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The impact of technology on quality in healthcare services

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Abstract

The healthcare sector faces various pressures, such as demographic changes, population aging, the emergence of new treatments and technologies, and increasing demands to improve the quality of services provided in order to remain competitive. At the same time, high-quality care is considered a right for all patients and a responsibility of the entire hospital staff. Compared to most other service sectors, healthcare services exhibit certain unique characteristics, including high complexity, while the economic and human consequences of poor quality are significant. Consequently, the demand for high-quality care continues to rise, and evidence suggests that hospital care quality can be further improved. To achieve this, caregivers must know what to do, how to do it, and be capable of improving care processes.

Research indicates that high-quality services contribute to retaining existing clients and attracting new ones, reducing costs, enhancing corporate reputation, generating positive word-of-mouth, and ultimately improving profitability. Beyond these factors, there is an increasing international interest in leveraging the potential of new technologies to enhance the quality and safety of healthcare. This often entails higher costs and large-scale expenditures on e-health initiatives, which are frequently justified by the argument that they represent effective and cost-efficient means to improve healthcare delivery.

Aim: The purpose of this dissertation is to systematically review the published literature and explore the potential impact of new technologies on the quality of health care.

Material and methods: A review of the literature, written in the English language, was carried out on PubMed for the period of January 2007 to July 2017. The eligibility criteria for study inclusion were developed using the acronym PICOS. The initial search resulted in 13200 articles, followed by restrictions on the type of studies (systematic reviews), the availability of the text of the articles (free full-text availability), the date of publication (01/01/2007 - 10/07/2017) and the reference population (human species). The final sample consisted of 18 studies.

Keywords: Health Care Services; Technology; Quality; Healthcare management; Social work

1. Introduction

Service quality is a relatively recent focus in management, with its origins tracing back to the 1980s, when many authors described service quality as the result of a comparison by customers between their expectations of the service they will receive and their perceptions of the company providing those services.

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Today, the concept of quality is gaining increasing significance, as consumers continuously seek high-quality products and services. This demand for quality has led corporate managers worldwide to consider quality a strategic objective for achieving competitive advantage. Due to its subjective nature and intangible characteristics, quality is difficult to define and represents an elusive and abstract concept with multiple meanings and interpretations. Consequently, depending on whose perspective is considered and the context in which quality is assessed, numerous and varied definitions of the concept emerge.

Researchers suggest that service quality can be evaluated by measuring the gap between service expectations and service performance.

Lascelles and Dale (1991) define quality as "the complete satisfaction of the customer, which requires dynamic activities collectively known as quality management". Deming (1982) defined it as "the production of goods with a predictable degree of uniformity and reliability, at low cost, and suitable for the market." Feigenbaum (1991) described quality as "the totality of marketing, engineering, production, and maintenance characteristics of a product or service through which the product or service, when used, will meet customer expectations," while Flood (1993) argued that quality is "the ability to meet customer requirements, both formal and informal, at the lowest cost, the first time and every time".

Crosby (1979) defined quality as the absence of defects, while Juran (1980) described it as conformance to requirements. Others have defined it through the measurement of internal and external failures. Regarding product quality, it can be measured objectively using indicators such as durability, presence of defects, and reliability. In the service sector, however, quality definitions tend to focus on meeting customer requirements and how well service providers fulfill customer expectations, with service quality being defined as "a global judgment or attitude relating to the overall excellence or superiority of the service».

Thus, service quality is a multidimensional concept stemming from the unique characteristics of services, such as variability, intangibility, inseparability, and perishability. It contributes to customer loyalty and acquisition, employee satisfaction and engagement, enhanced corporate image, cost reduction, and improved business performance.

According to the literature, service quality consists of two distinct dimensions: technical and functional. Technical quality relates to what the customer receives and whether the services meet technical specifications and standards, while functional quality describes how products and services are delivered, i.e., the service–customer interactions.

2. Material and method/Methodology

The methodology followed for the development of this thesis is a literature review of scientific journals, textbooks, books, and the internet, with the aim of providing the most accurate depiction of the phenomenon of medical tourism based on real-world data.

