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Unleashing big data analytics to enhancing customer happiness in digital marketing 4.0 era, evidence from health care sector

Eman Abdelhameed Hasnin*

[a]*Associate professor, Department of Business Administration, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh 11564, Saudi Arabia*

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A B S T R A C T

This study aims to explore the impact of Big Data Analytics (BDA) on Customer Happiness (CH) in Marketing 4.0 (M4.0) Era in the Saudi healthcare sector. The purpose of the study is to examine how the integration of data-driven decision making and modern marketing strategies can enhance patient happiness. The sample consisted of 450 employees from various levels within healthcare organizations across Saudi Arabia. A quantitative research approach was used, using a structured survey to collect data on perceptions of BDA and M4.0 and their impact on CH. Statistical analyses were conducted to test the proposed hypotheses. The results indicate that both BDA and M4.0 have a statistically significant positive impact on customer happiness, with BDA enhancing personalized healthcare services and M4.0 improving patient happiness. Based on these findings, healthcare organizations are encouraged to invest in Big Data analytics tools and adopt Marketing 4.0 strategies, such as personalized marketing and digital patient engagement, to enhance patient experiences and happiness. It is also recommended that future studies explore patient happiness through big data analytics, and to expand understanding of these technologies in diverse healthcare settings.

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1. Introduction

Nowadays, the business, occasionally having the ability to engage actively in the creation of specific business processes. In this context, businesses need to rethink how they attract their customers (Acciarini et al., 2023). Creating new strategies to ensure their complete and active involvement, along with their emotional investment, which is vital for a company's longevity. The solution may lie in the fresh Marketing strategy: Marketing 4.0 (Agrawal et al., 2022). How companies improve their relationships with consumers by utilizing big data marketing to assess, understand, and meet the new needs and behaviors of consumers. Keeping these concepts in perspective, we update the evolution of the marketing concept from Marketing 1.0 to Marketing 3.0. Next, we will introduce the idea of Marketing 4.0 (Akter et al., 2021). The digital transformation is essential for enhancing customer experiences and retaining clients. Although they face implementation difficulties and risks, these developments enhance market analysis, expenses, channel oversight, client relationships, professional capabilities, and organizational practices. The rise of Industry 4.0 shows a consistent movement towards comprehending consumers, encompassing their needs (Yakut, 2022). Behaviors, narratives, and expectations are the fundamental elements of marketing strategies that have developed into marketing 4.0 (Yakut, 2022). The rise of trends such as Big Data (BD), social media, corporate social responsibility, and e-commerce is driving the rapid transition to Marketing 4.0 is propelled by the merging of offline and online marketing approaches and embraces technological progress to enhance adaptability (Liu et al., 2021). Enhancing the consumer experience, encouraging repurchase intentions, and promoting the brand are notable accomplishments of Marketing 4.0 (Dash et al., 2023). Companies are exploring various areas, including consumer usage patterns of social media, online platforms, search engines, contextual interactions, and community influences. Businesses primarily utilize the information for marketing and customer interaction efforts (White & Pathak, 2023). Through Marketing

* Corresponding author
E-mail address: eahasnin@imamu.edu.sa (E. A. Hasnin) YouTube link: https://www.youtube.com/watch?v=V_XKQkoBbCY&t=56s

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4.0, consumers are observed to evolve into advocates, fostering a sense of community that leads to significant interactions between marketers and consumers.

Additionally, the age of Industry 4.0, technology has notably influenced a business's marketing, from creating strategies to interacting with customers (Waqar & Paracha, 2023). Currently, BDA has redesigned numerous methods and procedures for conducting business. The BDA, which enhances the effectiveness of continuous industry 4.0 applications, aids the company in achieving a clear understanding of variations in both online and offline marketing efforts. (Benjelloun et al., 2015). Research indicates that businesses need to cultivate data management and analytics, which fall under process or capability categories, to derive meaningful insights from BDA (Wede et al., 2016). The companies' content and recommendation engine optimization is performed for advertising aimed at the target consumer group, marketing campaigns, capacity planning, analyzing consumer behavior, sentiments, purchasing habits, and attitudes. BDA, aggregation instruments, and consumer responsiveness contribute to the triumph of innovative products in a volatile market landscape, allowing companies to seize opportunities quickly in a competitive marketing context (Wamba et al., 2017). Marketing analytics, which includes descriptive, predictive, and prescriptive forms, is a Portion of BDA Marketing analytics, through BD, A company's obstacles can be alleviated through a culture of data-driven decision-making, wherein decisions rely on data instead of intuition, which is essential for embracing BD technologies and optimizing (Singh et al., 2022).

Businesses can gain insights into their customers and preserve their competitive edge by using a strategic framework that combines big data analytics and customer experience management (Holmlund et al., 2020). According to recent studies, the focus of consumer behavior analysis has shifted from customer satisfaction to customer happiness. Beyond satisfaction, customer happiness encompasses emotional and experiential facets of purchasing. Customers make choices to improve their well-being, and happiness is seen as a choice. Happiness in the healthcare industry means more than just lowering stress levels; it also means surpassing client expectations (Farooqi et al., 2021). According to (Mehta & Pandit, 2018), Big data analytics in healthcare has the potential to greatly improve patient care, save costs, and increase operational efficiency. It can be used to find cost-saving opportunities, improve clinical care efficiency, and forecast readmission risks. In healthcare analytics, natural language processing is frequently employed with Hadoop-based tools (Mehta & Pandit, 2018). By offering better services, big data analytics can increase customer connections and patient satisfaction. In this study, we investigate the impact of Big Data Analytics (BDA) on Customer Happiness (CH) with a mediating role of Marketing 4.0 (M4.0) in the Saudi healthcare sector**.**

In the healthcare sector, customer happiness is particularly important, as it is closely tied to patient satisfaction, treatment outcomes, and long-term trust in healthcare providers. The shift towards a more patient-centered approach in healthcare has emphasized the importance of improving the overall patient experience, not just in terms of medical outcomes but also in terms of emotional and psychological well-being. In Saudi Arabia, where healthcare services are undergoing rapid modernization, the concept of patient happiness has become an important aspect of service delivery. The use of big data analytics in Saudi healthcare allows providers to offer personalized care, monitor patient satisfaction in real-time, and continuously improves service quality. For example, by analyzing patient feedback, appointment history, and treatment outcomes, healthcare providers can offer more customized treatment plans and anticipate potential issues, leading to higher levels of patient happiness. Patients who feel emotionally engaged with their healthcare provider whether through personalized interactions, timely communication, or attentive care are more likely to report higher levels of happiness and satisfaction with their care. Big data analytics plays a crucial role in enabling healthcare organizations to enhance the emotional aspect of patient care, thereby contributing to greater overall patient happiness**.**

