

Enhancing Customer Outcomes in Retail Pharmacy: The Effect of QR Code Implementation Assessed Through Service Quality Theory and Multiple Regression Analysis

Catrina Mae S. Tulinao¹, Nelson C. Bool²

^{1,2}University of Santo Tomas Graduate School

ABSTRACT: This study examines the effects of QR code implementation in retail pharmacy settings, focusing on how digital innovation influences customer satisfaction, trust, and repurchase intention through the lens of service quality theory. Two primary research questions guide the analysis: identifying the factors that affect customer outcomes before and after QR code adoption, and assessing how the relationships between service quality dimensions—service quality, waiting time, and store attributes—and customer outcomes evolve following implementation. Using multiple regression analysis, the study finds that all predictors significantly impact customer satisfaction, trust, and repurchase intention in both pre- and post-implementation phases, with service quality showing a notable increase in influence after QR code integration (unstandardized coefficient rising from 0.22 to 0.37 and standardized coefficient from 0.23 to 0.38). Store attributes remain a strong determinant of positive customer experiences, while waiting time continues to have a moderate negative effect. The explanatory power of the models improves post-implementation, as indicated by an increase in satisfaction R^2 from 0.54 to 0.56. These results underscore the value of QR code technology in enhancing service quality and customer outcomes in retail pharmacy, supporting the integration of digital solutions to improve service delivery and customer experience.

KEYWORDS: QR code implementation, retail pharmacy, service quality, customer satisfaction, customer trust, repurchase intention, digital innovation, multiple regression analysis, waiting time, store attributes, customer experience, healthcare technology.

I. INTRODUCTION

In the rapidly evolving landscape of retail pharmacy, the enhancement of customer outcomes remains a critical concern as competition intensifies. This study investigates the implications of implementing Quick Response (QR) codes within the retail pharmacy context, leveraging service quality theory as the theoretical underpinning and employing multiple regression analysis for a comprehensive evaluation. Customer satisfaction, a key determinant of consumer behavior in retail pharmacy settings, significantly influences loyalty, retention, and referral rates, directly affecting overall business performance (Glaveli et al., 2020; Chen & Fu, 2015). Moreover, empirical evidence suggests a strong correlation between service dimensions—such as responsiveness and assurance—and customer satisfaction, emphasizing the need for pharmacies to adapt to consumer expectations effectively (Chen & Fu, 2015).

The integration of QR codes is proposed not only as a technological advancement but also as a strategic enhancement in service delivery, enabling pharmacies to provide timely, accessible information to their patrons (Yan et al., 2021) (Nguyen et al., 2023). QR codes offer distinct advantages in facilitating consumer engagement and improving interaction within the retail pharmacy context. Their utility lies in extending consumer access to vital product information, promotional offers, and services, significantly enhancing the shopping experience (Tanner et al., 2019). Research indicates that when consumers are presented with supplementary information through QR codes, this can lead to more informed purchasing decisions and increased satisfaction levels (Nguyen et al., 2023; Tanner et al., 2019). Furthermore, studies illustrate that QR codes can effectively bridge the gap between physical and digital experiences, allowing customers to engage in pre-purchase information searches that align with their prior online behaviors, thus enhancing their overall shopping experience (Tanner et al., 2019). In light of the COVID-19 pandemic, the role of QR codes has been magnified, providing a hygienic alternative to traditional interaction methods and contributing to the overall safety of the shopping experience (Yan et al., 2021).

Enhancing Customer Outcomes in Retail Pharmacy: The Effect of QR Code Implementation Assessed Through Service Quality Theory and Multiple Regression Analysis

The successful implementation of QR codes in retail pharmacies, however, requires careful consideration of various factors, including consumer education regarding their usage and the types of information provided through these codes (Žurbi & Gregor-Svetec, 2023). Research indicates that a lack of understanding of QR code functionalities remains a barrier to their widespread adoption among consumers, necessitating clear communication strategies in pharmacies to raise awareness and educate customers (Žurbi & Gregor-Svetec, 2023). Moreover, the integration of QR codes should align with overall service quality initiatives, where their usage is tailored to genuinely improve customer service experiences and operational efficiency. By doing so, pharmacies can potentially capitalize on the growing interest in mobile technology and digital engagement, ensuring that they remain relevant in an increasingly competitive marketplace.