3. Results

Service quality is measured using multidimensional scales, as unidimensional scales have been criticized for lacking power and direction for service improvement. Parasuraman, Zeithaml, and Berry (1988) developed the SERVQUAL model for measuring service quality. This model included five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. Although widely used in the service industry, SERVQUAL has been criticized by many researchers. To address its limitations, Cronin and Taylor (1992) developed a new model, which has been extensively applied to study the significant role of service quality in various sectors and industries, such as retail banking, the hospitality industry, and healthcare services.

Quality has concerned humanity since ancient times, with a notable example being the Hippocratic Oath (5th century BCE), which for the first time established the principles of Greek medical ethics and continues to serve as a code of good practice, morality, and professional conduct. However, prior to 1960, the history of quality in healthcare services consisted of a fragmented collection of unrelated events rather than an organized effort. By the late 1970s, quality assurance in healthcare remained largely academic in nature, in contrast to the industrial sector, where statistical methods had been applied since the 1930s.

The roots of the quality improvement movement can be traced to the work of Ignaz Semmelweis, a 19th-century obstetrician who advocated for the importance of handwashing in medical care. In 1858, Florence Nightingale created

a remarkable and innovative graphical representation for recording morbidity and mortality among wounded soldiers during the Crimean War. This effort led to the allocation of British funds to modernize hospitals in Crimea, ultimately improving the quality of healthcare provided.

In 1910, Abraham Flexner published the Flexner Report, the first documentation of poor conditions in U.S. medical education and hospitals. Six years later, Ernest Codman, a surgeon and pioneer of patient outcome measures, published a study disclosing the most common errors in patient care at his hospital, aiming to improve care quality for surgical patients. His work influenced the development of the Hospital Standardization Program, introduced by the American College of Surgeons (ACS) in 1917. In 1952, the ACS, the American College of Physicians (ACP), the American Nurses Association (ANA), the American Medical Association (AMA), and the Canadian Medical Association established the Joint Commission on Accreditation of Hospitals, which continued accrediting hospitals based on the existence of "minimum standards".

In a review of studies from 1954–1984, Avedis Donabedian, the father of the concept of healthcare quality, documented and analyzed previous approaches and developed a quality assurance framework based on the triad of “appropriate structures, effective processes, and suitable outcomes”.

Service quality is a multidimensional concept that admits various definitions, as consumers possess different criteria and dimensions for its measurement. The international literature contains numerous references regarding the dimensions of service quality. In particular, key parameters for evaluating quality include: (a) the physical environment (facilities), (b) interpersonal interactions, either between customer and employee or between customers, and (c) the services inherent to the product itself. Additionally, various models have been developed to define these dimensions, which differ in the number of dimensions considered.

Despite the existence of multiple classifications for quality, the most widely used is that proposed by Donabedian (1988), according to which quality is distinguished into three dimensions: outcome, structure, and process. Outcome relates to changes in a patient’s health attributable to the healthcare received, while structure refers to relatively stable characteristics of the healthcare provider, including available technology, tools, resources, as well as organizational and infrastructural attributes of the workplace. Process, finally, encompasses the set of activities occurring within the provider–patient framework and constitutes quality only when linked to the desired health outcome.

For some researchers, patient satisfaction results from the gap between expected and perceived characteristics of a service. According to Parasuraman et al. (1988), who developed the SERVQUAL scale for measuring healthcare service quality the model revealed five dimensions of perceived quality: tangibles, reliability, responsiveness, assurance, and empathy. Tangibles include factors such as the appearance of employees, equipment, and facilities, influencing both satisfaction and customer/patient intentions. Therefore, healthcare providers must ensure that hospitals are equipped with modern physical facilities and visually appealing materials for patients, while hospital management should consistently ensure that staff appear clean and well-presented during working hours.

Assurance pertains to employees’ knowledge, courtesy, and ability to inspire trust. Empathy relates to the individualized attention given to patients’ needs and the provision of useful services. Reliability, considered the second most important dimension for determining satisfaction, refers to the accurate, dependable, and consistent delivery of services, while responsiveness concerns the willingness to assist patients and provide prompt service.

Vandamme and Leunis (1993) identified tangibles, medical responsiveness, assurance, nursing staff quality, and personal values as dimensions of hospital service quality. Similarly, Padma et al. (2010) employed dimensions specifically developed for healthcare services—including infrastructure, staff quality, clinical care processes, administrative procedures, safety indicators, hospital image, social responsibility, and hospital reliability—to analyze the relationship between service quality and customer satisfaction in hospitals in India.

