31 - 1.29	> 1.29
5%	90%	5%

Fig. 4.14 Probability density for the ED processing variable 1



< 5.99	5.99 - 279.08	> 279.08
5%	90%	5%

Fig. 4.15 Probability density for the ED processing variable 2

4.4.3.3 Predictive Analysis

A multiple regression analysis was performed with patient door-to-door service time used as the outcome variable and with all the other simulation variables used as independent variables. Two variables showed significant prediction: average wait time of patients at admission ($\beta = 0.96$, $t = 23.88$, $p < 0.001$) and time spent in the admission area ($\beta = 0.56$, $t = 13.96$, $p < 0.001$). The results of the regression analysis for the emergency department processing data are presented in Table 4.13.

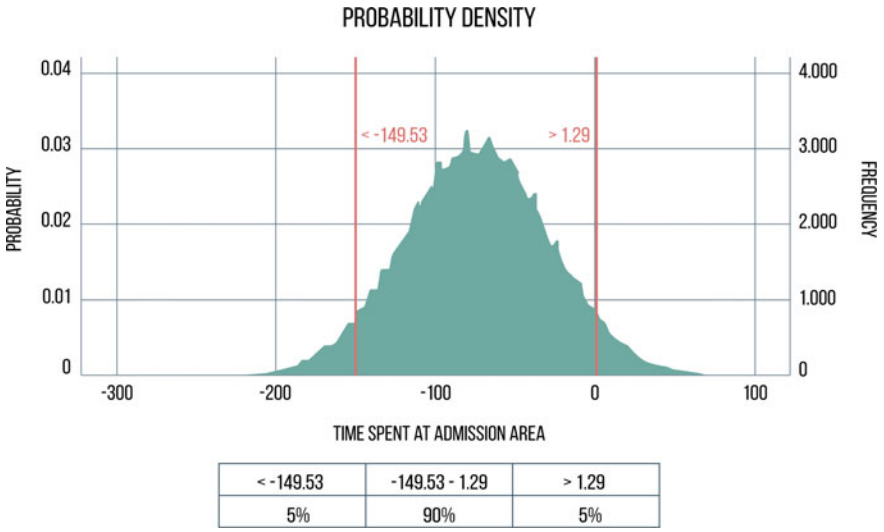


Fig. 4.16 Probability density for the ED processing variable 3

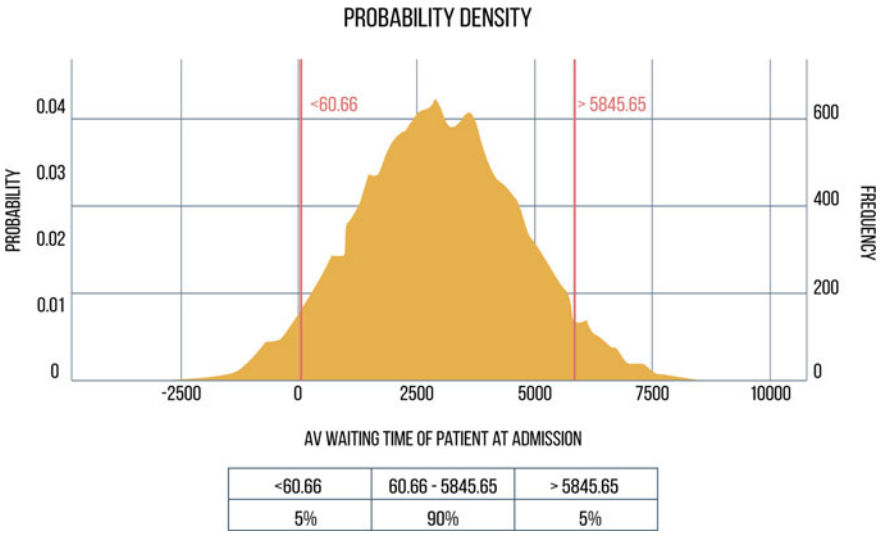
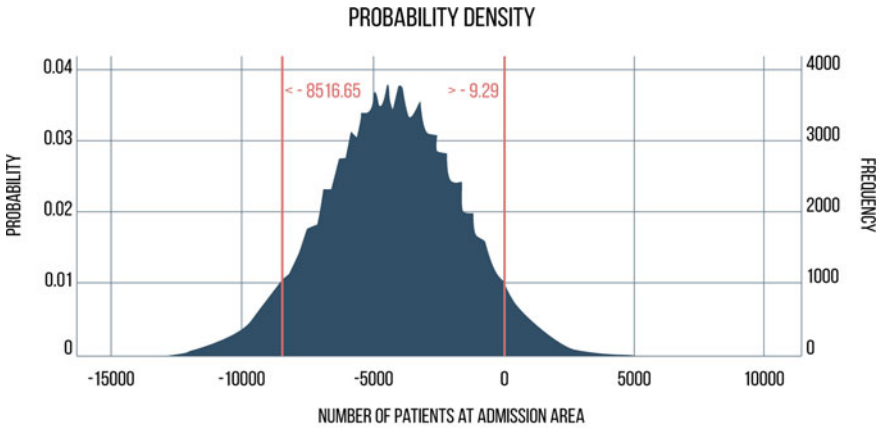
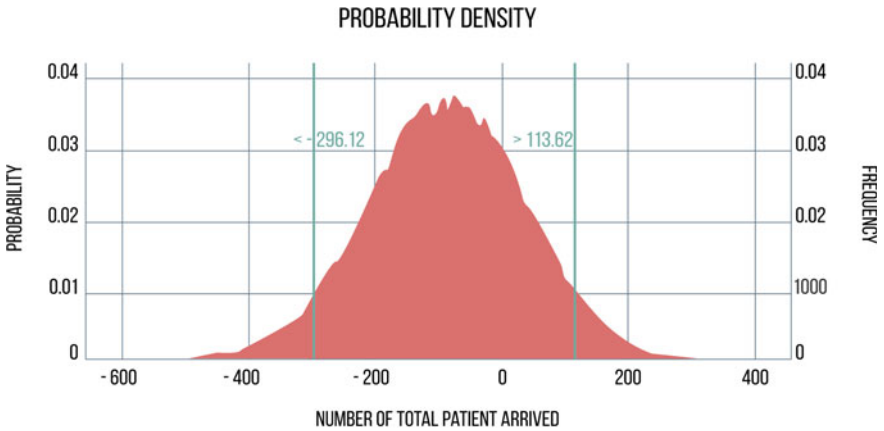


Fig. 4.17 Probability density for the ED processing variable 4



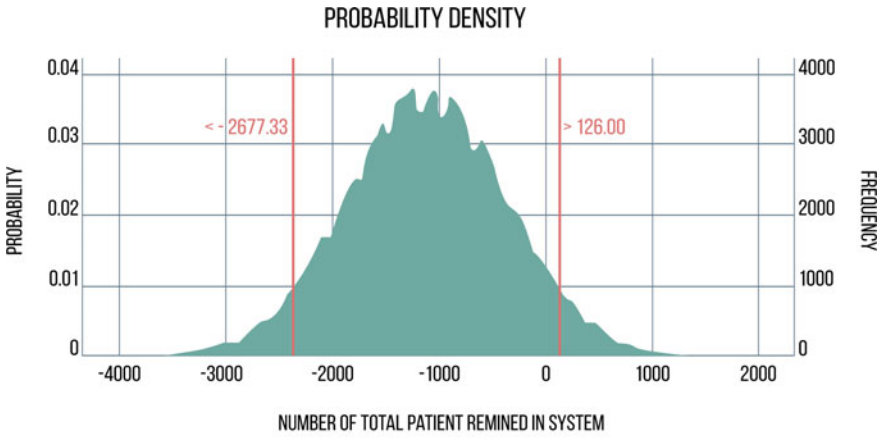
< - 8516.65	- 8516.65 - - 9.29	> - 9.29
5%	90%	5%

Fig. 4.18 Probability density for the ED processing variable 5



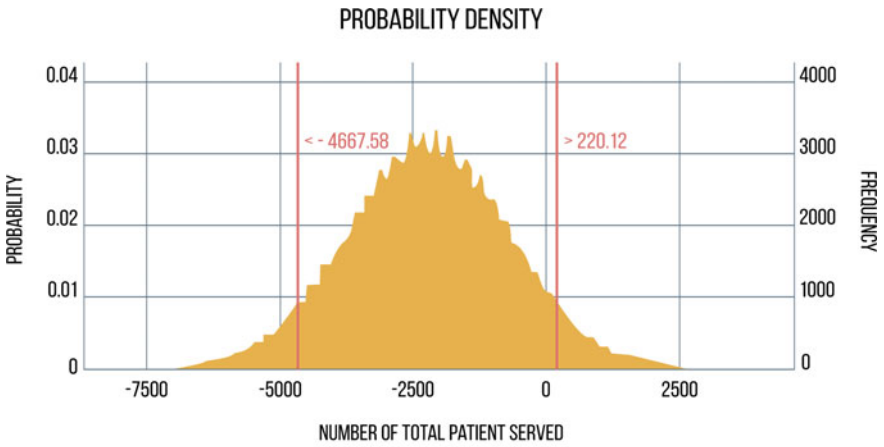
< - 296.12	- 296.12 - 113.62	> 113.62
5%	90%	5%

Fig. 4.19 Probability density for the ED processing variable 6



< - 2677.33	- 2677.33 - 126.00	> 126.00
5%	90%	5%

Fig. 4.20 Probability density for the ED processing variable 7



< - 4667.58	- 4667.58 - 220.12	> 220.12
5%	90%	5%

Fig. 4.21 Probability density for the ED processing variable 8

Table 4.12 Bootstrap statistics for the simulated emergency department variables

Items	Statistic				Bootstrap					
					Bias		95% confidence Interval			
							Lower		Upper	
	Min	Max	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Wait time after admission	1.00	6.00	2.83	1.54	0.01	−0.02	2.48	1.25	3.23	1.77
Wait time from ED admission to first contact with a doctor	3.00	7.00	4.40	1.48	0.01	−0.02	4.03	1.29	4.80	1.62
Time spent in the admission area	1.00	4.00	1.57	0.92	0.00	−0.01	1.35	0.69	1.78	1.10
ED processing time	1.00	6.00	2.97	1.43	0.00	−0.02	2.62	1.19	3.31	1.63
Utilization of the ED	50.29	99.92	88.62	19.41	−0.01	−0.23	83.85	15.12	93.28	22.07
Average wait time of patients at admission	15.00	126.3	50.44	29.43	0.00	−0.42	43.45	22.44	57.67	35.33
Number of patients in the admission area	1.00	41.00	21.68	13.72	0.00	−0.12	18.45	11.91	24.77	14.93
Average door-to-door service time (simulated)	28.90	654.5	351.51	215.42	−0.13	−2.02	297.6	189.80	404.32	235.43
Total number of patient who arrived at the ED	30.00	231.0	103.48	54.01	−0.02	−0.79	90.48	40.59	117.26	63.68
Total number of patients served	12.00	340.0	96.75	112.55	−0.13	−1.42	70.08	90.37	125.37	129.34
Total number of patients who remained in the system	1.00	340.0	64.77	104.61	−0.15	−2.06	41.90	68.47	92.46	129.65
Patient door-to-door service time (actual/real)	3.00	7.00	4.54	1.36	0.00	−0.01	4.20	1.20	4.85	1.49

Table 4.13 Regression analysis for ED processing data

Variable	Standardized coefficients (beta)	t	Significance
Average wait time of patients at admission	0.964	23.884	>0.001
Time spent in the admission area	0.563	13.964	>0.001

4.4.3.4 Prescriptive Analysis

Table 4.14 shows the analysis of sex differences using the independent samples t-test

Table 4.14 Sex differences for ED processing

Variable	Sex	N	Mean	SD	t	df	Sig
Wait time after admission	Male	40	2.75	1.50	0.856	63	0.395
	Female	25	3.14	1.70			
Wait time from ED admission to first contact with a doctor	Male	51	4.47	1.42	0.733	63	0.466
	Female	14	4.14	1.70			
Time spent in the admission area	Male	51	1.73	0.98	2.75	63	0.008
	Female	14	1.00	0.00			
ED processing time	Male	51	2.76	1.38	2.28	63	0.026
	Female	14	3.71	1.38			
Utilization of ED	Male	51	85.60	20.95	2.487	63	0.016
	Female	14	99.61	0.32			
Average wait time of the patients at admission	Male	51	47.16	29.72	1.746	63	0.086
	Female	14	62.42	25.90			
Total number of patients who arrived at the ED	Male	51	105.92	60.87	0.694	63	0.49
	Female	14	94.57	0.85			
Total number of patients served	Male	51	115.71	120.29	2.717	63	0.008
	Female	14	27.71	12.98			
Total number of patients who remained in the system	Male	51	73.24	116.86	1.251	63	0.216
	Female	14	33.93	6.44			
Number of patients in the admission area	Male	51	19.08	14.26	3.106	63	0.003
	Female	14	31.14	4.62			
Average door-to-door service time	Male	51	319.51	218.82	2.367	63	0.021
	Female	14	468.10	160.17			

for the equality of means. As shown in Table 4.14, there were significant differences in the time spent in the admission area and the total number of patients served in favor of males; there were significant differences in ED processing time and utilization of the ED in favor of females.

Table 4.15 shows the analysis of differences among the US, KSA, and Malaysia with regard to the emergency department processing variables. According to Table 4.15, there were significant differences in the wait time from ED admission to the first contact with a doctor, the ED processing time, the average wait time of the patients at admission, the average door-to-door service time, and the total number of patients who remained in the system in favor of Malaysia.

Table 4.15 Differences in ED processing variables among countries

Variable	Country	N	Mean	SD	F	Significance
Wait time after admission	US	15	3.20	1.66	2.40	0.10
	KSA	38	2.95	1.56		
	MY	12	2.00	1.04		
Wait time from ED admission to the first contact with a doctor	US	15	4.80	1.66	4.38	0.02
	KSA	38	4.58	1.45		
	MY	12	3.33	0.78		
Time spent in the admission area	US	15	1.60	0.83	0.48	0.62
	KSA	38	1.63	1.05		
	MY	12	1.33	0.49		
ED processing time	US	15	2.60	0.83	11.07	<0.001
	KSA	38	3.53	1.50		
	MY	12	1.67	0.49		
Utilization of the ED	US	15	92.41	12.16	0.79	0.46
	KSA	38	88.91	20.21		
	MY	12	82.97	23.97		
Average wait time of the patients at admission	US	15	45.29	12.63	7.50	<0.001
	KSA	38	60.05	33.54		
	MY	12	26.48	8.48		
Number of patients in admission area	US	15	18.00	12.09	1.85	0.17
	KSA	38	24.39	14.38		
	MY	12	17.67	12.31		
Average door-to-door service time	US	15	267.83	142.45	9.47	<0.001
	KSA	38	436.00	223.01		
	MY	12	188.57	117.11		

(continued)

Table 4.15 (continued)

Variable	Country	N	Mean	SD	F	Significance
Total number of patients who arrived at the ED	US	15	112.00	64.57	2.40	0.10
	KSA	38	109.63	52.92		
	MY	12	73.33	32.00		
Total number of patients served	US	15	74.60	80.82	1.35	0.27
	KSA	38	91.00	110.50		
	MY	12	142.67	145.74		
Total number of patients who remained in the system	US	15	19.40	12.79	4.19	0.02
	KSA	38	61.87	97.51		
	MY	12	130.67	154.60		

4.5 Discussion

Emergency departments may experience different problems such as long wait times, inefficient use of ED resources, an unbalanced healthcare workforce and scheduling difficulties. This paper applied Arena simulation [18] as a first effort to model the operations of emergency departments the Saudi Arabian healthcare system and the Malaysian healthcare system. The model was based on real world data collected by a well- developed survey designed specifically for the purpose of the current study. Analysis of the responses to this survey revealed that public emergency department usage was higher than that of private emergency departments. The survey results also showed that the use of the ED was almost even during the day and night, with slightly more visits at night and slightly fewer visits at midnight. Urgent and emergent severity cases accounted for most of the cases received by the EDs. In addition, most patients stayed in the waiting room area or an emergency department bed after admission. Furthermore, most ED patients rated their experience as acceptable or good.

Factor analysis revealed that the evaluated items loaded onto six factors: general quality, wait time and service time, ambulance time, emergency department layout and operations, emergency department environmental noise and pollution, and characteristics of the emergency department and patients. Structural equation modeling analysis revealed that characteristics of the emergency departments and patients could predict wait time and service time with general quality as a mediating variable. This result directed our attention to the importance of the emergency department and patient characteristics and the essential role of service quality in the emergency department systems.

Furthermore, using multiple regression analysis, result showed that the overall patient experience was predicted by wait time (how long a patient waited until he/she saw the doctor from the time he/she entered the emergency department). This result draws our attention to the importance of wait time as an operationalization of service quality in emergency room departments. In addition, significant sex differences were found in favor of females in some variables, such as the impact of traffic congestion,

environmental factors related to the admission desk or registration areas (noisiness), service delays due to patient resistance, receiving full service in the emergency department, and time spent receiving the healthcare services. These results assured the importance of sex variables in simulating and modeling emergency department systems (ambulance transfer and emergency room processing).

Differences related to country were also present for some variables. US emergency departments provided better service according to the patients' responses to the survey, especially with regard to factors such as those related to the admission desk or registration areas (noisiness), service delays due to patient resistance, and time spent receiving the healthcare services. Again, these results reflect the importance of the country variable in the modeling and simulation processes. Patients reported that the following items happened most of the time in the emergency departments: traffic congestion; service delays caused by bystanders, patients, or family members; noisiness and unprofessional behavior at the admission desk or in the registration areas; negative impressions of patients and their family about the admission or registration process; and interference of legal issues and litigation proceedings with the efficiency of the admission process. However, patients reported that the following two factors happened rarely: friendly behavior of the staff at the admission or registration desk and patients left before being seen or receiving healthcare services.

Given that wait time was the main factor affecting the quality of services in the emergency departments, as revealed by patients' responses, a model was developed to help emergency department mangers understand the hidden causes of excessive wait times. This model served as a tool for assessing the impact of major output variables on key performance indicators and was also used as an effective method for testing different scenarios for possible system improvement based on real data collected from the emergency department sites. The quality of the ambulance transfer and emergency department processing simulated data were assured using probability density and bootstrap methods. The multiple regression analysis showed that four variables could predict ambulance operations per minute per week using the ambulance transfer simulated data. These variables were ambulance transfer time from the patient location to the emergency department (minutes), number of successful transfers, number of failed transfers or transfers stuck in traffic, and utilization percentage. No significant differences related to sex were found in the ambulance transfer data; however, there were differences in favor of the US with regard to ambulance response time to patient the location (minutes), average number of patients served (patients dropped off), and utilization percentage. On the other hand, the emergency department processing simulated data analysis revealed that it was possible to predict patient door-to-door service time with the average wait time of the patients at admission and time spent in the admission area. Sex differences were found; significant differences in the time spent in the admission area and the total number of patients served favored the males, and significant differences in ED processing time and utilization of the ED favored the females. Finally, there were significant differences in wait time from ED admission to the first contact with a doctor, ED processing time, average wait time of patients at admission, average door-to-door service time, and the total number of patients who remained in the system in favor of Malaysia.

4.6 Conclusion

Simulation models were used to examine the utilization of ED resources in various settings to analyze the average performance of ED systems. It is imperative to conduct additional simulation studies in developing countries in the future. This experiment involved the simulation of practical data with the help of a basic ED model (10%).

This study is the primary and principal ED simulation study in Kingdom of Saudi Arabia and Malaysia. The simulation models represented the exact real-world ED settings and thus offered convenient and clear analyses, which makes them an efficient mathematical model to improve decision-making in emergency departments. In the industrial sector, simulation modeling explains complex systems and offers solutions to significant issues.

Simulation models are also used to design real-world systems that provide practical views. Hence, it becomes easy to predict the resources required by the actual ED and the performance of the actual ED prior to its deployment. The application of more simulation models has been recommended by ED experts. The results of the current study show a feasible 38.76% reduction in wait time for door-to-door service based on ED layout, available resources, daytime patient ambulance transfers and patient ED processing, and the overall capacity of the emergency departments mid-normal mode in Saudi Arabian healthcare systems.

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Chapter 5
Conclusion

5.1 Conclusion

In this book on EDs, the cost is the one factor that stands out. Cost reflects many areas not only in terms of money but also time. The high costs have a negative impact on the use of existing health care by patients, which means that more regulation is expected in this area. Emergency management has several complex factors, which should be used to test a health technology [1] on its quality by way of an objective decision-making process. This analytical system should be frequently updated as simulation processes are critical for the management of physician, personnel, and patient pathways care in hospitals. The ED and the problems that occur are complicated and thus this research is very important. In contrast, some experiments have used mathematical models, although only a few studies have adapted ED structures to mathematical models.

