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Review Article

MULTI-CRITERIA DECISION MAKING TECHNIQUES FOR HEALTHCARE SERVICE QUALITY EVALUATION: A LITERATURE REVIEW

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ABSTRACT

Service quality is a significant factor in development, achievement and survival of any company, assuming the significance of estimating future developments of the company. Evaluating service quality of healthcare management in the light of patient's sense is beneficial for hospitals' management to find basic factors affecting service quality and implement effective procedures to solve problems of hospital service quality. The main purpose of this paper is to provide a systematic review of multiple criteria decision-making (MCDM) techniques used in healthcare service quality evaluation to understand the link between service quality and healthcare. MCDM techniques are progressively used to implement decisions in healthcare involving multiple and conflicting criteria. This study reviewed 42 articles from 33 journals, published from 2004 to 2016. Articles are categorized based on the year of publication, country of origin, publication name and methods used in the study.
Keywords: Multiple criteria decision making, healthcare service quality, literature review.

1. INTRODUCTION

In a competitive environment, a company can survive only if it has the capability to provide best service quality to its customers. The aim of evaluating service quality is to measure service performance, define service problems, and ensure optimal service for all customers [1]. Service quality was used to define service estimations, an ideal standard, a property of significance, and customer evaluation of the service quality [2]. The most widely known approach for measuring service quality is SERVQUAL [3]. As a comprehensive measurement instrument, SERVQUAL is developed to reach customer perceptions of service quality [4]. Parasuraman et al. [5] define fundamental service attributes used by customers in assessing the quality of service. Ten dimensions of initial SERVQUAL decreased to five dimensions by Parasuraman et al. [4]. Reliability, responsiveness, assurance, empathy and tangibles are the five dimensions of SERVQUAL.

In a competitive world, the service industry is under pressure to serve lasting performance and quality improvement. For the last years, it is observed that healthcare has become one of the highly complicated sectors in the world [6]. Service quality in hospitals is a significant element.

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This importance level comes from both economic sustainability concerns and its direct relation to human health. To be successful in the healthcare industry, it is important to provide patients with service that meet or exceed their expectation [3]. In order to ensure future success, being able to provide good healthcare service quality is the most significant element [7]. The reaction of patients is a crucial source of information in finding problems and generating a useful plan of act for development of quality in hospitals [8]. Patients put emphasis on quality and effectiveness of the hospitals when searching for healthcare services. If the patients are not pleased with the provided service quality, they will look for other hospitals. Therefore, hospitals should improve their healthcare quality and effectiveness to keep their current patients and to attract new ones [9]. Due to the increased consciousness level of the patients on the service quality and changes in the competitive environment, healthcare services have to manage challenges. In order to be successful in a challenge, the expectation of patients must be satisfied by hospital managers. Service quality and improved patient satisfaction level are key factors and are important to the long-term achievement and profitability of healthcare service providers [10]. Milosevic and Bayyigit [11] report the value of evaluating patient satisfaction to healthcare organizations. Observing patient satisfaction is an important element of a hospital's effectiveness and should be a preference of quality improvement [12]. Thus, evaluation of hospital's service quality from patient's point of view is useful for hospital's manager to find major factors affecting service quality and apply effective methods to solve problems of hospital service quality.

Evaluation of hospital service quality is complex and includes multiple criteria, qualitative and uncertain factors that are difficult to evaluate [13]. There is a significant relationship between service quality and patient satisfaction [14, 15]. Hospital service quality evaluation process requires multiple criteria consideration, which can be qualitative and quantitative, hence the Multi-Criteria Decision Making (MCDM) methodologies are applicable [16, 17]. Service quality could be evaluated by different approaches such as statistical approaches, Quality Function Deployment (QFD), Analytic Hierarchy Process [18], Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) [19], VIKOR (Vısekriterijumska Optimizacija i Kompromisno Resenje) [20, 21], Preference Ranking Organisation Method for Enrichment Evaluation (PROMETHEE) [22], Elimination and Choice Translating Reality (ELECTRE) [23], Analytic Network Process [24]. In this study, a systematic review of MCDM techniques used in the evaluation of healthcare service quality is presented. This literature review identified a substantial body of literature on the application of MCDM techniques and approaches used to address service quality problems. There exist several studies in the literature that evaluate service quality of different industries. This study is based on the papers that evaluate healthcare service quality.

