



The influence of customer relationship management and service quality on customer loyalty in the medical equipment business

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Abstract

The medical equipment business faces increasing competition and changing customer expectations, making customer relationship management and service quality important factors in maintaining customer loyalty. Customers increasingly expect reliable products, professional consultation, responsive communication, technical support, and effective after-sales service. Therefore, this study aimed to examine the influence of customer relationship management and service quality on customer loyalty in the medical equipment business. A quantitative research design was employed, and data were collected from 400 customers using a structured questionnaire. The data were analyzed using descriptive statistics, an independent-samples t-test, one-way analysis of variance, and multiple regression analysis. The results indicated that customer relationship management, service quality, and customer loyalty were perceived at high levels. Customer loyalty differed significantly according to age and educational level, whereas gender and income were not statistically significant. The regression analysis showed that customer relationship management had a statistically significant influence on customer loyalty. Service quality also had a statistically significant influence on customer loyalty. Among the service quality dimensions, tangibility, reliability, responsiveness, and assurance were significant predictors of customer loyalty, whereas empathy was not statistically significant. The findings imply that medical equipment businesses should strengthen customer relationship management through continuous communication, customer follow-up, understanding customer requirements, and value-added services. Organizations should also improve service reliability, responsiveness, assurance, technical knowledge, and professional service delivery. These practices can strengthen customer confidence, encourage repeat purchasing, develop long-term relationships, and enhance customer loyalty and sustainable competitiveness in the medical equipment business.

Keywords:

Customer loyalty
Customer relationship management
Customer relationships
Medical equipment business
Service quality.

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Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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1. Introduction

1.1. Background and Importance of the Problem

At the global level, the healthcare sector has become increasingly important as countries face demographic changes, population aging, and the growing prevalence of non-communicable diseases. These developments have increased demand for healthcare services and medical technologies that support diagnosis, treatment, monitoring, and patient care. Medical equipment has therefore become an essential component of modern healthcare systems. At the same time, technological development has resulted in increasingly sophisticated and specialized medical equipment, requiring healthcare organizations to consider not only product quality but also technical consultation, installation, maintenance, and after-sales support. As competition among medical equipment suppliers increases, organizations cannot rely solely on product characteristics or price. Building long-term customer relationships and providing consistent service quality have become important strategies for maintaining customers and developing sustainable business relationships (Grönroos, 2000). Customer relationship management (CRM) has consequently become an important strategic approach for organizations seeking to develop long-term relationships with customers. CRM involves systematically managing customer information, understanding customer needs, creating customer value, and maintaining continuous interaction with customers. Effective CRM can help organizations improve customer satisfaction, strengthen relationships, and encourage customer loyalty (Kumar & Reinartz, 2006). In addition, service quality is an important factor influencing customers' evaluations of an organization and their subsequent behavioral intentions. When customers perceive that services are reliable, responsive, and capable of meeting their expectations, they are more likely to maintain their relationship with the organization. Therefore, CRM and service quality are important considerations for businesses seeking to achieve sustainable customer loyalty.

At the regional level, businesses in Asian markets have experienced increasing competition and changing customer expectations. Customers increasingly expect organizations to provide reliable communication, personalized attention, professional assistance, and continuous support throughout the customer relationship. This trend is particularly important in businesses involving specialized products and services, where customers require information and assistance before, during, and after purchasing. Service quality therefore plays an important role in strengthening customer relationships and influencing customer loyalty. Previous research conducted in various Asian business contexts has demonstrated relationships among CRM, service quality, customer satisfaction, and customer loyalty, including studies in retail, coffee shops, supermarkets, logistics, and other service businesses (Grihani & Kusumadewi, 2021; Sehani & Hettiarachchy, 2022). At the Thailand level, the healthcare sector has become increasingly important as demographic changes and the prevalence of non-communicable diseases contribute to growing healthcare needs. The increasing demand for healthcare services has also increased the importance of medical equipment in supporting healthcare providers and patients. Medical equipment businesses in Thailand operate in a competitive environment in which customers require reliable products, appropriate technical information, professional consultation, and effective after-sales services. Therefore, suppliers need to develop strategies that go beyond completing individual sales transactions and instead focus on maintaining continuous and mutually beneficial relationships with customers.