Reassessment of the research objective and answering the research questions was developed in this research regarding the EDs current EDs problem and methods were used, an abstraction one of the data mining processes was used to create momentum on answering these questions. From 2000 to 2019 a table of data extraction was created in Appendix and furthermore discussion in [2] and [3] and Chap. 3. Answering the research question regarding the optimal way to harness our knowledge and improve EDs was covered in Chap. 4. All research objective was achieved. Each article cover the objective that was planned to achieve. Current knowledge on the area was fulfilled and satisfied.

Feasibility and focus and effect on focused and definitive results such as professional skills and professional practice [4], lessened the acute in-patient care, was the greater health system savings factor [5]. ED advises the management and preparation of emergency services and provides an insight of the publics' health, the growing importance of EDs in the delivery of medical care in complex cases, along with

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the evolving nature of the disease in the population in need of immediate medical attention [6]. The initiative of $167 million was intended to provide leadership in the implementation of evidence-based clinical practices to the Front-Line Registered Nurses (RN) at the bedside [7]. The cost model and the metrics of this model for EDs are the cost optimization of the process; Value, organizational performance, time, cost assessment, hospital stay and preparation for discharge [8]. A sustainable connection essential to the transformation of the healthcare system [9]. A new health care administration educational environment to help emerging new staff [10] requires more research to verify the researchers' results. Increased use of care management processes analysed to influence patient experience and healthcare quality positively [11]. There has been some progress in clinical outcomes and process indicators [12]. Extreme importance of patient satisfaction to guarantee a better care quality [13]. Reducing the variability in the Emergency Department hospital admissions results in savings. For different emergency departments the uniform thresholds of admission to risk are very significant [14]. The goal of generating savings for patients joining services should be to ensure that qualified patients who are involved can be enrolled promptly [15], with both increased service quality and reduced costs. Profile innovation is new tool to provide hospitalist reviews to improve collaboration and patient development. Teamwork is an important competency in the health sector [16]. Patients with short-stay can save $3.1 billion a year [17]. A shift in the process would encourage employees to take up more of their time in direct patient care to achieve optimum performance, thereby reducing the overall cost and the patient's total time in the hospital. Management may have to redistribute resources to improve the quality of operations [18]. The health information exchange (HIE) is thought to increase performance, reduce the cost of healthcare and improve patient satisfaction by exchanging electronic information such as laboratory reports, clinical summaries and prescription lists [19]. Public health, hospital system and service management need to consider high-reliability systems of patients requiring zero result defects [20].

The options in this analysis are as follows. Continuous preparation and exercises with detailed data analysis is needed for emergency preparedness programs. The main factors are the people involved, the officials and equipment to be used in emergency situations. The emphasis should be on patient experience, degree of patient satisfaction, productive processes, patient safety and fast response systems. Health care systems are rather weak in developing countries, so it is important to address problems and the demands for emergency health care in hospitals. The implementation uncertainties for activity-based funding also need to be handled.

To maintain informed decision-making and an efficacious handling of emergencies in regular or emergency circumstances with reduced and managed crowding, it is important to manage EDs and give personnel information of the ED policy, structure, power, network, etc. Analyses and use of the correct technique to execute emergency procedures is successful. Researchers need to analyse the current scenario and the work holes for ED simulation modelling [21]. Case studies for multi-label

health care personnel should be undertaken to recognize skills and abilities in the workforce [10]. In order to ensure command in EDs [22] EDs need leadership inside management [23].

Quality standards in hospitals must be updated with Chaps. 3 and 4, characteristics and observations into the research subject to be undertaken in the emergency and risk management field in the future [24]. Based on the findings of this report the following approaches are recommended: Emergency preparedness programs and comprehensive information analyses require ongoing training and simulations. It continues to be a challenge to Evidence based Practice in EDs and their effective and efficient participation in medical and administrative leadership. It is necessary to use a scientific classification-based structure, framework, process and results to identify existing barriers to EBP adoption. The operation of EDs and the processes involved should be overseen by an experienced management team with knowledge, skill and experience in improving quality, modelling, simulation and process reengineering. Instead of handling tasks and procedures in the healthcare system, especially for EDs, a greater number of doctors should thus remain just doctors. For this reason, it is important that technicians with a history in six-sigma and quality assurance be included in the leadership team in order to oversee health care workers and their facilities. The terms are listed in this report as components of EDs, ED organizational leadership, staff competencies and expertise, emergency preparedness, technology performance and use and simulation of education, even though ED is the whole term and describes the ranking tree by each definition. Health systems are severely deprived of medical services in developing countries; hence it is important to address the remaining issues and to meet the essential healthcare requirements for the hospital. There must also be control of the risk of introduction of activity-based financing.

Primary and secondary evidence must be collected by interviews, polls, literature reviews and analysis at both medical and national level by the managers. Data should be interpreted and processed by the Managers by meta-analysis and should be able to highlight similarities, disparities and deficiencies of waiting time, registration process, costs, visits to patients, and other aspects. Ultimately, the problems faced by ED can be overcome when service risks are adequately tracked and handled, and patient information is properly recorded. In particular, ED administrators are required to prevent overpopulation and prolonged waits by monitoring patient stays and using their staff's skills and expertise.

If the administrator prevents conclusions, provisional inference, data collecting with a single phase and selection of the meta-analysis for the primary data-analysis, data collection from a specific data source or costing method and information tracking mistakes, such as in the case of self-reporting patients, the quality of the health services can also be assured. In order to analyse factors such as waiting time, patient registration, costs, number of visits and others, the director is required to conduct interviews, assessments, research reviews and meta-analysis, and to identify the comparisons, various types of analysis and the median discrepancies. The ED manager must be mindful of the standard of health services, treatment costs, service times, patient satisfaction, and duration of stay, quality of ED performance, healthcare access, patient admission, and demographics.

5.2 Future Research Directions

The successful application of real-time analysis of information in EDs and quality evaluation in emergency systems should be focussed in future research. The implications of this work can be used to improve healthcare standards. The work on crises and risk management that should be carried out in future is addressed in Chaps. 3 and 4.

In comparison, emergency response, patient satisfaction, waiting time and hospital-based overcrowding; issues, challenges and strategies will be identified in upcoming regional organizational research studies along with national healthcare skills and competencies. The findings must be treated as true and confirmed. The feasibility of real time data collection, quality assessment of emergency systems, organizational control, process reengineering and the use of modelling in EDs should also be the subject of future research.

Research on the performance of emergency systems and ensuring that practices are continued to collect patient data in EDs in real time are required for the hour. Studies are needed to assess the quality of emergency departments with respect to the demographic characteristics of patients, patient movement through an ambulance and ED time in order to carry out clinical criteria as well as ED time simulator management tests. When undertaking multi-label research, the skills and talents of the personnel involved in health care can be found out [2]. To order to facilitate smooth operations within EDs, emergency departments require management [3] which gives leadership [2] to the followers. ED management must ensure better and revised quality of care and services over time [3].

5.3 Research Recommendations

This thesis has its general research recommendations and specifics as shown in the following:

- Effective E-Systems, ERP systems or standard governmental databases (i.e. healthcare databases) possess great capability may provide for the more effective decision-making process [1].
- Services should concentrate on ensuring that qualified patients are timely registered [15].
- Additional research to verify the findings of the researchers is needed. Facility and priority and the influence of the associated interventions on desired and established performance like professional competence and professional practice [4].
- Quality standards for health care, regulations, architecture, efficiency, network, etc., must be updated accordingly [3].
- The main factors are people, agencies and emergency management equipment and the focus should be on the experience of patients, rates of engagement, effective procedures, patient safety and quick response programmes. The activity of

EDs and the associated systems should be managed by a professional project management team with expertise, skills and know how to improve quality, design, simulation and engineering [2] and [3].
- System for training advancement of the emerging new health services administration workforce [10].
- Reducing variance in the Emergency Department's hospital admissions [14].
- Analysed procedures to have a positive impact on patient experience and healthcare quality [11].
- Leadership has to reallocate resources and increase the efficiency of operations [18].
- Extreme flexibility in achieving better quality of care for patients [13].
- New tool for providing feedback on better inter-professional collaboration and patient care to hospitalists. Health care role in communities is critical [16].

5.3.1 Other Specific Recommendations

The EDs scenery within the healthcare is quite complex and the amount of data generated is complex too therefore, a data mining technique is essential to analyze and draw conclusions. Furthermore, considerations to Quality Care; Management (Patient Record) along with continues quality Improvement tools: "Lean Six Sigma" and eHealth: "Admission-Discharged Process" are highly important to improve quality care and beneficiary to healthcare systems in short- and long-term strategy planning.

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Appendix
Data Extraction of Chapter 3

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https://doi.org/10.1007/978-3-030-53832-3

ID	Author name	Data extracted
1	Curt Hagquist et al.	**Year**: 1998, **Country**: Sweden, **Objective/Problem**: The purpose of the study was to discuss on the importance of goodness of fit is as a tool in regression analysis. **Method**: The method that the researchers used was the goodness of fit in regression model. **Measurements**: Measurements used in the study were the outcome (model orientation), the effects, the regressors and the factor orientation. **Findings/Conclusion**: R2, F, −2 Log · L0 = L1/ and G2 have scales that are independent of the scale of Y, while SEE and −2 Log L does not. R2, F, −2 Log L, −2 Log · L0 = L1/ and G2 are sample specific measures, while SEE is an estimated property of the estimates. **Limitations/Shortcoming/Deficiency**: Secondary methods of data collection were used. The observed data was not analyzed
2	Merkle J.F.	**Year** 2002, **Country** USA, **objective/Problem**: the increase in patient load and severity mix has had a significant impact on the efficiency of operations in the primary care clinics and leadership believed that inefficiencies existed in the configurations of primary care clinics. These inefficiencies were characterized by poor access, high total patient time in the clinic, high patient wait time, and inappropriate resource utilization. **Method**: Computer simulation is one of the most widely used methods of evaluating, improving, and optimizing many types of processes because it is an imitation of an actual process over time and interviews with the staff and Historical data on clinic visits. **Measurements**: patient timeliness, "output" performance measures. daily work hours, personnel shifts, and lunch breaks. clinic visits and simulation model include entities, locations, arrivals, pathways, processes, and resources. **Findings/Conclusion**: A simulation model imitates a system's behaviour, referred to as "baselining," and it evaluates possible changes in the system's structure, environment, or underlying assumptions in the form of "what-if analysis". Simulation results typically identify the largest single challenge that faces outpatient facilities: the time patients spend waiting to see a healthcare provider. simulation offers a practical alternative approach to problem solving. Because simulation models evaluate outcomes without making changes in the system, simulation modelling can allow the consideration of several alternatives before any resources, especially human, are expended. This is especially important given that healthcare is a dynamic service industry with high human involvement, sporadic workflow. **Limitations/Shortcoming/Deficiency**: The primary limitation of this study is that the simulation model cannot replicate every variable or occurrence of the system; the complexity of such a detailed model would actually decrease its utility. The major assumption governing this study was that a one-month study of the FCC was enough to attain an accurate representation of the system; the second assumption was that all data collected relating to workload and appointment scheduling were accurate

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ID	Author name	Data extracted
3	De Angelis et al.	**Year** 2003, **Country** UK, **Objective/Problem**: The paper tries to solve the problem of selecting the configuration of the servers to maintain the ATiS at a minimum within budgetary constraints. **Method**: The authors propose an integrated methodology which combines on-field survey, system simulation, estimation of the target function, and optimization to calculate and authenticate the optimal configuration of servers. **Findings/Conclusion**: The researcher measures the configuration of servers, as well as the minimum cost configuration of servers that satisfy an upper bound constraint on the ATiS's users. **Limitations/Shortcoming/Deficiency** The researcher found that the methodology is organized in a system that is easy to use, with a friendly interface, and that produces outcomes that can be evaluated and interpreted by health managers in the absence of a precise operational research background
4	Hamdan et al.	**Year** 2004, **Country** KSA, **Objective/Problem**: The paper sought to provide a comparison of the recorded management of acute bronchial asthma at the ER with Saudi National Guidelines. **Method**: The researchers compared documentation of the indices of severity, history, pre-discharge evaluation and prescriptions, and treatment given, with nationally recommended standards of management. **Findings/Conclusion**: A total of 150 ER records of patients diagnosed with asthma over a one-year period were retrospectively analyzed. **Limitations/Shortcoming/Deficiency** The history of the present attack, frequency of β-agonist use, nocturnal symptoms and durations, previous ER visits and hospitalization, accessory muscle and peak flow rate were only documented in at most 50% of patients. ICU admission and incubation were recorded for less than 15% of asthma patients. Only 46% of acute asthma patients visiting the ER received steroids and only 64% were given a follow-up appointment. The research is not a review of actual care provided in the ER
5	Qinan Wang	**Year** 2004, **Country** Canada, **Objective/Problem**: The researchers are concerned with the risk and suffering faced by patients waiting in line and try to establish a patient model which considers the patient's condition and its changes while patients queue. **Method**: A patient queue model is developed for this study that considers the condition and how it changes over the period a patient is waiting for service. For homogenous conditions, a basic patient queue model is set up while a two-class priority queue model is developed for heterogenous conditions. **Findings/Conclusion**: The study measures conditions and how they change while a patient waits in line. **Limitations/Shortcoming/Deficiency** Patients face and suffer high risk when there is delay in medical treatment for certain conditions. Therefore, it is crucial to address the patients' condition

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ID	Author name	Data extracted
6	Alexander Komashie and Ali Mousavi	**Year** 2005, **Country** UK, **Objective/Problem**: The hospital managers in Britain are in search of a way to improve operation processes in the hospital, and they experience a lot of pressure in the process of coming up with the improved system which will be cost effective. **Method**: Researchers used frequent observation of the patients who required particular care and attention as well as interviews and questionnaires issued to the staff. Approximately 6000 patients were used in the study. **Findings/Conclusion**: The admissions management provided data on admissions with entailed lengths of stay and queuing times for patients both minors and majors, and it provided an insight into the impact of the delayed admission. **Limitations/Shortcoming/Deficiency** The results showed that total patient time in the present system was 249 min for majors and 182 min for minors. Moreover, the idea of adding a doctor or a nurse in the minor's section was useful as n the fracture clinic the queuing time reduce by 83% and the total patient time went done by 9%. The researchers lacked prior research studies on the topic. At least there could be just a little of prior data involved in the topic of study
7	Ruohonen et al.	**Year** 2006, **Country** Finland, **Objective/Problem**: The paper suggests a simulation model that highlights the operations in the ED of Special Health Care at the Central Hospital of Jyvaskyla in Finland. This is based on the likelihood of combination of units and operations which will result in an increase in number of patients. **Method**: The simulation model is employed to test out various process scenarios, assign resources and complete activity-based cost analysis. **Findings/Conclusion** Patients in the ED were observed for two weeks and data collected included patients' arrival time, urgency, process times, symptoms and number of patients. The findings ascertained that this method enhances the operation of the ED by over 25%. **Limitations/Shortcoming/Deficiency** The observation period of two weeks may have been too short
8	Alexander Komashie and Ali Mousavi	**Year** 2007, **Country** UK, **Objective/Problem**: The research studies quality assessment methods used in manufacturing industries and healthcare and the extent to which the industrial techniques have been adopted in healthcare and a presentation of new approaches is proposed. **Method**: Prior research studies were used by the researchers from books written by prominent experts in the field as well as reviewing studies carried out in current approaches in healthcare and publications from various sources obtained worldwide. **Findings/Conclusion** The data collected was in terms of concerns for quality and the type of processes and outputs involved over a range of time (years). The research showed that the quality management in industries is more advanced than in healthcare because of certain reasons one of them being differences in concerns processes in both sectors. healthcare would, therefore, be improved by enhancing staff ownership and pride in a way similar to the time of craftsmen, but with the use of new technology. **Limitations/Shortcoming/Deficiency** The primary sources of data were not used such as observational studies and experimental trials

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ID	Author name	Data extracted
9	Marcos Singer and Patricio Donoso	**Year** 2007, **Country** Chile, **Objective/Problem**: Since ambulance services deal with situations of death and life, they have drawn a lot of extension from the operations research. A vital aspect of the ambulance service quality in the healthcare is the waiting time owing to the possibility of all ambulances being busy. **Method**: To understand the determinants of the waiting time in the ambulance services, the researcher used the Markov chain model to define the set of scenarios or states and the rate at which they transmit among themselves by use of a case study of the Chilean ambulance firm. In addition, the researcher used secondary data by reviewing what other researchers have published about the same issue. **Findings/Conclusion** The researcher aimed at calculating the system's steady state probability. **Limitations/Shortcoming/Deficiency** The research study found out that simple mathematical expressions were important in the process of evaluating and improving the ambulance operations. In addition, for the ambulance services to respond to a particular emergency with a promptitude, the service providers must serve regular calls if the minimum number of ambulances remain idle
10	Oddoye et al.	**Year** 2007, **Country** UK, **Objective/Problem**: The Medical Assessment Unit has increasingly been used in most healthcare trusts in the UK as a result of the continued investment in serious medicine. Therefore, there is need to examine, understand and develop the MAU's source requirements and to develop a standard or provide a framework that all the hospital clinical managers and develop could consult. **Method**: Primary data was collected through observing nurses and doctors on the MAU. **Findings/Conclusion** The time activities on average performance were monitored. From the study, it is very clear that simulation model is a very effective method of finding solutions to the resource levels which are required by a health care facility for patients in the facility to go through the MAU with the least possible delay. **Limitations/Shortcoming/Deficiency** The questions and challenges that MAU is challenged by are multi-objective, and therefore, it requires a multi-objective approach to collecting data
11	Rifat Rehmani, Ahmed Norain	**Year** 2007, **Country** KSA, **Objective/Problem**: The paper evaluates the differences in utilization of the emergency department over a 3-year period while identifying the factors that influence this utilization. **Method**: The researchers analyzed administrative ED documents at King Abdul-Aziz Hospital from 2003–2005. **Findings/Conclusion** The study measured the acuity level, periodicity of ED use and demographic characteristics. Number of ED visits during the research period rose by about 30%. Fall appeared to be the busiest season. The greatest volume of visitors was observed between 3 and 11 pm. **Limitations/Shortcoming/Deficiency** Data set did not have a chief diagnosis or complaint, making it hard to adequately assess reasons for visits. It is also impossible to generalize data to other hospitals based on the findings of one hospital

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ID	Author name	Data extracted
12	Christine Duguay and Fatah Chetouane	**Year** 2007, **Country** Canada, **Objective/Problem**: The study sought to reduce patient waiting times and enhance overall system throughput and service delivery. **Method**: The methodology considers the examination room, nurses and physicians as control variables. Data was collected through interviews and on-site observations. Key performance improvements were evaluated using DES. **Findings/Conclusion** The researchers measured time activity durations and waiting durations. Shorter waiting time increases service level. The number of examination rooms did not affect the waiting time if not accompanied by increased number of staff. **Limitations/Shortcoming/Deficiency** Data was collected over summer, making generalization of data to other seasons difficult. The flow of patient assigned triage code one or two was not considered. Transfer times in the ED were ignored. Arrivals on Saturday and Sunday were eliminated from the model
13	Eduardo et al.	**Year** 2008, **Country** USA, **Objective/Problem**: Although very little about hypothermia-related mortality has been published, little have been published about the risk factors and incidences that are related to hypothermia morbidity. **Method**: The researchers pointed out hypothermia as well as other morbidity related to cold ED visits, which had been recorded in the National Hospital Ambulatory Medical Care Surveys from 1995 to 2004. **Findings/Conclusion** The morbidity surveys were done using the cause of injury codes and the international classification of diseases. In the U.S., a total 15,574 hypothermia, as well as other morbidity ED visits related to cold, were recorded between 1995 and 2004. As compared with the patients with ED, the patients who had Hypothermia as well as other morbidity diagnoses related to cold were older with a mean age of (45 vs. 36 years: $p = 0.009$) and were more expected to be uninsured with a risk ratio of 2.44. In addition, the hypothermia, as well as other morbidity ED visits related to cold, needed more transfers to the clinical care units that the other ED visits. **Limitations/Shortcoming/Deficiency** The small number of individuals that were identified from the database limited the ability of the researchers to extrapolate national estimates that are reliable with regard to the subgroups of interest which include sex and race
14	Moskop et al.	**Year** 2008, **Country** USA, **Objective/Problem**: The problem at hand was the issue of crowding in emergency departments in many hospitals. **Method**: The researchers used secondary methods of data collection by reviewing other published documents used by other authors. **Findings/Conclusion** The study involved the patients in the emergency department and the type of response they gave regarding the services they got. The research, therefore, gave moral consequences of crowding in the emergency department including the high risk of patients being maltreated, interruptions in providing the needed care, cooperated secrecy and concealment, impaired communication and diminished access to care. **Limitations/Shortcoming/Deficiency** The study in order to come up with the article did not involve primary data collection such as observation or questionnaires hence might not be perfect information

