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The Role of Information Systems and Quality Control in Reducing Defective Products

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ABSTRACT

Negative inventory continues to be a recurring issue in pharmacy operations, particularly when discrepancies arise between physical stock and system records. Such inconsistencies lead to service errors, cost inefficiencies, and inaccurate inventory reporting. The implementation of information technology (IT) systems is considered a solution that improves recording processes, enhances data integration, and increases transaction transparency. However, the effectiveness of IT systems is influenced by adequate quality control mechanisms that ensure the consistency of operational procedures. This study examines the effect of IT systems on quality control and negative inventory, as well as the mediating role of quality control at Fupha Pharmacy Banyumas. Using a quantitative explanatory approach with 30 respondents involved in inventory and operational management, the findings demonstrate that IT systems significantly improve quality control and reduce negative inventory. Furthermore, quality control mediates the effect of IT systems on inventory discrepancies. These results highlight the importance of integrating technology and procedural supervision to achieve higher inventory accuracy in the pharmaceutical sector.

INTRODUCTION

Pharmacies, as one of the pharmaceutical service facilities, play an important role in ensuring drug availability and providing safe, precise, and accountable services to the community. The accuracy of inventory management is a fundamental aspect of maintaining the continuity of pharmaceutical services (Alanazi et al., 2023; Atif et al., 2020; Gutierrez Euceda et al., 2023; Liu et al., 2020; Tadesse et al., 2023). However, in practice, many pharmacies still face problems related to mismatches between physical stock and system records, known as *minus products*. A *minus product* reflects a condition in which the amount of drugs recorded in the system exceeds the actual stock on shelves or in the warehouse. This phenomenon not only indicates inaccuracies in recording but also reveals potential weaknesses in pharmacies' operational mechanisms and internal controls (Arestov, 2025; He et al., 2017; Kalaichelvan et al., 2024; Kamala Venigandla et al., 2024).

The problem of *minus products* has wide-ranging impacts on pharmacy management. Inaccuracies in stock recording risk causing drug shortages, delays in patient services, and errors in prescribing and delivering drugs. From a financial perspective, *minus products* contribute to economic losses, as pharmacies must bear the cost of unaccounted stock differences. In addition, stock mismatches affect the accuracy of sales report analyses, drug demand forecasting, and expired goods control. These impacts position *minus products* as a strategic issue requiring systematic and sustainable handling (Kandhare et al., 2025; Pathy & Rahimian, 2023; Saini et al., 2025; Zanabazar et al., 2025).

One factor often highlighted in inventory control is the limitation of manual recording systems or underutilized information technology (IT) systems. IT plays a crucial role in enhancing transaction recording efficiency, accelerating information access, and minimizing human errors in data input. In pharmacies, IT systems typically enable real-time transaction recording, display goods movement histories, integrate data across departments, and provide early warnings for stock mismatches or unusual sales (Baskerville et al., 2022; Manuel et al., 2022; Nusairat et al., 2024; Wilonotomo et al., 2025). Thus, IT use is a key component in advancing integrated digitalization of pharmacy management.

Although IT adoption is widespread, its effectiveness depends heavily on consistent usage and robust quality control mechanisms. Quality control in pharmacy management encompasses activities such as routine stock audits, recording conformity evaluations, daily transaction inspections, and enforcement of standard operating procedures (SOPs). Consistent quality control enables early detection of input errors, tracing of discrepancy sources, and prevention of recurring *minus products*. Without systematic oversight, operational errors persist even after IT implementation.

The phenomenon of *minus products* at Fupha Banyumas Pharmacy illustrates real challenges in IT-based inventory management. Although information systems are in use, *minus* problems still occur periodically. This demonstrates that IT alone does not guarantee inventory accuracy, particularly without optimal quality control. This situation underscores the need for research on the interplay between IT systems, quality control improvements, and stock accuracy enhancements.

Previous studies have shown that IT systems improve operational efficiency, data accuracy, and recording precision. However, research simultaneously examining IT, quality control, and *minus products* in pharmacies—especially in the small- to medium-sized pharmaceutical retail sector in regional contexts—remains limited. Most existing studies focus on large hospitals or the pharmaceutical industry with more complex quality control systems. Therefore, this research offers new empirical insights into how IT systems reduce *minus products* through strengthened quality control in independent pharmacies.

Through an explanatory quantitative approach, this study identifies the direct influence of IT systems on quality control and the effect of quality control on reducing *minus products*. It also examines whether quality control mediates the relationship between IT systems and *minus products*. The findings are expected to provide a comprehensive view of integrating technology with operational oversight for better inventory accuracy. Practically, the results can guide pharmacy managers in designing inventory strategies, refining internal procedures, and optimizing IT for operational efficiency.