The ongoing integration of QR codes in retail pharmacy settings not only aims to streamline administrative processes but also addresses consumer expectations for digital solutions in their shopping experiences. Research indicates that various factors influence customers' acceptance of QR codes, particularly among younger demographics such as Generation Z, whose expectations regarding technology usage vary significantly compared to older consumers (Imani & Anggono, 2020). Factors such as performance expectancy, hedonic motivation, and perceived security play crucial roles in shaping behavioral intentions toward utilizing QR codes in payment systems, highlighting both technical functionality and experiential factors in the adoption of QR code technologies (Chang et al., 2021; Nandru et al., 2023). Additionally, the COVID-19 pandemic has accelerated consumer reliance on digital solutions, underscoring the effectiveness of QR codes in maintaining hygiene and reducing physical contact in pharmacies, thereby positively impacting customer satisfaction and loyalty (Yan et al., 2021). As retail pharmacies continue to navigate the digital transition, understanding these dynamics will be essential for developing strategies that enhance service delivery and align with evolving consumer behaviors and preferences.

II. LITERATURE REVIEW AND PROPOSED MODEL

The Role of QR Codes in Retail Pharmacy

The integration of Quick Response (QR) codes within retail pharmacy settings represents a significant advancement in the pursuit of enhanced customer outcomes and operational efficiency. As the healthcare sector evolves, consumer expectations for convenience, speed, and personalized service have intensified, prompting pharmacies to adopt innovative digital solutions. QR codes, as a form of mobile technology, offer a transformative strategy for bridging the gap between traditional service delivery and modern consumer demands. Their implementation enables rapid access to information, supports contactless transactions, and fosters proactive engagement, all of which are critical in today's competitive retail pharmacy landscape (Salvaña et al., 2023).

Theoretical Framework: Service Quality Dimensions

Service quality theory provides a robust foundation for evaluating the impact of QR code technology in retail pharmacy. This theory delineates five core dimensions—reliability, assurance, tangibility, empathy, and responsiveness—that collectively shape customer perceptions of service excellence (Abdul & Siddiqua, 2019). QR codes can enhance reliability by ensuring accurate and timely dissemination of pharmaceutical information, while also increasing tangibility through the provision of digital resources and interactive experiences. Assurance is strengthened as customers gain confidence in the transparency and accuracy of information delivered via QR codes. Furthermore, the technology enables pharmacies to demonstrate empathy by offering personalized health information and responsive engagement, thereby reinforcing the overall service quality framework.

Customer Expectations, Waiting Time, and Service Perceptions

Customer expectations and perceptions are central to the assessment of service quality in retail pharmacy environments. Waiting time, in particular, is a critical determinant of customer satisfaction and loyalty. Prolonged wait times can lead to negative perceptions of service quality, resulting in dissatisfaction and decreased customer retention (Abdul & Siddiqua, 2019). The adoption of QR codes has been shown to reduce both perceived and actual waiting times by enabling self-service options, streamlining prescription refills, and facilitating efficient communication between customers and pharmacy staff. These improvements not only enhance responsiveness but also contribute to a more positive overall customer experience.

QR Codes and Public Health: Lessons from the COVID-19 Pandemic

The COVID-19 pandemic accelerated the adoption of contactless technologies, including QR codes, in retail pharmacy settings. During this period, community pharmacies played a pivotal role in providing essential services such as medication dispensing, vaccination, and public health information dissemination (Maidment et al., 2021). QR codes emerged as a vital tool for promoting accessibility and efficiency while adhering to public health guidelines. By facilitating contactless transactions and providing up-to-date medication information, QR codes aligned with evolving consumer expectations for safety and convenience, thereby supporting the continuity of care during unprecedented times.

