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Improving Patient Satisfaction through a Hybrid Approach of Queuing Theory, Discrete-Event Simulation, and Service Quality in Admission and Appointment Scheduling at a Public Hospital

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Abstract

This paper presents a comprehensive improvement approach to the admission and appointment scheduling processes in a public hospital located in North Lima, where significant operational and technical gaps were identified. A total of 73.3% of patients reported dissatisfaction with the admission service, exceeding the acceptable threshold of 40% by 33.3 percentage points (Office of Quality Management, 2024). Moreover, 57.71% of users experienced waiting times longer than 30 minutes, established as the benchmark by the MINSA "Zero Queues Plan" (Ministry of Health, 2022). By applying queuing theory, process standardization, and discrete-event simulation, the operational flow was redesigned, and quantifiable improvements were projected. The results indicate a reduction in waiting times of more than 40% and a 33% increase in overall patient satisfaction, highlighting the potential replicability of this proposal in other public healthcare facilities in Peru, particularly those characterized by high demand and limited resources.

Keywords
Queuing theory; hospital processes; simulation; patient satisfaction; operational improvement.

1. Introduction
Public health systems in Latin America, particularly in Peru, face persistent structural challenges such as institutional fragmentation, low interoperability, and insufficient funding. In 2022, health expenditure in Peru accounted for only 6.2% of GDP, below countries such as Costa Rica (7.8%) and Colombia (7.7%) (World Bank, 2024). These constraints translate into operational congestion, service duplication, and extended waiting times.
A regional study by the Pan American Health Organization (PAHO, 2023) reported that in many countries across the region, more than 60% of hospital service users wait over 45 minutes to be attended, with marked disparities between urban and rural areas. In Peru, such delays directly affect continuity of care and treatment adherence, particularly among vulnerable populations. Moreover, inefficiencies in outpatient appointment scheduling and admission

processes have been identified as critical drivers of user dissatisfaction, negatively influencing institutional perception and perceived service quality (Matute-Calle & Murillo-Párraga, 2021).

This study was conducted in a high-demand public hospital located in North Lima, serving a population of over one million inhabitants. In the outpatient department alone, the hospital provides care to between 700 and 900 patients daily, supported by 224 administrative staff and more than 1,300 healthcare professionals. Surveys conducted by the hospital's Quality Office in 2024 revealed that 73.3% of users reported dissatisfaction with the outpatient care process, citing excessive waiting times, insufficient guidance, and disorganized patient flow as the main issues.

In contrast with recent studies such as those by Subburaman et al. (2023), Kumar and Gupta (2023), and Ceccolini (2024), this study proposes a comprehensive model that combines queuing theory (M/M/1 and M/M/c), discrete-event simulation, and service quality evaluation through SERVQUAL, all articulated within the PDCA continuous improvement cycle. While previous research focused on optimizing isolated components—such as cycle times, patient registration, or standardized guidance—the present study integrates these approaches into a hybrid framework that simultaneously addresses operational efficiency and user experience. Moreover, it introduces an innovative digital component modeled as a virtual server, which expands system capacity without requiring additional physical infrastructure. This methodological combination represents a distinctive contribution to the hospital management literature by providing empirical evidence of a replicable and adaptable model for high-demand public hospitals in Latin America, characterized by limited resources.

1.1 Objectives

- Identify and analyze the critical factors generating queues and patient dissatisfaction through process analysis tools and user surveys.
- Improve the admission and appointment scheduling processes in a public hospital in North Lima by applying process standardization and queuing theory, with the aim of reducing waiting times and enhancing the patient experience.
- Design, implement, and validate an improvement model incorporating standardized workflows, differentiated guidance by patient type, and partial automation, while assessing its impact on operational efficiency and perceived service quality.

1.2 Research Questions

- RQ1: To what extent does the integration of a digital orientation platform, modeled as an additional server within the M/M/c queuing system, improve the operational outcomes of the admission and appointment scheduling process?
- RQ2: To what extent does the application of the SERVQUAL model validate the sustainability of the improvement in perceived service quality?
- RQ3: Can the proposed hybrid approach—based on queuing theory, SERVQUAL, and discrete-event simulation—be replicated in other public hospitals with limited resources?

2. Literature Review

Queuing theory has been extensively applied in hospital environments to redesign critical processes and reduce waiting times. Puspitasari et al. (2022) reported an increase in patient satisfaction from 50% to 66.7% in an obstetric clinic after reorganizing patient flow. Sharma et al. (2019) applied the M/M/1 model in outpatient care, identifying operational saturation ($\rho = 4$) and reducing waiting times from 61 to 19 minutes through pre-registration improvements. Zhang et al. (2023) combined queuing theory with an electronic management system to reduce both actual and perceived waiting times, achieving significant gains in patient satisfaction.