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ID	Author name	Data extracted
15	Hoot et al.	**Year** 2008, **Country** USA, **Objective/Problem**: The aim was to develop a separate event simulation of ED patient flow with the purpose of forecasting operation conditions in the near future and authenticate the forecasts with several measures related to ED crowding. **Method**: Researchers obtained data from the ED information systems by use of patient real time tracking application. **Findings/Conclusion** Research was done in terms of the time of initial registration at the ED, time placed into an ED treatment bed, time of hospital bed request if applicable, time of discharge from the ED facility, triage category assigned to the patient, and finally if the patient left without being seen. The relationships between crowding forecasts and actual outcomes started high and reduced gradually up to 8 h into the future while the discriminatory for ambulance diversion remained consistently high up to 8 h into the future. **Limitations/Shortcoming/Deficiency** One possible limitation of the study was the constricted purpose for which the forecasted simulation was planned
16	Puente et al.	**Year** 2008, **Country** Spain, **Objective/Problem**: Many businesses in which employees are subject to work rotation are affected by the issue of work rosters or organizing shifts. The study concentrates on shift management for a second category Spanish hospital's HED. **Method**: The study analyzes the satisfaction of the soft and hard constraints by the monthly schedule, as well as the relevance of each constraint. It delves into the main features of the genetic algorithm (GA) which is projected to solve the problem. **Findings/Conclusion** The study measures the satisfaction of hard and soft constraints imposed by the monthly schedule. **Limitations/Shortcoming/Deficiency** The GA was found to be a suitable way to configure timetables automatically for services
17	Alexander Kolker	**Year** 2008, **Country** UK, **Objective/Problem**: ED ambulance diversion because there are no available beds has become a shared problem in many of the nation's major hospitals. **Method**: Methodology utilized is founded on the principles of Operations Research and was executed by creating a model of ED patient flow with a simulation software package that was available. **Findings/Conclusion** The model was designed to measure productivity improvement, activities and resource utilization, throughput capacity, bottleneck finding and analysis, cycle time, capacity planning and production and staff scheduling. The simulation of different scenarios of ED patient flow led to the acknowledgment that ED diversion could possibly be negligible if admitted patients stay for at most six hours and discharged patients stay in the ED for a maximum of 5 h. **Limitations/Shortcoming/Deficiency** The study tried to apply a 'one size fits all' approach

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ID	Author name	Data extracted
18	Nathan R. Hoot and Dominik Aronsky	**Year** 2008, **Country** USA, **Objective/Problem**: ED crowding signifies an international crisis that could impact access and quality of healthcare. **Method**: The study involved a PubMed search to identify articles that described data collection and analysis methodology, studied solutions, causes and effects of ED crowding. **Findings/Conclusion** The researchers applied a 5-level quality evaluation tool to rank the methodology of each study, happened in a general ED setting. Measures included influenza season, frequent-flyer patients, financial effect, additional personnel, treatment delays, hospital bed shortages, nonurgent visits, crowding measures, ambulance diversion and many more. The findings demonstrated that ED crowding is a complex problem. **Limitations/Shortcoming/Deficiency** Study may not have extensively covered all articles studying the solutions, effects and causes of ED crowding. Search was limited to English-language articles
19	Melissa et al.	**Year** 2009, **Country** USA, **Objective/Problem**: Crowding has numerous effects on ED waiting roam, boarding, and treatment times across multiple acuity groups and sites. **Method**: The researcher carried out a retrospective cohort study, which included the ED visits as well as the inpatient clinical occupancy data at 4 emergency departments for a period of 1 year. This was done by measuring crowding at intervals of 30 min throughout every ED stay of each patient. **Findings/Conclusion** The researchers estimated the impact of crowding on the waiting room, the treatment time, and the boarding time disjointedly, by use of the discrete-time survival analysis by use of time-dependent crowding extent (number of patients waiting, the number of patients being treated, the number of patients boarding, and the rate of inpatient occupancy). The patients' waiting room and the time of boarding with no treatment were substantially delayed by crowding. During the day, when the total number of patients increased from 50 to 90%, the median time spent in the waiting room (26–70 min) increased to (288–921 min). The findings depended on site. Crowding was responsible for the high-acuity in level two patients delay at all the sites. During the periods when the facility was crowded (90%), the attuned median time spent in the waiting room of the high-acuity patients of level 2 were approximately 3–35% which was higher compared to the normal periods, conditional to the crowding measures and the site. **Limitations/Shortcoming/Deficiency** The study did not take into account that the nature of crowding also varies with time. during the stay of an ED patient, the levels of crowding fluctuate, and hence the research should consider that

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ID	Author name	Data extracted
20	Ibrahim Al-Kattan	**Year** 2009, **Country** UAE, **Objective/Problem**: The aim of this study was to evaluate the performance of the emergency department disaster recovery plan. **Method**: Research was based on data from hospital database, direct observation, and expert opinion. **Findings/Conclusion** The researcher was able to extract the average number of patients who arrived in the ED using the hospital's database. He thus classified them in terms of their triage status (T1 to T5) and determined the treatment time. **Limitations/Shortcoming/Deficiency** The research showed that in major disasters with an arrival rate of 1000 patients in a day, with T1 20% and T2 15%, the average waiting time was 111 min. This implied that improving the performance of the emergency department was hardly needed to reduce the waiting times. Considering that data was obtained with some assumptions being made, the results will not be accurate and reliable since huge data was required in order to make a good estimate of the input values
21	Darabi et al.	**Year** 2009, **Country** USA, **Objective/Problem**: Healthcare organizations lack unified information systems. The aim is to define a technique that will build formal models capturing the state of the hospital departments as well as the interactions within departments during the operations in the hospital. **Method**: The method used in the study is the use of petri nets. **Findings/Conclusion** The study with the follow measures guiding the study; patient workflows, human resource classes, inanimate resource classes, and hospital functions. **Limitations/Shortcoming/Deficiency** The study was to be implemented and the expectations will be to monitor in real-time the condition of every patient, the availability of medical personnel as well as the status of the hospital equipment and facilities. Inaccurate data due to estimation may lead to inaccurate results therefore, errors
22	Leora I. Horwitz and Elizabeth H. Bradley	**Year** 2009, **Country** USA, **Objective/Problem**: The amount of time a patient needs to wait to see a physician in EDs in the US is increasing. It may differentially influence patients with different ethnic/ racial backgrounds and insurance status. **Method**: The study examined trends in percentage of patients observed by triage category and within the triage target time. A stratified random sampling of 151,999 visits was used, representing ED visits between 1997 and 2006. **Findings/Conclusion** Percentage of patients seen was measured by triage category including nonurgent, semi urgent, urgent, and emergent. Patients seen during the target triage time decreased by 0.8% annually. For emergent patients, the percentage declined by 2.3% annually. Patients of every payment type and racial/ ethnic group experienced the same decreases in percentage observed within the triage target time. **Limitations/Shortcoming/Deficiency** Software limitations led to problems in weighting medial wait time results

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ID	Author name	Data extracted
23	Mohamed A. Ahmed, Talal M. Alkhamis	**Year** 2009, **Country** Kuwait, **Objective/Problem**: Busy healthcare systems constantly challenge decision-makers and managers because of limited healthcare resources and budget, high costs, and high demand for service. The paper incorporates simulation with optimization to create a decision support tool for the handling of an ED in a Kuwait government hospital. **Method**: The methodology utilizes a simulation integrated with optimization to establish optimal number of nurses, lab technicians, and doctors needed to reduce patient time in system and maximize patient throughput. **Findings/Conclusion** The decision supporting tool measures the effect of staffing levels on service efficiency. **Limitations/Shortcoming/Deficiency** Using current hospital resources, the optimization simulation model yields optimal staffing allocation that would facilitate average reduction of 40% patient waiting time and 28% increase in patient throughput
24	Horwitz et al.	**Year** 2009, **Country** USA, **Objective/Problem**: The study sought to illustrate hospital-level performance on ED visit length and wait time in the US. **Method**: The researchers carried out a reflective cross-sectional study. They used a stratified random sampling of 35,849 patient visits in 2006, to 364 nonfederal US hospital EDs. **Findings/Conclusion** Measures used included the EDs' median visit lengths and wait times, median proportion of dispositioned patients within 4 h, and median proportion of patients treated by physician within triage recommended time. 78% of all patients and 67% of triaged patients received treatment from a physician within target triage time. 31% EDs attained their triage target for over 90% of patients. **Limitations/Shortcoming/Deficiency** Data is extracted from charts by every hospital and may not be reflective of actual practice
25	Pawel Skruch and Wojciech Mitkowski	**Year** 2010, **Country** Poland, **Objective/Problem**: The methodology for shape optimization is faced with a problem. This problem entails finding a particular shape (in three or two dimensions) that is optimal in a definite sense and satisfies various requirements. Therefore, the aim of this paper is to find a mathematical model that can allow emulation of the behavior of facilities and components. **Method**: The solution will obtain numerically, by use of iterative methods. In this research, finite element method was used. By use of a computer program (MATLAB), the researcher started with an initial guess for a certain shape and then gradually evolved it, until it falls into an optimum shape. **Findings/Conclusion** The researcher aimed at finding the bounded set D that minimizes the functional J(D) and fulfills the constraints $B(D) = 0$. The study found out that the problem is not trivial at all times and the general proof of this can be very difficult. However, by use of an operational Pontryagin's method of optimization, a numerical algorithm was designed and implemented. In addition, the results of the simulation showed that proposed method was very effective. **Limitations/Shortcoming/Deficiency** The overall solution and proof to this problem are often not possible

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ID	Author name	Data extracted
26	Jeffery K. Cochran and James R. Broyles	**Year** 2010, **Country** USA, **Objective/Problem**: Administrators the hospital managers know that ED overcrowding is a challenge to the hospitals. The lead times to alter the ED capacity are considerably long and therefore; they require strategic tools. **Method**: The researcher used a binomial retort nonlinear weighted regression model in the study that best fits the p_k to predict the ED patients that leave without being treated to the long term ED performances by use of the Gauss-Newton linearization. **Findings/Conclusion** The study measuring the ED capacity was based on the safety of patients rather than the congestion measures. **Limitations/Shortcoming/Deficiency** The results of the study included an asymptotic Wald confidence interval on the prediction variable, specific Deviance and Pearson goodness of fit, and a residual analysis which facilitates the identification of the data points that are outlying. None of the structures exists for the balking or reneging models that were presented previously in the literature
27	Karen Hickman Rutherford	**Year** 2010, **Country** USA, **Objective/Problem**: The law requires all the ED doors to be open at all times, which creates a growing public demand for the ED services. As a result, a contributing factor for the challenge of overcrowding and increased waiting time in the ED is created. **Method**: The researcher used a qualitative causal-comparative method of research with a correlational and non-experimental design. The data collected was measurements in the form of numbers. **Findings/Conclusion** The dependent variable that was used in this study is the ED waiting time in the Dallas-Fort Worth Metroplex hospitals. In the study, the independent variable is the non-existence or existence of a fast track. The research revealed that the waiting time in both acuity level 5 and level 3 were similar since the Levin's Test for Equality of Variance was insignificant hence indicating that there was no significant difference in the wait times for both facilities. However, for the acuity level 4, the Levin's Test for Equality of Variance was significant indicating that the waiting times for the different facilities collectively for the patients of level 4 in facilities with wand without were unequal. Nevertheless, the analysis of data for the three levels showed that the three models were not significant. **Limitations/Shortcoming/Deficiency** The study was limited with respect to the volume of patients from the community events that produce increased patient flows like community disaster or festivals
28	E.D. Gunes and H. Yaman	**Year** 2010, **Country** Turkey, **Objective/Problem**: The study aims at presenting an integer programming formulation for the hospital re-planning problem which comes up when hospital network mergers. **Method**: The integer programming formulation model was used by the researchers. **Findings/Conclusion** The model takes into account various factors during the study. They are; enough demand assigned to a hospital service so that service providers offer quality service, availability of all required resources is ensured, and finally the probability to examine whether a health facility is to be closed. The model in study can be used as an assessment tool to determine the possibility of changing the initial network and merging with another network, which will improve the capacity of the hospital. **Limitations/Shortcoming/Deficiency** Assumptions were made since the data was inaccurate and varying

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ID	Author name	Data extracted
29	Badran Al-Omar and Saad Al-Ghanim	**Year** 2010, **Country** Saudi Arabia, **Objective/Problem**: The paper attempts to demonstrate the inappropriate use of resources in hospitals in the Ministry of Health, private and military health sectors in Saudi Arabia. **Method**: Health staff were assessed and it could be debated that if patients' assessments had been used, then it would have resulted in a different rate of inappropriate use of hospital resources. **Findings/Conclusion** The study measured the assessments of health care providers. Despite hospital ownership or type, a significant percentage of participants regarded hospital resources as being inappropriately used. **Limitations/Shortcoming/Deficiency** The study relied mainly on the assessments of health staff. The representation may have been different if, for example, patient assessments were used
30	E. Drazen	**Year** 2011, **Country** USA, **Objective/Problem**: Margins are thin for hospitals in the US and bed capacity is at a premium. The paper suggests that improvement of service capacity is more feasible than increasing physical capacity to respond to rising patient volumes. **Method**: The article compares technologies for improving patient flow such as real-time location systems (RTLS) and event-driven data. **Findings/Conclusion** RTLS enables the tracking of patients, assets and staff. They record patient characteristics (e.g. selected diagnoses, fall risk), times, locations, and status. Event-driven data is integrated with other systems like EMR and ADT. **Limitations/Shortcoming/Deficiency** Patient flow technology cannot be implemented properly without the review of hospital processes. Patient tracking systems are therefore complementary. They are not mutually exclusive
31	A.S. O'Malley	**Year** 2012, **Country** USA, **Objective/Problem**: An important goal of the Affordable Care Act was to provide people with an improved access to primary care. Maintain an access to primary care outside of business hours is one of the most important factors which were supposed to enable the success of this plan. The study carried out by O'Malley (2012) investigates the access to primary care outside of regular business hours. **Method**: A statistical analysis of the data from the 2010 Health Tracking Household Survey was conducted with the method of regression modelling. **Findings/Conclusion** Emergency department use, the number of overnight hospitalizations Among patients who tried contacting their primary care providers after business hours, those who had an easier access fo medical services had lower emergency department use rates and a smaller number of unmet medical needs. **Limitations/Shortcoming/Deficiency** The cross-sectional time horizon prevents authors from determining the sequence of events. In addition, the data was self-reported by patients

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ID	Author name	Data extracted
32	D.Y. Shin et al.	**Year** 2012, **Country** USA, **Objective/Problem**: A relationship between payer mix and health information technology has been researched in detail. However, the impact of payer mix on electronic health record systems has not received a lot of attention in the scientific world. **Method**: Logistic regression, chi-square, multinomial regression. **Findings/Conclusion** EHR adoption in hospitals A relationship between payer mix and EHR adoption exists, although it is slight. Medicare and Medicaid volumes are not associated with the adoption of EHR at all. Indirect incentives also don't influence EHR adoption **Limitations/Shortcoming/Deficiency** The limitations of this research are connected with the small size of its sample and a cross-sectional time horizon
33	R.B. Salmon et al.	**Year** 2012, **Country** USA, **Objective/Problem**: Cigna's Collaborative Accountable Care Initiative is aimed at improving the efficiency and quality of care in commercial open-access benefit plans. The study seeks to find early results of the initiative. In order to achieve this goal, the authors review the implementation of the three provider practices in Texas, New Hampshire and Arizona. **Method**: Meta-analysis of the existing data was enriched by a calculation of adjusted medical costs on the basis of available data. **Findings/Conclusion** Quality of care, overall medical costs Early results provide a compelling reason to believe that the Cigna's Collaborative Accountable Care Initiative may improve the quality of care and decrease medical costs. **Limitations/Shortcoming/Deficiency** The inferences of this study are not statistically significant since they are rather early results
34	C.N. Rosenberg et al.	**Year** 2012, **Country** USA, **Objective/Problem**: One of the most promising instruments of ensuring an improved access to quality care for Americans is the patient-centred medical home. Simultaneously, there is no agreement among specialists at the moment concerning the exact way in which this model can be designed. The current investigation reviews the early results of the pilot patient-centred medical home in accordance with the UPMC health plan. **Method**: A difference of differences approach, a logistic regression, content analysis, observations. **Findings/Conclusion** Hospital readmission rates, clinical quality measures, medical and pharmacy costs, return on investments Sites which took part in the UPMC pilot study reported lower pharmacy and medical costs, lower hospital readmissions and reduced use of emergency departments. **Limitations/Shortcoming/Deficiency** The risk of multiple biases is significant. The study didn't contain any data on patient satisfaction or patient experience

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ID	Author name	Data extracted
35	M. Takach	**Year** 2012, **Country** USA, **Objective/Problem**: Experts consider patient-centered medical homes as one of the most promising instruments of enhancing the cost-effectiveness and the quality of the U.S. health care system. Medicaid plays a substantial role in this process. The current scientific article is focused on exploring recent reforms in the field of Medicaid patient-centered medical homes. **Method**: Meta-analysis of the existing data. The empirical data was collected from the Commonwealth Fund project during the period between 2011 and 2012. **Findings/Conclusion** Medical costs, population health, patient experience Payment models related to Medicaid patient-centered medical home activities are not static. Early results of pilot studies from the five states indicate that innovative payment models are likely to have a positive impact on health outcomes and medical costs. **Limitations/Shortcoming/Deficiency** Results of the programs have not been published yet. Thus, early conclusions made by the authors are waiting for the justification by the empirical data
36	B.J. Chesluk et al.	**Year** 2012, **Country** USA, **Objective/Problem**: The importance of teamwork for health professionals is emphasized by many specialists. Unfortunately, most of existing systems in which they work don't encourage teamwork. The authors propose a solution of this problem which is the Teamwork Effectiveness Assessment Module that can be used for evaluating the teamwork of physicians at health organizations. **Method**: Exploratory cognitive interviews and a meta-analysis of the existing data. **Findings/Conclusion** Teamwork competencies of individual physicians, quality of teamwork, quality of care the model presented in this paper provides an effective and efficient instrument of improving the quality of physicians' teamwork in hospitals and health organizations. **Limitations/Shortcoming/Deficiency** The framework described in this article hasn't been fully tested yet
37	C.W. Baugh et al.	**Year** 2012, **Country** USA, **Objective/Problem**: The ways of improving the efficiency of hospital care is a popular research problem among scholars. The authors suggest that observation units in hospitals are one of the most effective instruments of achieving this goal. The article justifies the usage of hospitals' observation units and calculates the costs which might have been saved with this mechanism. **Method**: Content analysis, simulation model and a national survey. **Findings/Conclusion** Cost savings per patient, annual cost savings and national cost savings Hospital observation units are very promising in regards to reducing costs. If they had been used in all the U.S. hospitals, it would have generated $1572 of cost savings per patient, $4.6 million of annual cost savings and $3.1 billion of national cost savings. **Limitations/Shortcoming/Deficiency** The study didn't make a distinction between various types of observation units and didn't consider the specifics of various costing methods employed for calculating savings

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ID	Author name	Data extracted
38	A.E. Essain et al.	**Year** 2012, **Country** UK, **Objective/Problem**: The quality of health care is a disturbing issue among UK scholars. This article presents a systematic view on the problem of health care quality's improvement at individual, group and organizational levels. **Method**: The methodology of this article is mixed as it includes observations, questionnaires and reflective accounts. Eleven multi-disciplinary groups were included in the empirical part of this study in order to investigate the nature of individual and group responses. **Findings/Conclusion** Changes in health care quality Solution versus problem identification leads to certain confusion and affects the eventual results. A successful achievement of quality improvement is only possible under the condition of sufficiency time for problem solving. **Limitations/Shortcoming/Deficiency** The research methodology of this study is mixed which is supposed to ensure results validity. At the same time, it should be noted that 11 groups collected from English trust funds constitute a small sample and might be characterized by unique characteristics that are not inherent for other health care employees
39	Weissman et al.	**Year** 2012, **Country** USA, **Objective/Problem**: The aspect of payment in the U.S. health care system is a critical component of upcoming reforms. It is crucial to understand how various forms of physician payment may influence financial risks for providers and payers. Among different approaches toward this problem, saved savings programs are one of the most discussable. The study conducted by Weismann et al. (2012) explores this phenomenon and focuses on the Massachusetts Patient-Centered Medical Home Initiative as a bright example of a successful saved savings program. **Method**: On the basis of the list of payer and provider organizations available online, the authors conducted 32 interviews. **Findings/Conclusion** Cutoff levels for outliers, providers' costs, payers' costs, The concept of shared savings programs is an unalienable part of the modern medical reform. However, in order to succeed, this instrument should be used thoroughly and carefully. The formula proposed in this article might be a valid option. However, payers and providers must agree on the matter of savings that would be recognized as "real". Financial incentives should be mainly targeted to a coherent organizational unit of a provider which manages a separate population. **Limitations/Shortcoming/Deficiency** The research exclusively focuses on the aspect of financial incentives and doesn't consider other factors which influence the implementation of medical reforms such as organizational structures and culture

