

# Development of a Web-Based Queuing System for Municipal Health Center of Mabini

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## ABSTRACT

The continuous advancement of digital technology has encouraged public healthcare institutions to adopt computerized systems to improve service delivery, efficiency, and patient satisfaction. This study focuses on the development and evaluation of a web-based queuing system for the Municipal Health Center of Mabini, which continues to rely on manual and paper-based queuing processes. These traditional methods often resulted in long waiting times, overcrowding, and difficulties in managing patient flow. Data for the study were gathered through structured survey questionnaires distributed to selected healthcare staff and patients of the health center to assess the performance and effectiveness of the developed system. The system was developed using the Rapid Application Development approach and designed following a three-tier architectural structure to ensure organized data processing, system reliability, and ease of maintenance. The web-based queuing system enables faster patient registration, systematic queue management, and real-time monitoring of queue status. The quality of the system was evaluated based on the software quality standards of the International Organization for Standardization. Healthcare personnel and patients served as respondents in the system evaluation. The results revealed an overall weighted mean of 4.43, interpreted as Excellent, with high ratings in efficiency, security, and acceptability. The findings indicate that the developed web-based queuing system effectively addresses issues related to long waiting times and unorganized patient flow. The study concludes that the system provides a reliable, secure, and acceptable digital solution that can enhance service delivery in community healthcare centers.

**Keywords:** Web-Based Queuing System, Three-Tier Architecture, Healthcare Technology, Software Quality Evaluation, Rapid Application Development

## INTRODUCTION

The modernization of public health institutions increasingly relies on the integration of automated systems to optimize service delivery and address the growing demand for medical services [1], [2]. At the Municipal Health Center of Mabini, the absence of a localized digital infrastructure has resulted in significant operational inefficiencies, particularly in managing patient flow. The facility delivers essential healthcare services, including general consultations, maternal care, and laboratory testing, to approximately 50 to 100 patients daily. However, its queuing process remains entirely manual, relying on paper-based registration and tracking. This approach creates administrative bottlenecks, disorganized patient flow, and prolonged waiting times, which negatively impact both service quality and patient satisfaction [3].

Although the health center utilizes Wireless Access for Health (WAH), it lacks functionalities for real-time queue monitoring and patient-side access to live updates. Existing studies emphasize that web-based queuing systems improve operational transparency and reduce perceived waiting time by providing real-time information to users [4]. Furthermore, the transition from manual to automated systems has been identified as a critical factor in improving data accuracy, efficiency, and service delivery in healthcare institutions [5], [2]. Strategic adoption of digital technologies also enables organizations to remain adaptive and responsive to stakeholder needs in increasingly dynamic environments [6]. In high-demand public healthcare settings, where human resources are

often limited, the implementation of a computerized queuing framework is no longer optional but essential for maintaining service efficiency and accountability [1].

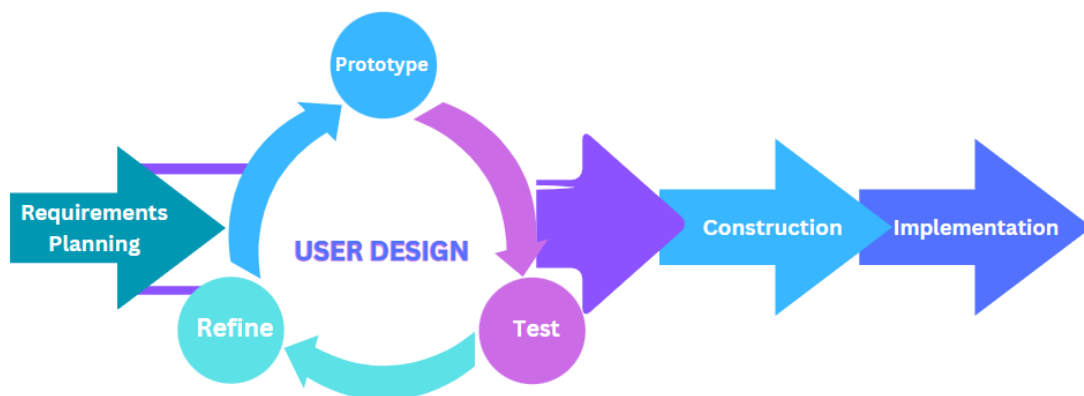
In response to these challenges, this study focuses on the development of a Web-Based Queuing System tailored for the Municipal Health Center of Mabini. The system aims to transform the existing manual process into a structured, transparent, and data-driven workflow. By integrating real-time monitoring, automated queue handling, and centralized data management, the proposed solution is expected to reduce patient waiting time, minimize administrative workload, and enhance overall service delivery. Ultimately, this innovation provides a scalable and sustainable digital solution that aligns with the institution's goal of delivering efficient and patient-centered healthcare services [7], [6].

## METHODOLOGY

This study employed a structured research and development approach to design, develop, and evaluate the Web-Based Queuing System. A mixed-method methodology was adopted to ensure comprehensive data collection, combining quantitative data from surveys with qualitative insights gathered through interviews and direct observation [8]. This approach enabled a more holistic understanding of both system performance and user experience, thereby improving the reliability and validity of the findings. The overall research design was guided by established project development frameworks, ensuring alignment between system objectives, user requirements, and evaluation processes [9].

The system development followed the Rapid Application Development (RAD) model, which emphasizes iterative design, user feedback, and rapid prototyping [10]. The first phase, Requirements Planning, involved conducting interviews with staff and observing the existing queuing process to identify inefficiencies and define system requirements. The second phase, User Design, focused on developing system architecture and interface prototypes, including the queuing dashboard and administrative modules. The third phase, Construction, involved the implementation of the system using a defined software stack, followed by iterative testing and refinement. The final phase, Cutover, included system deployment, user training, and transition from manual to automated operations.