Beyond queuing optimization, several authors have explored process standardization as a complementary strategy to improve patient flow and satisfaction. Matute-Calle and Murillo-Párraga (2021) enhanced internal coordination and user experience, reversing dissatisfaction levels above 50% through SERVQUAL and standardized workflows. In the Peruvian context, Becerra-Canales and Condori-Becerra (2019) increased patient satisfaction from 63.1% to 73.7% by implementing the "Zero Queues" plan, which relied on appointment digitization, unified protocols, and strict scheduling. Pereira et al. (2021) addressed administrative inefficiencies in hospital admissions through institutional flowcharts, leading to better access and patient guidance. These findings support the integration of digital tools such as informational platforms and virtual care systems, which expand the effective capacity of healthcare services without requiring additional physical infrastructure.

In comparison with recent studies such as Zhang et al. (2023) and Bauerhenne et al. (2024), which optimized scheduling systems through electronic solutions and robust appointment allocation models, respectively, the present study extends the analysis by simultaneously integrating operational efficiency and user perception. Unlike those investigations, developed in technologically advanced environments, the proposed model demonstrates that the combination of queuing theory, discrete-event simulation, and SERVQUAL can be effectively adapted to Latin American public hospitals characterized by structural and resource constraints. This approach provides empirical evidence on the feasibility of hybrid strategies that balance operational capacity and perceived service quality, contributing to international literature from a contextual, low-cost, and highly replicable perspective.

3. Methods

The research followed an applied, quasi-experimental approach aimed at analyzing and improving admission and appointment scheduling processes in outpatient care. The methodology was structured around the PDCA (Plan–Do–Check–Act) continuous improvement cycle (Figure 1), integrating both quantitative and qualitative tools. Queuing theory, discrete-event simulation, and operational indicators were employed to model the system. In parallel, the SERVQUAL model was applied as a mixed instrument to identify gaps in perceived service quality by contrasting user expectations and perceptions. Data collection comprised structured surveys based on the five SERVQUAL dimensions (n = 383), complemented by administrative records and direct observations of activity times, which provided the parameters for analytical and simulation models. This mixed-methods design ensured a comprehensive evaluation of both operational efficiency and user experience.

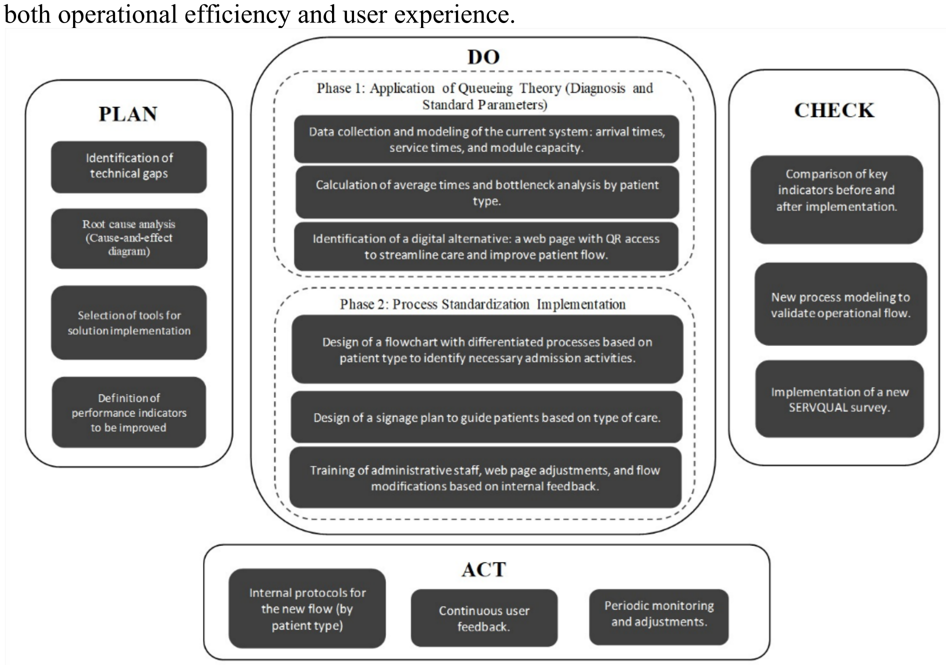


Figure 1. PDCA-based framework for redesigning the admission and appointment scheduling process in outpatient care. Source: Authors' elaboration (2024).

3.1 Methodology for Applying Queuing Theory in Operational Redesign

As part of the methodological approach implemented in the Do phase, queuing theory was applied to model and evaluate the operational performance of the hospital admission system. This method uses probabilistic models to represent systems where users experience delays due to limited service capacity. The procedure involved selecting an appropriate model based on the observed arrival and service patterns, estimating key parameters such as the arrival rate (λ) and service rate (μ), and calculating performance indicators including average waiting time in the queue (W_q), average queue length (L_q), and system utilization (ρ). In this study, an M/M/1 model was developed for each critical activity, assuming Poisson arrivals and exponential service times. Based on empirical observations, the estimated arrival rate was $\lambda \approx 0.422$ patients per minute (equivalent to an average inter-arrival time of 2.37 minutes), while the service rate was determined as the inverse of the average observed service time.

The results indicated high saturation levels in several activities, with utilization values (ρ) exceeding 1.0, a clear sign of operational instability. These findings supported the need to redesign the system configuration to enhance effective capacity. Table 1 summarizes the key performance indicators obtained in the current scenario.