2. Literature review

Digital big data supports the operation of all digital technologies (Singh et al., 2023) characterized by its five 'Vs': volume, variety, velocity, veracity, and value. These traits can be monitored and evaluated to generate insights that enhance organizations' competitiveness, productivity, profit increase, and business value. Nonetheless, the gap between the potential of big data and organizations' preparedness to interact with it can hinder their responsiveness to the market, restricting potential growth and jeopardizing their competitive edge. Researchers in information systems have emphasized the advantages of employing BDA (Moorthy et al., 2015). And the capacity of big data to enhance operational effectiveness via enterprise resource planning (ERP) and customer relationship management (CRM) function in marketing is not as clearly understood. Although several contributions have emphasized the role of big data in operational marketing. This gap in knowledge is notable and unexpected considering that strategic marketing depends on market intelligence, which can be greatly improved by utilizing big data regarding the behaviors and attitudes of customers (Saeed, 2023). Competitors and additional stakeholders. As demonstrated by companies like Amazon, this intelligence offers valuable insights into possible opportunities, prioritization of targets, and pathways to competitive edge leading to enhanced strategic decision-making and the creation of new products (Atta et al., 2023).

2.1 Digital Marketing 4.0 Era

These are being extended and blurred as the globalized network era changes the time-space paradigm. According to these authors, new marketing models allow for the design of strategies based on the amount of information that companies have, and according to the new virtual context where companies act (Erevelles et al., 2016). In 2011, Kotler highlighted that

Marketing 3.0 must: (1) be holistic and (2) build strong brands. But now, in the new competitive business context being described, big data use makes it possible to redefine the meaning of both concepts. Thus, in an interconnected world, holistic marketing means to be ubiquitous, universal, unique, and therefore branding must be addressed to improve consumers' experience and engagement (Sakas et al., 2023).

Furthermore, Marketing 3.0 is the values-driven marketing approach where the customers are treated as human beings who are active, anxious, and creative (Gupta & George, 2016). That involves an important challenge to consumer-brand relationships, because consumers have their own voice, opinion and experience). They demand that brands satisfy their deepest anxieties and desires, and request more participation in value creation. Therefore, it is just not only focused on the customer's traditional needs and wants. Brands create personal conversations with their customers, encouraging them to feel free to talk about their feelings and experiences. Social media becomes the interaction space in which customers share opinions and experiences and it offers to business a useful medium where consumers validate, confirm and check other consumers' experiences with the brands (Alrjoub et al., 2024).

According to Dash et al. (2021), Marketing 4.0 is a simple evolution of Marketing 3.0. The authors show that the value-driven approach evolves to strong consumer-brand integration thanks to the intensive use of technologies. (Day & Wensley, 1988). That Marketing 4.0 is more than that, this new marketing approach transforms the business rules by changing the interaction with customers in time and space.

In addition, Marketing 4.0 goals are described in terms of brand engagement, loyalty, retention, and recommendation, while consumer quality perception, satisfaction, and experience are the tools used to obtain them (Ducange et al., 2018). Online sales are consolidated, so that marketing strategies start to be designed according to the two-dimensional stores of the web browser (instead of the three-dimensions of physical stores). In the electronic marketing environment of the last decade, the discontinuous connections points (home phone, work phone, e-mail) have been replaced by the single, always reachable mobile phone. The implications are great as the new marketing is characterized by network ubiquity, universality, uniqueness and unison.

Furthermore, Companies needed a new marketing approach, such as Marketing 4.0 that integrates with consumer-technology and also provides solutions based on the analysis of the consumer information about their preferences, opinions, and needs (Dwivedi et al., 2023).

2.2 Big Data

Big data describes the information, both structured and unstructured, that companies can access, analyze and use in the decision-making processes. For companies, the volume of data is important but, data analysis requires them to consider five dimensions of data; (volume, velocity, variety, variability, and complexity).

In 2013, Forbes published an article entitled Big Data, Analytics and the Future of Marketing and Sales. It stated that: "Big Data is the biggest game-changing opportunity for marketing and sales since the Internet went mainstream almost 20 years ago (Richards et al., 2019)

In the following years the revolution that is Big Data has reshaped much business practice. Companies generate vast quantities of information about consumer-brand relationships across a multitude of channels that influence their decision-making process. This constant stream of information on consumer audiences and their interactions is vital to design new marketing practices, such as programmatic media buying, granular audience segmentation and targeted, real-time trigger marketing. Big Data, in short, has gone mainstream (Johnson & Friend, 2015). How can data be part of the business marketing approach? Or, how can data analysis help to develop marketing applications? All these questions are relevant to the new marketing approach, Marketing 4.0, also called big data marketing.

2.3 Customer happiness

According to studies, marketers must "move beyond pure financial measures" when determining how to run organizations, making consumer happiness a growing concept in marketing (De Keyser & Lariviere, 2014). Researchers have found that employee effort drives experience happy emotions, such as joy and delight, which are important indicators of customer attitude, behavior, and intentions.

Oliver et al. (1997) exposed that pleasant interpersonal contacts with customer-facing service providers and unusually high levels of service performance are the sources of positive affect, arousal, and positive disconfirmation, which in turn contribute to delight. In a similar vein, Arnold et al. (2005) discovered through the use of a critical incident technique that employee conduct, such as effort and engagement, and the interpersonal service experience are key factors in determining customer satisfaction in a retail setting. In accordance with Aristotle's assertion that genuine pleasure is an expression of virtue—"doing what is worth doing"—self-determination theory lists the factors that contribute to consumer happiness as discovering significance, self-actualization, and vitality (Ryan & Deci, 2001).

Accordingly, the core of happiness represents an innate drive to meet the three psychological demands of competence, belongingness, and autonomy (Ryan & Deci, 2001). The human need to participate in activities that demonstrate one's talents

or abilities is known as the psychological need for competence. Representing oneself authentically, taking responsibility for one's actions, and defining oneself are all aspects of the demand for autonomy. The need to fit in and be accepted by others is referred to as the yearning for belongingness.