Coddington and Moore report that the five primary factors determining the quality of healthcare providers from the consumer’s perspective are: (a) warmth, care, and concern, (b) medical personnel, (c) technology and equipment, (d) specialization and breadth of available services, and (e) outcomes. According to the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), hospitals have nine quality dimensions: effectiveness, efficiency, appropriateness, safety, respect and caring, continuity, availability, and timeliness of care. These elements closely correspond to the five factors identified by Coddington and Moore and the dimensions of SERVQUAL, while providing a more comprehensive framework for understanding healthcare service quality dimensions.

Measuring quality in healthcare services represents the first and most crucial step toward improving the care provided, while the quality delivered plays a particularly significant role in patient satisfaction. Furthermore, the increasing complexity of the healthcare sector and the growing demand for enhanced patient safety have made monitoring the quality of healthcare services both urgent and essential.

Quality assessment involves the process of measuring care quality, including the development of quality metrics, implementation of activities to measure quality, and monitoring of resulting information to detect trends or identify healthcare providers, organizations, or communities with high or low performance. Quality measures are multidimensional and may focus on the structure, process, and outcomes of care, drawing upon administrative, clinical, or patient-reported data. The results derived from measuring and evaluating quality can empower all stakeholders involved in healthcare, from patients to payers and policymakers.

The measurement of healthcare quality can be conducted by comparing the performance of an individual or a group with an ideal standard or a benchmark. Customers serve as the primary evaluators and play a crucial role in assessing the quality of a service or product. In the healthcare sector, customers are patients, whose perceptions are considered the main indicator for evaluating the quality of services provided. According to Gronroos (1984), service quality can be measured in terms of technical and functional quality. In healthcare, technical quality is primarily defined based on the accuracy of medical diagnoses and procedures or compliance with professional standards, while functional quality refers to the manner in which healthcare services are delivered to patients.

In the traditional approach, quality assessment is conducted using objective measures such as mortality and disease outcomes, which serve as fundamental tools for evaluating the quality of clinical services. In addition, for many years, various unidimensional scales were employed to assess healthcare services; however, these are not suitable for measuring a multidimensional perception. Statistical methods and the SERVQUAL methodology have also been used for measuring service quality.

The SERVQUAL scale is a widely used, validated, and generally accepted instrument for assessing service quality. Developed by Parasuraman et al. (1988), it is a multi-item tool comprising five dimensions, characterized by 22 paired items, half of which measure consumer expectations and the other half measure what consumers actually perceive. The model requires measuring customers' expectations of a service and their perceptions of the quality of the service actually delivered. The gap for each item is calculated as the perception score minus the expectation score. A positive gap score indicates that expectations have been met or exceeded and that service quality is satisfactory, whereas a negative gap score suggests that expectations have not been met and service quality is deemed unsatisfactory. In other words, minimizing the difference between customer expectations and perceptions can lead to maximized service quality.

A significant and relatively recent approach to measuring quality is the "voice of the patient." Today, patients can provide reliable reports of their care experiences through standardized surveys, which include questions on communication, pain relief, and satisfaction with care, while also offering valuable insights regarding outcomes that only the patients themselves can know. Indicators are based on care standards, and their measurement and monitoring provide, among other things, the ability to document the quality of care, perform benchmarking over time across different entities (e.g., hospitals), set priorities, support quality improvement, and enable healthcare professionals and organizations to monitor and evaluate patient outcomes as a result of how well professionals and organizational systems meet patients' needs. However, indicators are not a direct measure of quality. Since quality is multidimensional, understanding it requires multiple measures.

Quality indicators aim to detect inadequate care in terms of structure, process, or outcome, and can be used as a tool to guide the quality improvement process in healthcare. Quality monitoring makes hospital care more transparent for physicians, hospitals, and patients, providing useful information for setting targets to enhance quality, although data collection for quality indicators imposes an administrative burden on physicians and hospitals. To facilitate quality improvement initiatives, numerous healthcare quality indicator standards have been proposed, which help make quality visible through objectively measurable processes and outcomes. Furthermore, healthcare personnel, through the use of standardized quality indicators, aim to compare their performance with similar healthcare providers, understand the concept of service quality and its associated processes, track achievements over time, and implement measures both to prevent problems and to eliminate recurrence.