Table 1. Performance Indicators of the M/M/1 Model (Current Scenario)

Activity	Avg. Time (min)	μ (1/min)	c	ρ	Wq (min)	Lq	P0
Reception and initial orientation	7.63	0.131	1	3.22			
Validation RefCon and scheduling	3.78	0.265	2	0.796	6.23	2.63	0.204
Orientation to waiting room	4.91	0.204	1	2.07			
Orientation for referral	3.41	0.293	1	1.44			
SIS affiliation verification and scheduling	2.43	0.412	3	0.34	0.2	0.08	0.66

Source: Authors' calculations based on collected data (2024).

Activities such as reception, orientation to the waiting room, and referral orientation exhibited operational saturation ($\rho \geq 1$), indicating that patient demand exceeded the available service capacity. Under these conditions, the M/M/1 model becomes unstable, as queue length and waiting times tend to grow indefinitely, preventing the system from reaching a steady state (Gross & Harris, 1998). This outcome highlighted the need to transition to a multi-server configuration (M/M/c).

Considering the limitations in expanding physical resources, a digital component was incorporated as an additional server to increase effective system capacity. Specifically, a web-based informational platform was integrated to assume guidance tasks previously handled by admission staff. Operating continuously and without the need for extra physical infrastructure, this component was modeled as a virtual server. As a result, the system evolved into a hybrid M/M/c structure, where c includes both physical and digital servers. Table 2 presents the parameters and performance indicators obtained under this new configuration.

Table 2. Performance Indicators of the M/M/c Model with Digital Platform Integration

Activity	Avg. Time (min)	μ (1/min)	c (incl. digital)	ρ	Wq (min)	Lq	P0
Reception and initial orientation	7.63	0.131	2	1.61	20.07	8.46	0.193
Orientation to waiting room	4.91	0.204	2	1.03	5.19	2.19	0.242
Orientation for referral	3.41	0.293	2	0.72	2.02	0.85	0.278

Source: Authors' calculations based on collected data (2024).

The queuing model allowed for a quantitative estimation of the system's capacity to absorb demand and for evaluating the impact of incorporating a digital platform as a complementary resource. This approach provided a solid technical basis for redesigning the system in operational contexts with capacity restrictions.

3.2 Process Standardization Methodology

To assess the impact of standardizing the admission and appointment process, data from the hospital's annual SERVQUAL survey were analyzed, focusing on patient perceptions of service quality. Particular attention was given to questions related to informational tools and the clarity of the care flow. The analysis was complemented by expert judgment and semi-structured interviews with key stakeholders. The survey instrument covers five dimensions and 22 items. Table 3 summarizes the methodological components employed.

Table 3. Structure of the Survey Instrument

Dimension	Related Questions
Reliability	- Question 5: Did you find available appointments and obtain them easily? Measures the hospital's ability to provide accurate and timely services, fulfilling commitments made to patients.
Responsiveness	- Question 6: Was the service at the cash desk or SIS admission module fast? Measures service speed, response time for requests, and emergency handling.
Aspectos Tangibles	- Question 19: Are the signs and arrows adequate to guide patients? - Question 20: Did the outpatient area have staff available to inform and guide patients? Covers aspects of physical facilities, cleanliness, visibility of signage, adequacy of equipment, and presence of staff to provide guidance.

Source: Authors, adapted from the institutional quality evaluation system (2024).

4. Data Collection

To assess deficiencies in the user experience, a structured survey based on the SERVQUAL model was administered to 383 users of the admission and appointment scheduling service. The findings revealed a satisfaction level of 26.7%, which falls significantly below the minimum standard expected for public health services (≥ 60%). This highlights the existence of a critical technical gap in service delivery. To further analyze this issue, an Ishikawa diagram was constructed (Figure 2), which revealed structural causes such as deficiencies in the appointment system design, absence of time monitoring mechanisms, inadequate signage, and inconsistent guidance provided to patients throughout the process.

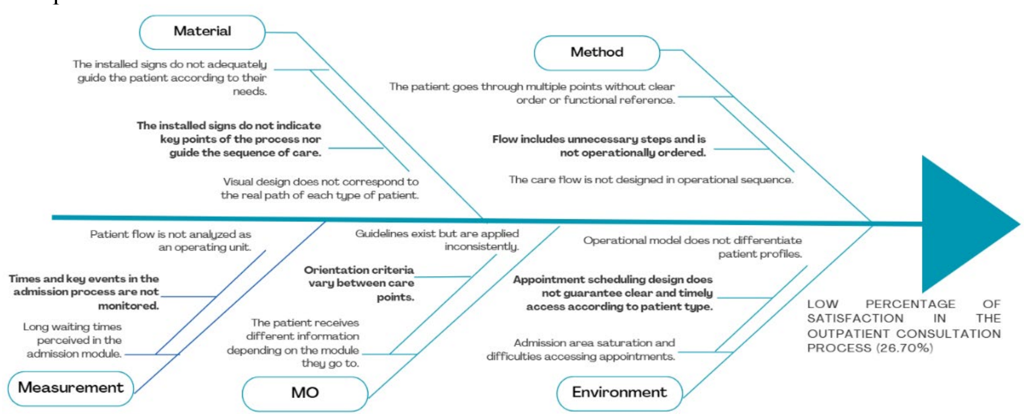


Figure 2. Ishikawa chart. Source: Authors' elaboration based on field data collected during process observation (2024).