2. METHODOLOGY

This section describes the methodology to identify, and clarify the literature on healthcare service quality evaluation by using MCDM methodology. 42 papers are reviewed in proceedings and journals. The classification of the reviewed papers is made with respect to some characteristics such as year of publication, method, country of origin, the aim of the study, evaluation area, and software used in the study. A literature review in the SCOPUS, Science Direct, Taylor&Francis, Ebsco, Web of Knowledge, and Google Scholar databases was implemented between 2006 and 2016 using the following search terms: ("multi-criteria" and "healthcare service quality"), ("fuzzy" and "multi-criteria" and "healthcare service quality"), ("hospital service quality" and "multi-criteria decision making") and ("SERVQUAL" and "multi-criteria" and "healthcare").

The first step of literature process is to determine the keywords for the search in the databases. After identifying the keywords, next step is to determine the databases to be searched. The

number of papers found relevant is presented in Table 1. The last part of this process is the classification of the papers.

Table 1. The number of papers

	"multi-criteria" and "healthcare service quality"	"fuzzy" and "multi-criteria" and "healthcare service quality"	"hospital service quality" and "multi-criteria decision making"	"SERVQUAL" and "multi-criteria" and "healthcare"
Science Direct	6	5	6	12
Taylor&Francis	7	140	0	28
Ebsco	17	17	183	17
Web of Knowledge	0	1	2	0
Scopus	1	0	3	1
Google Scholar	163	144	145	257

An extensive search for appropriate English-language literature was applied using six popular publication databases and indexing services. Table 1 indicates the keywords and the number of papers that are searched in several databases. After the search of papers in databases, papers are examined and eliminated by checking whether it is related to the subject or not. Papers are excluded that are not related to the evaluation of healthcare service quality.

3. LITERATURE REVIEW AND DISCUSSION

The steadily growing amount of literature on service quality in healthcare covers a variety of implementations. This study is composed of the literature that has papers using MCDM techniques. There exist several papers which include different techniques except MCDM for the healthcare service quality evaluation. Womack et al. [25] suggest how to implement lean principle to health care along with case example of Seattle's Virginia Mason Medical Center. Zidel [26] introduces lean principles, basic lean tools, and applications of these tools for health care industry. Grove et al. [27] provide challenges faced during lean implementation from UK hospitals. Torres and Guo [12] state three approaches to make healthcare quality improvement to provide patient satisfaction. These approaches are measuring patient perspective, improving patient outcomes and using Six Sigma approach. According to our knowledge, for healthcare quality literature, there exist two literature review studies. Talib et al. [28] present a literature review that contains various aspects belongs to healthcare quality. Classification is applied for different categories such as quality of healthcare, studies on Indian healthcare system, service quality in healthcare, development and implementation of SERVQUAL. The review focuses on the papers that include methods of SERVQUAL, total quality management (TQM), MCDM, and exploratory factor analysis (EFA). Mardani et al. [29] investigate the papers that applied MCDM in different industries such as tourism and hospitality, airline, healthcare, transportation, manufacturing, banking and education. In the study, articles are classified into the titles of author, year, application area, the nationality of the author, technique, the number of criteria, research purpose, gap and research problem, results and outcome. Considering only the service quality evaluation in the healthcare industry, according to their findings, previously used techniques are statistical approaches, multi-criteria satisfaction analysis for benchmarking analysis, AHP, VIKOR, fuzzy AHP, PROMETHEE, and TOPSIS. The MCDM papers in literature are classified into three

categories. These categories are individual techniques with crisp data, fuzzy individual techniques with fuzzy data and integrated techniques.

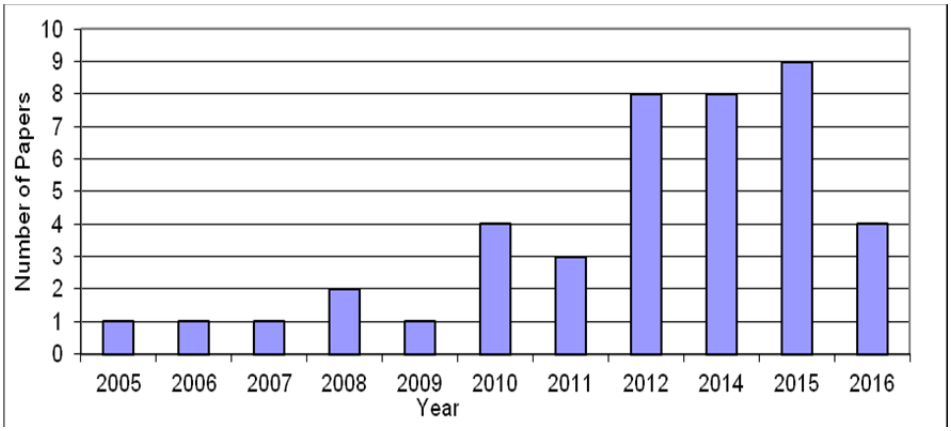

Figure 1. Distribution of Healthcare Service Quality Evaluation Papers by Publication Year

