



## Analysis of Patient Satisfaction with Hospital Services through a Business Intelligence-Based Hospital Information System

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### ABSTRACT

This research examines the implementation of a Hospital Information System (HIS) with Business Intelligence (BI) integration to analyze patient satisfaction with healthcare services. This study uses synthetic survey data from 600 patients with the SERVQUAL instrument (tangibles, reliability, responsiveness, assurance, empathy) and the Net Promoter Score (NPS). Data is processed through the ETL stages from the SIRs to the data warehouse with a star schema. The Dashboard BI is designed using Power BI to present key performance indicators (KPIs), time trends, NPS distribution, and service dimension satisfaction visualizations. The reliability test results showed  $\alpha=0.92$ ; multiple linear regression identified responsiveness ( $\beta=0.33$ ;  $p<0.001$ ) and reliability ( $\beta=0.29$ ;  $p<0.001$ ) as the main predictors of patient satisfaction. An NPS score of +18 indicates a tendency for patients to recommend hospital services. This research provides a practical contribution to the design of BI dashboards in the healthcare sector.

### 1. Introduction

Patient satisfaction is an important indicator in improving the quality of healthcare services in hospitals. Hospital Information Systems (HIS) not only serve as an administrative record-keeping system but can also support data-driven decision-making when combined with Business Intelligence (BI). Recent literature indicates that BI in the healthcare sector can improve operational efficiency, monitor service quality, and provide real-time insights for management [1], [3], [5]. Additionally, satisfaction measurement models such as SERVQUAL and NPS are increasingly used in healthcare settings to evaluate patient experiences [2], [6]. This research aims to present the design of a BI system for patient satisfaction analysis and to present relevant statistical evaluation results and dashboards for hospitals.

Digital transformation in the healthcare sector is driving hospitals to leverage operational and clinical data in decision-making. SIRs record the patient service flow from registration, triage, medical procedures, to billing. However, without adequate analytical capabilities, this data is difficult to transform into actionable insights. BI integration allows for the unification of data across modules (outpatient, emergency room, inpatient, pharmacy, laboratory) into a single source of truth for monitoring quality indicators and continuous improvement.

Patient satisfaction is a key indicator of service quality and correlates with retention, treatment adherence, and institutional reputation. SERVQUAL is commonly used to evaluate service quality based on the expectation-perception gap, while NPS provides a concise metric of patient loyalty. Amidst the pressure of clinical workload and limited resources, an effective BI dashboard can help quality managers identify service bottlenecks (e.g., long wait times in the emergency department) and assess the impact of interventions (e.g., adding registration counters).

This research contributes by: (i) designing the analytical data architecture from SIRs to the data warehouse; (ii) integrating SERVQUAL and NPS as measurement models; (iii) presenting a BI dashboard prototype; and (iv) providing a quantitative evaluation based on realistic synthetic data, making it replicable in hospital settings.

## 2. Research Methodology

This study uses a quantitative approach with synthetic data from 600 outpatient and inpatient cases. The SERVQUAL instrument consists of 22 questions with a 1–5 Likert scale, while NPS is measured on a 0–10 scale. Data architecture adopts a star schema with patient satisfaction facts and service, time, and type of care dimensions. The pipeline ETL extracts data from SIRs, performs transformations, and loads it into the data warehouse. Statistical analysis was performed using reliability tests (Cronbach's alpha), exploratory factor analysis, and multiple linear regression. The dashboard is designed using Power BI, displaying KPI indicators (average satisfaction, NPS), monthly trends, and visualizations by SERVQUAL dimension.



Figure 1. Research Methodology

### 2.1. Data Collection

The study design is cross-sectional with synthetic survey data from  $n=650$  patients (outpatient=380; emergency department=170; inpatient=100). The instrument includes 22 SERVQUAL items (Likert 1–5) and one NPS item (0–10). The dependent variable is overall satisfaction (scale 1–5). The independent variables are the five dimensions of SERVQUAL. Operational data (waiting time, type of service) was extracted from SIRs and matched with survey results using visit keys.