Continuous quality improvement (CQI) is a philosophy aimed at the ongoing enhancement of processes related to the delivery of a good or service, so that they meet or exceed customer expectations. CQI differs from traditional quality

assurance methods primarily due to its emphasis on understanding and improving underlying processes and work systems to add value, rather than simply correcting errors made by individuals. In the healthcare sector, interest in defining "quality improvement" has been steadily increasing. Batalden and Davidoff (2007) proposed defining it as "the combined and continuous efforts of all—healthcare professionals, patients and their families, researchers, payers, policymakers, and educators—to implement changes that will lead to better patient outcomes (health), improved system performance (care), and enhanced professional development".

A quality assurance (QA) system is a set of processes designed to ensure that the delivery of a service or product meets established quality specifications and requirements. This system serves as a method for preventing errors or avoiding problems that may arise during the execution of a service. Quality assurance consists of a series of measures aimed at providing high-quality outcomes and guarantees that the product, service, or organization meets the necessary conditions or standards to achieve the desired quality. QA includes technical requirements and studies for ensuring quality. In healthcare services, quality assurance encompasses monitoring daily procedures to ensure accurate, timely, and comprehensive reporting, as well as the implementation of policies and procedures to prevent or promptly identify errors.

Total Quality Management (TQM) is a quality philosophy that has evolved over time and is widely regarded as a powerful tool for fostering a culture of quality, as it emphasizes leadership, communication, training, and continuous improvement. TQM was initially developed in the Japanese industry and later adopted by the U.S. Navy. It aims at a comprehensive approach to quality improvement at the levels of management, personnel, customer, organization, and resources. Donald Berwick, an American pediatrician, recognized the success of TQM theory and applied it to the U.S. healthcare sector, achieving significant results. The core principles of TQM applied in healthcare included a focus on the patient, the improvement of care processes, collaboration among professionals, and highlighted the importance of a dedicated leadership style.

According to data, over the past decades, it has been found that low-quality care is associated with significant economic and human burdens on healthcare systems worldwide, with the problem persisting despite more organizations than ever actively engaging in quality improvement. Specifically, the continuously increasing demand for accountability and transparency regarding the provision of increasingly expensive medical services has prompted providers to implement programs for continuous quality improvement aimed at optimizing care, enhancing efficiency, and ultimately achieving better patient satisfaction, improved patient-reported outcomes, and overall cost savings. Continuous quality improvement has been shown to lead to the delivery of high-quality patient care and is widely used to enhance patient care.

Healthcare systems face risks related to increasing demand, rising costs, inconsistency and poor-quality care, as well as inefficient and poorly coordinated care processes. In response to these risks, governments have developed various strategies, one of which involves investments in information and communication technologies (ICT) for health. The term used for the application of ICT in healthcare is e-health, which encompasses the adoption and integration of ICT across the healthcare sector. According to the World Health Organization, e-health is defined as the use of digital data that are electronically transmitted, stored, and retrieved to support healthcare both locally and remotely. E-health covers a range of technological areas and applications that electronically support the ordering of tests and medications, clinical decision-making, reporting of results, communication of essential health information, and the digital storage of images, photographs, and texts.

The use of ICT in healthcare is associated with multiple benefits, as it provides the potential to improve individual health and the performance of healthcare providers, offering enhanced quality, cost savings, and greater patient engagement in their own care. ICT for health also has the potential to dramatically transform healthcare delivery, making it safer, more effective, and more efficient, with a limited number of studies suggesting that ICT contributes to improving the quality of pediatric care. Specifically, studies indicate that the implementation of a multifunctional system can yield tangible benefits, including increased provision of guideline-based care (particularly in preventive health), enhanced monitoring and supervision activities, reduction of medication-related errors, and decreased rates of unnecessary or inappropriate care.

Advances in information and communication technologies have also led to the development and use of mobile information and communication technologies and their applications in healthcare and public health (mobile health). These mobile technologies can facilitate data collection and encourage healthcare consumers to adopt healthy lifestyles or self-manage chronic conditions. In particular, healthcare professionals use medical devices and applications for purposes that can mostly be grouped into five broad categories: administration, maintenance and access to health

records, communication and counseling services, reporting and data collection, and medical education. Robinson et al. (2016) conducted a systematic review to examine the impact of health information technologies (HIT) on surgical practice.