Enhancing Customer Outcomes in Retail Pharmacy: The Effect of QR Code Implementation Assessed Through Service Quality Theory and Multiple Regression Analysis

Store Attributes, Accessibility, and Digital Interaction

Beyond waiting time, store attributes such as layout, cleanliness, and digital interaction capabilities fundamentally influence customers' perceptions of service quality. Accessibility, in particular, has been identified as a highly valued aspect of pharmacy interactions, especially during the pandemic when many patients relied heavily on pharmacy services (Loo et al., 2021). QR codes enhance accessibility by allowing patrons to quickly obtain necessary information without direct staff interaction, effectively mitigating concerns related to in-person contact. The integration of QR codes into store design and workflow not only improves operational efficiency but also elevates the perceived quality of service, reinforcing the importance of digital innovation in retail pharmacy. The implementation of QR code technology in retail pharmacy settings offers substantial benefits across multiple dimensions of service quality, customer satisfaction, and operational efficiency. By addressing key factors such as waiting time, personalization, and store environment, QR codes contribute to a more responsive, reliable, and customer-centric service model.

III. METHODOLOGY

In this study, a quasi-experimental quantitative design was employed to examine the impact of the QR code system on customer satisfaction, trust, and repurchase intent within selected retail pharmacies in Metro Manila. This methodological approach is particularly effective for evaluating the outcomes of an intervention by systematically measuring the critical variables associated with QR code implementation. By adhering to the principles of quantitative research, the study incorporates predetermined variables, formulated hypotheses, and structured designs, ensuring a robust evaluation framework (Creswell, 2014, as cited in Kannan & DiPietro, 2021). A stratified purposive sampling technique was utilized to select a total of 400 participants, effectively capturing a representative demographic to facilitate an in-depth analysis of the QR code system's influence on customer-oriented metrics in retail pharmacy services. Data gathered from survey questionnaires were subsequently analysed using advanced statistical tools such as SPSS and Minitab, underscoring the rigor of the quantitative methods employed. To further validate findings, it is essential to integrate qualitative measures alongside the quantitative data. One potential avenue for this is through conducting follow-up interviews with a subset of participants, allowing for deeper insights into their perceptions of the QR code system's effectiveness.

IV. RESULTS AND DISCUSSIONS

A. Wilcoxon-Rank Test

Table 1

<i>Statistical and practical significance of pre-and post-differences in satisfaction, trustworthiness, and repurchase intention of customers.</i>					
Statistical Significance					
		Paired Differences			
		Mean	Std. Dev	W Stat	Sig. (2-tailed)
Pair 1.	presat-postsat	-0.090	0.611	1610.5	0.0028**
Pair 2.	pretrust-postrust.	-0.075	0.600	1806.0	0.0110*
Pair 3.	preInt-posIntent.	-0.103	0.598	1131.5	0.0004***
<i>Note: pre = pre-implementation of QR code post = post implementation of QR code</i> <i>sat = customer satisfaction on retail pharmacy store</i> <i>trust = customer's trust on the retail pharmacy store</i> <i>intent = customer's repurchase intention on the retail pharmacy store</i> <i>Significance levels: *** p<0.001 ** p<0.01 * p<0.05</i>					
Practical significance					
Intervention	Outcome	Effect size	95% Confidence Interval		CLES
QR-code imp.	Satisfaction	0.61	Lower	Upper	0.66
	Trust	0.60	-0.223	-0.026	0.66
	Intention	0.60	-0.270	-0.073	0.66
Cohen's Effect size: 0 - 0.2 = little or no effect, 0.2 - 0.5 = small, 0.5 - 0.8, medium; ≥ 0.8, large CLES: Common Language Effect Size statistic 95% confidence interval: If zero (0) is outside the range, then it is 'statistically significant at the 5% level'.					

The paired Wilcoxon signed-rank tests conducted to evaluate the impact of QR code implementation on customer outcomes in retail

Enhancing Customer Outcomes in Retail Pharmacy: The Effect of QR Code Implementation Assessed Through Service Quality Theory and Multiple Regression Analysis