To prioritize improvement efforts, a Pareto analysis was conducted using the relative frequency of dissatisfied users according to the identified root causes. The results showed that 86.56% of reports were concentrated in four critical factors: inefficient appointment system design (A – 23.25%), lack of key time monitoring (E – 22.88%), non-standardized operational sequence (B – 22.75%), and insufficient signage (C – 17.69%). This prioritization provided a clear basis for focusing the process redesign on areas with the greatest operational impact and the strongest negative influence on user perception, as illustrated in Figure 3.

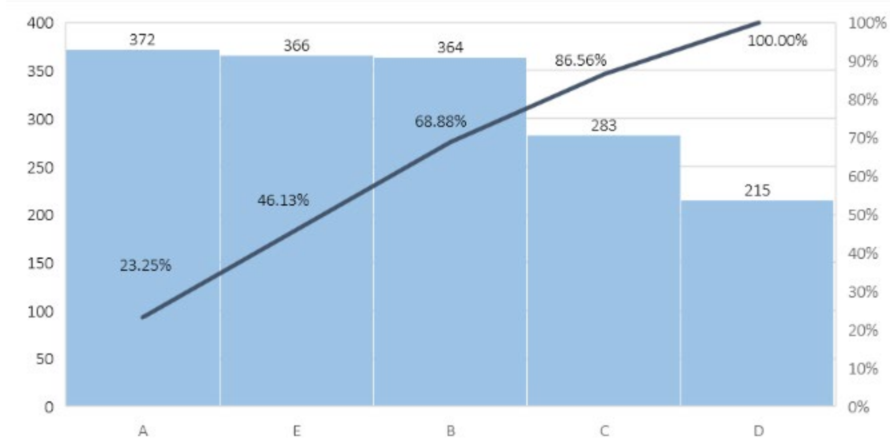


Figure 3. Pareto chart. Source: Authors' elaboration based on data analysis (2024).

4.1 Data Collection for Queuing Theory Analysis

To develop a representative simulation model of the admission and appointment scheduling process in outpatient care, time studies were carried out on a preliminary sample of 100 patients. Observations were distributed across the main process activities to record service times under real operating conditions.

Based on these initial data, the standard deviation of service times per module was calculated, allowing estimation of the statistically valid sample size required per activity. The following formula was applied, using a one-tailed 95% confidence level and a maximum error margin of 10%:

$$n = \left(\frac{Z \cdot s}{e}\right)^2$$

Where:

n= required sample size per activity

Z=1.6449 = Z-value for a one-tailed 95% confidence level

s= sample standard deviation

e=0.10 = acceptable error level (10%)

The following Table 4 presents the estimated standard deviations and the corresponding calculated sample sizes. These values served as the basis for modeling both the current scenario (As-Is) and the redesigned scenario (To-Be) of the process.

Table 4. Sample Size per Activity in the Baseline Model

Activity	Estimated Std. Dev. (min)	Required Sample Size (n)
Early patient arrival (5:00 a.m.)	0.57	88
Patient arrival (second shift)	0.61	100
Reception and initial orientation	0.85	195
Reference validation and appointment scheduling (RefCon)	0.76	156
Orientation to the waiting room	0.49	65
Orientation for referrals	0.52	73
SIS affiliation verification and appointment assignment	0.47	60

Source: Authors' elaboration based on field time measurements and statistical calculations (2024).

The use of a one-tailed 95% confidence level responded to the purpose of the study, which was to detect improvements in a single direction—namely, the reduction of waiting times—thereby justifying the one-tailed test approach. On the other hand, the SERVQUAL questionnaire is already used continuously by the hospital as part of its service quality evaluation system, and is therefore linguistically and culturally adapted to its institutional context, ensuring the relevance and comprehension of its items. Finally, the digital platform developed in Bubble was functionally validated through a pilot test with internal users and controlled observations, confirming its operability before being modeled within the simulation environment.

4.2 Data Collection for Process Standardization

The standardized process design was developed from SERVQUAL results, which revealed gaps in key service dimensions. User and staff interviews complemented these findings by identifying operational bottlenecks. Together, this evidence provided the basis for formalizing a standardized process framework

Table 5. SERVQUAL Dimensions

SERVQUAL Dimension	Key Question	Dissatisfaction Percentage
Reliability	Did you find available appointments and obtain them easily? (Q5)	97.13%
Responsiveness	Was the service at the SIS admission desk fast? (Q6)	95.56%
Tangibles	Are the signs adequate to guide patients? (Q19)	95.09%
	Was there staff available to guide patients? (Q20)	>95%

Source: Authors' calculations based on survey results (2024).