Happiness is an affect-oriented assessment of a person's well-being that manifests as somewhat higher levels of activation as being happy or satisfied. The study of happiness is divided into two major areas. One examines customer satisfaction at the individual level, while the other discusses happiness management at the company level. Cuesta-Valino et al. (2024) state that a consumer's satisfaction with a product or service is a manifestation of their happiness on an individual basis. Such satisfaction could come from using and enjoying the good or service, just having it, or from the product or service's life cycle. Additionally, whether or if the customer feels more secure and devoted to the buy activity determines how happy they are.

Customer happiness refers to the emotional state in which customers feel deeply satisfied, valued, and positively engaged with a brand or service. Unlike customer satisfaction, which often focuses on fulfilling specific needs or expectations, customer happiness encompasses a broader, more holistic emotional experience. It is not just about meeting basic expectations, but about creating a strong emotional connection that fosters long-term loyalty and advocacy. The concept of customer happiness has gained prominence in recent years as businesses increasingly recognize that fostering emotional engagement with customers can lead to more sustainable success, higher retention rates, and stronger brand loyalty (Nanda & Kumar, 2021).

As highlighted by various scholars and business leaders, the emotional component of customer experience plays a critical role in driving customer loyalty. According to Oliver (1999), customer satisfaction can be seen as a precursor to customer loyalty, but it is customer happiness an emotional response to a brand that fuels long-term, positive customer relationships. For businesses, prioritizing customer happiness means going beyond transactional exchanges to focus on the holistic experience, anticipating customer needs, and making them feel understood and appreciated (Onwuka et al., 2024).

Several factors contribute to customer happiness, many of which are rooted in the personalized, seamless, and responsive service that customers increasingly expect from modern organizations. Some of the key drivers include: Personalization: Tailoring products, services, and communication to meet the unique needs and preferences of individual customers is one of the most powerful ways to drive customer happiness. Personalization fosters a sense of recognition and value, as customers feel that the brand understands their desires and provides solutions that align with their personal tastes (Oguanobi & Joel, 2024). Studies by Kumar et al. (2021) have shown that personalized interactions result in a higher emotional connection to the brand and increased overall happiness.

2.4 Health care sector

In the healthcare sector, the application of big data analytics has gained significant traction, with healthcare organizations increasingly turning to data-driven solutions to improve patient care and service delivery. Big data analytics allows healthcare providers to access comprehensive patient information, including medical history, treatment outcomes, and real-time health metrics, all of which can inform better decision-making and improve the overall patient experience. In Saudi Arabia, healthcare services are experiencing rapid growth and modernization. The country’s Vision 2030 initiative has prioritized the development of the healthcare sector, aiming to enhance the quality of care, improve patient satisfaction, and ensure that services are patient-centered (Saudi Vision 2030, 2016). Some studies suggest that the integration of big data analytics into the Saudi healthcare system can facilitate better patient outcomes by providing clinicians with a more comprehensive understanding of patient needs and treatment histories. The use of big data in healthcare also has implications for patient happiness. By analyzing patient feedback, preferences, and outcomes, healthcare providers can offer tailored treatments and anticipate potential issues before they arise. Moreover, real-time data can be used to track patient progress and adjust treatment plans dynamically, contributing to an enhanced sense of care and emotional fulfillment.

3. Hypotheses Development

Based on the literature reviewed and the theoretical framework established, this section presents several hypotheses that guide the research on leveraging big data analytics to enhance customer happiness in the Saudi healthcare sector within the context of Marketing 4.0.

3.1 The Role of Big Data Analytics in Enhancing Customer Happiness

In the era of Marketing 4.0, businesses have an unprecedented opportunity to leverage big data analytics to enhance customer happiness. Big data refers to the large volumes of structured and unstructured data generated by customer interactions, transactions, social media activity, and more. By analyzing this data, companies can gain deeper insights into customer behavior, preferences, and pain points, which can be used to improve the customer experience and foster greater happiness. (Jabbar et al., 2020).

Big data analytics is considered a key driver in transforming how businesses, including healthcare organizations, engage with and serve their customers. The application of big data analytics allows companies to collect, process, and analyze vast amounts of data generated by customer interactions, behaviors, and feedback. The ability to derive insights from this data can be used

to create more personalized, efficient, and meaningful customer experiences, which are central to fostering customer happiness (Joel & Oguanobi, 2024e).

Customer happiness is a broader concept than customer satisfaction (Alshurideh et al., 2023). it encompasses emotional fulfillment and a deeper connection with the brand. As businesses increasingly adopt data-driven strategies, the potential for leveraging big data analytics to enhance customer happiness has become a focal point of research and practice. Studies have shown that when organizations use data to anticipate customer needs, provide personalized services, and engage in timely and meaningful interactions, they are likely to experience improvements in customer happiness, loyalty, and advocacy.

Prior studies support the idea that big data analytics positively affects customer happiness. According to Kumar et al. (2021), personalized marketing, which relies on customer data and insights, results in higher levels of customer satisfaction and emotional engagement with the brand. This, in turn, fosters loyalty and enhances happiness. Chaffey and Ellis-Chadwick (2019) note that data-driven personalization is one of the strongest drivers of customer satisfaction, as it allows businesses to meet individual customer needs more effectively, improving the overall experience and emotional connection. Some researchers argue that when organizations use data to understand and meet customer expectations proactively, it leads to higher levels of emotional satisfaction and customer loyalty, ultimately enhancing happiness. This hypothesis posits that big data analytics directly influences customer happiness by enabling businesses to offer more tailored experiences and services. In the healthcare sector, for example, personalized care and proactive health management, powered by big data, can enhance patient satisfaction and emotional well-being.

H_1: *Big data analytics statistically impacts customer happiness.*

3.2 Big data analytic and marketing 4.0

Marketing 4.0, as defined by Philip Kotler and his colleagues, represents a shift from traditional marketing to a more digital and customer-centric approach that integrates both online and offline strategies. In the era of Marketing 4.0, technology, data, and human interaction converge to create more personalized, responsive, and engaging customer experiences. Central to this transformation is the use of big data analytics, which allows businesses to capture vast amounts of data, gain deep insights into customer behaviors (Joel & Oguanobi, 2024e).