pharmacy settings yielded statistically significant improvements across all three measured variables, providing robust empirical evidence for the effectiveness of digital technology integration in healthcare retail environments. Customer satisfaction demonstrated a significant enhancement with a mean difference of -0.090 – 0.090 ($SD = 0.6110.611$), W -statistic = $1610.51610.5$, and p -value = 0.0028 , achieving significance at the 1% level. This improvement suggests that customers experienced measurably higher satisfaction levels following the introduction of QR code technology, likely attributable to enhanced service accessibility, reduced friction in information retrieval processes, and improved overall service efficiency. The magnitude of this change, while seemingly modest in absolute terms, represents a meaningful shift in customer perceptions within the context of healthcare services, where satisfaction improvements are typically incremental and require sustained effort to achieve. Customer trust exhibited a meaningful increase with a mean difference of -0.075 – 0.075 ($SD = 0.6000.600$), W -statistic = $1806.01806.0$, and p -value = 0.0110 significant at the 5% level. The enhancement in trust is particularly significant given that trust represents a fundamental component of the patient-pharmacy relationship and is notoriously difficult to influence through technological interventions alone. This finding indicates that QR code implementation successfully addressed customer concerns regarding service reliability, information transparency, and professional competence—all critical dimensions of trust in healthcare settings. The improvement in trust scores suggests that customers perceived the QR code technology as enhancing rather than replacing human interaction, thereby strengthening their confidence in the pharmacy's commitment to quality service delivery and patient care. Most notably, repurchase intention showed the strongest statistical significance with a mean difference of -0.103 ($SD = 0.598$ 0.598), W -statistic = 1131.5 , and a highly significant p -value of 0.0004 ($p < 0.001$). This finding is particularly important from both theoretical and practical perspectives, as repurchase intention serves as a leading indicator of customer loyalty and directly correlates with long-term business sustainability and profitability. The substantial improvement in repurchase intention suggests that QR code implementation not only enhanced immediate service experiences but also influenced customers' future behavioural commitments, indicating a transformation in the customer-pharmacy relationship that extends beyond transactional interactions to encompass emotional and relational dimensions. The negative mean differences across all outcomes reflect higher post-implementation scores, confirming the positive directional impact of QR code technology on customer perceptions and behavioural intentions. The standard deviations, ranging from 0.598 to 0.611 , indicate moderate variability in responses, suggesting that while the overall trend was consistently positive, individual customer experiences varied within the sample population. This variability is consistent with service quality research, where personal preferences, technological literacy, demographic factors, and individual health needs may influence customer responses to service innovations. The relatively consistent standard deviations across outcomes suggest that the intervention's impact was distributed fairly evenly across the customer base, rather than benefiting only specific customer segments. The practical significance of these statistical findings is further substantiated by the effect size calculations and confidence interval analyses, which provide crucial insights into the magnitude and reliability of the observed changes. Cohen's d values of approximately 0.60 – 0.61 for all three outcomes fall within the medium effect size range (0.5 – 0.8), indicating that QR code implementation produced meaningful and substantial improvements rather than merely statistically detectable changes. According to Cohen's established conventions, these effect sizes suggest that the intervention had a moderate to strong practical impact on customer outcomes, which is particularly noteworthy in healthcare retail where customer behavior change typically occurs gradually and incrementally due to the conservative nature of healthcare decision-making and the importance of established trust relationships. The Common Language Effect Size (CLES) value of 0.66 across all outcomes provides an intuitive and practically meaningful interpretation of the intervention's impact. This statistic indicates that there is a 66% probability that a randomly selected post-implementation score will exceed a randomly selected pre-implementation score, representing a substantial improvement over the 50% probability that would be expected by chance alone. From a managerial perspective, this translates to approximately two-thirds of customers experiencing improved outcomes following QR code implementation, providing a clear and actionable metric for evaluating the intervention's success and justifying continued investment in digital technology initiatives.

The 95% confidence intervals for satisfaction (-0.246 – 0.246 to -0.049 – 0.049), trust (-0.223 – 0.223 to -0.026 – 0.026), and repurchase intention (-0.270 – 0.270 to -0.073) do not include zero, reinforcing the statistical significance of the observed effects and providing evidence for the reliability and consistency of the intervention's impact across different customer segments and service contexts. The width of these confidence intervals suggests reasonable precision in the effect estimates, while their consistent positioning below zero confirms the directionality and magnitude of the improvements. These intervals also provide valuable information for future research and implementation efforts, as they establish the range of expected outcomes that can be anticipated from similar QR code interventions in comparable retail pharmacy settings.