**Figure 1. Rapid Application Development (RAD) Model**



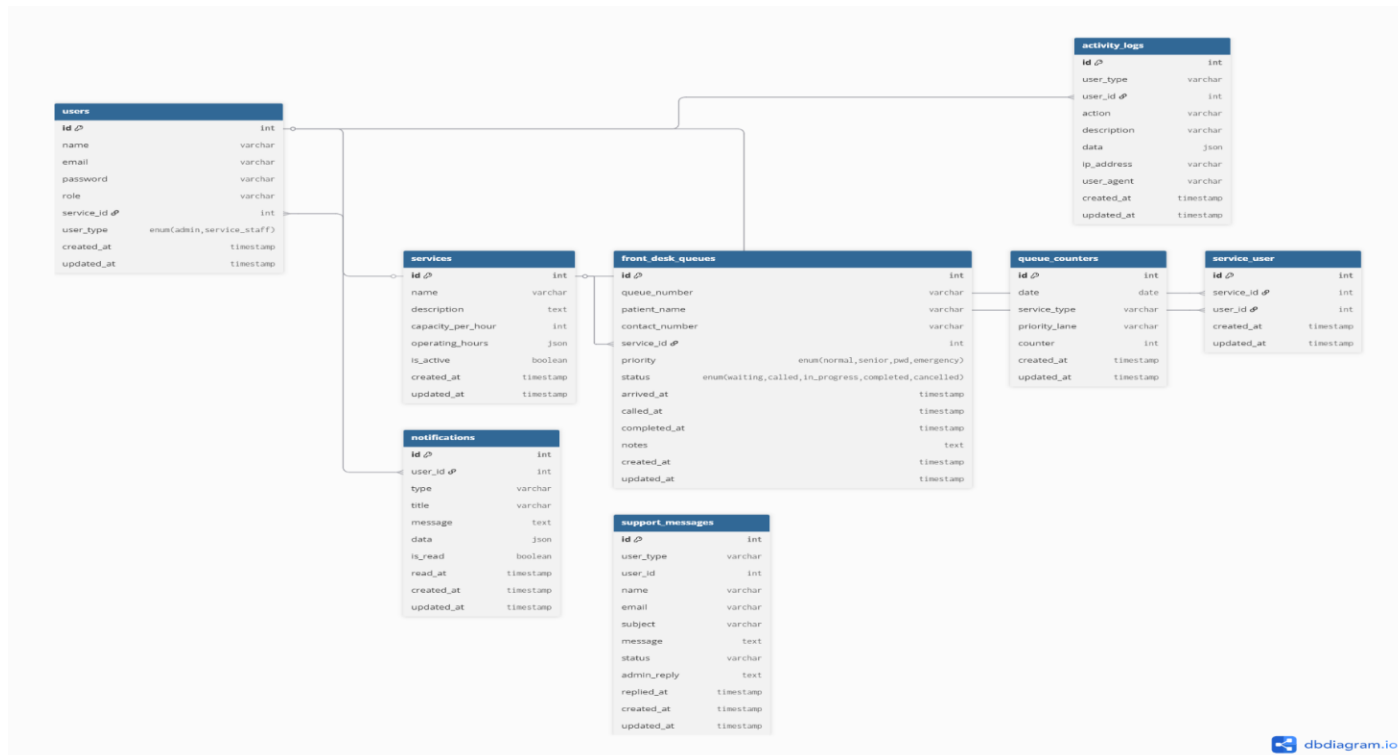
The system was developed using a structured three-tier technology stack. The back-end was implemented using the Laravel framework, which facilitated secure routing, authentication, and database interaction. The front-end utilized HTML5, CSS3, JavaScript, and Bootstrap to ensure responsiveness and usability across devices. MySQL served as the relational database for managing queuing data, patient records, and system logs. Development and

version control were supported by Visual Studio Code, Git, and GitHub, while Figma was used for interface prototyping. This combination of technologies ensured scalability, maintainability, and efficient system performance.

Building upon this technical foundation, a relational database schema was engineered to support the system's logic and data layers, ensuring high availability and data normalization. The resulting architecture is organized into interconnected modules that facilitate seamless data flow between patient registration, service-specific queuing, and administrative oversight. Central to the system's security and authentication is the users table, which incorporates role-based access control and security-focused fields such as hashed passwords and last\_logon at timestamps for comprehensive audit trailing. The core queue logic is driven by a specialized front\_desk\_queues table that captures critical time-series data through arrived\_at, called\_at, and completed\_at fields, allowing the system to measure service efficiency with high precision.

Furthermore, the database manages operational workflows through integrated service and notification structures. The services and service\_user tables allow the system to categorize patient flow based on specific health center departments, while the notifications table handles real-time patient updates to maintain transparency. To ensure hardware-level coordination, the queue\_counters table manages the relationship between service staff and specific physical stations. Finally, operational accountability is maintained through an activity\_logs table that records every system transaction, capturing user types, specific actions, and IP addresses to ensure administrative transparency and data integrity.

**Figure 2. Entity-Relationship Diagram (ERD) of the Web-Based Queuing System**



For system evaluation, a total of 67 respondents were selected, consisting of 50 patients, 7 staff members, 5 administrators, and 5 IT experts. The inclusion of diverse participant groups ensured both technical and user-centered perspectives in evaluating the system. Compared to typical small-scale evaluations, this sample size provides a more reliable basis for assessing usability, efficiency, and acceptability across different user roles.

**Table 1. Respondents of the Study**

Respondents	Number of Respondents
Staff	7
Admin	5

Patients	50
IT Experts	5
Total	67

The system’s acceptability was measured using a Five-Point Likert Scale aligned with ISO 25010 quality standards. This framework enabled the evaluation of key system attributes such as functionality, usability, reliability, efficiency, security, compatibility, maintainability, and portability. The use of standardized measurement criteria ensured objectivity in interpreting user feedback and provided a quantifiable basis for evaluating system performance.