The review also provided sufficient evidence that alert systems within electronic health records (EHRs) can improve patient surgical care. The effects of these technologies on surgical practice were associated with improved quality of surgical documentation, increased adherence to medication administration guidelines, and enhancements in patient care through electronic provider alerts. Specifically, these alerts improved laboratory monitoring of transplant patients and prophylactic antibiotic administration in the operating room. Additionally, computerized provider order entry (CPOE) was effective in limiting the prescription of inappropriate postoperative prophylactic antibiotics beyond the recommended time frame by medical staff. The authors concluded that electronic alert systems could support a wide range of quality improvement activities in surgical care. Whitehead and Seaton (2016) investigated the effectiveness of mobile phone and tablet applications in the self-management of key symptoms in patients with chronic health conditions. Out of 893 documents retrieved from various databases, nine articles met all predefined criteria. They concluded that the use of mHealth applications is associated with improved health outcomes among chronically ill patients through enhanced symptom management.

Kruse et al. (2016) analyzed 15 peer-reviewed articles from four databases, focusing on issues of cost, quality, and access. Their study aimed to explore the use of telemedicine in rural U.S. populations, emphasizing cost, quality, and access as defined by the Affordable Care Act of 2010. They sought to identify potential solutions from existing literature to address existing challenges and improve cost, quality, and access for better healthcare service delivery in these populations. Their findings indicated that telemedicine reduces healthcare costs, which often impede access to high-quality care and, in some cases, prevent patients from seeking care. Telemedicine, therefore, provides these rural communities with access to healthcare without incurring high expenses.

However, their study also found that the quality of care provided via telemedicine is not always patient-centered or culturally appropriate. Specifically, the Indian Health Service (IHS) has achieved significant quality improvements in Native American health, with national life expectancy increasing from 63.6 to 72.5 years over 22 years. A primary factor in this improvement was the expansion of telemedicine resources, which enhanced patient access to specialists. While this relationship is not necessarily causal, the increase in life expectancy coincided with the implementation of telemedicine services in these communities. The introduction of telemedicine services was accompanied by notable improvements in health outcomes, including reductions in infant mortality, tuberculosis-related mortality, and unintentional injury rates between 1972 and 2004.

White et al. (2016) conducted a systematic review on “mobile health” interventions targeting healthcare workers in low-resource settings. Inclusion criteria for the review comprised studies focused on the use of mobile technology by healthcare professionals in low- and middle-income countries. The final review included 31 articles. Their review identified four main areas where mobile health innovations were used to improve healthcare delivery: data collection during care provision, communication between healthcare professionals and patients, communication between healthcare professionals and the healthcare system, and health surveillance activities. Overall, their findings demonstrated significant benefits for healthcare workers, their patients, and healthcare systems when mobile technology tools, such as smartphones and tablets, were employed. The use of mobile health tools improved communication between healthcare professionals and patients, as well as between healthcare professionals and supervisors. Additionally, the use of mobile health tools by healthcare professionals was associated with improved adherence to treatment protocols among patients and enhanced health outcomes. These tools were also successfully utilized in surveillance efforts to improve the quality and efficiency of data collection. The study highlighted multiple advantages of integrating mobile health into healthcare delivery and suggested that widespread adoption of these tools could contribute to overall improvement in healthcare quality and outcomes. However, the authors noted that further research is needed to understand whether and how mobile phone use translates into improved patient health outcomes and community-level health improvements.

Pedone and Lelli (2015) conducted a systematic review to examine the literature published between January 2005 and December 2014 on the effectiveness of telemedicine in managing chronic obstructive pulmonary disease (COPD), specifically regarding reductions in emergency department visits, hospital admissions, length of stay, mortality, and patient quality of life. Their review ultimately included 12 randomized controlled trials. The evidence on the effectiveness of telemedicine in COPD was insufficient to draw generalizable conclusions, as the studies were generally small and of low quality, with many lacking complete data for proper critical interpretation. Nevertheless, most available evidence indicated a positive impact of telemonitoring on outcomes, particularly regarding hospital

admissions and emergency department visits, although statistically significant results were limited. Telemedicine interventions did not show any impact on mortality, and despite reported high patient satisfaction, quality of life did not appear to improve significantly.