5. Results and Discussion

5.1 Numerical Results

As part of the operational redesign of the admission and appointment scheduling process, queuing theory was employed to diagnose and optimize system performance. The initial analysis using the M/M/1 model revealed severe saturation in key activities such as reception, guidance to the waiting area, and referral orientation ($\rho > 1$), indicating system instability. Considering the constraints of public sector healthcare regarding the expansion of physical resources, the system was reconfigured to an M/M/c model, introducing a digital server as an additional resource. To operationalize this approach, a web platform was developed using Bubble, a no-code development tool that enabled the implementation of a functional and adaptable solution.

The platform incorporates the following features: (i) differentiated patient flows based on category (new, returning, or referred), (ii) an interactive internal navigation map according to type of care, (iii) display of specific requirements by patient category, and (iv) appointment scheduling by medical specialty. This configuration redistributes the operational workload, ensuring that face-to-face services are prioritized for elderly patients and those with technological limitations. To enhance accessibility, informational banners with QR codes were installed in admission areas, allowing patients to access the platform directly from their mobile devices.

Figure 4 illustrates the developed web platform and highlights its main functionalities designed to improve patient experience.

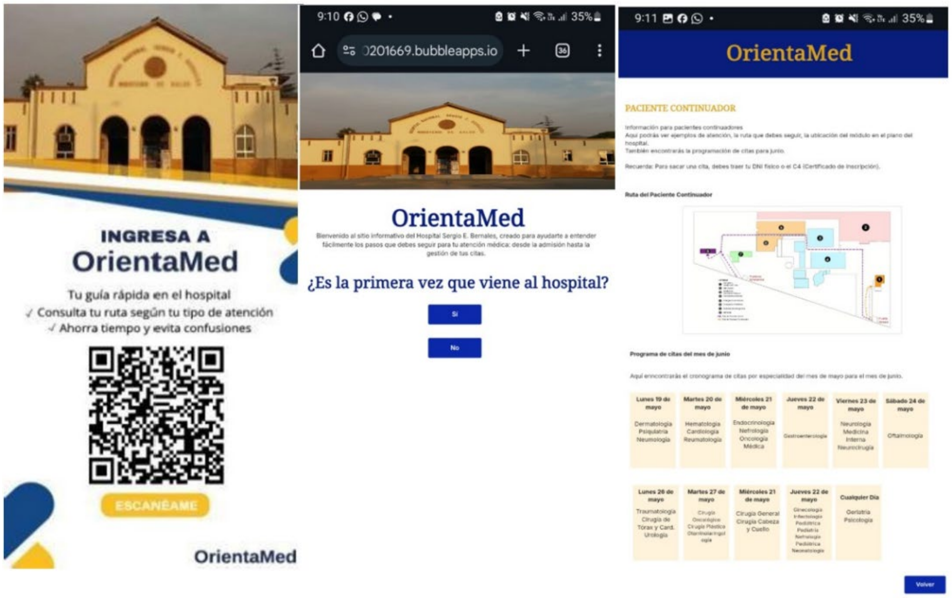


Figure 4. Web Page Development. Source: Authors' elaboration based on redesigned workflow (2024).

The operational flow was subsequently redesigned using Arena simulation software, eliminating redundant activities such as the duplicate initial orientation, which in the baseline scenario was performed by a single resource for both new and returning patients. In the redesigned model, a digital reception/orientation point was incorporated and activated only when required, thereby improving resource utilization. Additionally, operational branching was introduced according to patient type, streamlining care pathways and ensuring differentiated service delivery.

To assess the impact of the intervention, new service times were collected through a preliminary sample of 100 observations, complemented with statistically significant samples for the most critical modules. Table 6 presents a comparison of average service times before and after implementation.

Table 6. Comparison of Average Times per Activity: Baseline vs. Improved Scenario

Activity	Baseline Avg. Time (min)	Improved Avg. Time (min)
Reception and initial orientation (physical/digital)	7.58	1.64
Validate referral in RefCon and schedule appointment	3.82	1.89
Orientation to waiting room	4.85	3.53
Orientación de referencias	3.45	3.18
Referral orientation	2.42	2.01
Verify SIS affiliation and assign appointment	7.58	2.07

Source: Authors' calculations based on simulation and field validation (2024).

Both the baseline (As-Is) and redesigned (To-Be) scenarios were modeled in Arena®, employing the Input Analyzer tool to determine the most representative statistical distributions for each activity. To quantitatively assess the effectiveness of the redesign, four key performance indicators (KPIs) were defined and incorporated into the simulation model. The corresponding results are presented below.

Table 7. Key Performance Comparison: Baseline vs. Improved Scenario

Indicator	Unit	Baseline (As-Is)	Target (To-Be)	Result
Overall satisfaction level	% of satisfied users	26.70%	≥ 60 %	55.20%
% of users served in <30 min	% of users	42.29%	≥ 70 %	84.50%
Waiting time standard deviation	Hours (h)	1.20 h (72 min)	< 0.50 h (30 min)	16.1 min (0.27 h)
% of users receiving adequate guidance	% of users	43.86%	≥ 60 %	61.50%

Source: Authors' calculations based on Arena simulation outputs (2024).