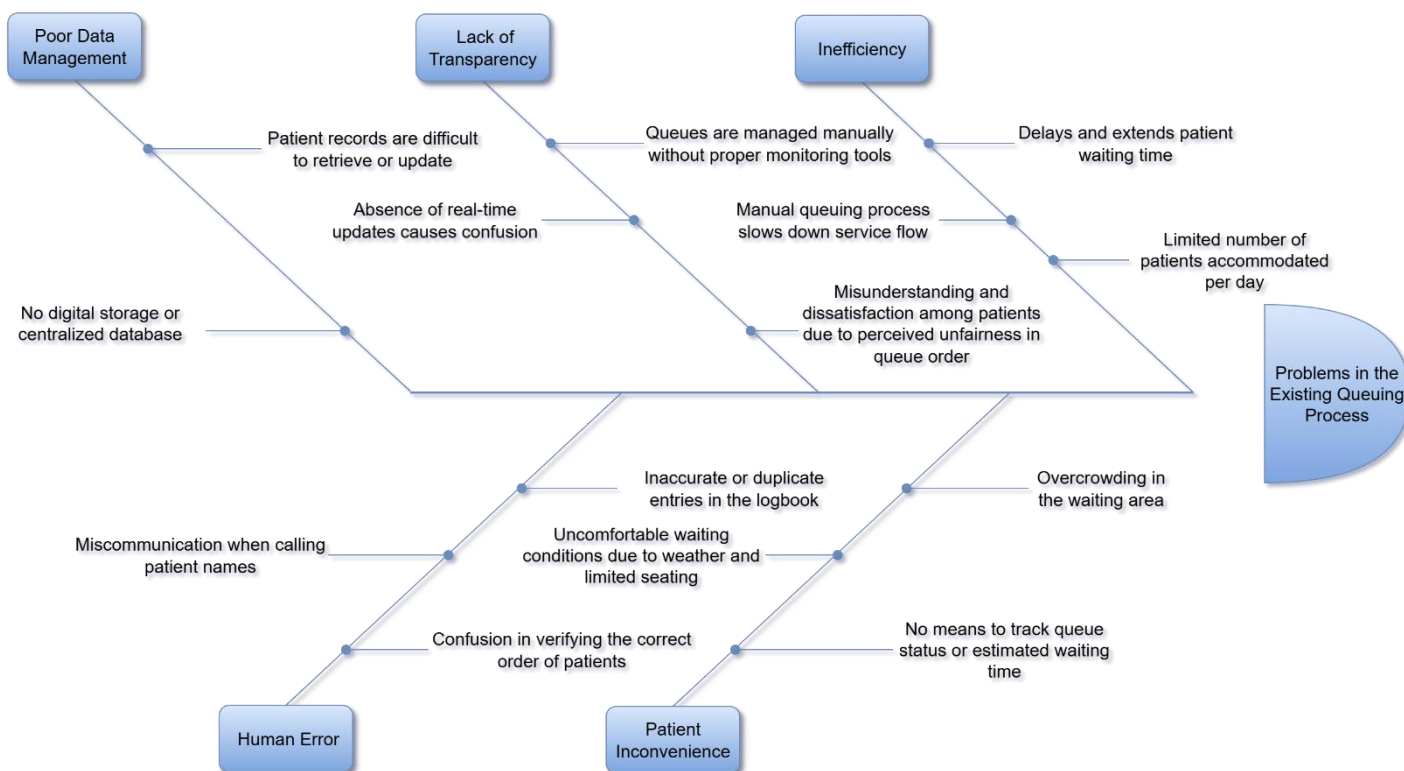
**Table 2. Scale of Measurement**

Scale	Statistical Limits	Rating	Descriptive Interpretation
5	4.21 - 5.00	Excellent	Condition is highly comprehensive and operating efficiently
4	3.41 - 4.20	Very Good	Condition is functioning properly
3	2.61 - 3.40	Good	Condition is satisfactory and meets most requirements
2	1.81 - 2.60	Fair	Condition is limited and needs improvements
1	1.00 - 1.80	Poor	Condition does not meet the necessary requirements

## RESULTS AND DISCUSSION

The analysis of the existing queuing process revealed that the Municipal Health Center of Mabini relies entirely on manual logbook-based registration and tracking. This method leads to prolonged waiting times, inefficient patient flow, and difficulty in maintaining accurate records. Observations and interviews identified multiple operational bottlenecks, which were further analyzed using a Fishbone Diagram to determine the root causes of inefficiency, including environmental discomfort, human error, and the lack of real-time visibility.

**Figure 2. Fishbone Diagram of the Problems**

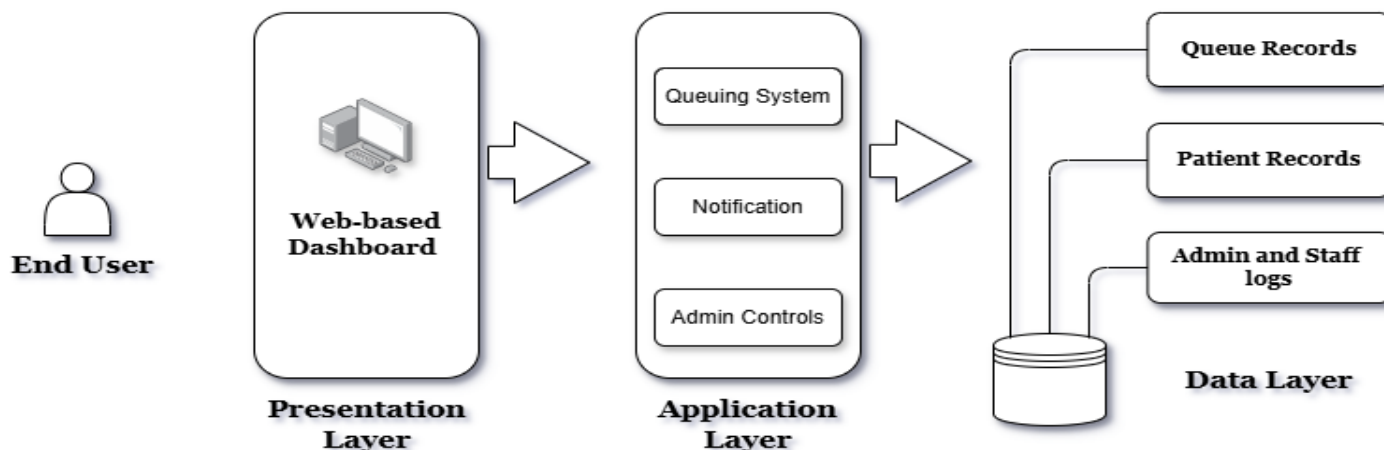


The findings indicate that manual processes significantly affect operational productivity, as staff are required to perform repetitive administrative tasks such as verifying entries and calling patients manually. This reduces the time available for clinical assistance and limits patient throughput. From the patient perspective, the absence of real-time queue visibility creates uncertainty and inconvenience, particularly for vulnerable individuals.