Figure 1 presents the number of papers reviewed on MCDM in hospital service quality literature between 2005 and 2016. In 2015, the number of published papers reaches their highest level with nine papers. On the other hand, in 2005, 2006, 2007 and 2009 they are at the minimum with one paper.

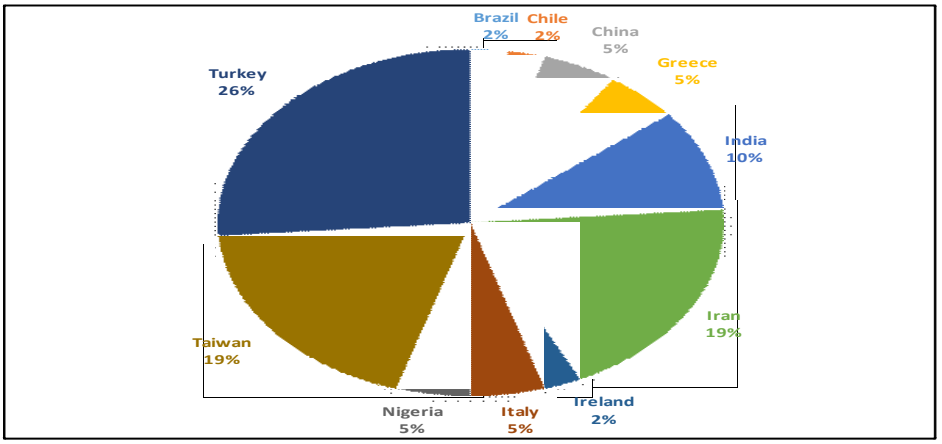

Figure 2. Percentage of Papers by Country of Origin

The percentages of papers by country of origin are shown in Figure 2. The highest percentage of 26% belongs to Turkey followed by Iran and Taiwan with 19%.

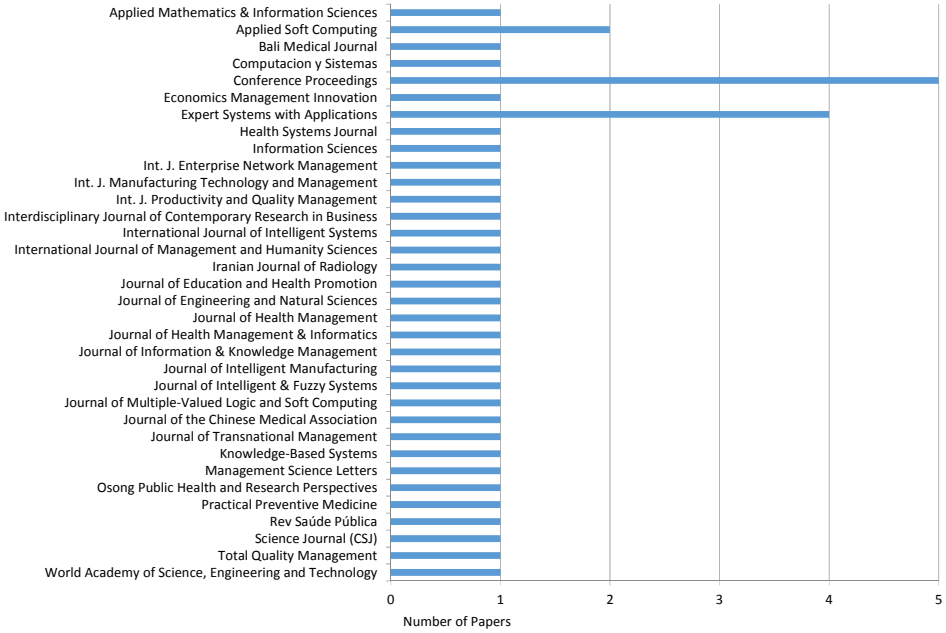

Figure 3. Distribution of Healthcare Service Quality Evaluation Papers by Publication Name