Brunton et al. (2015) conducted a systematic review and meta-analysis of published qualitative studies to investigate user experiences (patients, caregivers, and clinicians) with telemedicine technologies for managing COPD. Their review included seven studies, revealing both positive and negative experiences with telemedicine in COPD management. Findings suggested that telemedicine technologies could be beneficial compared to usual care alone (e.g., enhancing self-management, providing reassurance, and empowerment). However, the benefits could also be seen as burdens (e.g., increased dependency, workload). Patients were generally more positive toward telemedicine use than healthcare professionals, likely because most patients in the sample received enhanced care, with telemedicine supplementing usual care rather than replacing existing services.

Bashshur et al. (2015) reviewed available literature on the value of telemedicine interventions in diagnosing and managing dermatological conditions (teledermatology). Motivated by high prevalence, high costs, and limited dermatology access in some regions, they analyzed studies published between January 2005 and April 2015. Seventy-one publications met inclusion criteria. Findings revealed the lack of a universally accepted definition of teledermatology and that outcome measures included diagnostic agreement, treatment plans, and skin health. Despite these challenges, sufficient evidence supported teledermatology's effectiveness in improving access to specialist care, diagnostic and therapeutic concordance, and primary care management, while reducing costs. One study reported inadequate clinical outcomes for patients with pigmented skin lesions. Conversely, confocal microscopy and advanced dermoscopy improved diagnostic accuracy, especially when provided by experienced teledermatologists. Oyeyemi and Wynn (2015) examined the impact of mobile phones and radio communication systems on delays in receiving medical assistance for pregnant women in low- and middle-income countries. Their review included 15 articles and found that mobile phones can help reduce delays in care at various stages. However, few studies have addressed this issue, with heterogeneous designs and outcome measures.

Widmer et al. (2015) performed a systematic search of PubMed, MEDLINE, EMBASE, Web of Science, OVID, CINAHL, ERIC, PsychInfo, Cochrane, and CENTRAL from January 1, 1990, to January 21, 2014, including studies related to any digital health interventions (DHIs) (e.g., telemedicine, online strategies, email, mobile phones, mobile apps, text messaging, and monitoring sensors) and cardiovascular outcomes or risk factors. Two reviewers independently assessed study quality using a modified Cochrane Collaboration risk assessment tool. Results were extracted from 51 full-text articles meeting inclusion criteria. Their review and meta-analysis indicated that digital health interventions, compared to usual care, may reduce cardiovascular disease outcomes (RR = 0.61, 95% CI 0.45–0.83, P = .002; I^2 = 22%) and positively impact risk factors. Notably, the review observed nearly a 40% relative risk reduction in adverse cardiovascular outcomes, with particular effects on secondary prevention and patients with heart failure.

Kitsiou et al. (2015) conducted a systematic review aiming to collect, evaluate, and synthesize existing evidence from systematic reviews regarding the effectiveness of home telemonitoring interventions for patients with chronic heart failure, to inform policymakers, healthcare professionals, and researchers. A total of 15 articles published between 2003 and 2013 were included. Data from high-quality reviews, following meta-analysis, indicated that home telemonitoring interventions reduce the relative risk of all-cause mortality (0.60–0.85) and heart failure-related mortality (0.64–0.86) compared to usual care. Absolute risk reductions ranged from 1.4%–6.5% and 3.7%–8.2%, respectively. Improvements in heart failure-related hospitalizations were more pronounced in patients with stable heart failure (hazard ratio [HR] 0.70, 95% credible interval [CrI] 0.34–1.5). Reductions in all-cause mortality and hospitalization appeared greater for patients recently discharged (≤28 days) from acute care following a heart failure exacerbation (HR 0.62, 95% CrI 0.42–0.89 and HR 0.67, 95% CrI 0.42–0.97, respectively). However, the quality of evidence ranged from moderate to low, suggesting that further research could impact confidence in these estimates. The meta-analysis identified five primary types of non-invasive telemonitoring technologies included in the systematic reviews: (1) video consultations, with or without vital signs transmission, (2) mobile telemonitoring, (3) automated device-based telemonitoring, (4) interactive voice response, and (5) Internet-based telemonitoring. Only automated device-based telemonitoring and mobile telemonitoring were effective in reducing all-cause and heart failure-related mortality.