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ID	Author name	Data extracted
40	A. Mehrotra and J.R. Lave	**Year** 2012, **Country** USA, **Objective/Problem**: The phenomenon of retail clinics plays an important role in the U.S. health care system. Its importance is gradually increasing which is recognized by many analysts. In this situation, the topicality of investigating their effectiveness and popularity seems to be obvious. The authors of this study explore visits to retail clinics during the period between 2007 and 2009. **Method**: Statistical analysis of the existing data collected from TakeCare, MinuteClinic and LittleClinic during the period between 2007 and 2009. **Findings/Conclusion** Number of visits, share of inpatient visits The number of visits to retail clinics is growing rapidly, although they their share of total outpatient visits is still slight. In general, retail clinics meet patients' needs. The main reasons of their popularity are the accessibility after business hours and convenience. **Limitations/Shortcoming/Deficiency** The study has three limitations. Firstly, the sample only contained 81% of retail clinic. Secondly, there is a high chance that the number of patients who had primary care physicians is actually significantly higher than reported due to the fat that some respondents don't want their physicians to know about their visits to a retail clinic. Thirdly, the focus of retail clinics was shifted to chronic diseases in 2010 after the study had been conducted. Thus, the results might be partially obsolete
41	Ellis et al.	**Year** 2012, **Country** USA, **Objective/Problem**: An opinion that fee-for-service reimbursement is not effective anymore in the U.S. health system is shared by most modem scholars. However, the issue of controlling costs under new reforms still hasn't been researched in detail. It is especially relevant to costs for care financed by private insurance. The current investigation addresses this research gap. **Method**: The study uses a statistical analysis of the data collected from the Premium Designation program on performance assessment. **Findings/Conclusion** Physicians' performance on care quality, costs for episodes of care The study didn't find a significant correlation between episode costs and measured quality across markets. New payment incentives might be useful in ensuring better performance. However, providers are not equally ready for such reform and, thus, some of them would need support on the first stage of reform's implementation. **Limitations/Shortcoming/Deficiency** The research is likely to underestimate the importance of pricing differences in the episode costs' variation. The second limitation of this investigation is that it only included in the sample those doctors who received a quality designation. In other words, a potential correlation between the variation in costs and the quality of physicians' performance that provides higher-quality care

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ID	Author name	Data extracted
42	Jiang et al.	**Year** 2012, **Country** China, **Objective/Problem**: Delivering the clinical information of the patients in a facility to the physician's point of care is vital to increase the healthcare services' quality especially in the ED of hospitals. However, because the clinic data and medical records are distributed among various hospitals, it becomes difficult to ubiquitously collect all the patient's clinical data in case of an emergency. **Method**: A resource model was first proposed with the aim of identifying and getting clinical data that is stored in the heterogeneous hospital information systems. At that time, a ubiquitous clinical data assessing method was proposed built on the resource mode. The related clinical data of a particular patient was collected together with the aim of coming up with the combinational resource, that can be accessed by any physicians who is authorized. **Findings/Conclusion** The clinical data of the patients is defined as a data resource labeled with a unique URL address. According to the study, as compared to the traditional middleware technology or the industry data standard, resource model is extra flexible for accessing the heterogeneous data. From the research study, it is very evident that with the resource model, patients' clinical data can be accessed by physicians more conveniently. **Limitations/Shortcoming/Deficiency** The limitation of this research is that resource model described by the research study did not focus on the authorization mechanism for clinical data confidentiality which is very important in the healthcare sector
43	Abdulkader Ali Murad	**Year** 2012, **Country** Saudi Arabia, **Objective/Problem**: The purpose of this study was to discuss a GIS application created for health care planning. Its main intention was defining the accessibility to health care facilities, the identification, and classification of the distribution of health demand in Jeddah city and finally modelling a spatial variation of patient locations. **Method**: The researcher used secondary data collection methods using the geo-database. In addition, he used raster surface models using the Kriging function in which the raster surfaces provided a prediction of health demands in the area of study. **Findings/Conclusion** The researcher used cover points, lines and polygon features such as health care facility location, road networks, and population districts. The output obtained from this application would be used by health care planners in making a decision and evaluating the existing health care facilities as well as the density of these facilities in a given area. This information from the application can also be used in determining where to build up another health care facility. **Limitations/Shortcoming/Deficiency** The Kriging model used in this study is based on assumptions objects that spatially distributions are spatially correlated and therefore cannot be proofed

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ID	Author name	Data extracted
44	Griffith et al.	**Year** 2012, **Country** USA, **Objective/Problem**: The main aim of the study was to improve ways of data recording in health facilities where in many instances data was lacking due to unimproved technology. The major issue was to in a tool that aided in data collection, storage, analysis and near real-time availability of emergency department. **Method**: Data collection was collected both on paper and electronically. The facilities that had no electronic documentation recorded their data on paper and the data eventually fed in the Meditech. Nurses, as well as service providers for instance physicians and registration staff, also contributed in data collection process. **Findings/Conclusion** Measures of the study where in terms of a span of time and the rate of attendance and service between patients and service provider as technology advanced. The ED Dashboard and Reporting Application contributed greatly in by decreasing the 'arrival to greet' time from an average of 51 min in 2007 to 35 min in 2010. Between 2007 and 2010 the overall length of stay decreased by 10.5% while annual visit time increased by 13.6%. **Limitations/Shortcoming/Deficiency** Since the data collection process was self-reported, it was limited by missing, incorrect and not viable information
45	Deiorio et al.	**Year** 2012, **Country** USA, **Objective/Problem**: The aim of the study is to identify areas necessary for research regarding effectiveness of educational intervention for teaching emergency medicine in terms of skills, knowledge, and attitudes outside the clinical environment. **Method**: The method used for data collection was through open discussion, questions and at the end voting. The sessions were recorded electronically. **Findings/Conclusion** Six tables were attendees rotated with a moderator and an education expert in which each session took 15 min. The researchers came into conclusion that there were many teaching modalities that are employed in the current medical education for both the graduate and undergraduate levels. **Limitations/Shortcoming/Deficiency** During the study, questions arose and were not taken into consideration. As researchers, attention must be given to the questions and focus on the outcomes to achieve the highest Kirkpatrick level possible in future educational researches
46	Khan et al.	**Year** 2012, Saudi Arabia, **Objective/Problem**: The study sought to analyze the perceptions and attitudes of medical nurses and doctors in the Emergency Department toward the function of clinical pharmacists. **Method**: A pilot study was carried out among the paramedical and medical staff of the ED of Al-Ahsa in Saudi Arabia using a 24-item questionnaire on the Pharm-D program, along with medical staff and clinical pharmacist attitudes towards the availability and likely function of clinical pharmacists in EDs. **Findings/Conclusion** The researcher uses a questionnaire to measure attitudes and perceptions of medical and paramedical staff. 81.3% of respondents viewed the availability of a full-time pharmacist positively while the view on the function of pharmacists in patient care and drug adherence was less favourable. **Limitations/Shortcoming/Deficiency** The study lacked adequate data to establish why medical staff members had different attitudes towards the possible role of pharmacists in direct patient care

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ID	Author name	Data extracted
47	Jeremy et al.	**Year** 2012, USA, **Objective/Problem**: The authors suggest that machine-learning can be useful in providing insights to the research of MI prediction and risk-factor identification. **Method**: The study involves the application of two statistical relational learning (SRL) algorithms to predict primary myocardial infarction. **Findings/Conclusion** The intention of the study is to measure the plausibility and importance of machine learning in identifying MI risk factors and predicting its likelihood. The authors observe that the two SRL algorithms forecast results more efficiently than their propositional analogs. Relational functional gradient boosting performs better than propositional learners, especially in the medically applicable high-recall region. **Limitations/Shortcoming/Deficiency** The experiment does not address the use of other relational information including hierarchies (such as drugs, laboratory values, diagnoses)
48	Morgan et al.	**Year** 2012, **Country** UK, **Objective/Problem**: The complexity of care required in the ED leads to long waiting times and there is increased pressure to reduce these times. **Method**: A search strategy was established to recognize published literature analyzing waiting times in the ED using mathematical modelling techniques. **Findings/Conclusion** The researchers developed individual search strategies for electronic databases. Databases searched include EMBASE, OVID MEDLINE, Inspec, EBSCOhost Business Source Complete and Engineering Village 2 Compendex. Staff operational hours or shift patterns, resource allocation, shortening of laboratory/ diagnostic processes, hospital layouts, and fast-tracking low acuity patients are considered strategies to improve the efficiency of ED. **Limitations/Shortcoming/Deficiency** The cross-disciplinary nature of systems analysis caused challenges when creating the literature search strategy. Searching tools in the business and engineering databases were not as detailed
49	Cabrera et al.	**Year** 2012, **Country** Spain, **Objective/Problem**: An Agent-Based modelling (ABM) simulation is presented to create a decision support system (DSS) for EDs. It seeks to help heads of EDs to set up management guidelines that improve the operation of EDs. **Method**: The study utilizes an exhaustive search optimization to identify the optimal ED staff configuration, including admission personnel, triage nurses, and doctors. **Findings/Conclusion** The length of patient stay in the ED is measured and an index suggested to minimize this period. The experienced and greater number of ED staff, the less mean patient length of stay is estimated. **Limitations/Shortcoming/Deficiency** The facility that was tested did not have a comprehensively detailed ED unit, and the budget could be more realistic

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ID	Author name	Data extracted
50	Alharthi, S.	**Year** 2012, **Country** Ireland, **Objective/Problem**: Industry today has become quite complex and necessitates the use of a certain set of tools to manage daily workings. This article discusses the use off Six Sigma and Lean techniques to improve a company's competitive advantage. **Method**: The study investigates measures such as the lean strategy which concentrates on minimizing cists through elimination of waste, Six Sigma which improves business process outputs that are invaluable to the customer. **Findings/Conclusion** Factors considered for measurement include business intelligence, competitive advantage (CA), and organization learning. **Limitations/Shortcoming/Deficiency** It is crucial to sustain CA within the function of customer relationship management and enable the use of business intelligence and ISP to create a hybrid solution for effective and efficient processes and for comparison of results with competitors
51	Esther Hing and Farida Bhuiya	**Year** 2012, **Country** USA, **Objective/Problem**: Number of visits to ED increased by 32% from 1999 to 2009. Some increases in ED visits led to ED overcrowding in some hospitals and longer wait times for minor and major issues. **Method**: The report involved the study of mean wait time in EDs in the United States between 1999 and 2009. **Findings/Conclusion** The report focused on the variations in wait times for treatment based in two ED crowding measures: boarding of admitted patients and ambulance diversions. **Limitations/Shortcoming/Deficiency** Longer wait times were reported in urban EDs compared to nonurban ones. Mean wait times were longer in EDs that boarded admitted patients in hallways or went on ambulance diversion
52	M.A. Ross et al.	**Year** 2013, **Country** USA, **Objective/Problem**: A lot of patients who contact emergency departments at hospitals are simultaneously not credible for a full inpatient admission and for an immediate discharge. Hospitals usually use four observation approaches towards such patients. This article seeks to determine their effectiveness. **Method**: The authors employ the research method of observation in order to compare effectiveness of the four well-known approaches towards observation services. **Findings/Conclusion** Length of stay, Probability of subsequent inpatient admission, cost saving per year. The type 1 observation services, which imply dedicated units with defined protocols, were found to be the most effective. They improve the main medical outcomes and ensure reduced costs. **Limitations/Shortcoming/Deficiency** A distinction between the four approaches under investigation is not clear in some aspects. Therefore, a conclusion regarding the extreme effectiveness of the type 1 observation services should be verified by further researches

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ID	Author name	Data extracted
53	P. Parmar, M. Arii and S. Kayden	**Year** 2013, **Country** USA, **Objective/Problem**: The U.S. health response system is barely effective as it is not able to adequately respond to unexpected disasters, such as the Hurricane Katrina in 2005. The authors analyze the experience of the Japanese health response system which has been evolved after the disturbing 2011 accident and try to justify the applicability of this experience in the U.S. **Method**: The study contains a literature review of the articles which analyze the Japanese experience in regards to the problem under investigation. A content analysis is the only research method used in this investigation. **Findings/Conclusion** The coverage of areas which need improvement from the perspective of the U.S. health response system, emergency supplies, disaster drills. The positive experience of Japan may be useful for the U.S. health response system. It can benefit from introducing more shelters with a sufficiency provision of water, food, privacy and sanitation as well as from extending care of large populations of patients who are chronically ill. **Limitations/Shortcoming/Deficiency** A substantial difference between the Japanese and American cultures complicates an implementation of the Japanese mechanisms of improving a health care response system in the United States. Thus, more empirical investigations should be conducted in order to justify the usage of Japanese experience in the U.S. health care
54	U. Hwang et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The factor of population's aging in the U.S. creates a set of complications for the health system. In particular, it causes significant problems for emergency departments which are supposed to adapt to the needs of the aging population in a fast and flexible way. **Method**: The study doesn't entail designing any empirical studies. It employs the method of content-analysis for reviewing the existing literature and justifying the importance of EDs' transformation. **Findings/Conclusion** Patient health outcomes, patient satisfaction, care costs. A variety of mechanisms may be implemented in order to eliminate the needs in emergency department visits, initial hospitalization and rehospitalization among older adults. Emergency departments should become patients' partners in care coordination. **Limitations/Shortcoming/Deficiency** Like any other study based on a meta-analysis of the existing data, this research bears a risk of transforming databases' errors and other scholars' biases in the eventual conclusions

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ID	Author name	Data extracted
55	R. Martinez and B. Carr	**Year** 2013, **Country** USA, **Objective/Problem**: Most of databases and scientific articles dedicated to the problems connected with the new health care reform didn't pay a lot of attention to the fact of emergency care. At the same time, the critical importance of this component of the care delivery system is obvious. The current investigation is devoted to the problem of creating new networks which could help in improving emergency care. **Method**: Like the previous article, this research is based on a content-analysis of the existing papers dedicated to the problem under investigation. **Findings/Conclusion** The current stage of the emergency care's development in the following fields: people, quality and processes, technology, finance, jurisdictional politics. In all the five aspects under investigation, integrated networks of emergency care have a potential to significantly increase the level of patient satisfaction, improve the quality of services, accelerate them and lead to an increased satisfaction of all the stakeholders. **Limitations/Shortcoming/Deficiency** The study lacks empirical data since an analysis of the existing researches might omit a lot of errors and limitations from other authors. In the future, a longitudinal study will be required in order to verify these research findings
56	S.L. Berstein and G. D'Onofrio	**Year** 2013, **Country** USA, **Objective/Problem**: As stated in numerous reports, emergency departments in the U.S. experience problems since the number of their patients is dramatically increasing. Among many other negative consequences of this trend, there is a disturbing tendency concerning the patients with behavioural disorders and substance use. The current article aims to explain how SBIRT approach might improve the situation. **Method**: The authors conduct a met-analysis of the seven studies dedicated to the SBIRT approach. An analytical method is used for using this data in justifying the applicability of SBIRT in emergency departments. **Findings/Conclusion** The use of ED by patients with substance use and behavioral disorders. The importance of ED visits for patients with behavioral disorders and substance use is significant. At the same time, interventions and policies are urgently needed in this field. Evidence-based treatments and the SBIRT approach might lead to significant improvements in the EDs' quality of services for patients with the aforementioned diagnoses. **Limitations/Shortcoming/Deficiency** A limited amount of data along with the absence of empirical studies to support the conclusions made in this article threaten the research's validity. Therefore, this study cannot be considered a single answer to the question about the ways in which emergency departments can improve their services for patients with substance use and behavioral disorders. It is rather an additional material which should be accompanied by a further empirical study

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ID	Author name	Data extracted
57	J. Billings and M.C. Raven	**Year** 2013, **Country** USA, **Objective/Problem**: In accordance with the Urban legend, frequent emergency department users don't have any serious diseases except for mental illness or substance use, but contribute to the departments' overcrowding by making unnecessary visits. This article seeks to verify this conclusion on the example of the New York's emergency departments. **Method**: The study operates with a statistical analysis of the existing data on Medicaid fee-for-service claims for patients aged between 18 and 62 years old in the New York City. The exact sample of this analysis is 212,259 patients. For completing a statistical analysis, a regression and predictive modelling have been run. **Findings/Conclusion** Number of visits per patient, demographic characteristics of frequent ED users, the number of visits for substance use and mental illness The so-called "Urban legend" has been proved to be wrong by this study. Most of ED users who have a high number of visits don't have a history of consistent visiting over a substantial amount of time. They only have one or several periods with a high number of periods which were reasoned by the state of their health. **Limitations/Shortcoming/Deficiency** The research only analyzed claims and encounter records for the identification of frequent ED users while other popular factors were not included in the study. The authors also didn't consider the information about providers' performance as well as about payments. Finally, it should be also noted that exclusively Medicaid beneficiaries were an object of this investigation. Thus, there is no premise to extrapolate its results on other patients
58	A. Alpert et al.	**Year** 2013, **Country** USA, **Objective/Problem**: There is a strong belief among experts that a substantial part of Medicare beneficiaries who call 911 can be easily cared for in settings. This decision could have reduced the overcrowding of emergency departments. The article addresses this problem and tries to estimate the costs which can be saved. **Method**: A potential influence of allowing EMS to manage selected Medicare beneficiaries in alternative ways on the number of EMS transports is calculated on the basis of the data collected from the Medicare claims for a random 5% of beneficiaries. An analysis has been conducted in order to determine the exact amount of potential savings of Medicare due to the implementation of the proposed plan. **Findings/Conclusion** The number of EMS transports, the costs savings of Medicare. The proposed decision can save Medicare around $283–$560 million annually. The sum of societal savings might be even bigger if private third-party players follow the suit. **Limitations/Shortcoming/Deficiency** The algorithm used in this article has not been used for similar aims before. It might overestimate the number of Medicare beneficiaries who don't need to be necessarily treated in ED settings. Besides, a focus on the New York City prevents experts from applying this model to the entire nation. Finally, the study didn't consider a significant amount of 911 callers who have not been eventually transferred to hospitals

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ID	Author name	Data extracted
59	N. Lurie, G.S. Margolis and K.L. Rising	**Year** 2013, **Country** USA, **Objective/Problem**: The necessity of urgent reforms of the U.S. emergency care system has been admitted by numerous experts. The current study presents an attempt to explain how this system should evolve in order to simultaneously meet everyday acute care needs and be ready for disasters such as the Hurricane Katrina. **Method**: This paper contains a meta-analysis of the existing data on the U.S. emergency care system and recommendations regarding its transformation. **Findings/Conclusion** The effectiveness of the U.S. emergency care system The current state of the U.S. emergency care system is unacceptable. Its quality of service and readiness for disasters don't meet the requirements of the nation at the current stage of its development. A sole implementation of the Affordable Care Act will probably improve the situation, but it will not be enough. In order to ensure radical changes, it is recommended to examine financial incentives embedded in the system, improve cooperation with stakeholders and provide local communities with more control over the components of the emergency care system which is needed. **Limitations/Shortcoming/Deficiency** The limitations of this study are standard for theoretical researches. It analyzes the existing data and doesn't imply conducting any empirical researches. Therefore, this study can be only considered as a basis for further research with significant empirical evidence
60	Eastman et al.	**Year** 2013, **Country** USA, **Objective/Problem**: A regionalized trauma system harmonizes with the 2011 Affordable Care Act that ensures the continued availability of trauma services. The current study explored the regionalized trauma system under the explanatory approach and describes its components. **Method**: The authors employ a meta-analysis of the existing data in order to describe the regionalized trauma system, determine its effectiveness and give recommendations regarding its further development. **Findings/Conclusion** The effectiveness of the regionalized trauma system in the U.S. A coordinated, regionalized approach towards managing trauma systems in the country is mandatory. In order to meet this requirement, a close federal-state cooperation is necessary as well as a unified consistent base that would advocate for public funding. **Limitations/Shortcoming/Deficiency** An analysis of the current situation doesn't provide a premise to forecast the future of the U.S. regionalized trauma system because recent reforms in the health care haven't demonstrated evident results yet. Thus, the factor of uncertainty is significant