CRM is particularly important in the Thai medical equipment business because customers often require continuing support after purchasing equipment. Salespersons may be responsible for providing product information, technical consultation, installation guidance, maintenance coordination, and follow-up services. Their ability to respond to customer requirements and provide reliable assistance can influence customer perceptions of the organization. Similarly, CRM activities can help organizations understand customer requirements, provide additional value, maintain communication, and strengthen long-term relationships. Previous studies in Thailand have found that CRM and service quality are associated with customer loyalty in several business contexts, including coffee shops, logistics operations, social-media services, and tire service centers (Jidapa, Pramet, & Taweep, 2022; Thanyasuda Sathiwongmas, 2026). At the case-study level, the medical equipment business represents a particularly important context for examining customer loyalty because the relationship between suppliers and customers often extends beyond the initial purchase. Medical equipment may involve specialized technical requirements, relatively high purchasing considerations, installation, maintenance, training, and continuing technical support. As a result, customers may evaluate

suppliers based not only on the products they purchase but also on the quality of the relationship and services they receive. Salespersons have an especially important role because they frequently serve as the primary point of contact between the organization and its customers. Professional knowledge, responsiveness, reliability, and the ability to provide appropriate assistance can influence customer confidence and satisfaction.

However, medical equipment businesses may encounter difficulties in maintaining customer relationships, such as inadequate customer information, limited coordination between sales and service departments, insufficient technical knowledge, inconsistent follow-up, and an emphasis on short-term sales performance. These issues may reduce the organization's ability to understand customer needs and provide continuous support. As a result, customers may become less satisfied and less willing to maintain long-term relationships with the organization. Effective CRM and high-quality salesperson service are therefore important mechanisms for strengthening customer confidence, satisfaction, and loyalty in the medical equipment business. At the research-gap level, previous studies have provided evidence that CRM and service quality can influence customer loyalty across different industries. However, much of the existing research has focused on retail stores, coffee shops, supermarkets, logistics services, educational services, and other general service businesses. Although these studies provide useful theoretical and empirical foundations, their findings may not fully reflect the characteristics of the medical equipment business, where products are specialized and customer relationships often require continuous technical consultation and after-sales support. In particular, there remains limited empirical evidence examining the combined influence of CRM and salesperson service quality on customer loyalty specifically in the Thai medical equipment business.

Therefore, this study aims to examine the influence of customer relationship management and salesperson service quality on customer loyalty in the medical equipment business. The study is expected to provide empirical evidence regarding the factors contributing to customer loyalty and provide practical guidance for improving customer relationship strategies and salesperson service quality. The findings may assist medical equipment businesses in strengthening long-term customer relationships, improving customer retention, and developing sustainable competitiveness.

1.2. Research Question

Based on the research objectives and the multiple regression analysis framework, the research questions are as follows:

1. Do customer relationship management and Salesperson service quality significantly influence customer loyalty in the medical equipment business?
2. Which factor between customer relationship management and Salesperson service quality has a statistically significant influence on customer loyalty?
3. To what extent can customer loyalty be predicted based on customer relationship management and Salesperson service quality?

1.3. Research Objective

Based on the research questions concerning the influence of customer relationship management and Salesperson service quality on customer loyalty in the medical equipment business, the research objectives using Multiple Regression Analysis are as follows:

1. To examine the effects of customer relationship management and Salesperson service quality on customer loyalty using multiple regression analysis.
2. To analyze which factors, namely customer relationship management and Salesperson service quality, have a statistically significant influence on customer loyalty.
3. To construct and evaluate a multiple regression equation for predicting customer loyalty based on customer relationship management and Salesperson service quality.

2. Literature Review

2.1. Related Concepts and Theories

2.1.1. Customer Relationship Management

Customer relationship management (CRM) is an important strategic concept for organizations seeking to establish, maintain, and develop long-term relationships with customers. CRM focuses on understanding customer needs, creating customer value, maintaining continuous communication, and developing relationships that encourage customer satisfaction and loyalty. Kumar and Reinartz (2006) explain that CRM involves the systematic management of customer information and interactions to improve the value of customer relationships. Similarly, Lawson-Body and Limayem (2004) emphasize the importance of managing customer relationships through appropriate information and relationship-oriented processes. In the present study, CRM refers to the strategic process used by medical equipment businesses to create, maintain, and develop continuous relationships with customers, with an emphasis on creating value, satisfaction, and long-term commitment in order to encourage customer loyalty. The attached research document specifically identifies four dimensions of CRM: reward, contractual, value-added, and educational. reward refers to benefits or incentives provided to customers, such as discounts, gifts, accumulated points, or special privileges, which

can increase customers' perceived value and encourage repeat purchasing. contractual refers to agreements, conditions, or commitments between the organization and customers, such as warranties, membership arrangements, or service agreements, which can increase confidence and continuity in the relationship. value-added refers to additional services beyond the core product or service, such as after-sales service, maintenance, installation, and consultation. These dimensions are consistent with the CRM framework developed by [Rapp and Collins \(1996\)](#) which is also identified as the source of the CRM dimensions in the attached research framework. The educational dimension refers to providing customers with specialized knowledge and useful information related to products, services, or their applications. This dimension is particularly relevant to the medical equipment business because customers may require technical information and professional guidance when selecting, using, maintaining, and evaluating medical equipment. Therefore, CRM in this context extends beyond conventional sales activities and emphasizes the development of continuous, value-based relationships with customers.