One of the key actions that enabled the previously reported results was the redesign of patient flow, which represented a critical step in standardizing the admission and appointment management process. This improvement was primarily intended to reduce patient confusion, prevent inefficient use of human resources, and enhance the overall operational efficiency of the service.

In the baseline scenario, the hospital operated with a general and poorly detailed flowchart that did not clearly differentiate care pathways by patient type (new, returning, or referred). This lack of definition, combined with inadequate signage and an outdated facility layout, caused disorientation for both patients and staff. As a result, patients often approached incorrect service desks, engaging personnel not assigned to their care, which led to work overload in some functions and unnecessary waiting times.

To address this issue, a standardized flowchart was developed for the admission and appointment management process, incorporating the following elements:

- Differentiated pathways for new (referred) and returning patients.
- Clear assignment of roles and responsibilities for each staff member involved.

Figure 5 presents the redesigned flowchart, providing a structured visualization of the patient journey and key process checkpoints.

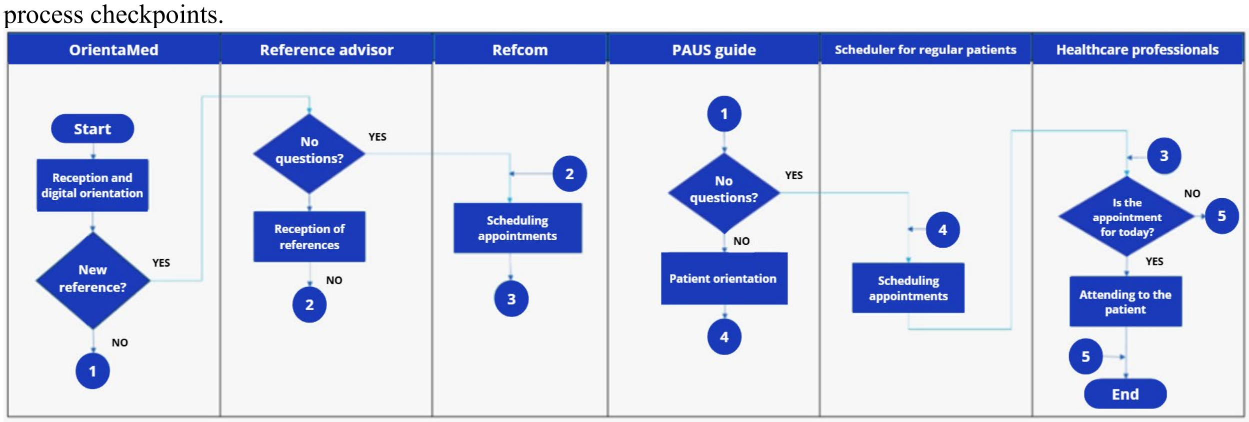


Figure 5. Improved flowchart. Source: Own elaboration based on workflow mapping (2024).

As a complementary measure, the original hospital floor plan was redesigned into a more functional and patient-centered version, as shown in Figure 6. The new layout incorporates clear and precise identification of strategic points related to the admission and appointment management process, enabling patients to navigate the facility independently throughout their journey. To maximize its impact, the updated floor plan was installed in high-traffic areas of the hospital, with the goal of improving the overall patient experience from the point of entry and reducing dependence on staff directions.

Figure 6. Functional floor plan of the hospital. Source: Authors' elaboration based on facility layout redesign and process observation (2024).

The interventions streamlined the care process and reduced the operational workload, thereby enhancing the overall patient experience. The redesign was guided by principles of process clarity, accessibility, and service quality.

5.2 Graphical Results

Based on the analysis of the admission and appointment scheduling process in a public hospital, an improvement proposal was designed that integrates two complementary methodological approaches: queuing theory and process standardization. The intervention was supported by the development of a web platform in Bubble, which allows segmentation of patient flows by type, visualization of specific requirements per category, and management of appointment scheduling by specialty. In addition, differentiated flowcharts and a functional floor plan were created to strategically reorganize the patient journey. Figure 7 illustrates the comparison between the baseline and redesigned scenarios, highlighting key operational changes in both the physical layout and the organization of care flows.

The validation of the redesign, conducted through simulation in Arena, showed substantial improvements. The percentage of users attended within 30 minutes increased from 42.29% to 84.50%, while the standard deviation of waiting times decreased from 1.20 hours to 0.27 hours. Likewise, the percentage of users receiving adequate guidance rose from 43.86% to 63.73%. Finally, a SERVQUAL-based survey confirmed an increase in overall satisfaction levels from 26.70% to 75.47%, thereby demonstrating that the combined use of queuing theory and process standardization generated comprehensive improvements in both operational efficiency and service perception.

Figure 7. Implementation of the improvement proposal. Source: Authors' elaboration based on process analysis and redesign (2024).

5.3 Proposed Improvements

To assess the statistical significance of the proposed redesign, a comparative analysis was carried out between the current and improved scenarios, using 145 replications per model at a 95% confidence level, as described in the methodological section. Figure 8 illustrates the improved scenario modeled in Arena, which provided the basis for the quantitative validation of the proposal. The Output Analyzer module in Arena was used to process the results.