These empirical findings provide robust support for service quality theory's proposition that technological innovations can enhance the fundamental dimensions of service delivery, particularly responsiveness, reliability, and tangibility in retail

Enhancing Customer Outcomes in Retail Pharmacy: The Effect of QR Code Implementation Assessed Through Service Quality Theory and Multiple Regression Analysis

pharmacy environments. The improvement in customer satisfaction can be theoretically attributed to QR codes' capacity to address multiple service quality dimensions simultaneously. Specifically, the technology enhances responsiveness by enabling immediate access to information without requiring staff intervention, improves reliability through consistent and accurate information delivery, and increases tangibility by providing digital touchpoints that customers can interact with independently. This multi-dimensional enhancement aligns with Parasuraman, Zeithaml, and Berry's seminal work on service quality, which emphasizes that superior service experiences result from improvements across multiple quality dimensions rather than isolated enhancements in single areas. The observed satisfaction improvements also support the expectation-confirmation theory, suggesting that QR code implementation exceeded customer expectations for service delivery, leading to positive disconfirmation and enhanced satisfaction levels. The enhancement in customer trust represents a particularly important finding given the critical role of trust in healthcare relationships and pharmaceutical services. Trust in pharmacy settings encompasses multiple facets, including confidence in medication accuracy, belief in pharmacist competence, and assurance regarding service reliability. The QR code implementation appears to have strengthened these trust dimensions by increasing service transparency, providing customers with independent access to medication information, and demonstrating the pharmacy's commitment to technological innovation and customer convenience.

This finding is consistent with technology acceptance literature, which suggests that perceived usefulness and ease of use of technological innovations can enhance user trust and confidence in service providers. Furthermore, the trust enhancement supports social exchange theory's predictions that when service providers invest in customer-beneficial technologies, customers reciprocate with increased trust and loyalty. The improvement in repurchase intention, evidenced by the strongest statistical significance among the three outcomes, has significant theoretical and practical implications. From a theoretical perspective, this finding supports the service-profit chain model, which posits that improvements in service quality led to enhanced customer satisfaction and loyalty, ultimately resulting in increased profitability and business growth. The repurchase intention enhancement suggests that QR code implementation creates a positive feedback loop where improved service experiences translate into stronger customer commitment and retention. This is particularly valuable in the competitive retail pharmacy market, where customer acquisition costs are high and customer lifetime value is significantly influenced by retention rates. The finding also aligns with the technology adoption lifecycle theory, indicating that customers who experience positive outcomes from technological innovations are more likely to continue engaging with the service provider and recommend the service to others.

The consistency of medium effect sizes across all three outcome measures is theoretically significant as it suggests that QR code implementation creates a comprehensive enhancement to the customer experience rather than isolated improvements in specific areas. This holistic improvement pattern supports systems theory's perspective on service delivery, which emphasizes that effective interventions should address multiple interconnected components of the service system simultaneously. The medium effect sizes are particularly noteworthy given the typically conservative nature of customer behaviour change in healthcare settings, where trust, safety, and reliability concern often create resistance to change. The fact that QR code technology achieved meaningful improvements across satisfaction, trust, and behavioural intention dimensions suggests that the intervention successfully addressed these inherent concerns while delivering tangible benefits.

Table 2

<i>Model Summary Pre and Post QR Implementation</i>						
Unstandardized Coefficients						
Predictor	Satisfaction		Trust		Rep. intent	
	Before	After	Before	After	Before	After
(Constant)	0.67**	0.37*	0.66**	0.61**	0.68**	0.68**
Service quality	0.22**	0.37**	0.19**	0.34**	0.14**	0.26**
Waiting time	0.20**	0.15**	0.24**	0.17**	0.24**	0.14**
Store attributes	0.42**	0.39**	0.40**	0.34**	0.44**	0.35**
R2	0.54	0.56	0.56	0.48	0.54	0.45
F	157.66**	167.74**	164.87**	124.00**	155.84**	108.25**
<i>VIF = < 10, All predictors passed multicollinearity test</i>						
<i>* = significant at 5% level, ** = significant at 1% level, ns = not significant</i>						
Standardized Coefficients Beta						
Predictor	Satisfaction		Trust		Rep. intent	
	Before	After	Before	After	Before	After
Service quality	0.23	0.38	0.21	0.36	0.16	0.30
Waiting time	0.20	0.13	0.25	0.15	0.24	0.13
Store Attributes	0.41	0.35	0.40	0.31	0.44	0.34

Enhancing Customer Outcomes in Retail Pharmacy: The Effect of QR Code Implementation Assessed Through Service Quality Theory and Multiple Regression Analysis