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ID	Author name	Data extracted
61	S. Rosenbaum	**Year** 2013, **Country** USA, **Objective/Problem**: The Emergency Medical Treatment and Active Labour Act still remains to be an object of discussions among specialists. The current article explores this act and views its long-term effects. **Method**: A content-analysis is the main research method used by the authors since this paper is focused on describing the features of EMTALA and exploring its influence on the U.S. health system. **Findings/Conclusion** The quality of medical services at emergency departments under EMTALA Despite a certain controversy, the Emergency Medical Treatment and Active Labour Act is an effective instrument of ensuring the provision of medical services to all the people who need them. However, it should be noted that a lot of terms of this act have been softened over time. **Limitations/Shortcoming/Deficiency** The paper is focused on general regulations in regards to EMTALA and doesn't analyze any empirical data on the problem. In this situation, an analysis might seem a little superficial since no quantitative or qualitative data support the research findings. Further research is needed to verify the study's conclusions
62	Veillard et al.	**Year** 2013, **Country** USA, **Objective/Problem**: Implementation of the International hospital performance measurement project aimed at improving internal quality implied a set of challenges for hospital staff. The current paper reviews the main barriers and enabling factors experienced by hospital staff in eight European countries during the project's implementation. **Method**: The methodology is qualitative and entails conducting semi-structured interviews with the coordinators of the project from seven European countries. The ground theory approach is used for analyzing the empirical data. **Findings/Conclusion** Hospital performance The project has made a positive impact on the hospital performance in hospitals under investigation. Such elements as content, process support, context and leadership play an especially significant role in the process's implementation. **Limitations/Shortcoming/Deficiency** The size of the sample is quite small. Besides, hospitals which participated in the project had different starting conditions which might be considered a limitation of the study
63	Kimberly et al.	**Year** 2013, **Country** USA, **Objective/Problem**: Utilization of preventable emergency departments characterized by the low efficiency. At the same time, there is an assumption that the concept of patient navigation intervention might radically change the situation. The current article is aimed at verifying this assumption on the example of the Memorial Hermann Health System in Houston. **Method**: The study analyzes the data collected in order to facilitate the improvement of the patient navigation program. The research also implies conducting pretest and posttest observations. **Findings/Conclusion** The number of PCRED patients who returned to ED, total visits, total costs, costs per person. Patient navigation intervention decreases the possibility of returning to ED among not frequent PCR-ED users. A reduced number of PCR-ED visits significantly reduces the costs in comparison with the costs of launching the patient navigation program. **Limitations/Shortcoming/Deficiency** Some demographic characteristics not considered by the authors might have created additional differences between the observation groups. Besides, the specifics of respondents imply a substantial percentage of insincere answers

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ID	Author name	Data extracted
64	T.W. Elwood	**Year** 2013, **Country** USA, **Objective/Problem**: The term "allied health" is applied to a wide range of people who work as health workforce. A set of scope-of-practice regulations the function in different states prevents allied health from applying for jobs in patient care. The study examines this issue in detail and explores the impact of these regulations on allied health. **Method**: Meta-analysis of the existing data. **Findings/Conclusion** Scope-of-practice restrictions for allied health Scope-of-practice regulations which prevent allied health from applying for jobs in patient care are neither effective nor efficient. The authors recommend cancelling them in order to lower the costs of patient care and ensure that professionals from allied health gain a possibility to practice patient care. **Limitations/Shortcoming/Deficiency** The study's results are not confirmed by any empirical evidence
65	Everett et al.	**Year** 2013, **Country** USA, **Objective/Problem**: There is an assumption that including nurse practitioners and physician assistants in care teams leads to better health outcomes for patients. The study aims to check this hypothesis by exploring the treatment's outcomes of Medicare patients with diabetes. **Method**: Analysis of the existing data collected from Medicare claims and electronic health record data. **Findings/Conclusion** Quality of care, health outcomes There is no universal pattern which would explain a connection between a decision of including nurse practitioners and physician assistants in care teams and patients' health outcomes. Thus, this decision should be made separately in each specific case after analyzing the unique features of each situation. **Limitations/Shortcoming/Deficiency** The sample is small as the number of observations is only 13
66	Dower et al.	**Year** 2013, **Country** USA, **Objective/Problem**: Scope-of-practice regulations are determined by many experts as unnecessary restrictions which complicate the implementation of the Affordable Care Act by creating additional barriers to care. The paper aims to justify this statement and propose the needed reforms. **Method**: Meta-analysis of the existing data. **Findings/Conclusion** A consistency between state scope-of-practice regulations and health workforce's transformation The current scope-of-practice regulations are not consistent are not effective. They should be more consistent with the professional competence of health professionals. **Limitations/Shortcoming/Deficiency** The study's results are not confirmed by any empirical evidence

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ID	Author name	Data extracted
67	Torchiana et al.	**Year** 2013, **Country** USA, **Objective/Problem**: A lot of hospitals hire physicians as salaried employees. However, there is a shortage of studies which evaluate the influence of incentive programs on their behavior. This research examines effectiveness of the quality incentive programs implemented at the Massachusetts General Physicians Organization. **Method**: Content analysis of the existing data on the Massachusetts General Physicians Organization's incentive program. **Findings/Conclusion** Usage of electronic systems, usage of radiology, hand hygiene compliance, usage of emergency departments The program turned out to be very effective in regards to increased efficiency of radiology usage, improved hand hygiene compliance and a reduced usage of emergency departments. Thus, even small payment incentives might generate positive changes in physicians' work outcomes. **Limitations/Shortcoming/Deficiency** The study only analyzed one program implemented in a single organization. Therefore, it is not justified to use the results of this research for making far-reaching conclusions on the issue of using quality incentive programs to motivate physicians at hospitals and physician organizations
68	J.B. Kirby and T. Kaneda	**Year** 2013, **Country** USA, **Objective/Problem**: The Affordable Act Care aims to eliminate disparities in health care. At the moment, the situation in this field requires radical measures since, in accordance with the available evidence, such disparities still exist in the U.S. health care. The study examines this issue. **Method**: Authors analyzed the mortality data from the National Center for Health Statistics and self-reported data from the Medical Expenditure Panel Survey. **Findings/Conclusion** The risk of needing health care and the risk of being uninsured during a certain period of time Hispanics and blacks are likely to be uninsured during a significant part of their lives and to be at high risk of needing health care while being uninsured. In the case of whites, these risks are much lower. As a result, it can be stated that substantial disparities really exists in the U.S. health care. **Limitations/Shortcoming/Deficiency** Two tables of data used in the study represent slightly different population groups
69	C.D. Newgard et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The implementation of regionalized trauma care in the U.S. is an important research problem. The authors of the current study seek to find the ways of increasing the efficiency of trauma care by calculating acute injury costs. **Method**: The authors identify this research as a multiregional, population-based, retrospective cohort investigation which uses the data collected by 95 emergency medical services and 122 hospitals. **Findings/Conclusion** Acute injury costs, per episode cost of care, potential savings. It is crucial to develop field triangle guidelines which would prevent EMS from transporting low-risk injured patients to major trauma centers. This decision might save around $136.7 million annually. **Limitations/Shortcoming/Deficiency** The study doesn't include an evaluation of patients' outcomes and doesn't entail conducting a cost-effectiveness analysis

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ID	Author name	Data extracted
70	M.L. Miranda et al.	**Year** 2013, **Country** USA, **Objective/Problem**: Although electronic data systems are widely used in modern hospitals, there is still a disturbing problem of connecting patient records with data sets outside the health care delivery system. The current study describes the positive experience of the geographic health information system in Durham and explores its applicability throughout the country. **Method**: The authors constructed a data set for patient records in Durham County during a period between 2007 and 2009 by using various sets of data on patients' demographic, medical and laboratory characteristics. **Findings/Conclusion** "Triple Aim": population's health, care experience and health care costs per capita. A geographic health information system has a potential to contribute to the Triple Aim's achievement and to provide important information on area's population. **Limitations/Shortcoming/Deficiency** A successful implementation of GHIS requires a close cooperation between local health providers, knowledge on spatial statistics from users of some applications and an ability to prevent all participants from revealing protected information
71	DesRoches et al.	**Year** 2013, **Country** USA, **Objective/Problem**: Medicare provides around $30 billion of electronic health record incentives for hospitals. Unfortunately, there is no clear understanding of the way in which these funds are distributed across different hospitals in different years. This study addresses the issue in detail and makes forecasts regarding the types of hospitals which will be subject to financial penalties in the future. **Method**: Content analysis of the existing data and a statistical analysis of the three data sets. **Findings/Conclusion** The share of hospitals which received incentive payments in 2011 and 2012, the share of critical-access hospitals which received incentive payments. The percentage of hospitals which perceived incentive payments in 2012 is much bigger than the percentage of these hospitals in 2011. At the same time, publicly owned, critical-access, small and non-profit hospitals are at the risk of becoming a subject to financial penalties. Targeted grant programs are urgently needed to address this issue. **Limitations/Shortcoming/Deficiency** The data sets do not exclusively contain information about hospitals that received payments through Medicaid only. In addition, there is a potential inconsistency between the data sets since some of them use fiscal years instead of calendar years
72	Adler-Milstein et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The electronic exchange of health information is actively encouraged by policy makers. There are a lot of national programs aimed to support this effort. The paper explores these programs and tries to deduce their prospects. **Method**: A national survey of organizations that facilitate the exchange of health information. **Findings/Conclusion** The number of hospitals and ambulatory practices that participate in health information exchange programs, the number of programs which are characterized by sustainable business models. The number of hospitals and ambulatory practices that decide to participate in programs concerning electronic information exchange is slowly growing. However, most of them lack a sustainable business model which threatens their future. **Limitations/Shortcoming/Deficiency** The data used in the study is self-reported. Besides, the authors emphasize that they haven't considered all the programs related to the research problem as they are very hard to identify with the existing instruments

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ID	Author name	Data extracted
73	J.H. Wharam et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The number of workers with high-deductible health plans has been gradually growing. The study investigates whether the factor of significant costs might force these people to forgo emergency care. **Method**: Adjusted clinical groups algorithm, statistical analysis (chi-square tests and t-tests), Billings ED visits classification algorithm. **Findings/Conclusion** The number of emergency department visits among enrolees with high-deductible health plans during 2 years in Massachusetts High out-of-pocket obligations really lead to inappropriate reductions in care among enrolees with high-deductible health plans. Means-based deductibles and improved education might be effective measures which would address this issue. **Limitations/Shortcoming/Deficiency** The results can be only applicable to small organizations with less than 50 workers
74	Harrison et al.	**Year** 2013, **Country** Australia, **Objective/Problem**: A correlation between different characteristics of hospitals and patient outcomes is traditionally regarded an important research problem. The current article explores a potential impact of hospital occupancy on patients' discharge rates. **Method**: The authors fit a four-stage model to hospital admission and separation data. **Findings/Conclusion** Per-capita separation rate, the impact of hospital over-census actions An increase in hospitals' occupancy is associated with higher discharge rates among long-term patients. However, authors don't provide a clear explanation of this correlation. **Limitations/Shortcoming/Deficiency** A study is rather observational which results in authors' inability to explain a correlation between the two variables
75	P.K. Dilwali	**Year** 2013, **Country** USA, **Objective/Problem**: Hospitals' responsibility is gradually transforming. Modern hospitals are looking for a way to adjust their organizational structures and business models to post-acute care settings. The study argues that an alliance between hospitals and home care agencies is an effective solution of this problem. **Method**: Content analysis. **Findings/Conclusion** Patient outcomes, financial rewards, market position Modern hospitals need home care service lines because these lines can simultaneously act as a risk mitigation offering and as a profit center. An alliance between hospitals and home care agencies has a potential to lead to improved patient outcomes and to establish a profitable product line. **Limitations/Shortcoming/Deficiency** The study's results are not confirmed by any empirical evidence

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ID	Author name	Data extracted
76	M. Ewing	**Year** 2013, **Country** USA, **Objective/Problem**: Poor-quality outcomes accompanied by significant costs raise concerns regarding the effectiveness and efficiency of the U.S. health system. Patient-cantered medical home model is one of potential mechanisms of improving the situation. The authors explore this option in detail. **Method**: Content analysis. **Findings/Conclusion** Emergency department utilization, ED costs, per capita member costs, staff's satisfaction. PCMH models have a potential to improve service quality and reduce costs. Among all the models, NCQA (National Committee for Quality Assurance) has proven to be the most effective. **Limitations/Shortcoming/Deficiency** The study's results are not confirmed by any empirical evidence. In addition, it should be noted that only three PCMH models were analyzed in the study whilst there are much more of them in the U.S.
77	R. Kang and R. Hasnain-Wynia	**Year** 2013, **Country** USA, **Objective/Problem**: The spread of CSR practices makes specialists research the ways in which community orientation might increase the performance of firms. The current article conducts an investigation in line with this trend. The authors explore a correlation between hospitals' community orientation and patient experience. **Method**: Multivariate linear regressions. **Findings/Conclusion** Quality of care and patient experience A strong commitment to community implies a high patient experience of care. **Limitations/Shortcoming/Deficiency** There might be an inconsistency between the three data sets used in this study
78	D.J. Pallin et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The factor of population's aging is an important issue in the U.S. The authors seek to forecast an impact of this process on emergency departments. **Method**: Statistical analysis. **Findings/Conclusion** ED visits, ED average length of stay Population's aging is likely to increase the average length of stay at emergency departments by 10% without increasing the number of ED visits. **Limitations/Shortcoming/Deficiency** The research only considers those visits which are attributable to aging and only those hospitalizations which originate from emergency departments
79	S. Kangovi et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The fact that patients with low socioeconomic status prefer using acute hospital care more often than primary care is simultaneously harmful for them and costly to the U.S. health care system. This research is dedicated to a detailed investigation of this problem. **Method**: Qualitative methodology which implies conducting interviews with 40 patients. **Findings/Conclusion** Frequency of acute care episodes, frequency of primary care episodes The reason why SES patients prefer hospital care over primary care is because they think of it as more quality, more accessible and less expensive. At the same time, those patients who used hospital care more often reported social dysfunction and disability. **Limitations/Shortcoming/Deficiency** The demographic features of respondents are unique and, thus, can make study's results not generalizable beyond these demographic characteristics

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ID	Author name	Data extracted
80	S.L. Decker	**Year** 2013, **Country** USA, **Objective/Problem**: The Affordable Care Act increases payments for primary care physicians who provide services to Medicaid patients. There is an opinion among experts that this measure might lead to a wider acceptance of Medicaid patients among providers of primary care. The authors seek to check this hypothesis. **Method**: Meta-analysis of the existing data (NAMCS Electronic Records Supplement and 2012 NAMCS Survey). **Findings/Conclusion** Acceptance of new Medicaid patients An increase in Medicaid payments really are supposed to boost the acceptance rate of new Medicaid patients. However, there will be also other factors influencing this decision like the delays in payments, the factor of location and bureaucratic complications around Medicaid payments. **Limitations/Shortcoming/Deficiency** The study exclusively considered physicians' acceptance of new Medicaid patients as the measure of access to care whilst other factors can be also important. Besides, only acceptance of new patients among physicians was evaluated since the author didn't have an access to the data on patients' acceptance among other clinicians
81	D. Sherman and J. Zhu	**Year** 2013, **Country** USA, **Objective/Problem**: The problem of measuring productivity of service businesses is traditionally considered a complicated issue. The authors propose the method of balanced benchmarking in order to solve this problem. **Method**: Linear programming. **Findings/Conclusion** Daily inputs and daily outputs, The mechanism of balanced benchmarking can be used in service organizations in order to compare different service providers, identify the best practices and inefficiencies and allow managers to check their own hypotheses on the firm's productivity. **Limitations/Shortcoming/Deficiency** The method doesn't consider the unique features of each case. It claims to be universal; therefore, its implementation in the case of each industry and each firm should be accompanied by a thorough consideration of local specifics
82	Dill et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The upcoming physician shortages are supposed to increase the role of physician assistants and nurse practitioners. At the moment, there is no understanding regarding Americans' attitude towards this change. The current article addresses this research gap. **Method**: Online survey with the total sample of 5553 respondents. **Findings/Conclusion** A preference regarding a certain type of provider (physician, physician assistant and nurse practitioner) U.S. are open to the idea of widely using nurse practitioners and physician assistants in the future. **Limitations/Shortcoming/Deficiency** The sample was not entirely representative as some demographic characteristics were overrepresented or underrepresented. Respondents also may have had problems with differentiating between physician assistants and nurse practitioners

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ID	Author name	Data extracted
83	G. Melnick and K. Fonkych	**Year** 2013, **Country** USA, **Objective/Problem**: Uninsured patients who receive care at emergency departments get much higher charges for medical services than insured patients. This situation is disturbing because uninsured patients don't have enough money to afford health care services. The authors exemplify the "fair pricing" legislation in California as a potential solution of this problem. **Method**: The study implies an analysis of the existing data from the 2010 Annual American Community Survey and California Health Interview Survey. **Findings/Conclusion** Charges, Hospital prices at different income levels, uninsured visits by patient income Experience of the California Fair Pricing law can be considered positive. Around 4 million uninsured people in California are eligible for free care while almost 1.3 million are eligible for care at Medicare rates. Simultaneously, an implementation of this legislation is very simple and doesn't require any significant administrative burdens. **Limitations/Shortcoming/Deficiency** The specifics of California differ significantly from other U.S. states. As a result, the practical applicability of study's results is limited
84	C. Tanio and C. Chen	**Year** 2013, **Country** USA, **Objective/Problem**: Elderly patients with more than four chronic conditions are accountable for most of Medicare costs. The task of improving the efficiency of their treatment is a significant research problem. The authors propose the mechanism of chronic disease centers for seniors with multiple chronic diseases as an effective and efficient solution of this problem. **Method**: The study describes the existing model implemented at ChenMed and uses the method of content analysis in order to examine the facts related to the topic under discussion. **Findings/Conclusion** Cost of care, quality of care The centers such as ChenMed with multiple innovations including a small physician panel size, a collaborative physician culture and customized information technology really are a promising instrument of improving the quality and costs of care for seniors with multiple chronic conditions. **Limitations/Shortcoming/Deficiency** The study only describes an implementation of the proposed model at one organization. There is no available evidence to claim that this model can be easily applied at other health care organizations
85	S.P. Rosenberg and I.B. Hickie	**Year** 2013, **Country** Australia, **Objective/Problem**: Activity-based funding is an important concept which has been launched in Australian mental health care in 2013. However, there are concerns among specialists that valuable Commonwealth growth funds will rather support the system than ensure the development of new community-based care models. The authors address this concern by describing the main community-based care models and explaining the specifics of their emergence and development. **Method**: Meta-analysis of the existing data. **Findings/Conclusion** Confidence of mental health professionals in the mental health care system, quality of mental health care. The activity-based funding approach is ineffective at its current stage. It is likely to lose the confidence of all the stakeholders in the nearest future. **Limitations/Shortcoming/Deficiency** The study analyzes the program which has just been launched. Thus, detailed forecasts regarding its effectiveness lack the support of empirical evidence

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ID	Author name	Data extracted
86	S.M. Dennis et al.	**Year** 2013, **Country** Australia, **Objective/Problem**: The management of patients with chronic diseases is a complicated and expensive process. In this situation, it is of a critical importance to find a way to develop the mechanisms of this management which would be simultaneously effective and efficient. The current article explores one of such possibilities which is the provision of telephone-based coaching services. **Method**: Content analysis (a literature review of the existing studies on the problem under investigation). **Findings/Conclusion** Patient health behaviour, self-efficacy, health status All the three patient outcomes can be improved by telephone-based coaching services. This is especially relevant to patients who don't have access to health services or experience some problems with this access. **Limitations/Shortcoming/Deficiency** The study didn't research in detail the issue of barriers and enablers to effective telephone coaching
87	C. Eibner et al.	**Year** 2013, **Country** USA, **Objective/Problem**: Substantial spending on Medicare threaten the long-term fiscal balance of the U.S. budget. The study explores one of the possible options of reducing Medicare costs which implies making three changes: means-testing Part A, premium support credits and changing the age of eligibility. **Method**: The Future Elderly Model (a simulation model which was used to project spending). **Findings/Conclusion** Spending on Medicare, Medicare enrolment. **Limitations/Shortcoming/Deficiency** An implementation of the three policies reviewed in the article would lead to reduced spending and reduced enrolment. Thus, it is recommended to apply them in a combination with other changes. A projection might not have considered a set of factors which could have influenced Medicare in the future
88	Davis et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The problem of finding a way to improve the quality of Medicare and to reduce its costs is one of the most popular research problems in academic literature. This article presents the so-called Medicare Essential program which is supposed to improve the effectiveness and efficiency of Medicare services. **Method**: Medicare micromodel of the Actuarial Research Corporation was employed to calculate the savings provided by the proposed program. **Findings/Conclusion** Cost per beneficiary, health spending by payer, quality of care delivery. An implementation of the Medicare Essential program is supposed to lead to a provision of high-quality care at lower costs. Therefore, this program should be definitely a part of the discussion regarding the Medicare's future. **Limitations/Shortcoming/Deficiency** The model is purely theoretical. Thus, the issue of its practical applicability might be a subject of the debate