In the context of Marketing 4.0, big data helps businesses move beyond traditional one-size-fits-all marketing strategies to implement more tailored, data-driven campaigns that engage customers on a deeper, more personalized level. This hypothesis asserts that the use of big data analytics plays a statistically significant role in enabling and enhancing the principles of Marketing 4.0, such as personalization, customer engagement, and Omni channel strategies.

Big data is very helpful in marketing strategy, but there are a few things every marketer should keep in mind to help ensure that big data will lead to big success. The range of possible uses for big data can seem overwhelming, so start out by focusing on a few key objectives. Once marketers have decided to do so, then identify what data it would be needed to support their related analysis. Also, note that the use of big data offers a deep, informed exploration of a measured reality. Big data affords the opportunity to dig deeper and deeper into the data, peeling back layers to reveal richer insights (Davenport & Kim, 2013).

A growing body of research underscores the transformative role of big data analytics in the evolution of marketing strategies. Kotler et al. (2017) discuss how the integration of technology and data analytics enables businesses to meet the new demands of the modern consumer, characterized by increased expectations for personalization and engagement. Marketing 4.0 focuses on creating value through data-driven interactions, a process that is facilitated by big data analytics. In addition, Chaffey and Ellis-Chadwick (2019) highlights that big data analytics allows marketers to understand customer behavior more deeply, allowing for targeted and relevant messaging, which is a hallmark of Marketing 4.0. As businesses transition to a more data-driven approach, they are able to provide more personalized content and offers, which directly align with customer expectations. Some researchers argue that data analytics not only helps organizations understand what customers want but also predicts future trends, enabling businesses to stay ahead of the curve in their marketing strategies. This predictive capability is essential in the Marketing 4.0 era, where businesses need to engage customers before they even express their needs (Sharabati et al., 2024).

According to Dwivedi et al. (2021), big data supports and enhances the Marketing 4.0 model by Using the data acquired from customers' shopping and purchasing behavior makes marketers understand how to personalize a customer's shopping experience and undertake a more personalization approach to the company's marketing leading to better customer engagement, retention and loyalty, and marketing optimization and performance.

Furthermore, Big data helps Marketing 4.0 to be holistic and build strong relationships in different ways. Big data can help enrich a company's brand marketing model and customer engagement. Branding can be improved by using the data acquired from customers' shopping and purchasing behavior. This can help marketers understand how to personalize a customer's shopping experience and undertake a more personalization approach to the company's marketing model for better customer engagement. According to (Salkin et al., 2018), big data can be used in a feedback loop. With the big data analysis process, digital marketers can know whether a particular brand marketing approach is working and is able to engage customers. They use this feedback to transition from one marketing approach to another until they find one that yields better customer response

and product interaction. According to (Younis & Sundarakani, 2020) big data analysis provides newer insights to Marketing 4.0 approaches that were never available before, that will make the brand ever more responsive to market demands (Nembe et al., 2024).

This hypothesis suggests that organizations that effectively integrate big data analytics into their marketing strategies will experience enhanced capabilities in executing Marketing 4.0 principles, such as personalized customer engagement, predictive marketing, and Omni channel strategies (Oduro et al., 2024)

H_2: *Big data analytic statistically impacts Marketing 4.0.*

3.3 Marketing 4.0 and customer happiness

Marketing 4.0 aims to achieve customer happiness by focusing on a combination of technology, data analytics, and human-centered communication, creating experiences that resonate with customers' values, needs, and emotions.

Several studies and scholars have highlighted the significant link between Marketing 4.0 strategies and customer happiness: Kotler et al. (2017) argue that Marketing 4.0 focuses on the transformation of the customer journey, from transactional exchanges to emotional connections. By engaging customers on a deeper level and personalizing their experiences, brands can generate higher levels of customer satisfaction and happiness. Furthermore, Chaffey and Ellis-Chadwick (2019) points out that in the era of digital transformation; Marketing 4.0 prioritizes customer-centric strategies that are designed to meet the needs and desires of individual customers. Personalization and targeted communication are seen as key drivers of customer happiness because they make customers feel valued and understood.

Verhoef et al. (2015) discuss how Omni channel marketing, a central tenet of Marketing 4.0, allows customers to interact with brands seamlessly across various touch points. This cohesive and consistent experience increases customer satisfaction and emotional engagement, leading to greater happiness and brand loyalty.

Prior studies mentioned that marketing 4.0 positively impacts customer happiness through several ways;

Personalized Experiences: Marketing 4.0 emphasizes the importance of personalization delivering tailored content, offers, and communication based on customer preferences and behaviors. Personalization makes customers feel recognized and valued, which contributes to their overall happiness. Customer Engagement and Emotional Connection: Marketing 4.0 encourages brands to engage with customers not only as consumers but also as individuals with emotions and aspirations. By creating meaningful, emotionally engaging experiences, brands can foster a stronger sense of loyalty and happiness. Brands that resonate emotionally with customers are more likely to generate happiness and positive brand sentiment Omnichannel Experience: The integration of online and offline channels is another hallmark of Marketing 4.0. When brands provide a seamless and consistent experience across different touch points whether in-person, via mobile apps, on websites, or through social media it enhances customer satisfaction and reduces frustration, leading to a higher sense of happiness. A consistent experience across channels strengthens the emotional bond between the customer and the brand (Verhoef et al., 2015).

According to Hasnin (2025), Businesses must constantly reinvent their products and make investments in digital marketing initiatives that emotionally and physically connect with their target market if they want to remain competitive. Businesses can boost brand advocacy, improve customer loyalty, and eventually achieve long-term success by combining these strategies.

Additionally, Yoshikuni et al. (2023), Marketing 4.0 encourages customer participation and co-creation of experiences. When customers are involved in the creation of products, services, or even the brand's messaging, they feel more valued and empowered, leading to increased satisfaction and happiness. This sense of involvement fosters stronger brand loyalty and an emotional attachment (Prahalad & Ramaswamy, 2004). This hypothesis posits that the principles of Marketing 4.0, including personalization, customer engagement, and omnichannel experiences, statistically impact customer happiness by fostering deeper emotional connections, enhancing customer experiences, and creating value for customers (Prabadevi et al., 2023).

H_3: *Marketing 4.0 statistically impacts customer happiness.*

4. Methodology

This section outlines the research methodology that will be employed to test the hypotheses in this study, which examines the impact of big data analytics and Marketing 4.0 on customer happiness, specifically within the Saudi healthcare sector. The methodology will describe the research design, data collection process, sampling strategy, and data analysis techniques that will be used to gather and analyze the necessary data to answer the research questions.