Furthermore, the manual system lacks transparency and is prone to human error, such as skipped turns and duplicate entries, which contribute to patient dissatisfaction. From a managerial standpoint, the absence of a centralized database prevents efficient data retrieval and analysis, limiting the ability to make informed decisions regarding resource allocation.

To address these limitations, the developed system adopts a Three-Tier Architecture consisting of presentation, logic, and data layers. This design ensures scalability, modularity, and efficient separation of functions, allowing for independent updates and improved maintainability.

**Figure 3. Three-Tier Architecture**



The system integrates several functional modules that collectively enhance operational efficiency through a structured digital workflow. The process begins at the front desk module, which digitizes patient registration and service assignment to reduce manual entry errors and improve processing speed. Once registered, patients and visitors can view the public queue interface, which provides real-time updates and significantly reduces repetitive inquiries to staff members.

**Figure 4. Front Desk**

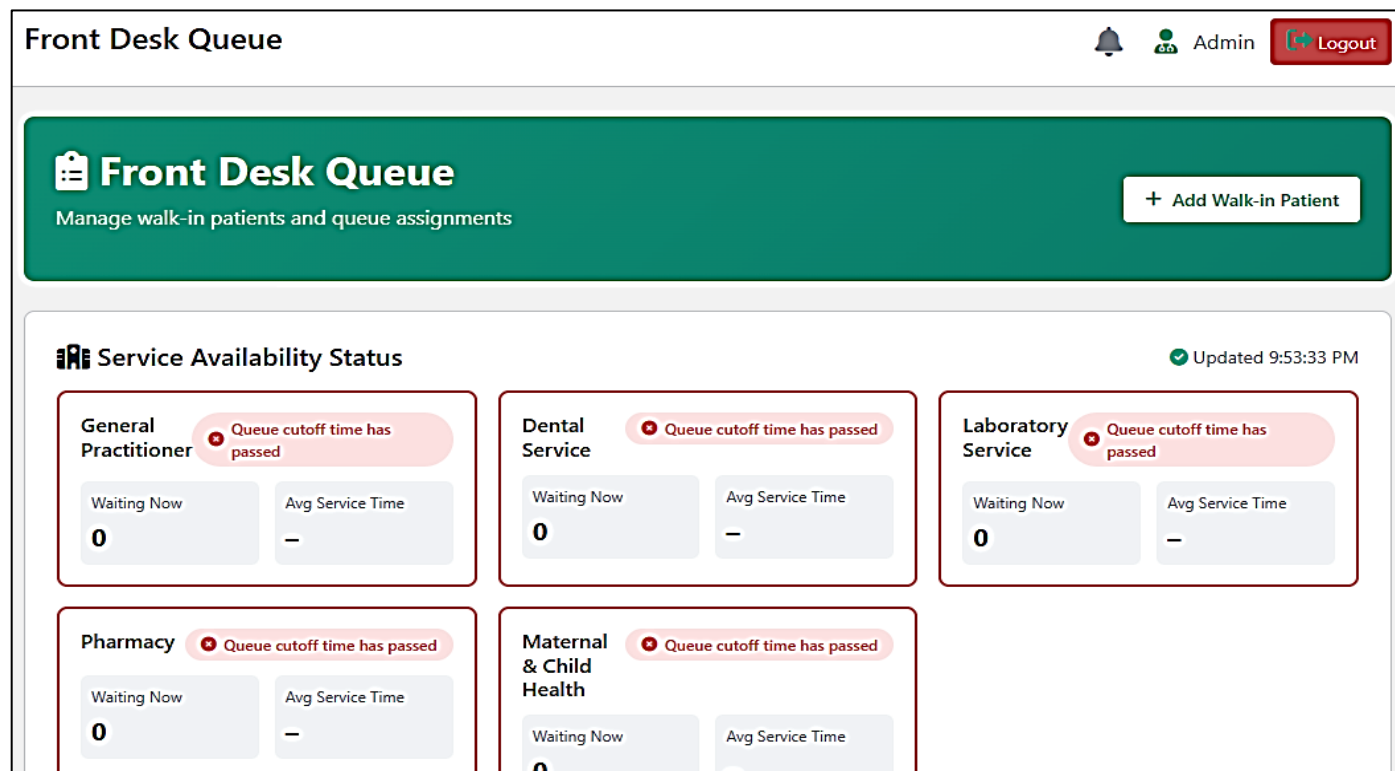
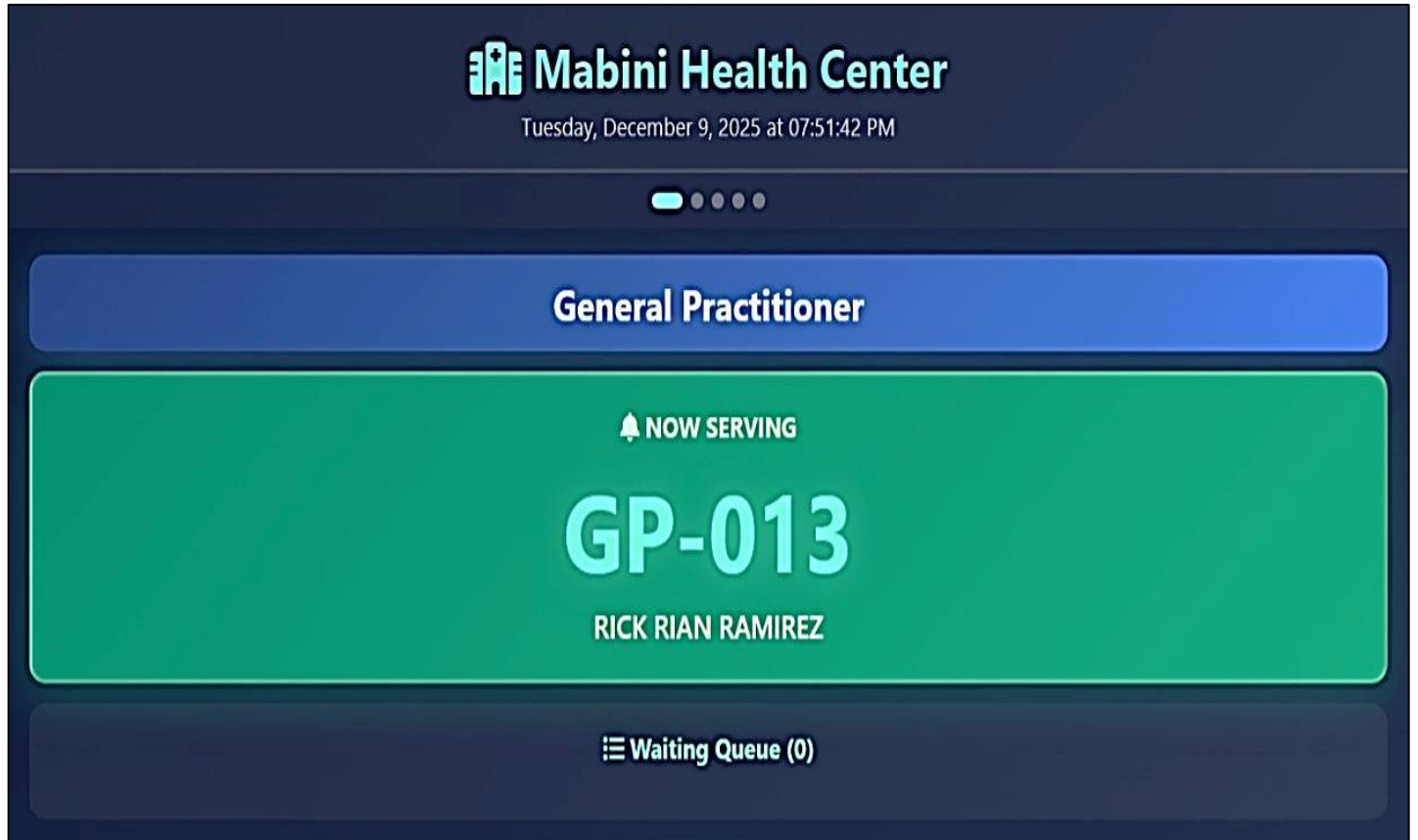
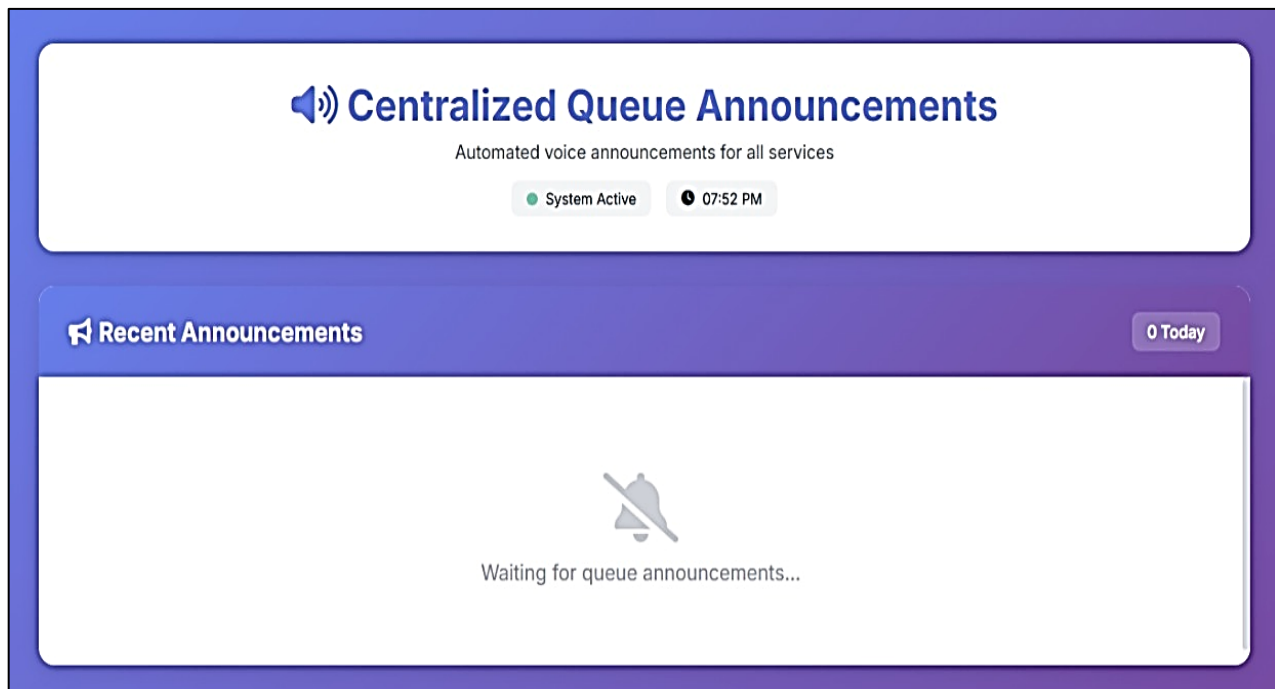