Confidence intervals were computed, and a paired t-test was applied to verify whether the differences observed across the four selected indicators were statistically significant.

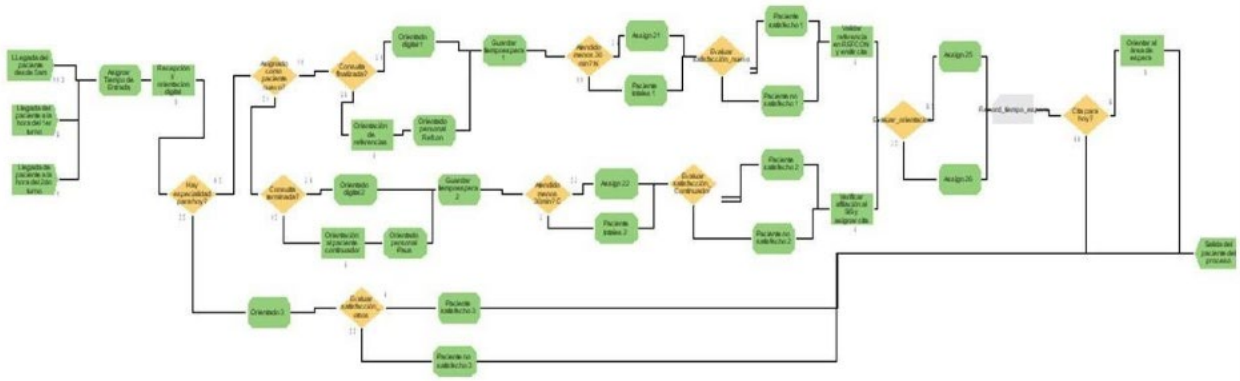
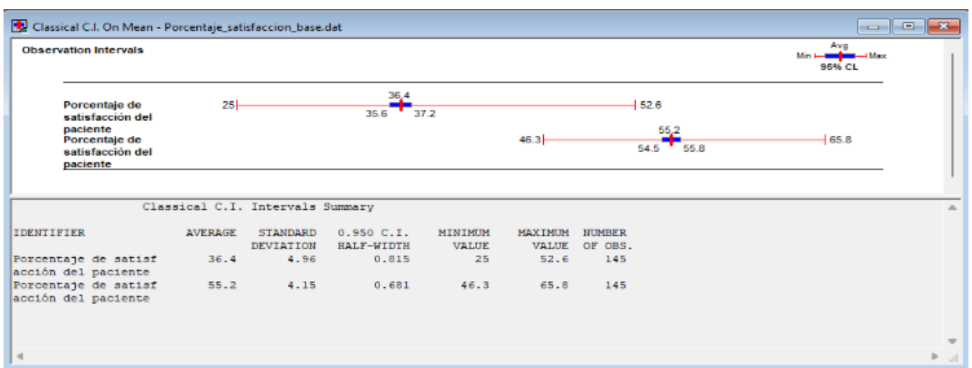


Figure 8. Simulation model of the proposed improvement scenario in Arena.

Output 1: Patient satisfaction rate

As shown in Figure 9, the percentage of patient satisfaction increased from 36.4% (CI: 35.6–37.2) in the baseline scenario to 55.2% (CI: 54.5–55.8) in the improved scenario. The absence of overlap between the confidence intervals confirms that the improvement is statistically significant. The paired t-test supports this result, indicating an average increase of 18.7 percentage points (95% CI: 17.7–19.8, $p < 0.05$).

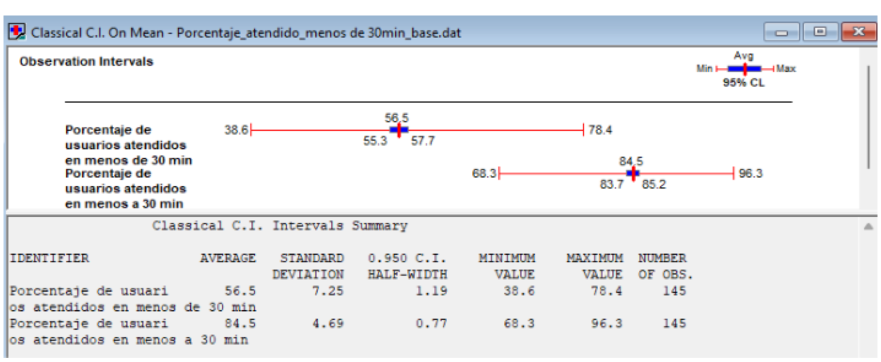


IDENTIFIER	AVERAGE	STANDARD DEVIATION	0.950 C.I. HALF-WIDTH	MINIMUM VALUE	MAXIMUM VALUE	NUMBER OF OBS.
Porcentaje de satisfacción del paciente	36.4	4.96	0.815	25	52.6	145
Porcentaje de satisfacción del paciente	55.2	4.15	0.681	46.3	65.8	145

Figure 9. Comparison of 95% confidence intervals. Source: Authors, Arena simulation results (2024)

Output 2: Percentage of users attended in less than 30 minutes

The proportion of users attended in a timely manner increased from 56.5% (CI: 55.3–57.7) to 84.5% (CI: 83.7–85.2), as shown in Figure 10. The paired t-test analysis indicates an average increase of 28 percentage points (95% CI: 26.5–29.5, $p < 0.05$), validating the improvement in the efficiency of the care process.