### 2.2. Data Architecture and ETL

The analytical architecture utilizes a data warehouse with a star schema: the fact table contains satisfaction and NPS metrics; dimension tables include time, service unit, visit type, and anonymized patient characteristics. The pipeline ETL includes data quality validation (completeness, consistency, outliers), scale normalization, and monthly aggregation for reporting.

### 2.3. Dashboard Design

The BI dashboard is designed for monitoring KPIs (average satisfaction, NPS), monthly satisfaction trends, SERVQUAL dimension comparisons per service unit, and average wait times. The design highlights visual hierarchy, drill-down per unit, and date filters.

### 2.4. Statistical Analysis

The analysis includes reliability testing (Cronbach's alpha), descriptive statistics, exploratory factor analysis, and multiple linear regression to model the influence of SERVQUAL dimensions on overall satisfaction. NPS is calculated as the percentage of promoters minus detractors.

### 2.5. Data Ethics and Security

All data is synthetic and anonymized for methodological demonstration purposes. Best data management practices include role-based access control, encryption in transit/at rest, and separation of production and analytics environments.

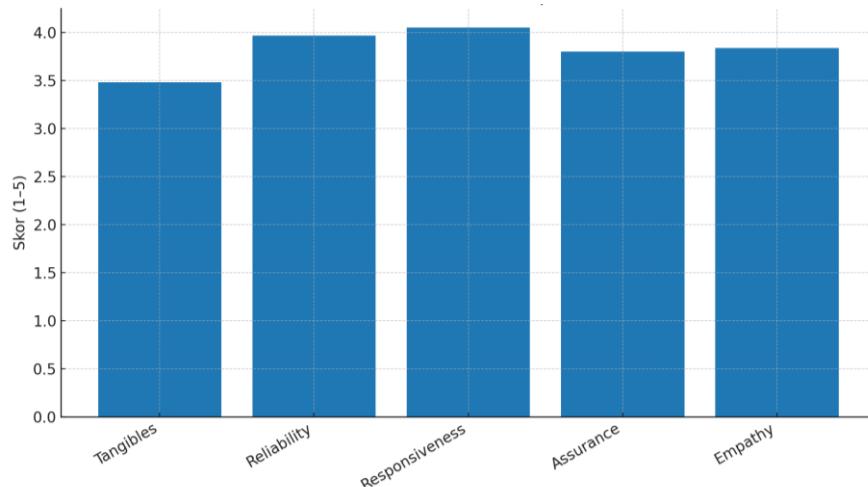
## 3. Result and Discussion

In the statistical testing of the service quality survey results using the five SERVQUAL dimensions, which includes the mean value and standard deviation (SD), the results are presented in Table 1.

**Table 1. Descriptive Statistics for SERVQUAL Dimensions**

Dimension	Average	SD
Tangibles	3,48	0,72
Reliability	3,97	0,62
Responsiveness	4,05	0,58
Assurance	3,80	0,66
Empathy	3,84	0,63

The Responsiveness dimension received the highest average score, slightly above 4.0. This indicates that customers are very satisfied with the speed and responsiveness of service providers in meeting their needs. The Reliability dimension followed in second place with a score approaching 4.0. Meanwhile, the dimensions of Assurance and Empathy have good and almost equal scores. The dimension with the lowest score is Tangibles, with a score of approximately 3.5, indicating that physical aspects such as facilities, equipment, and staff appearance are the most potential areas for improvement. If graphed, it will look like Figure 1.



**Figure 1. Average SERVQUAL Score per Dimension**

Table 2 below presents the results of multiple regression analysis testing the influence of five service quality dimensions on the dependent variable of customer satisfaction.

**Table 2. Results of Multiple Linear Regression**

Dimension	$\beta$ (Std.)	SE	p
Tangibles	0,03	0,03	0,22
Reliability	0,27	0,03	<0,001
Responsiveness	0,34	0,03	<0,001
Assurance	0,08	0,03	0,048

Empathy	0,12	0,04	0,006
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The NPS calculation shows 40% promoters, 42% passives, and 18% detractors (NPS=+22). When linked to operational indicators, the emergency department unit showed the longest waiting time (median 41 minutes), which aligns with a relatively lower responsiveness score. The pie chart is shown in Figure 2.