Figure 5. Real-Time Public View Queue

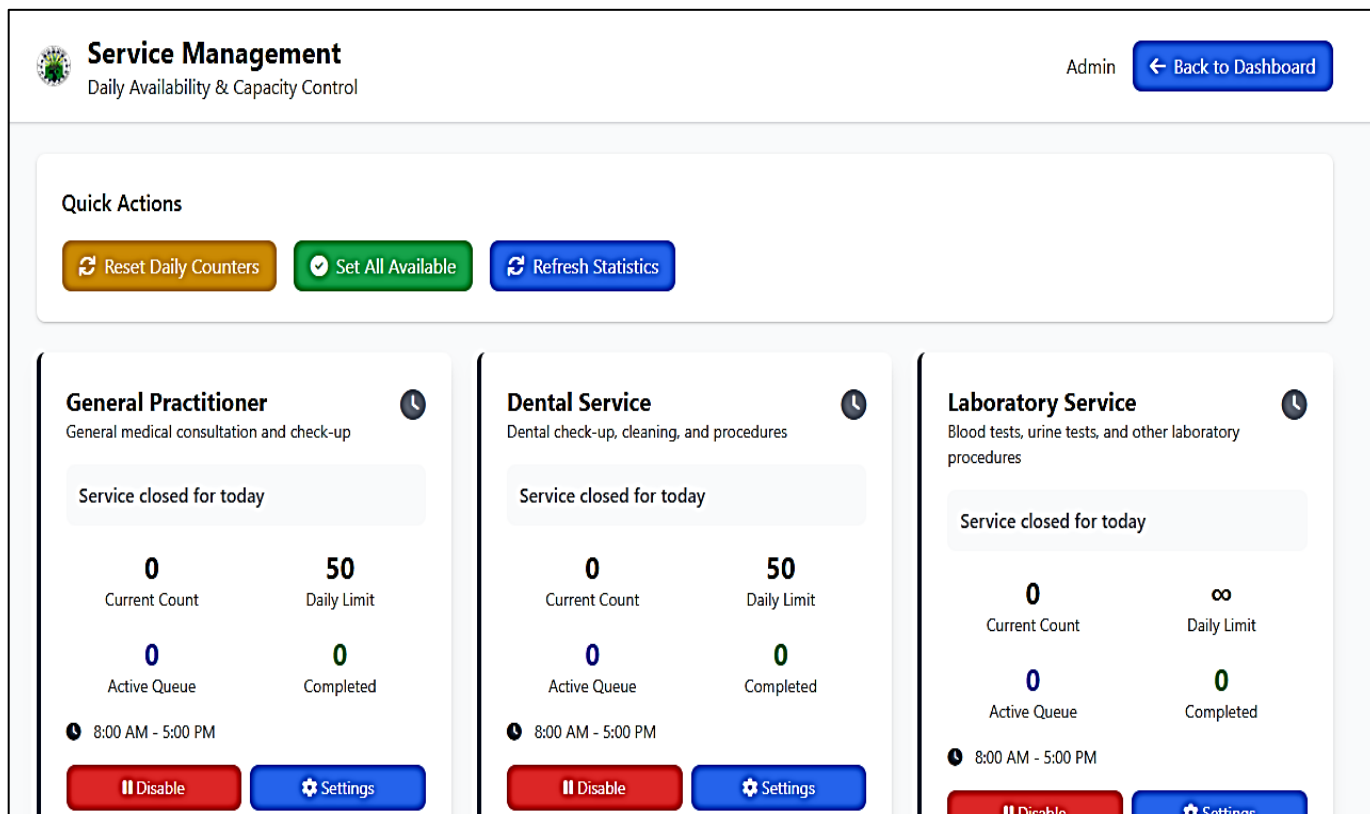


Operational transparency is further supported by an automated queue announcement system utilizing text-to-speech technology to ensure consistent and accurate patient calling. Simultaneously, the service dashboard allows healthcare providers to manage patient flow dynamically, effectively reducing idle time between consultations. To support long-term administrative improvements, the analytics module generates reports on wait times and patient volume, facilitating data-driven decision-making for center administrators.