2.1.2. Service Quality

Service quality refers to customers' perceptions and evaluations of the quality of services provided by an organization. [Grönroos \(2000\)](#) emphasizes that service quality is closely related to customers' experiences of service delivery and the development of customer relationships. [Parasuraman, Zeithaml, and Berry \(1996\)](#) further demonstrate that perceived service quality can influence customers' behavioral intentions and subsequent relationships with service providers. The attached research document applies five dimensions of service quality: tangibility, reliability, responsiveness, assurance, and empathy. tangibility refers to the physical appearance of service facilities, equipment, personnel, and materials associated with service delivery. reliability refers to the ability of the salesperson or organization to provide services accurately, consistently, and dependably. responsiveness concerns the willingness and ability to respond promptly to customer requests and problems. assurance reflects employees' knowledge, professionalism, credibility, and ability to create customer confidence. empathy refers to providing individual attention, understanding customer needs, and demonstrating care toward customers. These dimensions are particularly relevant to medical equipment because customers often require professional consultation, technical information, and continuing assistance.

2.1.3. Customer Loyalty

Customer loyalty represents a customer's continuing commitment to an organization and willingness to maintain a relationship with that organization. Loyalty may be reflected through continued purchasing, preference for a particular supplier, willingness to recommend the organization, and resistance to switching to competitors. In a competitive business environment, customer loyalty is particularly important because maintaining existing customer relationships can contribute to long-term business sustainability. The relationship between CRM and customer loyalty can be explained by the ability of CRM activities to create customer value, satisfaction, and commitment. When customers perceive that an organization understands their needs and provides appropriate benefits and support, they are more likely to continue the relationship. Similarly, high service quality can strengthen customer confidence and positive behavioral intentions. Previous studies have reported relationships between CRM, service quality, customer satisfaction, and customer loyalty in different business contexts ([Grihani & Kusumadewi, 2021](#); [Jidapa et al., 2022](#)). For the present study, customer loyalty is the dependent variable, while CRM and service quality are the independent variables, consistent with the research framework in the attached document.

2.2. Literature Surveys

2.2.1. Customer Relationship Management and Customer Loyalty

Previous research indicates that CRM is an important factor in developing customer loyalty. [Grihani and Kusumadewi \(2021\)](#) examined the role of customer satisfaction in the relationship between CRM and customer loyalty and demonstrated the importance of customer relationship strategies in strengthening customer loyalty. [Jidapa et al. \(2022\)](#) also examined CRM in the coffee shop context and found that relationship-oriented practices can contribute to customer loyalty. Similarly, [Yupawadee and Saengthong \(2022\)](#) investigated CRM through social media and its relationship with electronic loyalty, highlighting the importance of relationship management and service quality in developing continuing customer relationships. These findings suggest that organizations that effectively understand customer needs, provide benefits, communicate with customers, and create additional value are more likely to develop customer loyalty. This relationship is particularly relevant to the medical equipment business because customer relationships may continue through product installation, maintenance, technical consultation, and after-sales support.

2.2.2. Service Quality and Customer Loyalty

Service quality has also been identified as an important factor associated with customer loyalty. [Parasuraman et al. \(1996\)](#) established the behavioral consequences of service quality, while [Grönroos \(2000\)](#) emphasized the importance of service delivery in developing customer relationships. Empirical studies have subsequently examined service quality and loyalty in various industries. [Wittaya and Sirima \(2021\)](#) examined

perceived service quality and CRM in relation to customer loyalty in logistics operations. Their study demonstrates the relevance of both relationship management and service quality in maintaining customers. [Thanyasuda Sathiwongmas \(2026\)](#) similarly examined CRM and service quality factors affecting customer loyalty in tire service centers. These studies provide support for examining service quality as an important predictor of customer loyalty. In the medical equipment business, service quality may be particularly important because customers require accurate information, timely responses, professional assistance, and continuing technical support. Therefore, the quality of interaction between salespersons and customers may influence customers' perceptions of the supplier and their willingness to maintain the relationship.

2.2.3. Customer Relationship Management, Service Quality, and Customer Loyalty

The literature indicates that CRM and service quality are closely related to customer loyalty. CRM focuses primarily on managing and developing the customer relationship, while service quality focuses on the customer's evaluation of the service received. Together, these factors can provide a broader explanation of why customers remain committed to an organization. The attached research document similarly identifies CRM and service quality as the two independent variables and customer loyalty as the dependent variable. It proposes that CRM consists of reward, contractual, value-added, and educational dimensions, while service quality consists of tangibility, reliability, responsiveness, assurance, and empathy. Although previous studies have examined these relationships in retail, coffee shops, logistics, supermarkets, education, and service centers, fewer studies have specifically examined the medical equipment business. This provides a basis for applying the established concepts to the specialized context of medical equipment.