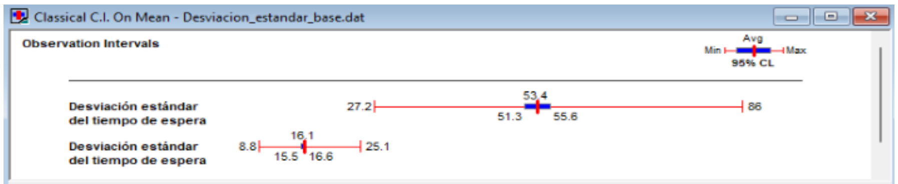


IDENTIFIER	AVERAGE	STANDARD DEVIATION	0.950 C.I. HALF-WIDTH	MINIMUM VALUE	MAXIMUM VALUE	NUMBER OF OBS.
Porcentaje de usuarios atendidos en menos de 30 min	56.5	7.25	1.19	38.6	78.4	145
Porcentaje de usuarios atendidos en menos a 30 min	84.5	4.69	0.77	68.3	96.3	145

Figure 10. Comparison of 95% confidence intervals. Source: Authors, Arena simulation results (2024).

Output 3: Standard deviation of waiting time

A significant reduction in the variability of waiting time was observed, decreasing from 53.4 minutes (CI: 51.3–55.6) to 16.1 minutes (CI: 15.5–16.6) (Figure 11). The paired t-test indicates an average decrease of 37.4 minutes (95% CI: –39.6 to –35.2, $p < 0.05$). This improvement reflects a more uniform and predictable system, reducing uncertainty for the user.



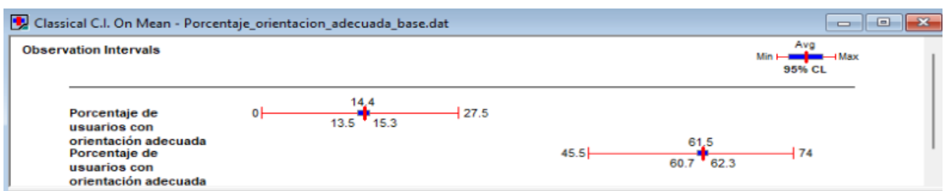
Classical C.I. Intervals Summary

IDENTIFIER	AVERAGE	STANDARD DEVIATION	0.950 C.I. HALF-WIDTH	MINIMUM VALUE	MAXIMUM VALUE	NUMBER OF OBS.
Desviación estándar del tiempo de espera	53.4	13.2	2.16	27.2	86	145
Desviación estándar del tiempo de espera	16.1	3.16	0.518	8.8	25.1	145

Figure 11. Comparison of 95% confidence intervals. Source: Authors, Arena simulation results (2024).

Output 4: Percentage of users receiving adequate guidance

The percentage of users who received adequate guidance increased from 14.4% (CI: 13.5–15.3) to 61.5% (CI: 60.7–62.3), as illustrated in Figure 12. The paired t-test confirms a significant increase of 47.1 percentage points (95% CI: 45.9–48.3, $p < 0.05$), demonstrating a strengthening of the mechanisms for patient guidance and information.



Classical C.I. Intervals Summary

IDENTIFIER	AVERAGE	STANDARD DEVIATION	0.950 C.I. HALF-WIDTH	MINIMUM VALUE	MAXIMUM VALUE	NUMBER OF OBS.
Porcentaje de usuarios con orientación adecuada	14.4	5.49	0.901	0	27.5	145
Porcentaje de usuarios con orientación adecuada	61.5	4.8	0.787	45.5	74	145

Figure 12. Comparison of 95% confidence intervals. Source: Authors, Arena simulation results (2024).

In addition to the quantitative results, the proposed improvements have a direct impact on the human experience within the hospital process. The reduction in waiting times decreases uncertainty and cognitive overload for patients, enhancing their sense of control and orientation throughout the admission flow. Similarly, the standardization of tasks reduces the duplication of functions and the physical and mental effort of administrative staff, fostering a more ergonomic and efficient work environment. Finally, the incorporation of the digital platform serves as a guidance and communication system that mitigates the stress associated with misinformation and overcrowded service counters.

6. Conclusion

This study provides evidence of the strategic value of combining analytical and service quality tools to improve hospital care management. The implementation of the proposed model made it possible to reduce waiting times, increase patient satisfaction, and enhance the internal organization of administrative staff.

Despite its favorable results, the research presents limitations related to the sample size and the specific context of the hospital. As a future line of work, it is proposed to extend the analysis to hospitals in different contexts, incorporate indicators of staff well-being, and explore artificial intelligence technologies that optimize real-time scheduling.

In summary, the proposal demonstrates that it is possible to generate a positive social impact through accessible digital solutions adapted to the capacities of public hospitals, contributing to a more humane, efficient, and sustainable healthcare system.

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