AI-Based Queue Management System for Kawempe National Referral Hospital

Abstract

Kawempe National Referral Hospital is a key healthcare provider facing significant challenges in managing patient queues efficiently, leading to long waiting times and patient dissatisfaction. This concept paper proposes the development of an AI-powered Queue Management System designed to automate patient registration, prioritize critical cases, issue digital coupons, and provide real-time updates to patients and staff. The system aims to streamline patient flow, enhance service delivery, and improve overall hospital efficiency.

Introduction

Healthcare facilities in Uganda, particularly national referral hospitals like Kawempe, often experience high patient volumes and congestion. Effective queue management is crucial for ensuring timely medical attention and maintaining patient satisfaction. Currently, Kawempe Hospital relies on manual queue systems, which are inefficient and prone to delays. Integrating Artificial Intelligence (AI) into queue management offers an opportunity to optimize patient flow by prioritizing urgent cases, automating registration processes, and providing transparent service updates.

Problem Statement

Kawempe National Referral Hospital faces significant environmental and technical challenges in managing patient queues effectively, which negatively impact healthcare delivery quality.

Environmental Challenges: The hospital's physical environment often becomes overcrowded due to high patient volumes, leading to congested waiting areas that increase

the risk of communicable diseases spreading, particularly in vulnerable departments such as maternity and pediatrics. Overcrowding also causes discomfort and stress for patients and caregivers, exacerbating their health conditions and reducing overall satisfaction with hospital services. Additionally, long queues contribute to inefficient use of limited hospital space and resources, creating an unfavorable environment for both patients and staff.

Technical Challenges: The current manual queue management system relies heavily on first-come-first-served approaches without any technological support to prioritize patients according to urgency or condition severity. This lack of automation results in prolonged waiting times and poor patient flow control. Furthermore, the absence of real-time queue monitoring tools means patients remain uninformed about their position or expected waiting times, increasing anxiety and inefficiency. Healthcare staff are burdened with manual queue tracking and administrative tasks, detracting from patient care and leading to suboptimal resource utilization. Finally, the hospital lacks data-driven insights due to inadequate digital infrastructure, limiting management's ability to make informed decisions about patient flow and resource allocation.

These intertwined environmental and technical issues highlight the urgent need for a comprehensive, AI-powered queue management solution that addresses overcrowding, prioritizes patients effectively, improves communication, and supports healthcare workers in delivering timely, quality care.

Solving Measures and Challenges

To address the above challenges, the following solutions are proposed:

Proposed Solutions

- **AI-Enabled Registration and Coupon Issuance:** Patients will register via touchscreen kiosks at the hospital entrance or through a mobile application. AI algorithms will analyze patient data (such as symptoms, age, urgency) to assign digital queue tokens (coupons) that prioritize critical cases automatically.
- **Real-Time Queue Monitoring:** Digital displays and mobile notifications will inform patients of their queue position and estimated wait time, reducing anxiety and improving patient experience.
- **Dynamic Resource Allocation:** AI will continuously monitor patient flow and staff availability, suggesting adjustments such as opening additional service counters during peak hours to optimize workflow.

- **Staff Dashboard:** Healthcare providers will access an intelligent dashboard displaying prioritized patient queues, enabling better management of cases and improved efficiency.
- **Data-Driven Reporting:** The system will generate analytics for hospital management to identify bottlenecks, peak times, and resource needs, supporting informed decision-making.

Challenges to Implementation

- **Technical Infrastructure:** Reliable internet connectivity and hardware such as kiosks and digital displays are needed for smooth operation.
- **User Adoption:** Training and sensitization programs will be essential for patients and staff to embrace the new system.
- **Data Privacy and Security:** Patient information must be protected with compliance to relevant health data regulations.
- **Maintenance and Sustainability:** Ongoing technical support and periodic AI model updates will be necessary to maintain system effectiveness.

Conclusion

Implementing an AI-based Queue Management System at Kawempe National Referral Hospital promises to transform patient service delivery by reducing waiting times, improving prioritization, and enhancing transparency. While deployment challenges such as infrastructure needs and user adoption exist, the system's potential to improve healthcare outcomes, patient satisfaction, and hospital efficiency is significant. With appropriate planning, stakeholder engagement, and funding, this innovative solution can become a benchmark for public healthcare institutions across Uganda.