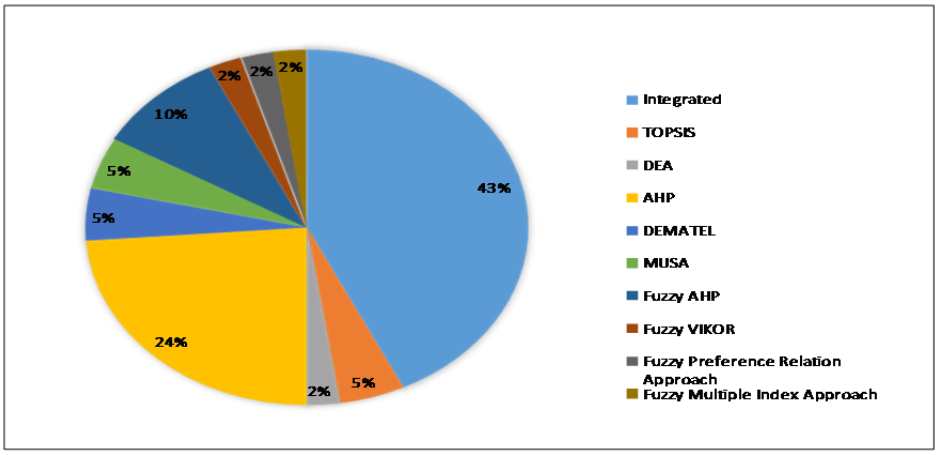

Figure 4. Distribution of Healthcare Service Quality Evaluation Papers by MCDM Methods

The number of papers reviewed on healthcare service quality evaluation in different sources is shown in Figure 3. As it can be observed, there is not a specific journal which focuses on this subject.

Figure 4 shows the percentage of MCDM methods used in reviewed papers. It is noted that AHP (24%) and fuzzy AHP (10%) receive more interests than the other methods.

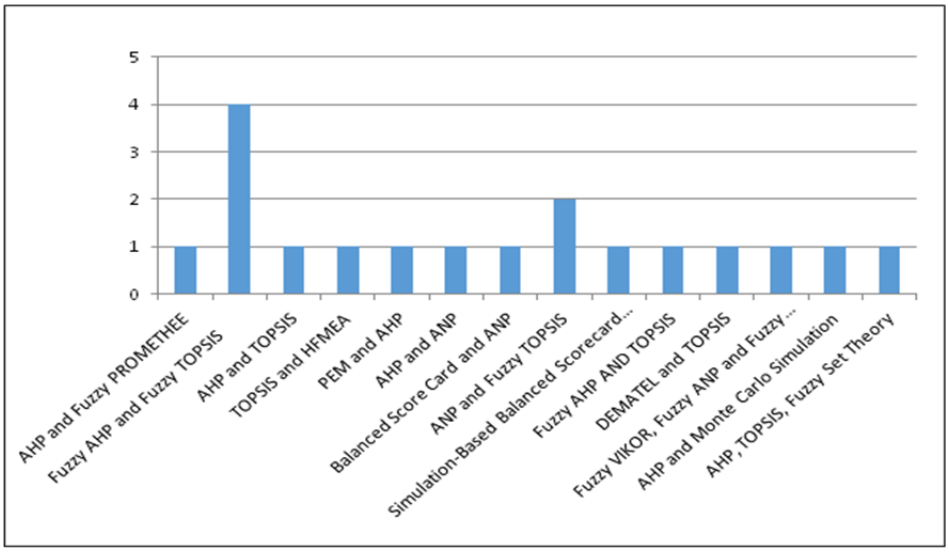

Figure 5. Integrated Techniques with Fuzzy Data

Integrated techniques with fuzzy data are shown in Figure 5. It is observed that the number of articles containing integration of fuzzy AHP and fuzzy TOPSIS is greater than the others.