2.3. Conceptual Framework

Based on the concepts, theories, previous studies, and the attached research document, the conceptual framework of this study consists of customer relationship management and service quality as independent variables and customer loyalty as the dependent variable. The original research framework identifies the same relationship and specifies the dimensions of each independent variable.

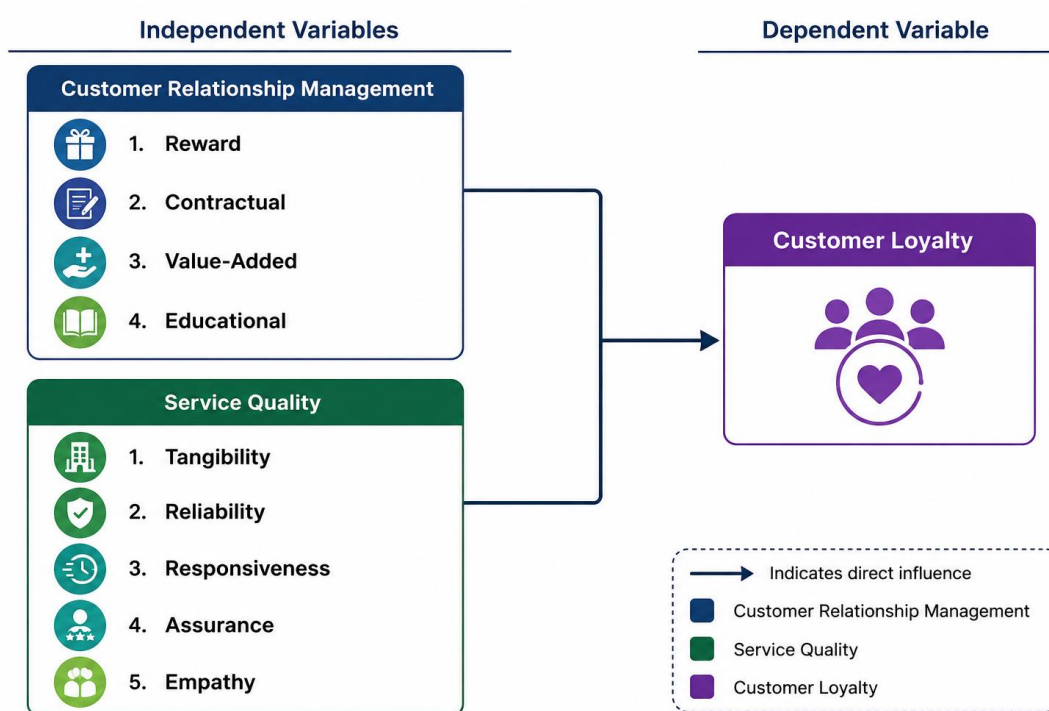


Figure 1. Conceptual framework.

This framework directly corresponds to the research objectives, which seek to examine the influence of CRM and salesperson service quality on customer loyalty in the medical equipment business.

2.4. Research Hypothesis

Based on the theoretical concepts, previous empirical studies, and the conceptual framework, the following hypotheses are proposed:

H₁: customer relationship management has a statistically significant influence on customer loyalty in the medical equipment business.

H₃: Salesperson service quality has a statistically significant influence on customer loyalty in the medical equipment business.

These hypotheses are consistent with the hypotheses stated in the attached research document, which proposes that CRM influences customer loyalty and that service quality influences customer loyalty. The hypotheses also provide a direct basis for the Multiple Regression Analysis specified in the research objectives. Specifically, the analysis will determine whether customer relationship management and Salesperson service quality significantly explain variations in customer loyalty and identify which factor has the stronger statistical influence.

3. Research Methodology

3.1. Research Design

This study employs a quantitative, cross-sectional research design to examine the influence of customer relationship management and salesperson service quality on customer loyalty in the medical equipment business. The quantitative approach is appropriate because the study aims to measure customers' perceptions of customer relationship management, salesperson service quality, and customer loyalty and to statistically examine the relationships among these variables. The study focuses on customers in the medical equipment business that has experience purchasing medical equipment in Bangkok and surrounding areas. Customer relationship management is examined through four dimensions: reward, contractual, value-added, and educational, while service quality is examined through five dimensions: tangibility, reliability, responsiveness, assurance, and empathy. Customer loyalty is treated as the dependent variable. These variables and dimensions are consistent with the conceptual framework presented in the attached research document. The research design is also consistent with the research objectives, which seek to examine the influence of customer relationship management and salesperson service quality on customer loyalty. The unit of analysis is the individual customer who has experience purchasing medical equipment, and data collection is conducted during March–April 2026, as specified in the research scope.