Kotb et al. (2015) conducted a systematic review comparing different telemedicine interventions for individuals with heart failure versus usual care. Structured telephone support reduced the odds of mortality (Odds Ratio [OR] 0.80; 95% CI 0.66–0.96) and heart failure-related hospitalization (OR 0.69; 95% CI 0.56–0.85) compared to usual care. Telemedicine interventions also reduced mortality (OR 0.53; 95% CI 0.36–0.80) and heart failure-related hospitalizations (OR 0.64; 95% CI 0.39–0.95). Interventions including ECG monitoring further reduced the odds of heart

failure-related hospitalizations (OR 0.71; 95% CI 0.52–0.98). Huang et al. (2015), in a systematic review of 18 studies published between 2000 and 2013, recommended the use of telecare for long-term management of patients with type 2 diabetes, as patients monitored through telecare demonstrated significantly improved outcomes and better glycemic control compared to those receiving in-person care.

Nuckols et al. (2014) evaluated the effectiveness of electronic order entry in reducing avoidable adverse drug events in hospital settings and found that electronic ordering was associated with over a 50% reduction in preventable medication-related injuries, errors, and adverse drug events compared to handwritten orders. Low et al. (2013) reviewed 57 articles to investigate the economic impact of health information technology, reporting that 75% indicated financial benefits for organizations using these technologies. Specifically, 46% reported cost savings, 11% revenue gains, and 19% a combination of cost savings and revenue gains. Common mechanisms for economic benefits included savings in administrative resources and staff, pharmaceutical costs, and increased revenue through improved billing.

Tele-emergency services provide real-time audio/video connections, typically between rural hospitals and a central urban emergency department. Mueller et al. (2014) conducted a systematic review to identify models of tele-emergency services and their outcomes. Of 334 unique references retrieved, 36 met inclusion criteria. Tele-emergency services were associated with reduced unnecessary patient transfers, reduced staffing needs, and significant cost savings. Real-time consultations helped stabilize severe trauma cases prior to hospital transfer, enhanced local provider skills, improved adherence to clinical protocols for stroke and myocardial infarction patients, and decreased morbidity and mortality compared to usual care.

Ammenwerth et al. (2012) conducted a systematic review to investigate the impact of electronic patient portals on patient care. The number of available controlled studies on patient portals was limited, and although portals are often discussed as tools for patient empowerment and quality improvement, insufficient evidence exists to support these claims. Wilcox and Adhikari (2012) examined the impact of telemedicine on critically ill patients. Of 865 references identified, 11 met inclusion criteria. Meta-analysis revealed that telemedicine, compared to standard care, was associated with lower ICU mortality (risk ratio [RR] 0.79, 95% CI 0.65–0.96, nine studies, n = 23,526, I^2 = 70%) and hospital morbidity (RR 0.83, 95% CI 0.73–0.94, nine studies, n = 47,943, I^2 = 72%). Reductions in hospital and ICU length of stay were statistically significant.

4. Conclusion

In recent decades, significant technological advances have taken place, and today there is real potential for applying these developments to improve the provision of healthcare worldwide. Healthcare providers across the globe are adopting various technologies in order to respond to the ever-increasing regulatory requirements for patient safety and care, the growing need to contain healthcare costs, as well as the demand for improving the quality of services, while at the same time maintaining the operational efficiency of healthcare organizations.

From this review, it becomes evident that a wide range of technological applications and systems can be utilized in the healthcare sector, contributing to the enhancement of parameters related to the quality of provided services. The findings of this review highlight the need for further investigation of the relationship between the use of technologies and the quality of healthcare services, as well as of the factors that are considered crucial for the effective and efficient implementation and use of such technologies in the modern and competitive healthcare environment.

With the aim of optimizing the quality of services provided to patients, decision-makers should be aware of the available technological advances and innovations and make use of the most appropriate technologies in each case, taking into consideration both the positive experiences of other countries and organizations that have implemented them, as well as the specific characteristics of their patients and the organizations they manage.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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