3.1. Individual Techniques with Crisp Data

Bahadori et al. [30] rank military hospitals in Iran according to the Joint Commission International (JCI) standards by using AHP method. SERVQUAL criteria are used for evaluating the quality of hospital services in their study. Another paper using AHP is prepared by Alimohammadzadeh et al. [31] which proposes a methodology to rank radiology departments in 6 hospitals in Tehran city by applying AHP. Standards of departments are compared to each other by using comparison matrix and are ranked by AHP. Herrera et al. [32] evaluate Information and Communication Technology (ICT) network system for healthcare related services by using AHP. AHP is also used for estimation of patients' satisfaction towards service delivery in six public teaching hospitals by applying cross-sectional survey research design [33]. Khan et al. [34] use AHP and SERVQUAL methodologies based on the selected criteria and sub-criteria in order to rank the best service quality offered by the five corporate hospitals. TOPSIS method was conducted to evaluate the quality of hospital medical services including 18 departments of a hospital. Basu and Bhola [35] evaluate the service quality dimensions in IT healthcare ventures from Indian context. As a linear programming based technique, Data Envelopment Analysis (DEA) method is used to measure the relative efficiency and relative performance of organizational units. Zaim et al. [36] propose a study to evaluate the efficiency of twelve hospitals in Turkey by applying DEA technique. Additionally, DEMATEL is applied for demonstrating the degree of influence of factors and observing the relationship among the factors based on a cause-effect diagram. Shieh et al. [37] implement SERVQUAL model to identify seven main criteria from the viewpoints of patients in a hospital in Taiwan. DEMATEL method is applied to the management of the hospital to prioritize the importance of criteria. Patients satisfaction is evaluated and solutions are proposed by Manolitzas et al. [38]. Multi-criteria Satisfaction Analysis (MUSA) methodology is used to measure and analyze the customer satisfaction and this methodology reveals the level of the patient satisfaction. Khan et al. [39] evaluate three hospitals

from the southern region of India by using SERVQUAL. As a decision making methodology, AHP is used to evaluate the three hospitals based on the selected criteria and sub-criteria. Aktas et al. [40] used AHP in order to provide a scientific basis for classification of three Turkish hospitals. Chang [41] determines service quality of four public hospitals by applying fuzzy preference relation approach using the criteria of hospital environment, service attitude, pharmacy treatment, professional capability, administrative policy. AHP method is used for the analyzing the quality of services offered by healthcare service providers [42].

3.2. Fuzzy Individual Techniques with Fuzzy Data

The fuzzy AHP approach is implemented in various MCDM techniques for evaluation of service quality in healthcare. Buyukozkan et al. [13] structure a fuzzy AHP to evaluate the proposed service quality structure of four hospitals in Turkey. This study finds out the best healthcare service quality performance among the alternatives by using SERVQUAL. Ho [43] adopted Fuzzy Analytic Hierarchy Process (FAHP) approach to make weight assessment on evaluation indexes of Health Management Center. The research investigates the health examination institutions and demands of their customers for Health Management Center and provides suggestions concerning improvement and future operation of Health Management Center in the current market. Sinimole [44] develops a fuzzy AHP model to evaluate service quality of four hospitals in India. SERVQUAL scale is used for the evaluation of hospitals. In addition to these studies, Lupo [45] applies fuzzy AHP method to assess service quality of nine relevant public hospitals by focusing on the criteria of healthcare staff, responsiveness, relationships and support services. Another method that is used to evaluate service quality under a fuzzy environment is VIKOR. Chang [46] evaluates hospital service by means of VIKOR where uncertainty, subjectivity and vagueness are addressed with linguistic variables. The aim of the study is to use a combined multi-criteria technique which includes fuzzy set theory and VIKOR to evaluate a set of feasible hospitals in an attempt to obtain the best hospital that satisfies the expectations of patients. Taskin et al. [47] use fuzzy DEMATEL approach for deriving interaction among the main criteria, fuzzy ANP for finding weights of the sub-criteria and VIKOR method for evaluating service quality performance of hospitals. Patient satisfaction, education and research, institution, administrative policy, financial aspects and infrastructure are considered as main criteria.