3.2. Population and Sample

The population of this study consists of customers in the medical equipment business in Bangkok and surrounding areas who have experience purchasing medical equipment. The exact size of the population is unknown, as stated in the research scope of the attached document. Because the population size is unknown, the sample size is determined using the formula developed by [Cochran \(1953\)](#). The study specifies a 95% confidence level, a .05 significance level, and an acceptable margin of error of no more than 5%. Based on these criteria, the required sample size is 385 respondents. The sample consists of customers located in Bangkok and surrounding areas who have experience purchasing medical equipment. The personal characteristics considered in the study include gender, age, educational level, and average monthly income, consistent with the research framework and research scope presented in the attached document.

3.3. Research Instruments

The primary research instrument for this study is a structured questionnaire developed based on the concepts, theories, dimensions, and previous studies presented in the literature review and according to the variables identified in the conceptual framework. The questionnaire is divided into four main parts. Part 1 collects information regarding respondents' personal characteristics, including gender, age, educational level, and average monthly income. These demographic characteristics are consistent with those specified in the attached research document. Part 2 measures customer relationship management and consists of four dimensions: reward, contractual, value-added, and educational. In the attached research document, customer relationship management is defined as a strategic management process used by an organization to create, maintain, and continuously develop relationships with customers, with an emphasis on creating value, satisfaction, and long-term commitment to encourage customer loyalty. The reward dimension refers to benefits or incentives provided to customers, such as discounts, gifts, accumulated points, or special privileges; the contractual dimension refers to agreements, conditions, warranties, memberships, or service contracts that create confidence and continuity; the value-added dimension refers to additional services such as after-sales service, maintenance, installation, or specialized consultation; and the educational dimension refers to providing customers with information, knowledge, or training concerning the use, maintenance, and technology of medical equipment. Part 3 measures salesperson service quality through five dimensions: tangibility, reliability, responsiveness, assurance, and empathy. These dimensions are specified in the original research framework. tangibility concerns the physical appearance of facilities, equipment, personnel, and communication materials; reliability concerns the ability to provide accurate, consistent, and dependable services; responsiveness concerns the speed and willingness to respond to customers; assurance concerns employees' knowledge, professionalism, credibility, and ability to create customer confidence; and empathy concerns individualized attention and understanding of customer needs. The attached research further emphasizes that service quality should respond accurately and continuously to customer needs and contribute to customer confidence and long-term relationships. Part 4 measures customer loyalty, which is treated as the

dependent variable and is examined in relation to customer relationship management and salesperson service quality. For the measurement sections, a five-point Likert scale, ranging from strongly disagrees to strongly agree, may be used to quantify respondents' perceptions and facilitate statistical analysis. The attached file establishes the research variables and dimensions but does not report the final number of questionnaire items, IOC results, or Cronbach's alpha values; therefore, these values should be reported only after the actual instrument-validation and reliability-testing results are available.

3.4. Data Collection

Data are collected from customers in the medical equipment business located in Bangkok and surrounding areas that have experience purchasing medical equipment. The researcher identifies potential respondents according to the established population and sampling criteria and provides information concerning the purpose and nature of the study before inviting them to participate. Respondents complete the structured questionnaire voluntarily, after which the researcher collects and checks the completed questionnaires for completeness and suitability for statistical analysis. The data-collection period is March - April 2026, consistent with the research scope specified in the attached document. A total of 385 respondents is targeted based on the sample-size calculation using Cochran (1953) formula at a 95% confidence level and a 5% margin of error. After collection, the completed questionnaires are screened, coded, and entered into statistical software for analysis. Incomplete or unusable responses should be excluded according to the predetermined data-quality criteria before conducting the statistical analysis.

3.5. Statistics Used for Data Analysis

The statistical techniques used in this study are selected to correspond directly with the research questions and research objectives. Descriptive statistics, including frequency and percentage, are used to summarize respondents' personal characteristics, namely gender, age, educational level, and average monthly income. Mean and standard deviation are used to describe the overall levels of customer relationship management, salesperson service quality, and customer loyalty as perceived by respondents. To examine whether customer loyalty differs according to respondents' personal characteristics, appropriate inferential statistics are applied according to the number of comparison groups. An independent-samples t-test is used when a personal characteristic contains two groups, while one-way analysis of variance (ANOVA) is used when a characteristic contains more than two groups. Where a statistically significant difference is identified through ANOVA, an appropriate post-hoc test may subsequently be applied to determine which groups differ from one another. The principal statistical technique for examining the influence of the independent variables is Multiple Regression Analysis. This analysis is used to examine whether customer relationship management and salesperson service quality significantly influence customer loyalty, to determine which factor has a statistically significant influence on customer loyalty, and to evaluate the extent to which customer loyalty can be predicted from these factors. Multiple regression analysis therefore corresponds directly with the research objectives of examining the effects of customer relationship management and salesperson service quality, identifying which factor has a statistically significant influence, and constructing and evaluating a regression equation for predicting customer loyalty. The analysis evaluates the overall significance of the regression model, the statistical significance of each independent variable, the contribution of each independent variable to customer loyalty, and the predictive capability of the model. The statistical significance level is set at .05. The use of Multiple Regression Analysis is consistent with the conceptual framework in the attached research document, which identifies customer relationship management and service quality as independent variables and customer loyalty as the dependent variable. Overall, the methodology is structured to provide a direct connection between the research questions, research objectives, conceptual framework, data collection, and statistical analysis. The study first describes the characteristics of the respondents and their perceptions of the key research variables, then examines differences in customer loyalty according to personal characteristics, and finally applies Multiple Regression Analysis to determine the influence and predictive contribution of customer relationship management and salesperson service quality on customer loyalty. This approach is consistent with the original research purpose of understanding customer loyalty in the medical equipment business and providing information that can support the development of customer relationship strategies, service systems, and salesperson capabilities.