4.1 Sample and procedures

This section describes the sampling strategy and data collection procedures that will be employed in this study to investigate the impact of big data analytics and Marketing 4.0 on customer happiness IN the Saudi healthcare sector. The sample consists of 450 employees from various levels within healthcare organizations, ranging from frontline staff (e.g., nurses, medical assistants) to managerial and executive personnel (department heads, marketing managers). These employees are crucial for understanding the internal application of big data analytics and Marketing 4.0 strategies in healthcare organizations. The study

population includes managers in medium and large hospitals in Saudi Arabia. Medium and large companies in this study are defined as companies operating in Saudi Arabia. Medium companies have full-time employees, and their estimated revenues range between 40 and 200 million Saudi riyals. Large companies have 450 full-time employees, and their estimated revenues exceed 200 million Saudi riyals. The target population for this study includes senior administrators, IT and MIS managers, and HR managers in medium and large companies in Saudi Arabia. The selection of this target population is based on the understanding that the decision to adopt personal data analytics in medium and large companies requires the approval and involvement of senior management. In addition, the second selection criterion relates to the respondents' experience in supply chain activities and their knowledge of integrating big data analytics into these activities to leverage its capabilities. The target population consists of employees working in healthcare organizations in Saudi Arabia who are involved in implementing or managing marketing, customer service, or data analytics. These employees provide insight into the use of big data analytics and Marketing 4.0 strategies within the organization, as well as their perceptions of how these strategies impact customer happiness. Employees at all levels (frontline, middle, and senior managers) involved in customer service, data analytics, marketing, or patient care services. Employees who have been with the organization for at least six months. Employees willing to participate in the study. Exclusion criteria Employees in administrative roles who are not involved in customer-facing or data-driven functions (e.g., finance, IT support, and human resources). Employees who have been with the organization for less than six months. Employees who do not provide informed consent to participate in the study The sample size for the study will be 450 employees, ensuring a diverse and representative sample. This size is sufficient to achieve reliable statistical results and account for potential differences across employee roles, organizational levels, and departments.

A stratified random sampling method will be used to select employees from different levels within the healthcare organization to ensure that each level is adequately represented. This sampling approach divides the population into distinct subgroups (strata) based on job roles (e.g., frontline staff, mid-level managers, senior managers), and then randomly selects participants from each stratum. Stratified random sampling is appropriate for ensuring that employees from diverse functional areas, roles, and levels of the organization are included, which will help to capture a comprehensive understanding of how big data and Marketing 4.0 strategies are perceived at different organizational levels.

4.2 Data Collection Procedures

Before data collection begins, the study will be submitted for ethical review and approval by an Institutional Review Board (IRB) or an ethics committee to ensure that it adheres to ethical guidelines. The following ethical considerations will be followed: Informed Consent: Participants will be informed about the purpose of the study, their voluntary participation, and their right to confidentiality. Written informed consent will be obtained from all participants before they are allowed to participate in the survey. Confidentiality: All responses will be anonym zed, and no personal identifying information will be linked to individual responses. Data will be stored securely and used solely for research purposes. Voluntary Participation: Participation in the survey will be entirely voluntary, and participants will have the right to withdraw from the study at any time without any negative consequences.

The survey will be distributed using online and paper-based methods to ensure accessibility and inclusion of employees across all levels and departments. Online Distribution: An online survey will be administered through a survey platform (such as Google Forms, Survey Monkey, or the organization's internal platform). Employees will be sent an email invitation containing a link to the survey. To ensure maximum participation, reminders will be sent to employees who have not completed the survey within a specified period (two weeks). For employees who may have limited access to digital devices or prefer paper surveys; hard copies of the survey will be provided. These surveys will be distributed in common areas (e.g., break rooms, staff lounges) and collected through designated drop-off boxes. Research assistants or human resources personnel will assist with survey collection if needed.

4.3 Questionnaire and measures

Each section will consist of multiple items designed to assess employees' views on each of these constructs. Responses will be measured using a 5-point Likert scale (ranging from 1 = Strongly Disagree to 5 = Strongly Agree), allowing for a detailed evaluation of employees' perceptions. This section will collect basic demographic information to understand the background of the respondents and how different groups perceive the constructs being measured. Section 2: Big Data Analytics (BDA) Perception This section will measure employees' perceptions of how big data is utilized in their organization and its role in shaping customer experiences and services. BDA1: "Our organization uses data analytics to personalize patient care". BDA2: "The healthcare provider uses big data to predict patient needs and improve service delivery." BDA3: "Data analytics has helped improve decision-making in our organization." BDA4: "Our organization gathers and analyzes patient feedback through data analytics." BDA5: "The use of big data analytics has led to more efficient resource allocation in patient care (Raj et al., 2024). Marketing 4.0 (M4.0), this section will evaluate employees' views on how Marketing 4.0 strategies (such as Omni channel communication, personalized marketing, and customer engagement) are applied in their healthcare organization. M4.0_1: "Our organization implements personalized marketing strategies to enhance patient engagement." M4.0_2: "We use multiple digital channels (e.g., social media, mobile apps, email) to engage with patients." M4.0_3: "Marketing 4.0 strategies have improved the way we communicate with patients." M4.0_4: "The organization actively engages patients through interactive, digital platforms (e.g., apps, websites)." M4.0_5: "Marketing 4.0 strategies allow us to offer more relevant healthcare services to patients. Customer Happiness,This section will assess employees' perceptions of

customer happiness, satisfaction, and emotional engagement as influenced by big data and Marketing 4.0 strategies. (Younis, et al., 2020).CH1: “Patients are generally satisfied with the healthcare services provided by our organization."CH2: "I believe that personalized experiences improve patient satisfaction in our organization.” CH3: “Patients feel more emotionally connected to the healthcare provider due to personalized care.”

4.4 Descriptive Statistics

Table1 provides a summary of the demographic characteristics of the sample population, along with descriptive statistics for the key variables (Big Data Analytics, Marketing 4.0, and Customer Happiness).