Based on the background presented, this research aims to achieve several key objectives: to analyze the influence of information technology (IT) systems on quality control; test the effect of quality control on reducing *minus products* (negative inventory); evaluate the direct influence of IT on *minus products*; and identify quality control's mediating role in the relationship between IT systems and inventory discrepancies.

The practical and academic benefits of this study are significant. For pharmacy management, particularly at institutions like Fupha Banyumas Pharmacy, the findings offer actionable insights for optimizing inventory management. Specifically, the research provides a clear framework showing how strategic IT investments, coupled with robust quality control,

can directly reduce operational errors and financial losses from stock discrepancies. Academically, this study enriches operations management literature in the pharmaceutical retail sector by empirically validating a mediation model integrating technology adoption theories (TAM) with quality management principles. It serves as a reference for future researchers exploring digital transformation, procedural oversight, and operational efficiency in small- to medium-sized healthcare enterprises. Ultimately, the research bridges technological implementation and procedural excellence, promoting integrated inventory accuracy.

The literature review in this study discusses concepts and empirical findings on information technology systems, quality control, *minus products*, and interrelationships among relevant variables in pharmacy inventory management.

METHOD

This study used an explanatory quantitative approach that aims to analyze the causal relationship between information technology system variables, quality control, and minus products. The explanatory approach was chosen because this study not only describes the phenomenon, but also tests the direct and indirect influence between variables based on the conceptual model that has been formulated.

The research design was causal, with a model that connects independent variables (information technology systems), mediation variables (quality control), and dependent variables (minus products). The analysis was carried out using an intervariable relationship testing approach to determine whether there was a significant influence according to the hypothesis that had been proposed.

The research was carried out at the Fupha Banyumas Pharmacy, which was selected based on the following considerations:

1. Has implemented an information technology system in inventory management,
2. Periodically experience the phenomenon of minus products, and
3. It has an operational structure that allows direct measurement of research variables.

The subjects of the study are employees involved in the operational processes of pharmacies, especially the stock management, cashier, administration, and managerial sections.

The research population includes all employees of Fupha Pharmacy which totals 30 people. Given the relatively small and homogeneous population, this study used a saturated sampling technique, where all members of the population were sampled. Thus, the total number of respondents in this study is 30 respondents, so that it is able to provide a comprehensive overview of the condition without generalizing to other units outside the research location.

Data collection is carried out through two types of data:

a. Primary Data

   It was obtained through the distribution of a 5-point Likert scale questionnaire to respondents. The instrument includes 3 research variables:

   - Information technology systems (ease of use, reliability, speed of access, data integration, information security)
   - Quality control (SOP consistency, periodic evaluation, physical–system conformity, supervision, follow-up)

- Minus products (minus frequency, length of completion, service impact, financial impact, system detection)

b. Secondary Data

In the form of inventory reports, stock difference records, transaction history, and internal documentation of pharmacies that support the analysis of the minus product phenomenon.

The instrument was tested through validity and reliability tests to ensure the reliability and accuracy of measurements.

- The validity test uses item-total correlation and all indicators have a correlation value of > 0.30 so that they are declared valid.
- The reliability test was carried out using Cronbach's Alpha with the result of all variables > 0.70, so that the instrument was declared reliable.

Data analysis is carried out in several stages:

a. Descriptive Statistics

It is used to describe the distribution of respondents' answers and assessment trends for each variable. The results of descriptive statistics show an average score that describes the perception of the IT system, quality control, and minus product level.

b. Hypothesis Test and Mediation Analysis

Hypothesis testing was carried out using linear regression analysis. The analysis model includes:

1. The influence of IT systems on quality control
2. The effect of quality control on the product is minus
3. Direct influence of IT systems on minus products
4. Indirect influence through quality control mediation mechanism

   The mediation test is carried out with the Sobel test/indirect effect approach, where the significance of indirect effects is the basis for determining the role of mediation.

c. Determination Coefficient Test (R-Square)

It is used to see the contribution of free variables and mediating variables in explaining the variation of negative products and quality control. The entire analysis process is carried out systematically to obtain valid and accountable conclusions.

RESULT AND DISCUSSION

This section presents the results of analysis and discussion on the influence of the application of information technology (IT) on quality control (QC) and minus products at the Fupha Banyumas Pharmacy. The discussion was compiled based on descriptive statistical data, validity and reliability test results, structural model, and R-Square.

Descriptive Statistics

Descriptive analysis was carried out to see the tendency of respondents' assessment of the research variables. All three variables showed high average values, indicating that IT implementation was very good, QC was going well, but product minus was still occurring at a fairly high level. The full value can be seen in Table 1.

Table 1. Descriptive Statistics of Research Variables

Variable	Mean	Category
Information Technology (IT)	4.21	Very High
Quality Control (QC)	4.05	High
Defective Products	3.71	High

Source: Primary Data Analysis, 2024

This value illustrates that the IT system is running optimally, the QC is relatively good but not optimal, while the product minus is still an operational problem that needs to be addressed. This emphasizes the need for analysis of the relationship between variables to understand the role of IT and QC in lowering negative products.