4. Data Analysis and Findings

4.1. Introduction

This section presents the data analysis and findings of the study on the influence of customer relationship management and service quality on customer loyalty in the medical equipment business. The analysis follows the research objectives and conceptual framework of the study. The data were obtained from 400 respondents and analyzed using descriptive and inferential statistics. The results are presented in four sections: qualitative data analysis, quantitative data analysis, and a summary of the major findings. The quantitative analysis focuses on respondents' personal characteristics, levels of customer relationship management, service quality, and customer loyalty, as well as the statistical relationships between the independent and dependent variables.

4.2. Data Analysis of the Qualitative Data

The study does not report a separate qualitative data collection process in the supplied Chapter 4 results. No interview transcripts, focus-group data, coding procedures, or qualitative themes are presented in the source material. Therefore, no independent qualitative findings are reported in this section. The main analysis is based on quantitative questionnaire data collected from 400 respondents. The quantitative findings provide evidence regarding customers' perceptions of customer relationship management, service quality, and customer loyalty and are used to test the research hypotheses.

4.3. Data Analysis of the Quantitative Data

4.3.1. Demographic Characteristics of Respondents

The sample consisted of 400 respondents. Most respondents were female (67.50%), while males accounted for 32.50%. Regarding age, the largest group was 31–40 years (41.50%), followed by 21–30 years (38.50%). Most respondents held a Bachelor's degree (80.25%) and worked in private companies (47.00%). In terms of income, the largest group earned 35,001–45,000 Baht per month (41.50%).

Table 1. Personal characteristics of respondents.

Characteristics	Category	Frequency	Percentage
Gender	Male	130	32.50
	Female	270	67.50
Age	21–30 years	154	38.50
	31–40 years	166	41.50
	41–50 years	34	8.50
	51–60 years	46	11.50
Education	Below Bachelor's degree	32	8.00
	Bachelor's degree	321	80.25
	Higher than Bachelor's degree	47	11.75
Occupation	Government/State enterprise	96	24.00
	Private company	188	47.00
	Self-employed/Business owner	82	20.50
	Other	34	8.50
Income	15,001–25,000 Baht	97	24.25
	25,001–35,000 Baht	64	16.00
	35,001–45,000 Baht	166	41.50
	45,001 Baht or above	73	18.25

4.3.2. Descriptive Analysis

The respondents reported high levels of customer relationship management, service quality, and customer loyalty. The overall mean for customer relationship management was 4.36, while service quality had an overall mean of 4.43. Customer loyalty achieved an overall mean of 4.45, indicating a high level of loyalty among the respondents.

Table 2. Descriptive statistics of the main variables.

Variable	Mean	SD	Level
Customer Relationship Management	4.36	0.62	Highest
Service Quality	4.43	0.58	Highest
Customer Loyalty	4.45	0.49	Highest

For customer relationship management, the highest-rated dimension was customer relationship, with a mean of 4.57, followed by understanding customer expectations (4.39), Interpersonal communication management (4.27), and customer follow-up (4.22). For service quality, assurance received the highest mean score of 4.50, followed by tangibility (4.44), responsiveness (4.43), empathy (4.42), and reliability (4.37).

Table 3. Dimensions of customer relationship management.

Dimension	Mean	SD	Level
Customer Follow-Up	4.22	0.66	Highest
Customer Relationship	4.57	0.51	Highest
Interpersonal Communication Management	4.27	0.75	Highest
Understanding Customer Expectations	4.39	0.54	Highest
Overall	4.36	0.62	Highest

Table 4. Dimensions of service quality.

Dimension	Mean	SD	Level
Tangibility	4.44	0.51	Highest
Reliability	4.37	0.68	Highest
Responsiveness	4.43	0.58	Highest
Assurance	4.50	0.54	Highest
Empathy	4.42	0.58	Highest
Overall	4.43	0.58	Highest

Customer Loyalty had an overall mean of 4.45 (SD = 0.49). The highest-rated item concerned customers' likelihood of using the organization's services again when needed, with a mean of 4.63. This indicates a strong tendency among respondents to continue using the organization's products and services.