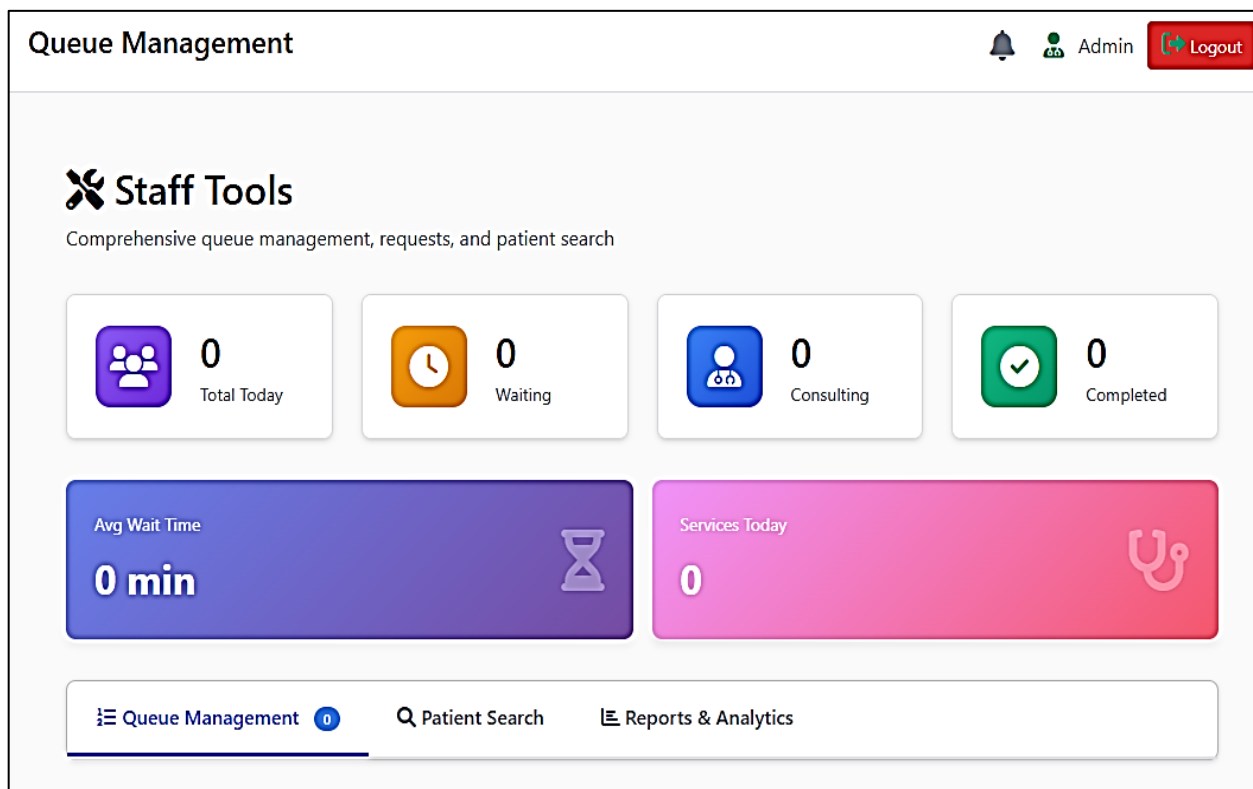
Figure 6. Automated Queue Announcement



**Figure 7. Service Queue Dashboard**

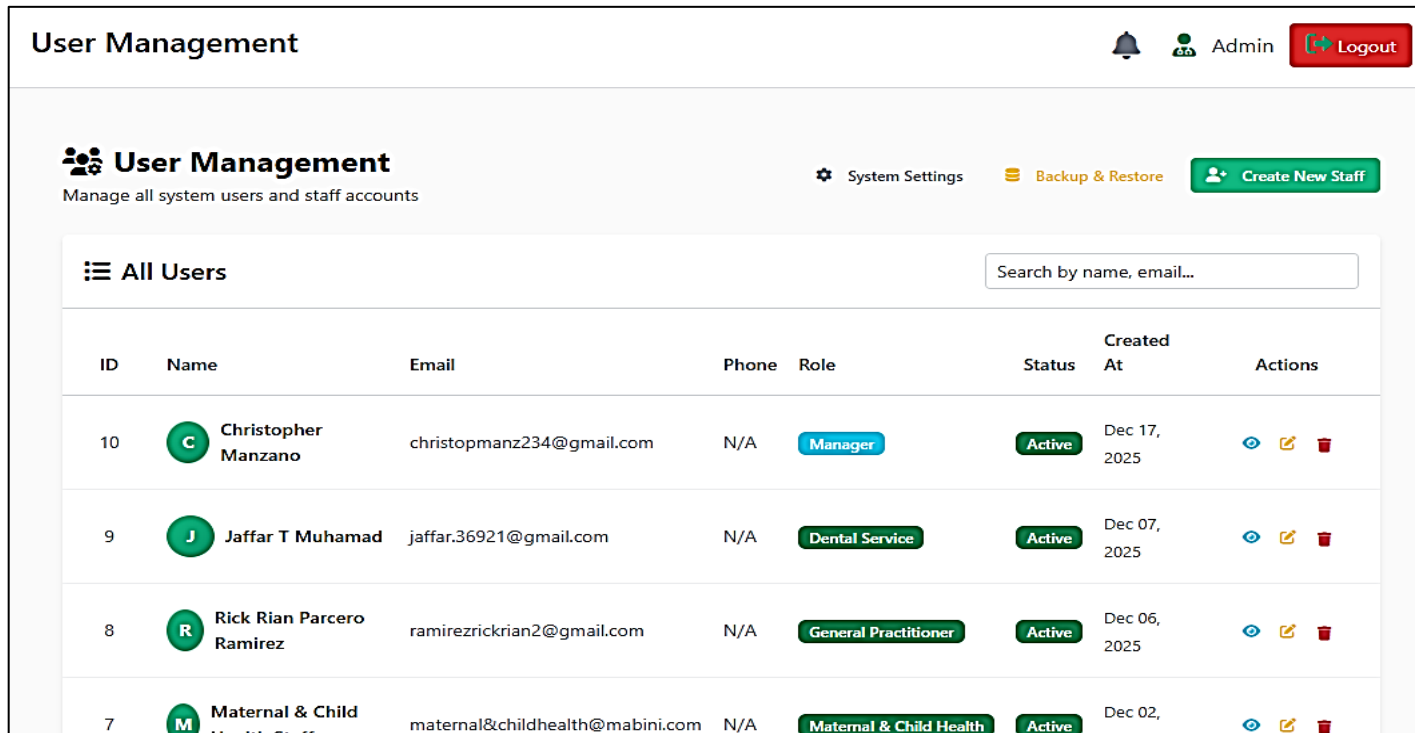


**Figure 8. Queue Analytics**



Centralized system control is maintained through the administrative panel, which handles user management and system configuration. Finally, the activity logs module enhances security and accountability by recording every system transaction, including the user type, action performed, and IP address. This digital audit trail directly addresses the security and transparency gaps identified in the previous manual logbook system.