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ID	Author name	Data extracted
89	Chircu et al.	**Year** 2013, **Country** USA, **Objective/Problem**: Global reforms in the U.S. health care system makes specialists pay more attention to the problem of administration's effectiveness. The current study is focused on exploring the impact of clinical handoffs on the quality of clinical information and the quality of medication administration. **Method**: The business process management perspective and accounting control theory were used in line with the case study in order to examine a connection between the variables. **Findings/Conclusion** Clinical information quality and medication administration quality Handoffs can have both positive and negative effect on the number of medication errors in dependence on various factors. **Limitations/Shortcoming/Deficiency** The investigation only analyzes one case study in one hospital unit. A practical applicability of its results is barely significant without a further research. Besides, a correlation between variables is usually explored with the quantitative, not qualitative methods
90	Kozhimannil et al.	**Year** 2013, **Country** USA, **Objective/Problem**: due to the specifics of new medical reforms, a substantial difference appears between the costs on this operation in different hospitals, especially in the case of Medicaid. The authors review four promising directions to decrease the cost variation: tying Medicaid payment to the improvements of quality, using the instrument of public reporting to improve the mechanism of patient-cantered decision-making, considering more data and ensuring a better coordinating maternity care. However, the main purpose is to analyze the nature and main reasons of the variation between rates on cesarean delivery. **Method**: A validated methodology was used to determine obstetric deliveries from the 2009 Nationwide Inpatient Sample. **Findings/Conclusion** total cesarean rates and cesarean rates for low-risk deliveries The variation between rates on cesarean delivery is very significant. The study found a large range in obstetric care practice patterns across hospitals. **Limitations/Shortcoming/Deficiency** The final data didn't include information regarding the reasons of cesarean delivery and excluded hospitals which had less than 100 cesarean deliveries in 2009
91	A.S. Kelley et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The Medicare hospice benefit has become a subject of the debate among specialists. There is a common opinion that it only produces saving for those patients who enrolled in 53–105 days before death. The study examines this variable across different aging groups. **Method**: Statistical analysis based on the data from the Health and Retirement Study. **Findings/Conclusion** Total Medicare spending The Medicare hospice benefit reduces expenditures regardless of the patient length of stay. Therefore, this program should be expanded. **Limitations/Shortcoming/Deficiency** The data is retrospective and doesn't include the details on care goals and individual preferences. In addition, the variable of care quality also wasn't fully assessed

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ID	Author name	Data extracted
92	Kutney-Lee et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The number of registered nurses with baccalaureate degrees has been increased dramatically. The current study aims to explore a correlation between an increase in the number of these nurses and clinical outcomes, primarily the rates of post-surgery mortality. **Method**: The methodology of this research implies using a retrospective two-stage panel design with the usage of data from the three sources: the American Hospital Association Annual Survey, nurse survey data and the administrative patient discharge data. A statistical analysis was used on the second stage of this study. **Findings/Conclusion** Nurse education, nurse staffing measure, number of deaths for 1000 patients An increase in the number of registered nurses with baccalaureate degrees leads to a reduction in the number of deaths for 1000 patients. Therefore, hiring registered nurses with baccalaureate degrees is highly recommended. **Limitations/Shortcoming/Deficiency** The sample only included patients' surgical population in Pennsylvania which might be considered a significant limitation of the study
93	D. Roseman et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The development of patient-cantered care hasn't still received its full implementation in practice since the issue of its effectiveness still raises concerns among specialists. One of the core challenges of this model is patients' involvement in care. The current article explores the matter of patients' involvement in four communities that participated in the Robert Wood Johnson Foundation's Aligning Forces for Quality Initiative. **Method**: Meta-analysis of the existing data. **Findings/Conclusion** Diagnostic tests and referrals, unexpected complications and deaths, health benefits for patient advisers Implementation of the Aligning Forces for Quality Initiative leads to an improved patient-centered culture, practice improvements and significant health benefits for patient advisors. **Limitations/Shortcoming/Deficiency** Only four alliances were observed in this study which is evidently not enough for making far-reaching conclusions regarding the model's effectiveness
94	J.H. Hibbard and J. Greence	**Year** 2013, **Country** USA, **Objective/Problem**: The matter of patient engagement is one of the most popular strategies of health reforms. The study investigates the effects of patient engagement on health outcomes, care experiences and costs. **Method**: Meta-analysis of the existing data. **Findings/Conclusion** Health outcomes, care experiences, costs The factor of patient engagement has a positive impact on both health outcomes and care experiences. However, its influence on costs is not clear. **Limitations/Shortcoming/Deficiency** Most of the studies reviewed in the article were published in 2011 and earlier. A fast rate of reforms' implementation might have made some of their results obsolete

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ID	Author name	Data extracted
95	Koh et al.	**Year** 2013, **Country** USA, **Objective/Problem**: A lot of scholars have proved that patient engagement in decision-making, self-management and prevention activities improves health outcomes. However, due to the insufficient health education, most patients cannot take advantage of this possibility. The authors propose a "health literacy care model" which is supposed to address the aforementioned issue. **Method**: Meta-analysis of the existing data. **Findings/Conclusion** Quality of care and patient outcomes. The model designed by the authors is supposed to help patients in understanding their health conditions and recognizing the most effective directions of the treatment. For organizations, this model is expected to become an organizational value which will influence all the aspects of their operations. **Limitations/Shortcoming/Deficiency** The model hasn't been tested yet in any organization. Thus, its practical applicability remains to be vague
96	E. Han et al.	**Year** 2013, **Country** USA, **Objective/Problem**: Although an engagement of patients and families in quality improvement has proved its effectiveness, there is a concern among experts that this recommendation is not used in health care as much as it could be. The study explores various patient-cantered home practices in 22 states in order to explore the specifics of patient engagement in quality improvement. **Method**: The methodology is mixed. Firstly, a web-based survey of the 447 practices which got the recognition of NCQA in 2010 was carried out. Secondly, follow-up interviews were conducted with 24 practices that participated in the survey. **Findings/Conclusion** Number of methods of patient and family involvement The method of involving patients and families in care improvement is not widely used by modern patient-centered medical home practices. Only a third of them use at least one of such practices at the moment. **Limitations/Shortcoming/Deficiency** Only those practices which received NCQA recognition were included in the sample. They also participated in various different training and demonstrating programs which might have influenced their usage of patient engagement mechanisms
97	Corlette et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The development of value-based health insurance is a new process in the U.S. health care system which implies a set of potential innovations. Different states took different approaches towards this issue as finding a balance between the existing exchange shopping experience and innovative benefit design is a complicated decision. The authors review the ways in which these two approaches can be balanced or combined. **Method**: Meta-analysis of the existing data. **Findings/Conclusion** Out-of-pocket costs for health services, the relative value of health services. The new value-based health insurance is more effective than the traditional concept, but it is very hard to explain both to consumers and to employers. Accordingly, the authors recommend states creating favorable conditions for explaining the benefits of the new insurance model to stakeholders. **Limitations/Shortcoming/Deficiency** Study's conclusions regarding the necessity of state-backed programs aren't supported by the empirical evidence on such programs. The investigation provides a set of recommendations which should be confirmed or rejected by further research

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ID	Author name	Data extracted
98	Veroff et al.	**Year** 2013, **Country** USA, **Objective/Problem**: It has been deduced in various empirical studies that the model of shared decision making can lead to improved health outcomes. However, its effect on costs is contradiction. The current investigation is focused on this research problem. **Method**: The study summarizes the results from a large randomized trial that explored a set of factors including the influence of support for shared decision making on medical costs. **Findings/Conclusion** Potential need for shared decision-making, health coaching support levels, health care costs. Shared decision-making tends to reduce medical costs. Interestingly, this conclusion is also applied to remote models of coaching. Thus, interventions can be simultaneously effective and low-cost. **Limitations/Shortcoming/Deficiency** Firstly, the sample size is quite small. Secondly, the authors reported problems with separating the effects of health coaching from the effects of other factors. Thirdly, the sample wasn't initially designed to be nationally represented
99	S.C. Brailsford et al.	**Year** 2013, **Country** UK, **Objective/Problem**: A failure of OR modelling is one of the most popular research problems in OR literature. The article written by Brailsford et al. (2013) reviews the adoption of Scenario Generator as an example of a simulation modelling tool. **Method**: Interviews with 28 primary care trusts that were involved in the initiative. **Findings/Conclusion** Barriers and enablers to the usage of S:G software as well as to any simulation tools Staff's insufficient knowledge, lack of understanding of the software's objectives and goals along with the low-quality training programs were the main reasons why simulation tools have not been widely implemented. **Limitations/Shortcoming/Deficiency** The qualitative data received through the interviews is only applicable to S:G software. A further research is needed to justify its application to all simulation tools in general
100	Malyon et al.	**Year** 2013, **Country** Australia, **Objective/Problem**: The implementation of the activity-based funding is a challenge to the Australian health care system. This concept implies that refined diagnosis related groups will become the basis for reimbursing public hospitals for patient services. In this situation, the issue of admitted patient costs is an important aspect. The study aims to explore the differences in admitted patient costs for people from remote locations and indigenous dwellers. **Method**: Multivariate regression analysis was used for estimating the variation in average costs. **Findings/Conclusion** Patient costs Most of the additional cost of remote and indigenous patients can be explained by the differences between major diagnosis categories. At the same time, some costs were found for remote patients which cannot be explained by this difference. Hospitals which serve more than average proportions of such patients might be underfunded under the ABF system. **Limitations/Shortcoming/Deficiency** The study was focused on researching the population of the Northern Territory. Besides, the period between 2007 and 2009 might not be demonstrative since it occurred under unusual circumstances connected with the world financial crisis

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ID	Author name	Data extracted
101	Z. Song et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The phenomenon of mobile health clinics is becoming popular. In this situation, scholars start paying a lot of attention to the problem of their efficiency and clinical impact. This paper researches the effects of the Family Van in Massachusetts as an example of such clinic. **Method**: The authors used the method of descriptive analysis for comparing different groups of patients from the mobile clinic database. **Findings/Conclusion** Number of visits, diastolic and systolic blood pressure, health care savings. Mobile clinics such as the Family Van in Massachusetts have a potential to lead to significant cost savings and lowering blood pressure. **Limitations/Shortcoming/Deficiency** The longitudinal analysis didn't contain a comparison group. The second possible limitation is a potential bias in self-reported data
102	Ward et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The current method of acquiring ED data in New Mexico has been experiencing many changes in authority, mechanisms, design, and approach. As a result, the next method is being piloted by use of the New Mexico Health Information Collaborative (NMHIC) interchange as part of the newly invented E-porting project, which will collect a bigger array of information about all the ED visits in a timelier manner. **Method**: The emergency departments were authorized to submit the New Mexico Ed data by the Notifiable Conditions when requested by the NMDOH. The 2013, 2012, and 2011 data was requested by NMDOH by use of letters from all the non-federal emergency departments. The data excluded any data of New Mexicans who visited the emergency departments, the Veteran Affairs Hospital, and the Indian Health Services Facilities. **Findings/Conclusion** The report presented all the New Mexico ED admission numbers and the rates by sex, age, and location for the NM residents. Ethnicity and race were also requested. Out of the 774,896 ED visits reported in 2013, females were 54.3%, while 45.7% were males. 16% of all the ED visits were among the residents who were above 65 years, which was an increase from 13% in 2010. Metro region had the largest number of ED admissions of 37% which was an increase from 31% in 2010. Poisoning and injury marked the highest rate (7738/100,000 population), while the congenital anomalies marked the lowest rate (27.8/100,000 population) of diagnosis in 2013 as compared to all the first listed categories of diagnosis. **Limitations/Shortcoming/Deficiency** The non-Federal NM hospitals were not included in the data. as a result, the ED rates and visits in areas with numerous AIAN populations are smaller than they would have been if the IHS hospital ED data of visits was included

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ID	Author name	Data extracted
103	Morganti et al.	**Year** 2013, **Country** USA, **Objective/Problem**: The paper establishes a more complete view of the contribution of EDs to the modern healthcare system. **Method**: The researchers reviewed recently published literature about the use of EDs. This information was used to build a conceptual model that portrays the various decisions made by ED providers and patients. **Findings/Conclusion** Four datasets were analyzed: the National Hospital Discharge Survey, HCUP NIS, HCUP NEDS, and CTS Household survey and health tracking household surveys. The number of admissions between 2003 and 2009 increased because of a 17% rise in unscheduled admissions in the ED. Office-based physicians seems to depend on EDs to analyze complex patients rather than dealing with them themselves. **Limitations/Shortcoming/Deficiency** National datasets for most states do not allow researchers to differentiate between traditional Medicaid FFS or Medicaid managed care or private FFS from private managed care
104	M. Courtney et al.	**Year** 2014, **Country** UK, **Objective/Problem**: Preventing and healing severe sepsis is an important objective in modern health care. Managing it early is the most effective way of achieving desirable results in this field. In order to go with this option, it is mandatory to deliver an appropriate fluid challenge. The current study is focused on exploring whether junior doctors prescribe adequate or not adequate fluid challenges nowadays. **Method**: The authors have designed a questionnaire for junior doctors in the UK hospitals. Three scenarios were included in this questionnaire whilst each scenario presented a patient with a specific weight (50, 75 and 100 kg respectively). **Findings/Conclusion** The adequacy of prescribed fluid challenges Only 6.5% of the respondents have given correct answers and prescribed adequate fluid challenges. As a result, it can be concluded that junior doctors in the UK don't follow mandatory guidelines while prescribing fluid challenges to patients with severe sepsis, don't adjust their volume in accordance with the body's weight and usually prescribe too little. **Limitations/Shortcoming/Deficiency** The results can be only relevant to the UK hospitals. Considering that this study is the first one which focuses on the problem under investigation, its results should be verified by further research

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ID	Author name	Data extracted
105	Edwards et al.	**Year** 2014, **Country** USA, **Objective/Problem**: Patient-central medical homes play a crucial part in most of medical reforms in the U.S. at the current stage of the country's development. The current article explores the nature of initiatives connected with patient-central medical homes and describes their providers, patients and payment incentives. **Method**: The authors have conducted a survey in order to evaluate all the patient-cantered medical home initiatives in the United States which employed payment reform incentives. The survey was conducted via the face-to-face, online and telephone channels. A statistical analysis with a focus on descriptive statistics was used for analyzing the data. **Findings/Conclusion** Providers, patients and payment incentives of patient-central medical home initiatives The significance of patient-central medical home initiatives with payment incentives in the U.S. health care system is rapidly increasing nowadays. They are becoming larger, paying largest fees and engaged in more risks. In general, they successfully play the role of one of the main drivers of medical reforms in the U.S. **Limitations/Shortcoming/Deficiency** Firstly, an analysis is exclusively descriptive. Secondly, the authors relied on a single informant in the case of each initiative. Thirdly, some initiative could have not been included in the sample despite all the efforts
106	V.A. Lewis et al.	**Year** 2014, **Country** USA, **Objective/Problem**: A lot of adults in the United States have at least one behavioural health condition. It is believed that an effective cooperation between the providers of behavioural health care and the providers of primary care might be considered a powerful driver of significant improvements in the field of improving health outcomes of patients with behavioural health conditions. The current article investigates this issue. **Method**: The scholars have conducted a global survey within 257 accountable care organizations in 2013. In-depth interviews were further conducted with 16 of these organizations. **Findings/Conclusion** Access of behavioural health care, quality of behavioural health care, health care costs, health care outcomes for patients with behavioural conditions An integration of primary care with the behavioural health care really can lead to significant improvements in treating patients with behavioural health conditions. This process might result in both improved quality of health care and reduced costs. **Limitations/Shortcoming/Deficiency** The study used a cross-sectional time horizon and only considered the situation in 2013. It is also important to point out that all the indices associated with the integration of primary health care and behavioural health care might not be completely justified from the perspective of statistical validity

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ID	Author name	Data extracted
107	R. Busse and J. Stahl	**Year** 2014, **Country** Germany, **Objective/Problem**: Care of patients with chronic diseases is an important problem since it implies significant costs and is characterized by a limited efficiency. Thus, there is an obvious need in developing a new delivery network which could lead to the increased efficiency, patient satisfaction and reduced costs. The current article evaluates three such models in the Netherlands, England and Germany. **Method**: The main method used in this study is an observation. The authors have observed the implementation of models in Germany, England and the Netherlands. **Findings/Conclusion** Hospital admissions, patient satisfaction, providers' satisfaction, health care costs. The effectiveness and efficiency of the three models under investigation vary significantly. Nevertheless, a set of clinical outcomes and process indicators demonstrated a certain improvement in all the three models. However, in the case of the Dutch approach, reduced costs have not been ensured. The authors identify the Kinzigtal model as the most effective one and recommend its implementation in the United States. **Limitations/Shortcoming/Deficiency** A substantial variation between the characteristics of the three models complicates an analysis. It is possible that some additional factors were not considered. A bigger sample may solve this problem in further research
108	S. Stock et al.	**Year** 2014, **Country** USA, **Objective/Problem**: The Chronic Care Model has been created in the 1990s, but there are still a lot of discussions among specialists regarding its effectiveness. The authors are focused on determining the effect of CCP programs for the U.S. and German patients from the perspectives of treatment costs and the quality of care. **Method**: The study implied conducting a survey among patients under the Barmer and Geisinger ProvenCare Chronic Diabetes Program. **Findings/Conclusion** Quality of care, treatment costs and patient satisfaction. The Chronic Care Model demonstrates its extreme effectiveness in ensuring a higher quality of care, lower treatment costs and a higher level of patient satisfaction. Thus, its further analysis and implementation across the entire U.S. health care system seems to be a logical decision. **Limitations/Shortcoming/Deficiency** The study had a limited sample and only analyzed patients under the two CCM programs

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ID	Author name	Data extracted
109	Sabbatini et al.	**Year** 2014, **Country** USA, **Objective/Problem**: This article explores a popular research problem of emergency departments' effectiveness. As it is known, they are currently the main source of the U.S. hospitalizations with a wide variation of admission rates. The study analyzes the variation in hospital admission rates from emergency departments and their correlation with the inpatient mortality. **Method**: The research design implies using a national sample of ED visits for estimating a correlation between the variation in admission rates and national health expenditures. **Findings/Conclusion** Cost of health care, risk-standardized admission rates A variation in risk-standardized admission rates is very significant across various emergency departments. At the same time, some of the conditions are low-mortality and, therefore, might not be necessary. **Limitations/Shortcoming/Deficiency** The study didn't analyze in detail the issue of health care savings, although it deduced a set of recommendations in this field. The variety of data is another source of potential limitations of this research
110	F. Beaupert et al.	**Year** 2014, **Country** USA, **Objective/Problem**: The substantial amount of data on patients' complaints forces specialists to look for the ways in which this information can be collected and harnessed. The article reviews the most well-known approaches towards this problem. **Method**: The study is purely theoretical as it is a literature review collected with the help of a meta-analysis of the existing data. **Findings/Conclusion** Approaches towards regulating patients' complaints Self-regulation forms of dealing with patient complaints are being gradually replaced by the innovative forms of external oversight. Strategic and regulatory approaches towards this problem are known as the most popular among modern specialists. **Limitations/Shortcoming/Deficiency** The papers analyzed in this literature review operated with various research designs and samples. Therefore, some of the data collected in this study may not be comparable. The fact that no empirical studies were conducted to support the inferences made in this investigation is another possible limitation

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ID	Author name	Data extracted
111	W. Cabin et al.	**Year** 2014, **Country** USA, **Objective/Problem**: Most of the agencies in Medicare are represented now by for-profit home health agencies. In this situation, a lot of specialists seek to determine whether for-profit home health agencies are more effective than non-profit home health agencies. **Method**: This study is an analysis of the data from the National Medicare databases. The authors also assess a relationship between the three main cost variables of health care services and perform a subsidiary analysis of visits per patient and total cost per visit. **Findings/Conclusion** Visits per patient, total cost per visit, total cost per patient, benefit costs, administration salary. All the quality indices analyzed in this study illustrate that non-profit home health agencies are much more effective and efficient than for-profit home health agencies. Therefore, there is a compelling reason to claim that for-profit health agencies should be not be eligible for Medicare payments. **Limitations/Shortcoming/Deficiency** Without a doubt, there are some errors in many cost reports used in this study. A lot of agencies may have misreported some of their quality parameters. Finally, the usage of case-mix mechanisms in order to adjust cost figures is traditionally considered to be problematic
112	S-J. Wu et al.	**Year** 2014, **Country** USA, **Objective/Problem**: The prices on health care services vary significantly across different hospitals in the U.S. This factor motivates experts to think about the way which could help patients to select lower-price facilities if their quality of service is sufficient. This study aims to define the likelihood of patients' choice of lower-price facilities if they are aware of the alternatives under the insurer-initiated price transparency program. **Method**: A difference-in-difference regression has been conducted in order to assess the influence of insurer-initiated price transparency program on costs per unit. **Findings/Conclusion** Number of patients, number of MRI scans, average MRI scans per patient, average cost per MRI scan The unadjusted average cost of MRI scans has decreased in the intervention cohort. The authors have also found that U.S. patients are gradually shifting away facilities based in hospitals. As a result, hospital-based facilities reduced prices. **Limitations/Shortcoming/Deficiency** The study didn't contain a set of socioeconomic factors which may have influenced the problem under investigation. It is also worth mentioning that almost one-third of the respondents didn't have cost sharing for the imaging test