4.3.3. Hypothesis Testing

The study uses multiple regression analysis to examine the influence of the two major independent variables, customer relationship management and service quality, on customer loyalty. For customer relationship management, the regression model was statistically significant ($F = 847.388$, $p < 0.001$) and produced $R = 0.946$, $R^2 = 0.896$, and Adjusted $R^2 = 0.895$. This indicates that customer relationship management explained approximately 89.6% of the variance in customer loyalty in the reported model.

Table 5. Regression Analysis of Customer Relationship Management and Customer Loyalty.

Statistic	Value
R	0.946
R ²	0.896
Adjusted R ²	0.895
F	847.388

The reported regression coefficients show that all four customer relationship management dimensions were statistically significant predictors of customer loyalty. For service quality, the regression model was also statistically significant ($F = 250.998$, $p < 0.001$) and produced $R = 0.872$, $R^2 = 0.761$, and Adjusted $R^2 = 0.751$. Thus, Service Quality explained approximately 76.1% of the variance in Customer Loyalty.

Table 6. Regression analysis of service quality and customer loyalty.

Dimension	B	Beta	t	Sig.
Tangibility	0.717	0.685	18.822	0.000
Reliability	0.929	-1.319	12.528	0.000
Responsiveness	0.538	0.643	5.378	0.000
Assurance	0.931	1.040	12.124	0.000
Empathy	0.077	0.091	0.841	0.401

The results indicate that tangibility, reliability, responsiveness, and assurance were statistically significant predictors of customer loyalty, whereas empathy was not statistically significant because its significance value was 0.401.

Table 7. Summary of regression models.

Independent Variable	R	R ²	Adjusted R ²	F	Sig.
Customer Relationship Management	0.946	0.896	0.895	847.388	0.000
Service Quality	0.872	0.761	0.751	250.998	0.000

The results therefore provide strong statistical evidence that both customer relationship management and service quality significantly influence customer loyalty. Because the revised conceptual framework uses reward, contractual, value-added, and educational as the four CRM dimensions, the final hypothesis-testing tables should use these four dimensions if these were the actual dimensions measured in the questionnaire. Similarly, the service quality dimensions of tangibility, reliability, responsiveness, assurance, and empathy should be retained.

4.4. Summary of the Results

The findings indicate that respondents perceived customer relationship management, service quality, and customer loyalty at high levels. customer relationship management had an overall mean of 4.36, service quality had an overall mean of 4.43, and customer loyalty had an overall mean of 4.45. these findings suggest that respondents generally had positive perceptions of the organization's relationship-management practices and service quality and demonstrated a strong level of loyalty. the demographic analysis showed that the

sample was predominantly female, aged 31–40 years, holding a bachelor's degree, working in private companies, and earning 35,001–45,000 baht per month. the statistical tests reported in section 4 indicated significant differences in customer loyalty according to age and educational level, while gender and income were not statistically significant. the occupation result in the source file should be checked because the reported significance value and the accompanying written interpretation are inconsistent. the regression analysis provides the main findings of the study. customer relationship management had a statistically significant influence on customer loyalty, with the model explaining approximately 89.6% of the variance in customer loyalty. service quality also had a statistically significant influence, explaining approximately 76.1% of the variance. for service quality, tangibility, reliability, responsiveness, and assurance were significant predictors, while empathy was not statistically significant.

Table 8. Summary of research hypotheses.

Hypothesis	Relationship	Result
H1	Customer Relationship Management → Customer Loyalty	Accepted
H2	Service Quality → Customer Loyalty	Accepted

Overall, the findings support the proposed conceptual framework and demonstrate that both customer relationship management and service quality are important factors associated with customer loyalty in the medical equipment business. The results highlight the importance of developing strong customer relationships and delivering reliable, responsive, professional, and confidence-building services to maintain customer loyalty.

5. Conclusion, Discussion, and Recommendation

5.1. Conclusion

The findings of this study indicate that customer relationship management, service quality, and customer loyalty were perceived at high levels among customers in the medical equipment business. The overall mean of customer relationship management was 4.36, while service quality had an overall mean of 4.43 and customer loyalty had an overall mean of 4.45. These results indicate that respondents generally had positive perceptions of the organization's customer relationship practices and service quality and demonstrated a high level of customer loyalty. The demographic findings showed that most respondents were female, aged 31–40 years, held a bachelor's degree, worked for private companies, and earned an average monthly income of 35,001–45,000 baht. The statistical analysis further indicated that customer loyalty differed significantly according to age and educational level, whereas gender and income did not show statistically significant differences. The regression analysis demonstrated that customer relationship management had a statistically significant influence on customer loyalty, with the model explaining approximately 89.6% of the variance in customer loyalty. Service quality also had a statistically significant influence on customer loyalty and explained approximately 76.1% of the variance. Among the service quality dimensions, tangibility, reliability, responsiveness, and assurance were significant predictors of customer loyalty, whereas empathy was not statistically significant. Overall, the findings confirm that effective customer relationship management and high-quality service are important factors contributing to customer loyalty in the medical equipment business.