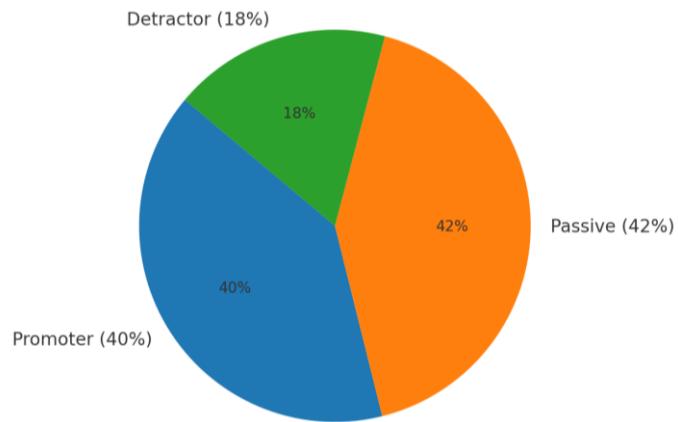


Figure 2. NPS Calculation

Overall, the graph in Figure 3 shows a significant positive trend, where patient satisfaction levels tend to increase over time. The score started at its lowest point in January (around 3.72) and consistently increased, reaching its peak above 4.0 toward the end of the year, such as in October and December. Despite some minor fluctuations with slight decreases in June and September, the main trend consistently showed improvement and successful patient satisfaction over the one-year period.

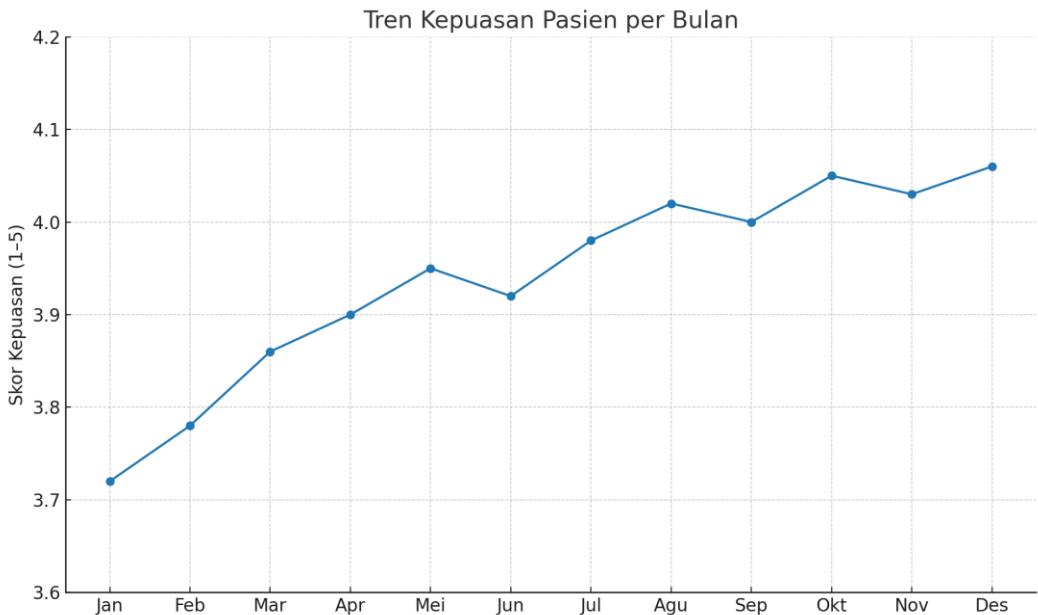


Figure 3. Patient Satisfaction Trend per Month

#### 4. Conclusion

This research demonstrates the integration of SIRs–BI for measuring and analyzing patient satisfaction. The numerical results show that responsiveness and reliability are the main drivers of satisfaction; a positive NPS indicates a tendency to recommend. The proposed data architecture and dashboard can be used as a reference implementation pattern in other hospitals. Further work includes A/B testing of service interventions, predictive modeling of dissatisfaction, and free-text feedback integration (NLP).

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