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ID	Author name	Data extracted
113	T.P. Walsh et al.	**Year** 2014, **Country** Australia, **Objective/Problem**: The Department of Podiatry has decided to provide a podiatrist who was supposed to assist in managing the outpatient waiting list. This decision was caused by the lack of orthopedic surgeons in the Southern Adelaide Local Health Network. **Method**: The study implied recruiting a sample discharged from the Department of Podiatry. With the help of the experiment designed on the basis of sample, the authors have gained an opportunity to evaluate patient satisfaction. **Findings/Conclusion** Patient satisfaction, discharge rate, the efficiency of care A podiatrist can effectively treat patients in the orthopedic outpatient waiting list. High level of patient satisfaction confirm this statement. **Limitations/Shortcoming/Deficiency** A small number of patients enrolled in the experiment might be considered a significant limitation of this study. From other perspectives, the current research doesn't have evident limitations except for the scope problem. The inferences made for the Southern Adelaide Local Health Network may not work with an equal effect in other networks
114	A. Bell et al.	**Year** 2014, **Country** Australia, **Objective/Problem**: In order to analyze and improve long-term clinical processes, a lot of specialists use the mechanisms of clinical redesign. The current article enriches the existing models with a new clinical redesign process. **Method**: With the help of team members, the authors evaluated a tripartite relationship between external consultants, system managers and the hospital team. **Findings/Conclusion** A set of thematic KIPs has been developed including an access block, morning discharge rates, the length of stay, etc. The proposed approach, the Queen Elizabeth II Jubilee Hospital (QEII) redesign project, has proved its effectiveness in improving all the thematic KPIs relevant to the team work. **Limitations/Shortcoming/Deficiency** Conclusions made on the Queen Elizabeth II Jubilee Hospital (QEII) redesign project can be barely applicable to the entire Australian health care system. Thus, they should be analyzed cautiously

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ID	Author name	Data extracted
115	Allen et al.	**Year** 2014, **Country** USA, **Objective/Problem**: The significance of the Affordable Care Act and its potential influence on Medicaid coverage was a topical research problem in 2014. The authors tried to forecast how Medicaid expansions would be able to cover new enrolees. **Method**: The authors have conducted a series of qualitative interviews with Oregonians who were members of the newly insured group. The sample consisted of 173 respondents. Atlas.ti software was employed for analyzing the data. **Findings/Conclusion** Access barriers, patient satisfaction, patients' self-perception, health care outcomes, At the moment when the article has been written, Medicaid worked ineffectively for patients who were newly enrolled in accordance with the Medicaid expansion. The spheres of information and communication are critical for any efforts aimed at improving the situation. **Limitations/Shortcoming/Deficiency** The most important limitation of this study is connected with the fact that it was focused on Oregon and, thus, cannot be automatically extrapolated to any other state. Besides, the scope and the nature of this problem require a further research with quantitative analyses
116	Stingley et al.	**Year** 2014, **Country** USA, **Objective/Problem**: There are plenty of challenges in the field of health care which rural residents face. In order to address this issue, a specific Rural Healthcare Program has been developed and implemented in 2009. This research analyzes the program's effects on the quality of health care services for rural patients and on various logistic aspects such as the reduction of patients' unnecessary transfers. **Method**: The study operates with the methods of content-analysis, observation and a survey. **Findings/Conclusion** access to care, time to transfer a patient to a medical facility, the usage of evidence-based treatment. The Helmsley Trust's Rural Healthcare Program is an effective mechanism of helping rural residents to get a more accessible health care in a more timely manner. **Limitations/Shortcoming/Deficiency** A small number of projects under the Program analyzed in this article might be considered a limitation since some of the program's effects might have been overlooked

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ID	Author name	Data extracted
117	Green et al.	**Year** 2014, **Country** Australia, **Objective/Problem**: The critical importance of emergency departments in the Australian health care system has been justified and explained by numerous specialists. In this situation, it is very important to understand whether the performance of emergency department varies across the different Australian states and regions. **Method**: The authors have employed a cross-sectional analysis of the Australian emergency departments during the period between 2009 and 2010. **Findings/Conclusion** A difference between the waiting time and the triage categories. The study has found that the indicator of waiting time doesn't differ significant across different Australian hospitals' emergency departments. **Limitations/Shortcoming/Deficiency** The study exclusively used a single source of data which might have automatically transferred in this research some of the database's errors
118	Huppertz et al.	**Year** 2014, **Country** USA, **Objective/Problem**: During the conduction of Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) surveys, some respondents tend to leave handwritten anecdotal comments. At the moment, there is no instrument to analyze them and include them in the data analysis. It looks wrong considering that the importance of comments in the Internet is significant. The current research investigates this problem in detail. **Method**: A content analysis of the comments in HCAHPS surveys hilts a regression analysis was performed in order to evaluate the influence of comments on patients' intention to recommended the specific hospital and their rating. **Findings/Conclusion** Comments (negative, mixed, neutral, positive), patient intention to recommend a hospital, hospital's rating determined by a patient. People who leave negative comments usually tend to give low rankings to hospitals as well as don't intend to recommend them to their friends and acquaintances. An analysis of the comments in surveys should be an important aspect of their surveys' analysis since it might enrich this analysis with some unique qualitative data. **Limitations/Shortcoming/Deficiency** Distinguishing between the comments' types is a complicated task. It is likely that scholars' bias has impacted their evaluation of the comments. Besides, although the effect of negative comments on other indices is obvious, it is unclear how mixed and neutral comments can help scholars in analyzing results of patient surveys

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ID	Author name	Data extracted
119	Ward et al.	**Year** 2014, **Country** USA, **Objective/Problem**: The current method of acquiring ED data in New Mexico has been experiencing many changes in authority, mechanisms, design, and approach. As a result, the next method is being piloted by use of the New Mexico Health Information Collaborative (NMHIC) interchange as part of the newly invented E-porting project, which will collect a bigger array of information about all the ED visits in a timelier manner. **Method**: The emergency departments were authorized to submit the New Mexico Ed data when requested by the NMDOH. The 2014, 2013, 2012, and 2011 data was requested annually by NMDOH by use of letters from all the non-federal emergency departments. The data excluded any data of New Mexicans who visited the emergency departments, the Veteran Affairs Hospital, and the Indian Health Services Facilities. **Findings/Conclusion** Out of the 810,154 ED visits reported in 2013, females were 54.6%, while 45.4% were males. 17% of all the ED visits were among the residents who were above 64 years, which was an increase from 13% in 2010. In 2013, it was an increase up to 1%. Metro region had the largest number of ED admissions of 37.5% which was an increase from 31% in 2010. Poisoning and injury marked the highest rate (830.1/100,000 population), while the congenital anomalies marked the lowest rate (3.3/100,000 population) of diagnosis in 2014 as compared to all the first listed categories of diagnosis. **Limitations/Shortcoming/Deficiency** The non-Federal NM hospitals were not included in the data. as a result, the ED rates and visits in areas with numerous AIAN populations are smaller than they would have been if the IHS hospital ED data of visits was included
120	Bukhari et al.	**Year** 2014, **Country** Saudi Arabia, **Objective/Problem**: Due to the daily challenge faced by the emergency department in Alnoor Hospital of the huge exposure to a number of patients, the researchers carried out research to measure the quality of provided services to patients in terms of measuring the total length of stay time in ED and its influencing factors **Method**: Researchers used questionnaires to conduct the study. **Findings/Conclusion** The emergency team filled questionnaires which consisted data of all patients in terms of, the time of arrival to emergency department, initial time of assessment by nurse, initial time of assessment by doctor, consultation time, time of arrival to specific area, time of arrival to consulted specialty, time of laboratory investigation, time of radiological investigation, time of final disposition and time of physical disposition. The research showed that prolonged LOS was associated with prolonged laboratory and consultation time, patient admission to observation or trauma areas, critical care management patients, and extended ultimate result from time to time of physical response to the ultimate result. **Limitations/Shortcoming/Deficiency** Data was obtained manually from handwritten study forms and study period was limited to a span of one month, precluding analysis of seasonal variations. Furthermore, a commendable percentage of charts were omitted due to incomplete documentation of LOS time

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ID	Author name	Data extracted
121	Lloyd et al.	**Year** 2014, **Country** UK, **Objective/Problem**: The system-level investigations of the emergency department operations are becoming outdated due to the emergence of new technology. Therefore, new methods should be used to advance the system. **Method**: The research study used the DES modelling suite to advance a model of the emergency department activity for a period of five days in July 2013. **Findings/Conclusion** The inputs of the model included. **Findings/Conclusion** facility characteristics, staffing levels, and the data of patients which was drawn from the electronic patient billing records, tracking databases, and detailed reviews of the 674 ED charts. The research found out that the EDSIM model forecasts the average service times for patients within 10% of the actual values. However, the accuracy of the paths followed by individual patients was variable. From the model, 28% of the treatment times of individual patients revealed an absolute error that did not exceed one hour, and 59% did not exceed three hours. **Limitations/Shortcoming/Deficiency** The model that was used in the study was not able to predict the individual patient times which is very important
122	Norazura et al.	**Year** 2014, **Country** Malaysia, **Objective/Problem**: The paper confers the combination of system dynamics (SD) and discrete-event simulation (DES) to get a better depiction of the actual system than using the modelling architypes alone. **Method**: Interviews were carried out with staff to identify vital components in the ED required in the model. Manual data gathering was conducted to collect information such as X-ray turnaround times and doctor-patient contact time. **Findings/Conclusion** Items measured include X-ray turnaround times and triage times, doctor-patient contact time, delay time for lab results and doctor-patient contact, inter-arrival time and time spent at registration counter. Medial assistants score the highest utilization (73%). Findings support the claim of the administration that medical assistants are the busiest resources. **Limitations/Shortcoming/Deficiency**: Interviews were carried out with staff only

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ID	Author name	Data extracted
123	Julie Gilchrist, Erin M. Parker	**Year** 2014, **Country** USA, **Objective/Problem**: Overall drowning rate for American Indians/ Alaska Natives (AI/ AN) was twice that of whites while the figure for blacks was 1,4 times that of whites, and the biggest disparities were identified in swimming pools. **Method**: Information was obtained from death certificate data for people aged 29 years and below, from the National Vital Statistics System. **Findings/Conclusion** The study sought to identify the demographic traits and ages of people who died from unintentional drowning. AI/ AN aged 29 years and below had the greatest drowning rates, while blacks had the second highest rates. The discrepancies in drowning rates were highest for deaths occurring in swimming pools. **Limitations/Shortcoming/Deficiency** A major limitation is the lack of exposure data in epidemiologic studies of drowning such as this
124	Weiss et al.	**Year** 2014, **Country** USA, **Objective/Problem**: EDs offer a vital source of medical care in the United States. The increase in utilization of EDs, over the past decade, has outperformed growth of the general population, in spite of a national waning of ED facilities. **Method**: Data is sourced from the Healthcare Cost and Utilization Project (HCUP) Nationwide Emergency Department Sample (NEDS). Significance level was lowered to 0.0005 for individual tests to lower the number of false-positive results. **Findings/Conclusion** Data collected regarded types of ED visits such as those with admission to the same hospital and those leading to discharge. Most patients under 18 years were admitted for asthma, pneumonia, and acute bronchitis. **Limitations/Shortcoming/Deficiency** Those aged between 45 and 84 were admitted for septicemia. ED visits leading to discharge were higher in rural areas

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ID	Author name	Data extracted
125	Carmen et al.	**Year** 2014, **Country** Belgium, **Objective/Problem**: This ED in Belgium is struggling with overcrowding, particularly in the late afternoon. This is made worse by the lack of ability of the ED to move patients that need to be admitted due to lack of inpatient beds. **Method**: The model developed in the article is reflective of patient boarding time using time-dependent boarding probabilities and boarding times. This article also applies a simulation model to study the ED operations. **Findings/Conclusion** The main types of data sought by the model. **Findings/Conclusion** are processing and routing data, admissions and boarding data, and arrival data. The general dynamic behaviour in the ED is activated by typical protocols and patterns and can be modelled acceptably through simulation. **Limitations/Shortcoming/Deficiency** There was a limited amount of data available
126	Davenport et al.	**Year** 2014, **Country** USA, **Objective/Problem**: The paper analyzed the perceptions of patients regarding ED waiting times and inpatient experiences. In majority of hospitals today, the ED is considered as the hospital's front door. **Method**: Data was collected from one community hospital in southeast Louisiana. It was drawn from electronic medical records of patients who reported to the ED and were admitted. Survey responses were used to determine patients' perception. **Findings/Conclusion** Data collected related to patient perceptions of care and wait time, as well as actual wait time. Important relationships exist between a favourable ED experience and a favourable inpatient experience. Perceived wait times in the ED served as a better predictor of positive ED rating than actual wait times. **Limitations/Shortcoming/Deficiency** Study was limited to one community hospital making it difficult to generalize findings to larger metropolitan hospitals
127	Halcyon et al.	**Year** 2014, **Country** USA, **Objective/Problem**: Over the past two decades, number of visits to EDs have increased. Nonetheless, ED visits for some conditions have decreased while others have demonstrated varying patterns. **Method**: The article investigates the factors that could affect the negative and positive growth trends for condition-specific ED visits. **Findings/Conclusion** The HCUP Statistical Brief displays data on fluctuations in overall ED visits between 2006 and 2011. The rates of ED visits are tracked by patient age and reported by demographic traits. The most rapid increase in ED visits was because of a condition referred to as septicaemia. Rate of ED visits for substance-linked conditions increased by 48%. **Limitations/Shortcoming/Deficiency** Superficial injury, strains and sprains decreased by 10% even though they are among the most common justifications for ED visits

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ID	Author name	Data extracted
128	M. Sharpe	**Year** 2015, **Country** USA, **Objective/Problem**: The article presents results of the Betty Irene Moore Nursing Initiative which was designed to improve patients' safety in hospitals. The authors describe results of the clinical efforts at the chosen hospitals in seven areas explored by this Initiative. According to the Initiative, a role of the main drivers in ensuring the desired improvements in patient safety was supposed to be played by front-line registered nurses. **Method**: The current article doesn't imply conducting any empirical researches. It operates with the existing data including the hospitals' evaluation plans and outcomes' assessments. In addition, it also analyzes results of the survey among 109 hospitals' representatives designed by the consulting firm "Informing Change". **Findings/Conclusion** Acute myocardial infarction mortality, falls with injury, medication administration errors, hospital-acquired pressure ulcers, rates of central line-associated bloodstream infections The potential of front-line registered nurses in improving patients' safety at modern hospitals is significant. The research findings provide a premise to believe that the role of front-line registered nurses in improving patients' safety is a promising research problem. In all the chosen areas, a substantial part of hospitals reported evident improvements due to the implementation of the Betty Iren Moore Nursing Initiative. **Limitations/Shortcoming/Deficiency** The variety of problems experienced by different hospitals makes an analysis of the changes in patients' safety extremely complicated. Besides, some hospitals didn't provide enough data on a regular basis or declined grants from the Betty Irene Moore Nursing Initiative as they participated in other programs
129	S.R. Dyas et al.	**Year** 2015, **Country** USA, **Objective/Problem**: A strong mutual interdependence between Medicaid and community health centres is one of the pillars of the U.S. health system. The current articles analyzes the nature of this relationship and explores its importance for medically underserved communities. **Method**: The research uses analytical instruments in order to develop a process map for emergency departments. A set of formulas is presented for calculating the results of model's implementation. (Lean methodology: using this methodology because the relationship between time and cost can be inconsistent. Patients who visit the ED have numerous diagnoses and complex conditions.) An understanding of the costs is necessary when using Lean Six Sigma methodology, particularly when the relationship between time and cost can be inconsistent. Apply cost accounting methods used in manufacturing to healthcare (activity-based costing (ABC) became the forefront approach for healthcare). Allocation method. COST-MODELING APPROACH. **Findings/Conclusion** Discharged patient hours, admitted patient hours, total patient hours, total costs, cost per discharged patient The process-improved cost model for hospital's emergency departments provides a chance to ensure lean process improvements at emergency departments while reducing their costs It's hard to analyze the processes at emergency departments separately from other departments. **Limitations/Shortcoming/Deficiency**: there are a lot of factors which influence the problem under investigation, but can be barely quantified

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ID	Author name	Data extracted
130	Shin et al.	**Year** 2015, **Country** USA, **Objective/Problem**: A strong mutual interdependence between Medicaid and community health centers is one of the pillars of the U.S. health system. The current articles analyzes the nature of this relationship and explores its importance for medically underserved communities. **Method**: The study is based on the method of content-analysis. With the help of this method, authors explore a relationship between community health centers and the Medicaid program using Patient and insurance data for 1.0 million patients designed to reflect the cost of treating a particular condition which combine capitation payments with quality. **Findings/Conclusion** An interdependence between the Medicaid program and community health centers A close relationship between Medicaid and health community centers is essential for the U.S. health system. This factor should be definitely considered while implementing any medical reforms in the United States. **Limitations/Shortcoming/Deficiency** The study lacks empirical evidence which would support research findings. More qualitative and quantitative studies are required in order to verify the inferences made by the authors. the relatively limited participation in Medicaid among office-based physicians and arrangements in connection with global payments, in which the providers' financial risk is limited
131	Wright et al.	**Year** 2015, **Country** USA, **Objective/Problem**: So-called "dual eligible" who are simultaneously eligible for Medicaid and Medicare experience evident problems with assessing primary care. This research aims to explore whether federally qualified health centers can address these barriers to assessing primary care. The overall objective of this study was to determine the association between use of federally qualified health centers and ambulatory care-sensitive hospital and ED visits among dual eligible. **Method**: The authors analyze Medicare data for dual eligible in Primary Care Service Areas who are either elderly or non-elderly disabled during the period between 2008 and 2010 health care resources measured and allocated. **Findings/Conclusion** The number of hospitalizations for dual eligible, the number of ED visits for ambulatory care-sensitive conditions. a random sample belonging to both Medicare A (inpatient) and B (physician services) programs. Using Dartmouth Atlas Project data. Federally qualified health centers have a potential to address the problem under investigation. The research illustrates that the number of disparties in preventable hospitalizations for dual eligible can be reduced due to these centers. **Limitations/Shortcoming/Deficiency** The data analyzed in this research only included dual eligible in fee-for-service Medicare. It also didn't consider other sources of primary care beyond the federally qualified health centers. Finally, the data used in this investigation might have contained some limitations connected with the severity of illnesses or patients' self-reflection which were automatically transferred to the current study

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ID	Author name	Data extracted
132	Z. Obermeyer et al.	**Year** 2015, **Country** USA, **Objective/Problem**: The available evidence provides a premise to claim that hospices help patients to reduce health care costs and even might prolong their survival. This statement increases the topicality of research problems connected with the factors which predict patient enrolment in hospices. The current investigation is focused on analyzing the factor of physician characteristics and its impact on patient enrolment in hospices during the period between 2006 and 2011. **Method**: The study uses a 20% sample of Medicare fee-for-service beneficiaries and measures a likelihood of enrolling in a hospice in the case of each patient. A logistic regression is used on the analysis stage. sensitivity analyses (how the uncertainty in the output of a mathematical model or system similar to simulation analysis) was carried out with alternative attribution methods-particularly the analysis using the first physician to treat each patient for his or her poor-prognosis cancer, since initial assignment to a physician unknown to the patient is unlikely to reflect shared preferences-were attempts to address this possibility. **Findings/Conclusion** Hospice enrolment, a likelihood of hospice enrolment define standards to promote quality improvement. Identify and remove any existing elements of quality measures or payment structures that could represent disincentives for discussions about end of-life care. Greater medical comorbidity, a female sex, older age and white race tend to increase the likelihood of patient enrolment in a hospice. improved measurement of the quality of end-of-life care could help incentivize provider behaviour change. **Limitations/Shortcoming/Deficiency** The study exclusively used the data on fee-for-service Medicare claims. The study is also rather observational and doesn't include a lot of factors in an analysis which can affect a likelihood of patient enrolment in a hospice. Efforts to improve training in end-of-life care are needed in residency and fellowship programs for physicians who will care for large numbers of poor-prognosis patients

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133	K. Carey and M. Lyn	**Year** 2015, **Country** USA, **Objective/Problem**: An implementation of the Medicare Hospital Readmissions Reduction Program implies significant financial penalties for hospitals which don't meet its requirements. In this situation, it seems important to explore the effectiveness of this program. Causes of observation services growth-a highly controversial issue owing to strong implications for Medicare patient cost sharing and potential inappropriateness of care. Adjustment for hospitals that serve large shares of poor patients-a major issue of concern. Continue to analyze full causes and consequences are better to be understood as policy makers consider expansion and modifications to the readmission reduction program. **Method**: The authors use the method of observation in order to compare the number of thirty-day readmissions among Medicare patients with selected high-volume conditions and Medicare patients with other conditions. Study Population Data are from the Agency for Healthcare Research and Quality to captures discharge information on all ED visits and identify the number of days between hospitalizations for the same person. a method that is useful for evaluating policy changes that apply to some but not all groups, to conduct a number of comparisons. **Findings/Conclusion** The number of thirty-day readmissions, Healthcare Cost and Utilization, discharge data and information on observation services. Reducing unnecessary hospital readmissions is a promising avenue for large-scale savings. The number of thirty-day readmissions has significantly fallen for the three chosen conditions in the target group. The Medicare Hospital Readmissions Reduction Program may be considered successful so far. Medicare Hospital Readmissions Reduction Program is affecting hospitals in the direction intended by the Affordable Care Act. High costs continue to threaten the sustainability of health care reform. **Limitations/Shortcoming/Deficiency** The study analyzes the current stage of the program's implementation and its results while the long-term results of this program are unclear at the moment