5.2. Discussion

The findings demonstrate that customer relationship management plays an important role in strengthening customer loyalty. The high overall mean of 4.36 indicates that respondents were generally satisfied with the organization's efforts to maintain and develop customer relationships. The strong regression result, with customer relationship management explaining 89.6% of the variance in customer loyalty, suggests that maintaining continuous and meaningful relationships with customers is particularly important in the medical equipment business. This finding is consistent with the view that customer relationship management enables organizations to understand customer needs, maintain communication, provide appropriate services, and develop long-term customer relationships. It is also consistent with previous studies that found a positive relationship between customer relationship management and customer loyalty in different business contexts. In the medical equipment business, customer relationships are especially important because customers may require continuous consultation, technical assistance, product information, maintenance, and after-sales support. Therefore, organizations that consistently maintain relationships with customers are more likely to encourage repeat purchasing, continued use of products and services, and customer recommendations. The findings also show that service quality significantly influences customer loyalty. The overall mean of 4.43 indicates that respondents perceived the organization's service quality positively. The regression model explained approximately 76.1% of the variance in customer loyalty, demonstrating the substantial contribution of service quality to customer loyalty. Tangibility, reliability, responsiveness, and assurance were significant predictors, suggesting that customers value professional physical presentation, dependable service, prompt responses, and employees who demonstrate knowledge and professionalism. These findings are consistent with the service quality concept proposed by [Parasuraman et al. \(1996\)](#) which emphasizes that service quality

affects customers' behavioral intentions and their willingness to maintain relationships with service providers. The findings also support Grönroos (2000) who emphasized the importance of service quality in developing long-term customer relationships. The non-significant effect of empathy suggests that individualized attention alone may not be sufficient to determine customer loyalty in the medical equipment business. Customers may place greater importance on the technical reliability of products and services, the speed of service, professional knowledge, and confidence in the salesperson and organization. This may be explained by the specialized nature of medical equipment, where purchasing decisions can involve technical requirements, operational risks, product specifications, installation, maintenance, and after-sales support. Therefore, customers may prioritize functional and professional aspects of service over interpersonal attention when evaluating whether to continue their relationship with a supplier. The demographic findings further indicate that customer loyalty varies according to age and educational level. This suggests that customers with different demographic characteristics may have different expectations, experiences, and evaluation criteria regarding medical equipment suppliers. Organizations should therefore consider customer characteristics when designing relationship-management and service strategies. At the same time, the absence of significant differences according to gender and income suggests that customer loyalty may be influenced more strongly by relationship management and service quality than by these demographic characteristics. Overall, the findings support the importance of developing customer-oriented strategies that emphasize long-term relationships, reliable service, professional knowledge, and continuous customer support.

5.3. Recommendation

Based on the findings, medical equipment businesses should strengthen customer relationship management by developing systematic and continuous customer-contact processes. Organizations should maintain accurate customer information, regularly follow up with customers, understand changing customer requirements, and provide appropriate information regarding products, services, maintenance, and new technologies. Customer relationship strategies should also provide meaningful benefits and value-added services that encourage customers to continue using the organization's products and services. In particular, organizations should focus on developing long-term relationships rather than emphasizing only individual sales transactions. Organizations should also improve service quality by strengthening reliability, responsiveness, assurance, and tangibility. Salespersons should receive continuous training in product knowledge, technical information, communication skills, problem solving, and after-sales service so that they can provide accurate and professional support. Organizations should establish clear service standards and response procedures to ensure that customer inquiries, complaints, installation requirements, and maintenance requests are handled promptly. In addition, the physical appearance of service facilities, equipment, documents, and promotional materials should be maintained professionally to strengthen customer confidence. For future research, studies should examine the revised Customer Relationship Management dimensions of reward, contractual, value-added, and educational activities together with the five Service Quality dimensions of tangibility, reliability, responsiveness, assurance, and empathy. Future researchers may also expand the study to other provinces, medical equipment suppliers, hospitals, healthcare organizations, or different types of customers to improve the generalizability of the findings. Additional variables such as customer satisfaction, trust, perceived value, corporate reputation, salesperson competence, after-sales service, and customer experience could also be examined to provide a more comprehensive understanding of customer loyalty in the medical equipment industry. Longitudinal research could further investigate how customer relationships and loyalty develop over time.

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