3.3. Integrated Techniques

Altuntas et al. [48] apply AHP and ANP with SERVQUAL technique to analyze perceived service quality in Turkish hospitals. The most important service quality dimensions are found as empathy, knowledge of personnel, trustworthy of personnel, services provided at the required time, and safe feeling of patients with hospital personnel. Hojati et al. [49] prioritize the dimensions of surgery department service quality of a hospital by using ANP with the approach of Balanced Score Card (BSC) which is one of the main performance measurement frameworks that operate strategy-linked leading performance measures. The Performance Evaluation Matrix (PEM) is proposed by Lambert and Sharma [50] which is applied as a strategy to make performance measurement and to establish best strategy for improving service quality. Chen and Yeh [51] aim to integrate the PEM and AHP methods in order to identify and prioritize areas of improvement in service quality. The objective of the study is to propose the methods to evaluate service quality, and then identify hospitals to state the elements that require service improvement. Khanjankhani et al. [52] apply DEMATEL technique to determine cause and effect relationships between identified service quality aspects of three hospitals and TOPSIS to rank these hospitals. The Healthcare Failure Mode and Effects Analysis (HFMEA) methodology is an adaptation of the Failure Mode and Effects Analysis (FMEA) method developed by the Department of Veterans

Affairs' National Center for Patient Safety (NCPS) to identify and avoid the potential errors in healthcare. Kuo et al. [53] apply TOPSIS to rank the severity of failure modes and HFMEA to find the effect of geriatric outpatient service process failures on elderly patients. Buyukozkan and Cifci [54] study electronic service quality analysis of healthcare sector in Turkey by using a combined multi-criteria decision making technique. SERVQUAL methodology is applied for the electronic service quality. Combined fuzzy AHP and fuzzy TOPSIS methods are included in the study in order to measure electronic service quality of thirteen hospital web sites. Buyukozkan and Cifci [55] consider healthcare service quality evaluation as a multi-criteria decision making problem and provide a new approach based on an integrated multi-criteria decision making approach consist of AHP to calculate criteria weights and TOPSIS to rank alternatives in an uncertain environment. The model is implemented in Turkish hospitals and accuracy of proposed framework is evaluated. Hamidi et al. [56] apply MCDM techniques (integrated ANP and fuzzy TOPSIS) to evaluate electronic service quality of four hospitals. They use ANP in order to obtain importance weights for criteria and Fuzzy TOPSIS for ranking alternatives of electronic service quality for the healthcare industry. In the study, evaluation of service quality is based on six criteria including tangibility, responsiveness, reliability, information quality, assurance, empathy. Birsel et al. [57] also evaluate the electronic service quality of Turkish hospitals by measuring the performance of the web sites of Turkish hospitals. Web site evaluation attributes are weighted applying AHP and in order to rank the web sites, fuzzy PROMETHEE is applied [57]. A recent study by Akdag et al. [58] apply the fuzzy MCDM techniques to evaluate the service quality of Istanbul (Turkey) hospitals. The authors use a number of MCDM techniques to evaluate the service quality of hospitals like AHP, TOPSIS, etc. Afkham et al. [59] evaluate and compare service quality of four hospitals in Iran by applying methodologies of AHP and fuzzy TOPSIS. SERVQUAL and DEMATEL methods are used to display the most substantial service quality dimension by means of patients' perspective and to decide which criteria to be focused in achieving the service quality, respectively [60]. Lee et al. [61] evaluate the four online auctions service quality to offer a solution with multiple criteria evaluation by the methods of AHP, Fuzzy set theory and TOPSIS. Mirbargkar and Zadmehr [62] integrate the methods of ANP and fuzzy TOPSIS to select the most convenient hospital in terms of electronic services. Criteria of the study are designed based on the six dimensions of SERVQUAL which are tangibility, responsiveness, reliability, quality of information, assurance and empathy.

4. CONCLUSIONS

This study aimed to review papers that used the MCDM techniques and approaches for the evaluation of the service quality in healthcare. The reviewed papers were published from 2005 to 2016 in 33 international journals and in 5 conference proceedings accessible in popular databases such as Ebsco, Taylor&Francis, Science Direct, Scopus, Web of Science and Google Scholar. This review study categorises the papers based on the year of publication, country of origin, publication name and methods used in the study. Individual techniques with crisp data, fuzzy individual techniques with fuzzy data and integrated techniques are the titles created for methods used in papers. Results indicated that the percentage of the studies with integrated methods has the maximum by 43% for the distribution of Healthcare Service Quality Evaluation papers by MCDM methods. These methods are followed by AHP (24%) and fuzzy AHP (10%). The number of articles includes integrated method of fuzzy AHP and fuzzy TOPSIS is the greatest one.

Based on our findings, most of the papers include service quality performance measurement of hospitals. MCDM methods are applied for ranking different hospitals. There exist an insufficient number of papers that evaluates the service quality of departments in hospitals. Additionally, although electronic services are currently used more than ever, the number of papers related to the evaluation of electronic service quality evaluation is very few.

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