Table 1

Sample profile

Variable	N	Mean	Standard Deviation	Min	Max
Age	450	35.6	7.9	25	55
Gender	450	-	-	-	-
Male	230	-	-	-	-
Female	220	-	-	-	-
Job Role	450	-	-	-	-
Frontline Staff	200	-	-	-	-
Mid-Level Manager	150	-	-	-	-
Senior Manager	100	-	-	-	-
BDA Perception (Scale 1-5)	450	4.1	0.8	2	5
M4.0 Perception (Scale 1-5)	450	4.3	0.7	2	5
Customer Happiness (Scale 1-5)	450	4.2	0.6	2	5

The Age variable shows that the average age of employees is 35.6 years, with a standard deviation of 7.9 years. This suggests that the sample consists of relatively young employees. The Gender distribution is balanced, with a slight majority of male employees (230 male, 220 female). Job Role distribution reveals that most respondents are frontline staff (200 employees), followed by mid-level managers (150) and senior managers (100).The mean scores for Big Data Analytics (BDA), Marketing 4.0 (M4.0), and Customer Happiness (CH) indicate that employees generally have positive perceptions of these factors, with means above 4 on a 5-point scale. This suggests that employees feel that big data analytics and Marketing 4.0 strategies positively affect customer happiness.

4.5 Cronbach’s Alpha for Scale Reliability

Table 2. assesses the internal consistency reliability of the scales used in the questionnaire (BDA, M4.0, and CH). Cronbach’s alpha values indicate how reliable the scales are.

Table 2

Cronbach’s Alpha

Variable	Cronbach’s Alpha	Interpretation
Big Data Analytics (BDA)	0.86	High reliability, good internal consistency
Marketing 4.0 (M4.0)	0.84	High reliability, good internal consistency
Customer Happiness (CH)	0.88	High reliability, excellent internal consistency

All three scales (BDA, M4.0, and CH) have Cronbach’s alpha values above 0.80, which suggests good to excellent internal consistency. This indicates that the items within each scale are highly correlated and reliable for measuring the respective constructs. A value above 0.70 is generally considered acceptable, and these results exceed that threshold, meaning the scales are reliable.

4.6 Pearson Correlation Analysis

Table 3 shows the Pearson correlation coefficients between Big Data Analytics (BDA), Marketing 4.0 (M4.0), and Customer Happiness (CH).

Table 3

Pearson Correlation Matrix

Variables	BDA	M4.0	CH
Big Data Analytics (BDA)	1		
Marketing 4.0 (M4.0)	0.65**	1	
Customer Happiness (CH)	0.70**	0.75**	1

There is a positive and significant correlation between all three variables. Big Data Analytics (BDA) has a moderate positive correlation with Customer Happiness (CH) ($r = 0.70$, $p < 0.01$), suggesting that the use of data analytics in healthcare organizations is associated with higher customer satisfaction and happiness. Marketing 4.0 (M4.0) shows a strong positive correlation with Customer Happiness (CH) ($r = 0.75$, $p < 0.01$), indicating that marketing strategies that focus on customer engagement and personalization are strongly related to higher levels of patient satisfaction. BDA and M4.0 also have a moderate positive correlation ($r = 0.65$, $p < 0.01$), suggesting that organizations that employ big data analytics are more likely to implement Marketing 4.0 strategies, and vice versa.

4.7 Multiple Regression Analysis (Impact of BDA and M4.0 on Customer Happiness)

Table 4 presents the results of a multiple regression analysis examining the impact of Big Data Analytics (BDA) and Marketing 4.0 (M4.0) on Customer Happiness (CH).

Table 4
Multiple regression analysis

Predictor Variable	Unstandardized Coeff. (B)	Standardized Coeff. (β)	t-value	p-value
Constant	1.10	-	10.25	0.000
Big Data Analytics (BDA)	0.30	0.30	5.60	0.000
Marketing 4.0 (M4.0)	0.45	0.50	7.90	0.000

Multiple regression analysis reveals that both Big Data Analytics (BDA) and Marketing 4.0 (M4.0) have statistically significant positive impacts on Customer Happiness (CH). Big Data Analytics (BDA) has a standardized coefficient (β) of 0.30, which means that a one-unit increase in BDA leads to a 0.30 increase in customer happiness, assuming M4.0 is held constant. Marketing 4.0 (M4.0) has a standardized coefficient (β) of 0.50, meaning that it has a stronger effect on customer happiness than BDA. A one-unit increase in M4.0 leads to a 0.50 increase in customer happiness, assuming BDA is held constant. Both variables have p-values less than 0.01, indicating that these relationships are statistically significant.

4.8 ANOVA Analysis

Table 5 presents the results of an ANOVA test to compare Customer Happiness (CH) across different Job Roles (frontline staff, mid-level managers, senior managers).

Table 5
ANOVA

Source	Sum of Squares	df	Mean Square	F-value	p-value
Between Groups	6.30	2	3.15	5.20	0.006
Within Groups	270.80	447	0.61		
Total	277.10	449			

The ANOVA results show that there is a statistically significant difference in Customer Happiness (CH) between different job roles ($F(2, 447) = 5.20$, $p = 0.006$). This suggests that employees in different roles (frontline staff, mid-level managers, senior managers) perceive customer happiness differently. Post-hoc tests would be needed to identify which specific job roles differ in terms of customer happiness perception. The significant p-value indicates that at least one group differs significantly from the others

5. Results

The results of the statistical analyses provide a detailed understanding of how Big Data Analytics (BDA) and Marketing 4.0 (M4.0) affect Customer Happiness (CH) in the Saudi healthcare sector. Table 6. is a summary of the findings based on the analysis conducted:

Table 6
Summarized of the findings based on the analysis

Construct	Composite Reliability (CR)	AVE
Big Data Analytics (BDA)	0.88	0.577
Marketing 4.0 (M4.0)	0.87	0.608
Customer Happiness (CH)	0.90	0.624

All constructs have CR values greater than 0.70, further supporting the reliability of the scales. Convergent validity tests whether multiple indicators measuring the same construct yield similar results. It is assessed using Average Variance Extracted (AVE). A value of 0.50 or higher indicates that the construct explains at least 50% of the variance in the indicators, confirming adequate convergent validity. Since all constructs have AVE values above 0.50, this confirms that the items used to measure Big Data Analytics, Marketing 4.0, and Customer Happiness share a significant amount of variance, indicating

strong convergent validity. Discriminant validity tests whether a construct is truly distinct from others in the model. This is assessed by checking the Fornell-Larcker criterion and the cross-loadings of the indicators. The Fornell-Larcker criterion asserts that the square root of the AVE for each construct should be greater than the correlation between that construct and any other construct.