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ID	Author name	Data extracted
134	Harding et al.	**Year** 2015, **Country** Australia, **Objective/Problem**: The disturbing significance of musculoskeletal conditions is increasing. Their impact on the community implies an increased number of patients with disabilities and a negative influence on socioeconomics. The current article addresses one of the aspects of a reform which is supposed to overcome this problem. In particular, it develops an advanced musculoskeletal physiotherapy clinical education framework which is supposed to support a new workforce. Competency standard and credentialing process to support advanced musculoskeletal physiotherapy roles. **Method**: The methodology entails conducting a literature review, conducting focus groups among physiotherapists, developing a framework and implementing it in six chosen hospitals. **Findings/Conclusion** Workforce's competence: clinical education framework, population, organisations and experienced musculoskeletal physiotherapists recruited to these roles and healthcare organisations and the physiotherapy profession. The authors have successfully designed and implemented a competency-based training and assessment program. The level of workforce's competence has increased, and the program has received positive evaluations from specialists. Learning resources and a mentoring program was developed. A competent workforce has direct benefits for the community, healthcare organisations and the physiotherapy profession. **Limitations/Shortcoming/Deficiency** The program was only implemented in six hospitals. Therefore, it is early yet to claim that it is effective
135	Skinner et al.	**Year** 2015, **Country** Australia, **Objective/Problem**: The significance of allied health professionals has been gradually increasing. They have a substantial impact on patient outcomes which has been confirmed by various scientific investigations. At the same time, there is no agreement among specialists regarding the approach towards their training which could support new roles of allied health professionals. The current article addresses this gap. **Method**: The research is purely theoretical. It uses the methods of content-analysis and doesn't imply conducting any empirical studies. However the author suggested to use mass production supported by industry e.g. simulation. **Findings/Conclusion** Advanced scope and extended scope of allied health professionals, their professional competence. Workforce demands and increased waiting lists for healthcare services There is a need in developing specific clinical standards which can be applied to all the allied health professionals regardless of their roles. The available evidence provides a premise to believe that restructuring models of health care delivery might positively affect their professional competence and facilitate their training. In achieving this goal, hospitals should work closely with government departments, training firms and universities. to clear delineation of practice standards. **Limitations/Shortcoming/Deficiency** The study isn't supported by any empirical data. Accordingly, there is a compelling reason to believe that its results might lack certain validity. A further research is needed to verify the conclusions made by the authors. feasibility and priority and the effect of relevant strategies on targeted and defined outcomes

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ID	Author name	Data extracted
136	Haeder et al.	**Year** 2015, **Country** USA, **Objective/Problem**: The Affordable Care Act provided new insurance plans through the Marketplace in the State of California. However, there is a risk that these plans might lead to a set of disturbing consequences. For example, they might restrict patients' access to those hospitals which are relative to plans in the commercial market. Besides, some specialists point out that hospitals in the Marketplace are of a lower quality that those in the commercial plans. **Method**: The study uses a standard observation as the main research method. It analyzes hospitals in the Marketplace as a target group and hospitals in the commercial plans as a control group. **Findings/Conclusion** analyzed differences in hospital networks: The percentage of people residing in a hospital, networks, quality of plans. Geographic access: percentage of people residing in at least one hospital market area Commercial networks have wider networks than Marketplace plans. However, there is no difference between them in the field of a geographic access. Finally, the quality of networks in the Marketplace plans is the same or even sometimes higher than the quality of networks in the commercial plans. **Limitations/Shortcoming/Deficiency** The study operates with a limited number of data and isn't supported by any empirical investigations. In the future, it is recommended to conduct a study with a longitudinal time horizon in order to deduce more far-reaching inferences on the current problem
137	Maeng et al.	**Year** 2015, **Country** USA, **Objective/Problem**: The health care industry is facing increasingly complex challenges such as new regulatory requirements, value based purchasing, an aging population, increased complexity of care delivery, and heightened focus on consumer-directed care. Although industry responses have been multifaceted, there is a wide spread agreement on the need to strengthen the primary care foundation of the health system Patient-centered medical homes are proved to improve patient outcomes and reduce care costs. However, there is no evidence to explain this influence, especially in the case of reducing cost. **Method**: examining longitudinal clinic-level claims data patients attending the clinics over a ninety-month period (2006 through the first half of 2013). **Findings/Conclusion** Members per month, sites per month, regression-adjusted cost estimates. Evidence suggests that the patient-centered medical home has the potential to improve patient outcomes while reducing the cost of care. However, it is unclear how this care model achieves such desirable results, particularly its impact on cost. Patient-centered medical homes really have a potential to simultaneously improve the quality of health care and reduce its costs. There is no correlation between the increase in health care's quality and the increased health care costs. **Limitations/Shortcoming/Deficiency** Data analyzed in this study originated only from a single health plan. The generalizability of study's findings are unclear because GHP membership only refers to a certain group of patients

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ID	Author name	Data extracted
138	Hsia et al.	**Year** 2015, **Country** USA, **Objective/Problem**: The role of emergency departments in the health care system is significant. It is the source of most hospital admissions and cares for those patients who don't have any other chance to get medical help. In this situation, specialists emphasize the growing topicality of research problems connected with analyzing the recent trends in EDs' disease profiles. **Method**: The study employs the methods of a retrospective analysis and a statistical analysis. **Findings/Conclusion** Visit rates for injuries, visits for non-injury diagnoses During the period between 2005 and 2011, a visit rate for injuries has experienced a 0.7% increase while a rate for non-injury diagnoses has demonstrated a 13.4% growth. Generally, emergency departments should adapt to the new conditions in which they are supposed to improve their abilities to provide complex medical care. profile of disease in the ED can inform emergency services administration and planning and can provide insight into the public's health. **Limitations/Shortcoming/Deficiency** There is a difference between the OSHPD methodology which summarizes hospitals' self-reports and survey data on insurance statuses analyzed in this study. It is also important to understand that the research findings can be only applied to the state of California
139	Rahurkar et al.	**Year** 2015, **Country** USA, **Objective/Problem**: The Health Information Exchange mechanisms have been implemented in the overwhelming majority of modern hospitals. They are used to transfer laboratory results, medical list, clinical summaries and other prices of electronic information. However, there is no agreement among specialists on the influence of health information exchange on cost, use and quality of care. **Method**: This articles employs the method of content-analysis to analyze 27 scientific articles on the problem under investigation. **Findings/Conclusion** Cost, quality and service use that is including: laboratory results, clinical summaries, medication lists, believed to boost efficiency, reduce health care costs, and improve outcomes for patients. 57% of published articles reported some improvements in measured indices due to the implementation of HIE, but the internal validity of most these articles is disputable. Moreover, some of the articles with a substantial internal validity reported no effect or even negative effects of HIE on cost, quality and service use. **Limitations/Shortcoming/Deficiency** Articles analyzed in this study varied significantly from the perspectives of research scopes, research designs and methodologies. Moreover, only 6 articles had a strong internal validity. Therefore, a wider sample is required in order to make the inferences of further researches more convincing

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ID	Author name	Data extracted
140	Griffith et al.	**Year** 2015, **Country** USA, **Objective/Problem**: Seeking zero defects in outcomes quality. Achieving high reliability. Strategic independence versus the high-reliability organizations (HRO) commitment to "zero patient harm" and quality as "the organization's highest-priority strategic goal". There is a common belief that healthcare organizations are supposed to seek zero defects in outcomes as a manifestation of a high reliability. One of the most well-known mechanisms of achieving this goal is the Baldrige model. The current article explores the differences compares the indices of high reliability with the Baldrige model and tries to deduce whether a high reliability may be achieved by implementing the Baldrige model. Define high-reliability organizations as having an environment of "collective mindfulness" in which all workers look for, and report, small problems or unsafe conditions before those issues pose a substantial risk to the organization and when they are easy to fix. labor problems, production problems, and increased costs. **Method**: The authors use recipients' measures from various websites, such as WhyNotTheBest.org. They analyze the cases of 14 recipients from the Baldrige website's list of rewarding order to evaluate 17 different measures. Tools such as Lean, Six Sigma, and change management are proving highly effective in tackling problems as difficult as hand-off communication failures and patient falls. **Findings/Conclusion** 17 indices including readmission rates, mortality rates, country health rankings, emergency care, healthcare costs, etc. The Baldrige model is an effective mechanism of generating higher performance and ensuring a higher level of reliability. The influence of this model on infections' reductions, safety and patient satisfaction was significant, although its impact on costs, readmissions and mortality was slight. Zero harm is a strategic target on the journey to performance excellence, journey requires knowledgeable and committed senior managers and time. **Limitations/Shortcoming/Deficiency** Most of the data is associated with the year of 2012 whilst the awards have been made in 2002. Besides, a lot of acquisitions which were supposed to change the measurements hasn't demonstrated a substantial impact on the research problem due to the limited amount of time

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ID	Author name	Data extracted
141	Wiley et al.	**Year** 2015, **Country** USA, **Objective/Problem**: An effective management of health care spendings in the United States is critically dependent on the effective management of those patients which suffer from chronic illnesses. The current study aims to identify whether the use of medical home and care management processes has increased due to the physician practices. **Method**: The study implied conducting 3 surveys which were called the National Studies of Physician Organizations. The surveys had different structures and samples, although they all were focused on the same research problems. **Findings/Conclusion** Medical home processes, practice characteristics, external incentives. Summary of the patient-centered medical, Small and Medium-Sized Physician Practices and independent variables from survey. A large increase in the overall use of the processes under investigation has been observed over time. However, large practices only used around a half of the processes which is much less than the small- and medium-sized practices. A greater use of the processes analyzed in this article is supposed to positively influence patient experience and the quality of health care. greater attention needs to be paid to increasing patients' and family members' activation and engagement in their care to achieve desired results. **Limitations/Shortcoming/Deficiency** The response rate was only 50%. The available evidence provides a premise to believe that a lot of respondents could have been prone to the so-called "desirability bias"
142	Muhammet Gul and Ali Fuat Guneri	**Year** 2015, **Country** Turkey, **Objective/Problem**: Hospital Emergences Departments play a vital role in health care mission. Therefore, it is important for these department to come up with rational solution methods to address issues that may occur during normal or disaster times. **Method**: Data collection was done by examining the various secondary resources. **Findings/Conclusion** The collection of data from the secondary data in this research was made with respect to various characteristics which included country of publishing, the country of origin, aims of the study, simulation methodology, simulation software used, and the key performance indicators The results revealed that most of the studies about the ED operations were undertaken in Canada, UK, and USA. In addition, most of these studies frequently used the DES modelling methodology. **Limitations/Shortcoming/Deficiency** The methodology used limited the time period coverage of the articles used over the last ten years
143	Dockins et al.	**Year** 2015, **Country** USA, **Objective/Problem**: The researcher's aim was to translate and adapt an effective validated, benchmarked and widely used patient satisfaction measurement tool in a population that speaks Arabic. **Method**: The study used three methods which were: translation process, survey process, and benchmarking process. **Findings/Conclusion** Researchers used scores compiled for each of the HCAHPS questions and for each of the six HCAHPS clinical composites, two non-clinical items and two global items. Clinical composite scores, as well as the two non-clinical and two global items, were analyzed for the 645 respondents, and the results showed that the Arabic translation and adaptation of the HCAHPS was a reliable, valid and feasible tool for evaluation and benchmarking of inpatient satisfaction in Arabic-speaking populations. **Limitations/Shortcoming/Deficiency** Secondary data collection methods were not used for instance previous studies done by other researchers and publications or journals

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ID	Author name	Data extracted
144	Tom R. McDougal, Jr.	**Year** 2015, **Country** USA, **Objective/Problem**: The current communication strategies emergency department operations are becoming outdated due to overcrowding of ED patients. Therefore, new communication methods should be used to advance the system. **Method**: The study focused on two wait time strategies of communication where data about the patients was collected. The use of the emergency department systems and the posting of the waiting times of the ED on the website of the hospital. **Findings/Conclusion** The dependent variable of the study was the ED Efficiency Index, the independent variables were the wait times on the website and the reservation system, while the controls were licensed beads, the metropolitan location, and the uninsured population. The results of this study indicated that the ED waiting times of the posting on the website of the hospital has a statistical association with the ED efficiency. But, the usage of the reservation systems in the study did not show any significant association with the ED efficiency. In addition, the hospital control variables which included licensed beads, the metropolitan location, and the uninsured population have a significant statistical association with the ED efficiency. **Limitations/Shortcoming/Deficiency** The study was limited with respect to the method that was used in determining the relationship between the two communication strategies
145	Ghanes et al.	**Year** 2015, **Country** France, **Objective/Problem**: Overcrowding in EDs affects the quality of care offered to patients and the working environment of employees and managers are seeking to enhance performance by reducing the mismatch between patient supply and demand. **Method**: The study utilizes discrete event stimulation (DES) because of the need for high impact solutions. **Findings/Conclusion** Measures in the study include average length of patient stay, staffing budget, arrival patterns, processing times, and routing probabilities. The staffing budget discloses a decreasing marginal impact on performance. Managers should recognize the correlation between average door-to-doctor time for LC patients and average length of stay in the system, for a given staff budget. **Limitations/Shortcoming/Deficiency** In practice, data such as processing times and routing possibilities depend on the medical specialty or patient age. An abandoned probability was used but is often unreliable because it is not registered in database when patient leaves ED
146	Venkatesh et al.	**Year** 2016, **Country** USA, **Objective/Problem**: Researchers use an analytical tool Kano Attractive Quality to improve a pointed outpatient experience gap in perceived comparison by emergency department providers. **Method**: Primary data collection methods were used in Kano Attractive Quality analysis by use of questionnaires and survey cards which were filled by patients. **Findings/Conclusion** The comparison was made in three phases which involved patients' perception of receiving compassionate care. The Kano analysis proved that it had a great likelihood of change in patient experience. Therefore, Kano method would have proven to be a very useful approach in the management of the health care industry as it has been in other industries. **Limitations/Shortcoming/Deficiency** The researchers were not able to reassess Professional Research consultants' data at the conclusion of this project because the institution was the study was carried had switched vendors. They, therefore, used their point-of-service surveying as the pre- and post-assessments although the individual provider variability for the groups was not accounted for

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147	Ganesan et al.	**Year** 2016, **Country** UK, **Objective/Problem**: Most of the patients that have ureteral stones are often presented to the ED for an initial evaluation with nausea and/or pain. However, a proportion of this patients consequently go back to the ED for more visits and hence, there is need to solve this problem. **Method**: The researchers reviewed all the ED visits at the health facility with urolithiasis' ICD-9 diagnosis, as well as the related computed tomography scans between the years 2013 and 2010. **Findings/Conclusion** The computed tomography was reviewed independently to confirm the stone location, size, and the extent of hydronephrosis. The characteristics of patients and stone parameters were recorded. After reviewing 1510 patients who presented to the Emergency department after being diagnosed with the ureteral stones and confirmed by the CT, the research found out that 11% of the patients had visited the Emergency Department within the last 30 days. In addition, the multivariate analysis revealed that there was the presence of the proximal ureteral stones in people who had the age of 30 years and below. Las, the result found out that the need for the IV narcotics in ED remained to be independently related to the ED visits. **Limitations/Shortcoming/Deficiency** The research was limited to only the first ED revisit. Hence, it did not consider the multiple visits within a span of 30 days
148	Christien et al.	**Year** 2016, **Country** Australia, **Objective/Problem**: The research aims at resolving the issue of overcrowding in the emergency department and the imbalance between the need for emergency care and available resources. The researchers, therefore, evaluated the impact of crowding on the triage process. **Method**: Researchers used secondary data which was a 1-year health record review of 49,539 patients who visited the emergency department. **Findings/Conclusion** Measures of data extraction included: occupancy ratio, demographics, emergency department occupancy, the length of stay, time of triage, triage score, years working as a triage nurse, and triage destination. They, therefore, came up with the results that, during crowding, target times to triage elapsed more often than during non-crowding that is 49.7% versus 24.9%, $p < 0.001$. Thus, at that hospital, crowding affects the triage process which leads to longer waiting times of triage and longer emergency department length of stay. However, crowding did not influence triage destination. **Limitations/Shortcoming/Deficiency** The results of the study could not be extremely accurate due to double recording of 335 records of patients
149	Nezamoddini et al.	**Year** 2016, **Country** USA, **Objective/Problem**: The study investigates the impact of transferring non-emergency patients to different hospitals in multi-hospital environments. **Method**: The study applies mixed integer programming to model patient transfer and waiting. A comprehensive set of experiments was used to study the impact of different parameters. **Findings/Conclusion** Notations for parameters, indices, and sets include demand and hospital area indices, time indices, patient type indices, total number of hospitals, optimization period, patient type variations, cost of overtime, cost of increasing one unit capacity in hospital, cost of income of accepted patients, period during/in which patient acceptance will need overtime, among others. Wait times decrease with the possibility of patient transfer. Patient transfer is also more effective with low arrival rates and for hospitals with high rates of arrival. **Limitations/Shortcoming/Deficiency** The stochastic nature of variables such as transfer times and treatment, which were regarded as deterministic, limited the study

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ID	Author name	Data extracted
150	Rein Nobel	**Year** 2016, **Objective/Problem**: The paper gives an overview of one-server queueing models with retrials in discrete-time. The number of primary customers coming in during a time slot usually follows a general probability distribution. Varied numbers of primary arrivals in successive time slots are mutually exclusive. **Method**: The research studies the steady-state behavior of all the models using the generating function of number of customers in circulation. **Findings/Conclusion** Performance measures deduced from the generating function include the mean busy period and the average orbit size. When the customer choice becomes more versatile, then models become intractable. **Limitations/Shortcoming/Deficiency** Analytical results are frugal for delay and loss models where customers must passively accept their future after arrival. For retrial models intractability is not far once customers are given the option to leave the system
151	Wachs et al.	**Year** 2016, **Country** Brazil, **Objective/Problem**: The origin and nature of resilience skills (RS) are often taken for granted, despite their use by the ED. The paper investigates where these skills come from. **Method**: The study adopted a case study approach because it is a way to develop context-dependent knowledge. Case studies undertaken related to the EDs of two university hospitals, in the United States and Brazil. Data sources included document analysis, interviews, meetings and direct observations. **Findings/Conclusion** The research measured characteristics of the socio-technical system, RSs, work constraints, organizational support and hidden curriculum. The acquisition and utilization of RSs was greatly a by-product of interactions between aspects not in management's full control, such as hidden curriculum, gaps in work system design and work constraints. **Limitations/Shortcoming/Deficiency** Qualitative research could be complemented with quantitative. Study did not offer tools to identify the normal threshold of resilience. Personality traits were not assessed
152	Leporatti et al.	**Year** 2016, **Country** Italy, **Objective/Problem**: The paper looks at the traits of common users of accident and emergency departments (AEDs) and suggests other medical services they could use. AED utilization today appears to be for primary care rather than as an intervention point for emergency services. **Method**: The study identifies and analyzes the prominent clinical and demographic risk factors of individuals accessing seven AEDs in Genoa, Italy. It implements a truncated count data model to found the determinants of access. A multinational logistic regression is used to identify likely differences among various user categories. **Findings/Conclusion** The study measures vulnerability conditions, such as drug and alcohol abuse, psychological distress and chronic conditions, and demographic drivers. There is a link between the frequent use of AEDs and lower level of urgency. **Limitations/Shortcoming/Deficiency** Analysis is limited to adult users and the definition of frequent users is arbitrary

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ID	Author name	Data extracted
153	Chaovalitwongse et al.	**Year** 2017, **Country** USA, **Objective/Problem**: to come up with large-scale data mining and optimization models that can solve the challenging problems in sciences and engineering that are data driven. **Method**: For an effective collection of data, the researcher invited a number of leading researchers and distinguished colleagues in applied data mining and optimization for their contributions. In addition, the researchers used secondary data from 20 papers as sources of information. **Findings/Conclusion** The research papers were categorized into various areas like applied mathematical optimization in data mining, scheduling, finance, energy, transportation, and energy. The categories were designed in this manner to offer detailed information about the underlying phenomenon. The research study revealed that large-scale data mining and optimization models could solve the data-driven challenges that face sciences and engineering. Successfully, various practical applications as illustrated have increasingly been visible in several domains like energy, logistics, transportation, and healthcare. **Limitations/Shortcoming/Deficiency** The new data optimization approach is characterized by inaccurate prediction and computational complexity as a result of data variety, volume, velocity, and veracity
154	Azadeh et al.	**Year** 2018, **Country** Iran, **Objective/Problem**: The study incorporates simulation technique with data envelopment analysis (DEA) and stochastic data envelopment analysis (SDEA) to improve the quality of care in the ED by demonstrating three varied human errors. **Method**: The research classified human errors by skill-, rule-, and knowledge-based behaviour, then simulated the existing system. **Findings/Conclusion** The study measures patient duration in ED, average number of three varied human errors, goals of the simulation model and the average length of queues. Higher numbers of physicians and nurses in ED decrease queue length and patient duration, as well as lower number of errors. **Limitations/Shortcoming/Deficiency** The simulation was based on one general hospital in Iran making it difficult to generalize results

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