Figure 9. Administrative Control



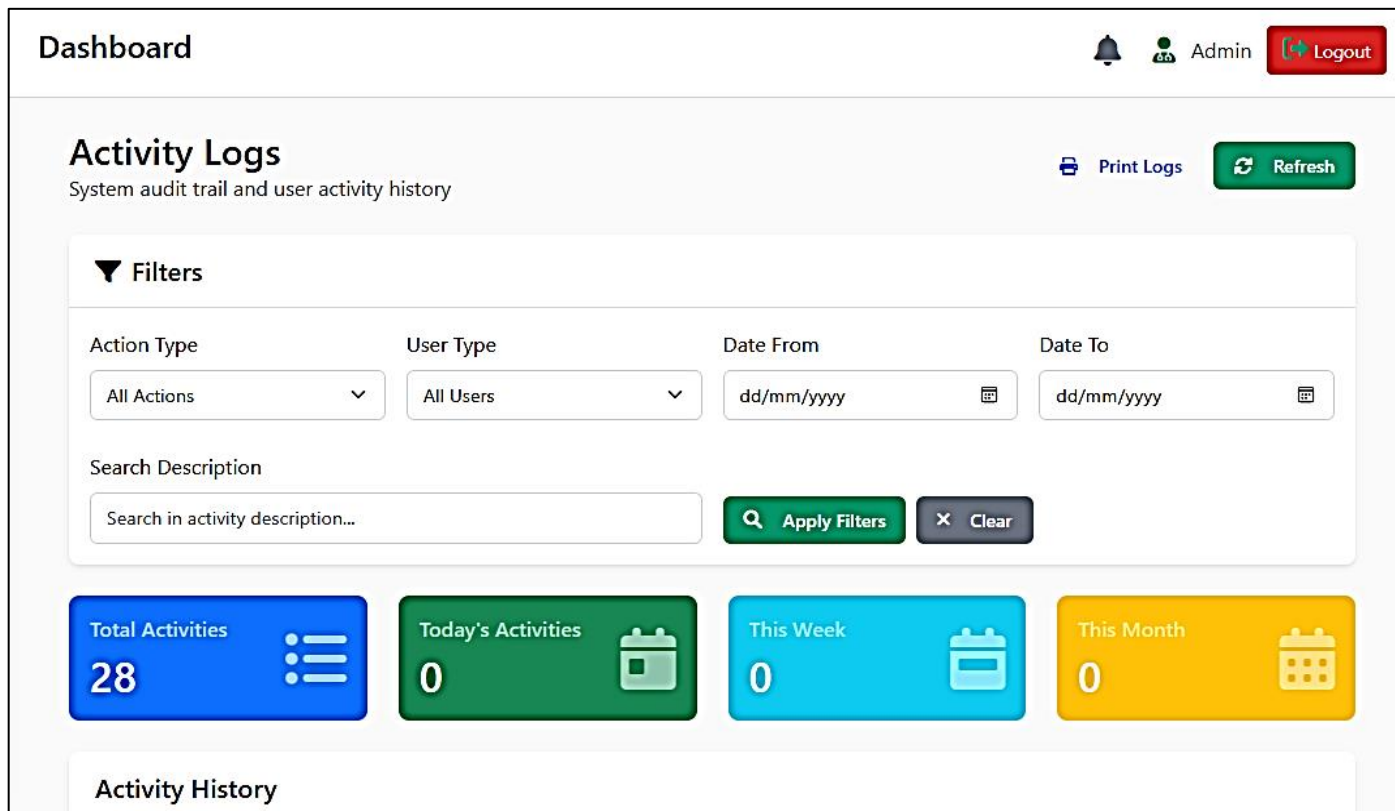
**User Management**  
Manage all system users and staff accounts

System Settings | Backup & Restore | Create New Staff

All Users | Search by name, email...

ID	Name	Email	Phone	Role	Status	Created At	Actions
10	Christopher Manzano	christopmanz234@gmail.com	N/A	Manager	Active	Dec 17, 2025	View   Edit   Delete
9	Jaffar T Muhamad	jaffar.36921@gmail.com	N/A	Dental Service	Active	Dec 07, 2025	View   Edit   Delete
8	Rick Rian Parcero Ramirez	ramirezrickrian2@gmail.com	N/A	General Practitioner	Active	Dec 06, 2025	View   Edit   Delete
7	Maternal & Child Health Staff	maternal&childhealth@mabini.com	N/A	Maternal & Child Health	Active	Dec 02, 2025	View   Edit   Delete

Figure 10. Activity Logs



**Dashboard**  
System audit trail and user activity history

Print Logs | Refresh

**Filters**

Action Type: All Actions | User Type: All Users | Date From: dd/mm/yyyy | Date To: dd/mm/yyyy

Search Description: Search in activity description... | Apply Filters | Clear

**Total Activities: 28** | **Today's Activities: 0** | **This Week: 0** | **This Month: 0**

Activity History

To validate the system’s quality, an acceptability evaluation was conducted based on ISO 25010 standards. The results showed an overall weighted mean of 4.43, interpreted as “Excellent.” High ratings in efficiency and security indicate that the system effectively handles patient flow while ensuring data protection. Although reliability received the lowest relative score, it remains within the excellent range, suggesting stable performance during testing.

**Table 3. System Evaluation Overall Weighted Mean**

Category Computed Mean	Description
1. Functionality 4.46	Excellent
2. efficiency 4.52	Excellent
3. Compatibility 4.34	Excellent
4. Usability 4.40	Excellent
5. Reliability 4.23	Excellent
6. Security 4.52	Excellent
7. Maintainability 4.40	Excellent
8. Portability 4.35	Excellent
Average Weighted Mean 4.43	Excellent

The system's performance was evaluated using data-driven metrics captured through the updated database schema. During testing, the system achieved an average ticket generation response time of 1.2 seconds, a critical metric for a facility managing up to 100 patients daily, as it prevents the digital interface from becoming a secondary bottleneck. By utilizing the `arrived_at`, `called_at`, and `completed_at` timestamps within the `front_desk_queues` table, the system demonstrated high "Time Behavior" efficiency, providing the baseline data needed to reduce perceived waiting times through instant status updates and automated notifications. Finally, the MySQL schema design-utilizing indexed identifiers and normalized tables for services and activity logs-ensures that system performance remains stable and scalable as the institution's volume grows. These findings demonstrate that the implementation of such a system, specifically through its service-oriented architecture, provides a robust and scalable model for modernizing public healthcare facilities.

## CONCLUSION

The findings of this study confirm that the transition from a manual queuing process to a web-based system significantly enhances the efficiency, transparency, and reliability of healthcare service delivery. The developed system successfully addressed key operational challenges, including long waiting times, administrative inefficiencies, and lack of real-time information. The achieved overall acceptability rating of 4.43 indicates that the system meets established quality standards and is well-received by both users and technical evaluators.

Moreover, the integration of automated features and centralized data management demonstrates the potential of digital solutions to support evidence-based decision-making and improve resource allocation in public health facilities. While the results are promising, future studies may further strengthen the system through expanded user testing, integration of advanced analytics, and performance benchmarking under larger-scale deployment. Overall, the study highlights the importance of adopting digital innovations in modernizing healthcare systems and improving patient-centered service delivery.

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