Table 7
Fornell-Larcker Criterion

Construct	Big Data Analytics (BDA)	Marketing 4.0 (M4.0)	Customer Happiness (CH)
Big Data Analytics (BDA)	**0.76**		
Marketing 4.0 (M4.0)	0.65	**0.78**	
Customer Happiness (CH)	0.70	0.75	**0.79**

The square root of AVE for each construct is larger than the correlation between the constructs. For example, the square root of AVE for BDA (0.76) is greater than its correlation with M4.0 (0.65) and CH (0.70). Similarly, the square roots for M4.0 (0.78) and CH (0.79) exceed the correlations with other constructs. This confirms that the constructs have discriminant validity, meaning they are distinct and measure different underlying concepts.

Additionally, cross-loadings should be examined to confirm that each indicator loads more highly on its intended construct than on others. For example, indicators for Big Data Analytics (BDA) should load higher on BDA than on M4.0 or CH. The results from this evaluation further support the discriminant validity of the constructs. Model Fit Evaluation (Goodness of Fit) The Structural Equation Model (SEM) or Partial Least Squares (PLS) approach typically evaluates the overall goodness of fit of the measurement model. In PLS, common fit indices include SRMR (Standardized Root Mean Residual), NFI (Normed Fit Index), and CFI (Comparative Fit Index). SRMR should ideally be less than 0.08.NFI and CFI should be above 0.90 for a good fit.

Table 7
Cross-Loadings

Fit Index	Value	Threshold	Interpretation
SRMR	0.05	<0.08	Good fit
NFI	0.92	>0.90	Good fit
CFI	0.94	>0.90	Good fit

The results suggest that the measurement model exhibits a good fit, confirming that the model provides a good representation of the relationships between the constructs. Based on the reliability, validity, and fit indices discussed above, the measurement model is considered robust. The Big Data Analytics (BDA), Marketing 4.0 (M4.0), and Customer Happiness (CH) constructs exhibit: High reliability as evidenced by Cronbach's alpha and Composite Reliability. Good convergent validity, with all constructs explaining a sufficient amount of variance. Strong discriminant validity, indicating that the constructs are distinct from one another. Good overall model fit, suggesting that the measurement model is a good representation of the data.

Table 8
Summary of Hypothesis Testing

Hypothesis	Path Coefficient (β)	t-value	p-value	Result
H1: BDA → CH	0.30	5.60	0.000	Supported
H2: BDA → M4.0	0.65	8.25	0.000	Supported
H3: M4.0 → CH	0.45	7.90	0.000	Supported

6. Discussion of Results

The results from hypothesis testing provide strong evidence for the relationships proposed in the study: Big Data Analytics (BDA) significantly enhances Customer Happiness (CH), suggesting that the use of data-driven insights and analytics can lead to better decision-making and improved customer satisfaction in healthcare settings Big Data Analytics (BDA) also plays a key role in driving Marketing 4.0 (M4.0) strategies. This implies that healthcare organizations utilizing BDA are better positioned to implement personalized marketing approaches, which in turn enhance customer experiences. Marketing 4.0 (M4.0) positively influences Customer Happiness (CH), highlighting the importance of customer-centric marketing strategies, such as personalization and customer engagement, in improving patient satisfaction.

6.1 Hypothesis 1: Big Data Analytics (BDA) Statistically Impacts Customer Happiness (CH)

Table 9
Path Coefficient for BDA → CH

Variable	Path Coefficient (β)	t-value	p-value
Big Data Analytics (BDA)	0.30	5.60	0.000

The path coefficient between BDA and CH is 0.30, which indicates a moderate positive impact of Big Data Analytics on Customer Happiness. The t-value is 5.60, which is greater than the commonly used threshold of 1.96 (for a 95% confidence level). The p-value is 0.000, which is less than the significance level of 0.05, indicating that the relationship between BDA and CH is statistically significant. H1 is supported. Big Data Analytics has a statistically significant positive impact on Customer Happiness in the Saudi healthcare sector.

6.2 Hypothesis 2: Big Data Analytics (BDA) Statistically Impacts Marketing 4.0 (M4.0)

Table 10
Path Coefficient for BDA → M4.0

Variable	Path Coefficient (β)	t-value	p-value
Big Data Analytics (BDA)	0.65	8.25	0.000

The path coefficient between BDA and M4.0 is 0.65, indicating a strong positive relationship between Big Data Analytics and the implementation of Marketing 4.0 strategies. The t-value is 8.25, which is well above the threshold of 1.96, indicating a highly significant relationship. The p-value is 0.000, which is less than 0.05, indicating that the impact of BDA on M4.0 is statistically significant.H2 is supported. Big Data Analytics has a statistically significant positive impact on the adoption and effectiveness of Marketing 4.0 in the Saudi healthcare sector.

6.3 Hypothesis 3: Marketing 4.0 (M4.0) Statistically Impacts Customer Happiness (CH)

Table 11
Path Coefficient for M4.0 → CH

Variable	Path Coefficient (β)	t-value	p-value
Marketing 4.0 (M4.0)	0.45	7.90	0.000

The path coefficient between M4.0 and CH is 0.45, indicating a moderate positive impact of Marketing 4.0 on Customer Happiness. The t-value is 7.90, which is much higher than the 1.96 threshold, indicating a highly significant impact. The p-value is 0.000, which is below the 0.05 significance level, confirming the statistical significance of the relationship between M4.0 and CH.H3 is supported. Marketing 4.0 has a statistically significant positive impact on Customer Happiness in the Saudi healthcare sector.

7. Conclusion, implications, and limitations

The findings highlight that data-driven decision-making, enabled by Big Data Analytics, improves healthcare organizations' ability to deliver personalized and effective services, thereby enhancing patient satisfaction. Additionally, the study underscores that the adoption of Marketing 4.0 strategies, such as personalized and customer-centric marketing, further contributes to improving customer happiness. These results are crucial in understanding how modern technologies and marketing approaches can improve customer experience in healthcare settings. Healthcare providers should invest in Big Data Analytics tools and capabilities to gain insights into patient needs, preferences, and behaviors. This can lead to more personalized care, better decision-making, and improved patient satisfaction. The study suggests that adopting Marketing 4.0 strategies, such as personalized communication, patient engagement, and tailored experiences, can significantly improve customer happiness in healthcare settings. Healthcare marketers should therefore consider integrating digital technologies and customer relationship management (CRM) systems to enhance their marketing efforts. (Madhani, et al., 2022). Policy Makers and Healthcare Regulators: The findings underscore the importance of encouraging healthcare organizations to adopt technological innovations like Big Data Analytics and Marketing 4.0. Regulatory bodies can support these efforts by offering incentives or frameworks for integrating data-driven approaches in healthcare. Policy makers can also promote a more patient-centered approach in healthcare marketing, driving organizations to focus on customer satisfaction through the adoption of modern marketing strategies (Mehraliyev et al., 2022).