The multiple regression analysis examined the relationships between service quality, waiting time, and store attributes with customer satisfaction, trust, and repurchase intention before and after QR code implementation. The analysis revealed substantial shifts in the predictive power and relative importance of these variables following the technological intervention. For customer satisfaction, service quality emerged as a significantly stronger predictor post-implementation, with its standardized coefficient increasing from $\beta=0.23$ to $\beta=0.38$, representing a 65% increase in predictive strength. Conversely, waiting time's influence diminished from $\beta=0.20$ to $\beta=0.13$, while store attributes decreased from $\beta=0.41$ to $\beta=0.35$. The model's explanatory power improved slightly, with R^2 increasing from 0.54 to 0.56, and the F-statistic rising from 157.66 to 167.74, indicating enhanced overall model fit. Trust exhibited a similar pattern, with service quality's coefficient increasing substantially from $\beta=0.21$ to $\beta=0.36$, representing a 71% enhancement in predictive power. Waiting time's influence decreased from $\beta=0.25$ to $\beta=0.15$, and store attributes declined from $\beta=0.40$ to $\beta=0.31$. However, the model's R^2 decreased from 0.56 to 0.48, with the F-statistic dropping from 164.84 to 124.00, suggesting some reduction in overall explanatory power despite the strengthened service quality relationship. Repurchase intention demonstrated the most pronounced shift in service quality's importance, with its coefficient increasing from $\beta=0.16$ to $\beta=0.30$, an 88% increase. Waiting time's influence decreased from $\beta=0.24$ to $\beta=0.13$, while store attributes fell from $\beta=0.44$ to $\beta=0.34$. The model's R^2 declined from 0.54 to 0.45, and the F-statistic decreased from 155.84 to 108.25. All predictors maintained statistical significance at $p<0.01$ across both time periods and all outcome variables. The regression results indicate that QR implementation fundamentally altered the relative importance of service quality dimensions in predicting customer outcomes. The consistent increase in service quality coefficients across all models suggests that QR technology enhanced customers' ability to perceive and evaluate service quality attributes, making this dimension more influential in shaping satisfaction, trust, and behavioural intentions. Conversely, the diminished influence of store attributes may reflect QR codes' capacity to transcend physical environmental limitations by providing digital access to information and services. The strengthened service quality relationships align with expectation-confirmation theory, which posits that technology-mediated service enhancements amplify the salience of quality perceptions in customer evaluations. These findings suggest that QR implementation creates a service environment where technical quality becomes more prominent relative to functional quality dimensions, potentially shifting customer expectations toward digital service capabilities rather than traditional retail attributes.

The regression results demonstrate that QR code implementation fundamentally altered the architecture of customer experience in retail pharmacy settings, shifting the relative importance of service quality dimensions in predicting key outcomes. The consistent and substantial increases in service quality coefficients across all three dependent variables—satisfaction, trust, and repurchase intention—suggest that digital technology enhanced customers' ability to perceive, evaluate, and respond to service quality attributes. This amplification effect indicates that QR codes did not merely add a new service feature but transformed how customers process and weight different aspects of their service experience. The diminished influence of waiting time across all models is particularly noteworthy, as it suggests that QR technology effectively mitigated one of the most persistent pain points in retail pharmacy operations. By providing immediate access to information, enabling self-service capabilities, and reducing perceived wait times through enhanced transparency, QR codes appear to have decoupled customer satisfaction from traditional temporal constraints. This finding aligns with service quality theory's emphasis on responsiveness as a critical dimension, demonstrating how technology can enhance perceived responsiveness even when actual service delivery times remain unchanged. The reduced predictive power of store attributes represents another significant shift in the customer experience paradigm. Pre-implementation, physical store characteristics—such as layout, ambiance, and accessibility—were strong predictors of customer outcomes, particularly for repurchase intention ($\beta=0.44$). Post-implementation, these coefficients decreased substantially across all models, suggesting that QR technology enabled customers to transcend physical environmental limitations through digital access pathways. This transformation reflects the broader digitalization of retail experiences, where virtual touchpoints increasingly complement or substitute for physical ones. From a theoretical perspective, these findings strongly support expectation-confirmation theory and the technology acceptance model. The enhanced role of service quality post-implementation suggests that QR codes helped customers form more accurate expectations about service delivery and provided clearer mechanisms for evaluating whether those expectations were met or exceeded. The technology appears to have made service quality more salient and observable, thereby strengthening its relationship with customer outcomes. This is consistent with research indicating that technology adoption can enhance the transparency and accessibility of service processes, leading to more informed customer evaluations. The varying changes in model fit statistics across outcomes provide additional insights into the differential impact of QR implementation. While satisfaction showed improved model fit (R^2 increased from 0.54 to 0.56), both trust and repurchase intention exhibited decreased explanatory power. This pattern suggests that QR technology may have introduced new, unmeasured variables that influence trust and behavioural intentions, potentially including factors such as perceived innovation, digital self-efficacy, or technology-mediated convenience. The reduced R^2 values for these outcomes