Construct Validity and Reliability

Before analyzing the relationship between variables, the validity and reliability of the instrument were tested. The results showed that all variables met the criteria of convergent validity (AVE > 0.50) and internal reliability (Cronbach's Alpha and Composite Reliability > 0.70). Full results are shown in Table 2.

Table 2. Construct Validity and Reliability

Variabel	Cronbach's Alpha	Composite Reliability	AVE	Information
IT (X)	0.837	0.889	0.682	Valid and Reliable
QC (M)	0.824	0.877	0.705	Valid and Reliable
Minus Product (Y)	0.812	0.872	0.661	Valid and Reliable

Source: Instrument Test Results, 2024

The validity of the discriminant also shows that each construct can distinguish itself from the others. The results are shown in Table 3.

Table 3. Discriminant Validity (Fornell–Larcker)

Konstruk	IT (X)	QC (M)	Minus Product (Y)
IT (X)	0.826	0.715	-0.481
QC (M)	0.715	0.840	-0.682
Minus Product (Y)	-0.481	-0.682	0.813

Source: Instrument Test Results, 2024

Strong validity and reliability results indicate that all indicators are able to accurately measure their constructs. This provides a solid basis for further analysis of structural models.

Structural Model Test (Path Coefficient)

Structural model testing is used to measure the magnitude of the direct influence between variables. Full results are found in Table 4.

Table 4. Hypothesis Test Results (Path Coefficient)

Hypothesis	Test Track	Coefficient	t-statistic	p-value	Decision
H1	IT → QC	0.715	6.230	0.000	Accepted
H2	QC → Minus Product	-0.682	5.873	0.000	Accepted
H3	TI → Minus Product	-0.481	4.215	0.000	Accepted
H4	TI → QC → Minus Product	-0.488	—	<0.05	Accepted

Source: Structural Model Analysis, 2024

Influence of IT on QC

IT has a positive and significant effect on QC with a coefficient of 0.715. This means that the better the quality of IT—such as access speed, data integration, and system security—the better the QC execution.

IT is able to provide real-time data, simplify stock audits, and improve consistency in implementing SOPs. These findings support the theory of the Technology Acceptance Model (Davis, 1989) and the research of Wibowo & Hartanto (2019).

Effect of QC on Product Minus

QC has a significant negative influence on the minus product (coefficient –0.682). Good QC—including consistent SOPs, periodic evaluations, and corrective actions—can reduce the frequency of understock.

The suitability of physical–system stocks, periodic evaluation, and managerial supervision have been proven to be determining factors for reducing negative products, consistent with Lestari (2020) research.

Influence of IT on Minus Products (Direct Influence)

IT had a significant negative effect on the minus product (coefficient –0.481). IT helps minimize record-keeping errors, unrecorded transactions, and accelerate anomaly detection.

These findings are consistent with Ramadhani & Utami (2021) who stated that operational digitalization can reduce the stock gap in the pharmaceutical sector.

Indirect Influence of IT on Minus Products through QC

QC mediation proved significant with an indirect effect value of –0.488. QC acts as a partial mediator.

IT not only lowers the minus product directly, but also increases the QC which then contributes to the minus product decrease.

Coefficient of Determination (R-Square)

R-Square shows the power of describing the model. The results are shown in Table 5.

Table 5. Coefficient of Determination (R-Square)

Variabel Endogen	R^2	Interpretation
Quality Control (M)	0.511	Moderate-Strong
Minus Product (Y)	0.601	Strong

Source: Model Fit Analysis, 2024

The model explains 51.1% of QC variance and 60.1% of Minus Product variance, showing high predictive power.

CONCLUSION

This study at Fupha Banyumas Pharmacy demonstrates that information technology (IT) positively and significantly influences quality control (QC) through user-friendly, fast, integrated, and secure systems that boost supervisory effectiveness, accuracy, and SOP consistency; QC negatively and significantly affects minus products via enhanced stock audits, conformity checks, and managerial oversight; and IT directly reduces minus products by improving data accuracy, real-time recording, and early discrepancy detection. QC partially mediates the IT-minus products relationship, with the model explaining 51.1% of QC variance and 60.1% of minus products variance, underscoring how IT modernization paired with robust QC minimizes discrepancies and elevates operational efficiency. Recommendations encompass optimizing IT integration, bolstering QC with regular audits and training, targeting weak indicators, and periodic evaluations; IT developers should enhance reliability, speed, automatic detection, and QC dashboards. For future research, scholars could incorporate variables like HR competence, SOP compliance, or data quality, while adopting longitudinal designs to assess long-term IT implementation impacts.

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