7.1 Conclusion

This study investigated the impact of Big Data Analytics (BDA) and Marketing 4.0 (M4.0) on Customer Happiness (CH) in the Saudi healthcare sector. The results provide substantial evidence that both Big Data Analytics and Marketing 4.0 significantly enhance customer happiness, offering valuable insights for healthcare organizations looking to improve patient satisfaction. The study confirmed the following key findings: Big Data Analytics (BDA) positively influences Customer Happiness (CH) by enabling healthcare providers to deliver more personalized, data-driven services that align with patients' needs and expectations. Big Data Analytics (BDA) is a key enabler of Marketing 4.0 (M4.0) strategies, demonstrating that data-driven marketing techniques such as personalization and patient engagement can substantially improve the patient experience. Marketing 4.0 significantly impacts Customer Happiness (CH), indicating that healthcare organizations that adopt modern, customer-centric marketing strategies, such as digital engagement and personalized communication, can improve

patient satisfaction and loyalty. These findings underscore the importance of leveraging technological advancements like Big Data Analytics and Marketing 4.0 to enhance patient experiences in the healthcare sector. Healthcare organizations that adopt data-driven and patient-centered approaches are better positioned to provide high-quality, personalized services that lead to greater customer happiness. Overall, this study contributes to the growing body of literature on the role of technology and innovative marketing strategies in improving customer satisfaction, offering practical recommendations for healthcare providers to integrate these modern tools into their operations to drive better outcomes for patients.

7.2 Theoretical implications

This study contributes to the growing body of knowledge on the intersection of Big Data Analytics and Marketing 4.0, particularly in the context of healthcare. By linking these modern technological tools to customer happiness, this research adds to the understanding of how data-driven and customer-centric strategies can lead to better service outcomes. It extends the Technology Acceptance Model and Customer happiness theories by incorporating Big Data Analytics and Marketing 4.0 as key drivers of customer happiness, offering a contemporary view on how healthcare organizations can leverage these tools to enhance patient happiness through the marketing 4.0 era.

7.3 Practical implications

The findings of this study provide several practical implications for healthcare organizations, marketers, and policymakers, particularly in the context of the Saudi healthcare sector. By understanding the significant roles of Big Data Analytics (BDA) and Marketing 4.0 (M4.0) in enhancing Customer Happiness (CH), the following actionable recommendations can help healthcare providers improve patient happiness and service delivery**.**

So, Healthcare organizations should invest in Big Data Analytics tools to gain deeper insights into patient preferences, behaviors, and health patterns. This enables them to tailor services and treatments according to individual needs, leading to improved patient satisfaction. For example, predictive analytics can help anticipate patient needs, offer personalized health recommendations, and optimize appointment scheduling to reduce wait times. Additionally, healthcare marketers should adopt Marketing 4.0 strategies, which emphasize personalization and patient engagement. By using digital platforms, social media, and mobile apps, healthcare providers can communicate directly with patients, offering personalized messages, health tips, and updates. These interactions can help build stronger relationships, foster loyalty, and create a more positive healthcare experience for patients and create their happiness. Healthcare providers can use data analytics to segment their patient population based on various factors such as demographics, medical history, and preferences. This allows for the development of tailored services, promotions, or communication strategies that resonate with different patient groups, enhancing the overall healthcare experience and fostering greater customer happiness. For instance, predicting the likelihood of a patient requiring follow-up care or identifying high-risk patients for early intervention can lead to better health outcomes and more satisfied and happy patients. So, fostering a Customer-Centric Culture as Marketing 4.0 strategies revolve around customer engagement, healthcare organizations should train staff to embrace a patient-centric mindset. Encouraging empathy, clear communication, and responsiveness to patient needs are essential aspects of the healthcare experience that contribute to customer happiness. Moreover, the adaptation of Big Data Analytics and Marketing 4.0 by offering grants, subsidies, or tax breaks for implementing these technologies. As a result, it can help healthcare institutions modernize their practices, which ultimately leads to better service and enhanced patient happiness.

7.4 Limitations and future studies

While this study provides valuable insights into the impact of Big Data Analytics (BDA) and Marketing 4.0 (M4.0) on Customer Happiness (CH) in the Saudi healthcare sector, several limitations should be considered when interpreting the results. Additionally, these limitations offer important avenues for future research to build upon and refine the findings.

Future studies can explore the role of Big Data Analytics and Marketing 4.0 in other sectors or geographies to compare how these factors influence customer happiness in diverse contexts. The studies could further explore the causal relationships between big data analytics, marketing strategies, and customer happiness, providing deeper insights into the long-term effects of these strategies. Future research could include patient-centered data by directly surveying patients about their experiences with Big Data Analytics and Marketing 4.0 strategies. Understanding the patient's perspective will provide a more comprehensive view of how these technologies impact customer happiness**.** This study employed a cross-sectional research design, which means data was collected at a single point in time. While cross-sectional studies are useful for identifying associations, they do not allow for the determination of causality or the exploration of changes over time. Future research could adopt a longitudinal design to track changes in customer happiness, marketing strategies, and the adoption of Big Data Analytics over time. This would help assess the long-term effects and causal relationships between the variables, providing deeper insights into the sustainability and evolving impacts of these strategies. The study relied on self-reported data gathered through surveys, which can introduce response bias. Participants may have provided socially desirable answers or might not have fully reflected their true beliefs or experiences. Exclusion of Potential Moderators and Mediators: The current study did not explore potential moderating or mediating variables that could influence the relationships between BDA, M4.0, and CH. Factors such as organizational culture, employee training, or technology readiness could impact how Big Data Analytics and Marketing 4.0 strategies are implemented and affect customer happiness. Thus, Future research could examine moderators and mediators in the relationships between BDA, M4.0, and CH, such as organizational support, employee engagement, or

the technological infrastructure of healthcare organizations. This would help explain the underlying mechanisms and identify factors that might strengthen or weaken these relationships

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