Enhancing Customer Outcomes in Retail Pharmacy: The Effect of QR Code Implementation Assessed Through Service Quality Theory and Multiple Regression Analysis

indicate that the traditional predictors—while still significant—may no longer capture the full complexity of customer decision-making in a technology-enhanced environment. The practical implications of these findings are substantial for retail pharmacy management and strategic planning. The elevated importance of service quality suggests that investments in staff training, process optimization, and service standardization may yield greater returns in a QR-enabled environment. Conversely, the diminished influence of store attributes indicates that pharmacies may be able to achieve competitive advantage through superior service delivery rather than costly physical infrastructure improvements. This is particularly relevant for smaller or resource-constrained pharmacies that may lack the capital for extensive facility upgrades but can implement relatively low-cost digital solutions. Furthermore, the sustained statistical significance of all predictors across both time periods indicates that QR implementation represents an enhancement rather than a replacement of traditional service factors. Waiting time and store attributes remain important, albeit less influential, suggesting that a holistic approach to service improvement—combining digital innovation with attention to fundamental operational and environmental factors—is likely to be most effective. These results also contribute to the growing literature on digital transformation in healthcare retail, providing empirical evidence that even simple technological interventions can have profound effects on customer experience and business outcomes. The findings suggest that QR codes serve as a gateway technology, potentially preparing customers and organizations for more advanced digital health solutions while delivering immediate benefits in terms of service quality perception and customer satisfaction.

V. CONCLUSIONS AND RECOMMENDATIONS

The findings from this study clearly demonstrate that implementing QR code technology in retail pharmacy settings leads to significant and meaningful improvements in customer satisfaction, trust, and repurchase intention. The results from both the Wilcoxon signed-rank tests and multiple regression analyses show that service quality becomes a more influential driver of positive customer outcomes after QR code adoption, while the importance of waiting time and store attributes diminishes. This shift highlights the value of digital innovation in enhancing the customer experience by making service delivery more efficient, accessible, and responsive to evolving consumer expectations. Based on these insights, it is recommended that pharmacy managers and decision-makers prioritize the integration of digital tools—such as QR codes—into their service processes to strengthen customer relationships and foster long-term loyalty. At the same time, while digital solutions should be at the forefront of service improvement strategies, maintaining attention to traditional factors like waiting time and store environment remains important for delivering a holistic and competitive customer experience.

VI. LIMITATIONS

Despite the valuable insights provided by this study, several limitations should be acknowledged. First, the research was conducted within a specific retail pharmacy context, which may limit the generalizability of the findings to other healthcare or retail environments with different customer profiles or operational structures. The sample size, while sufficient for statistical analysis, may not capture the full diversity of customer experiences and preferences, potentially introducing sampling bias. Additionally, the study relied on self-reported measures of satisfaction, trust, and repurchase intention, which are subject to social desirability and recall biases. The cross-sectional design also restricts the ability to draw causal inferences about the long-term effects of QR code implementation, as changes in customer perceptions and behaviors may evolve over time. Finally, external factors such as concurrent digital initiatives, staff training, or broader market trends were not controlled for and could have influenced the observed outcomes. Future research should consider longitudinal designs, larger and more diverse samples, and the inclusion of objective behavioral data to further validate and extend these findings.

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Enhancing Customer Outcomes in Retail Pharmacy: The Effect of QR Code Implementation Assessed Through Service Quality Theory and Multiple Regression Analysis

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