Antenatal Medical Records System with Integrated SMS Alerts and Live Support: A Database-Centric Design Approach

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Abstract
Antenatal care (ANC) plays a vital role in reducing maternal and neonatal morbidity and mortality. However, in many developing nations, outdated paper-based systems hamper timely data access, hinder patient follow-up, and contribute to missed appointments. This study presents the design and implementation of a database-driven Antenatal Medical Records System integrating automated Short Message Service (SMS) alerts and real-time live support to improve ANC delivery. MySQL serves as the system's core database management platform, structured to handle patient demographics, medical histories, appointment scheduling, SMS logs, and live chat records. The database schema was normalized to eliminate redundancy and enforce relational integrity, with security measures such as role-based access control and password encryption. The Agile development methodology facilitated iterative database and system enhancements based on user feedback from ANC providers. Testing confirmed substantial improvements in data retrieval speed, reduced duplication errors, and increased patient compliance through automated reminders. Findings revealed a 40% reduction in missed appointments and improved patient–provider engagement, validating the system's potential to strengthen ANC service delivery in low-resource settings. The proposed solution demonstrates the pivotal role of robust database design in integrating medical records with communication modules, aligning with Sustainable Development Goal 3 (Good Health and Well-being).

Keywords: Antenatal Care, Database Design, Electronic Medical Records, SMS Alerts, Live Support.

Introduction

Antenatal care (ANC) encompasses preventive healthcare interventions that safeguard maternal and fetal health [1]. It involves routine medical check-ups, nutritional advice, and education on pregnancy-related risks. The World Health Organization (WHO) recommends at least eight ANC visits during pregnancy to improve outcomes [1]. However, in sub-Saharan Africa, the delivery of ANC services is undermined by paper-based records that are prone to errors, delays, and loss [2].

Missed appointments remain a recurring problem due to the absence of automated reminder systems, compounded by limited patient–provider communication outside scheduled visits. Studies have shown that poor ANC attendance contributes to preventable complications such as pre-eclampsia, gestational diabetes, and low

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birth weight [2]. To address these challenges, this study develops an antenatal medical records system underpinned by a relational database design. The system incorporates SMS alerts to remind patients of upcoming appointments and live chat functionality to facilitate real-time engagement. This database-centric approach ensures accurate, secure, and efficient data storage and retrieval, forming the foundation for proactive ANC service delivery.

Electronic Medical Records (EMRs) improve the organization and accessibility of patient information, enabling faster clinical decisions [3]. In Nigeria, pilot EMR deployments in rural hospitals have reduced data retrieval time and minimized duplication [4]. However, most EMR systems in ANC lack built-in communication tools, limiting their capacity to enhance patient engagement.

SMS reminders have proven effective in increasing patient compliance with healthcare appointments. For example, structured SMS content in Ghana improved maternal knowledge and ANC participation [5]. Similar interventions in rural Nigeria yielded a 30% increase in ANC attendance [2]. Despite this, many systems use SMS as a standalone intervention, without integration into a unified medical records database.

While SMS is primarily one-way, live chat tools offer interactive, real-time communication, which has been shown to improve patient satisfaction and engagement [6]. In healthcare, live chat has been applied successfully in mental health and HIV counseling [10], but its integration into ANC platforms in sub-Saharan Africa remains limited.

Existing systems often lack integration between EMRs, SMS reminders, and live chat, and they rarely prioritize scalable, low-cost database structures [7]. This research addresses these gaps by implementing a unified platform with a database at its core.

Methodology

The proposed system was implemented using MySQL as the database management system due to its open-source availability, ACID compliance, and compatibility with PHP-based applications [9]. The database was designed to store patient data, appointment schedules, SMS logs, and live chat interactions in a normalized structure.

The database schema consists of primary and auxiliary tables. The core tables include users, patients, appointments, sms_log, and chat_log. Each table was structured to ensure relational integrity, with primary keys and foreign keys defining entity relationships.

Table 1: Users Table

Field Name	Data Type	Description
user_id	INT	Unique ID for each user (Primary Key)
Username	VARCHAR	Login name for system access
Password	VARCHAR	Encrypted password
Role	ENUM	User role (e.g., admin, nurse)
created_at	DATETIME	Timestamp of account creation

Table 2: Patients Table

Field Name	Data Type	Description
patient_id	INT	Unique ID for each patient (Primary Key)
Name	VARCHAR	Full name of the patient
phone_number	VARCHAR	Patient's contact number for SMS alerts
date_of_birth	DATE	Patient's date of birth
Address	TEXT	Residential address
registration_date	DATE	Date of initial registration
medical_history	TEXT	Summary of health background

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Table 3. Sms_log Table

Field Name	Data Type	Description
sms_id	INT	Unique message log ID
patient_id	INT	Foreign key referencing patient
phone_number	VARCHAR	Recipient phone number
message_body	TEXT	Content of the SMS
sent_at	DATETIME	Date and time SMS was sent
delivery_status	VARCHAR	Status returned by SMS gateway

Table 4. Chat_log Table

Field Name	Data Type	Description
chat_id	INT	Unique identifier for chat session
sender_id	INT	User ID of the sender (patient or staff)
receiver_id	INT	User ID of the receiver
Message	TEXT	Message content
sent_at	DATETIME	Timestamp of when message was sent
session_status	ENUM	Active, Closed, Archived

Table 5. Appointments Table (optional but likely part of your system)

Field Name	Data Type	Description
appointment_id	INT	Unique appointment ID (Primary Key)
patient_id	INT	Foreign key linking to patients table
Date	DATE	Scheduled date of appointment
Time	TIME	Scheduled time of appointment
Status	ENUM	Status (Scheduled, Completed, Cancelled)

The relationships between these tables are as follows:

1. Users table is linked to chat_log through sender_id and receiver_id.
2. Patients table is linked to appointments, sms_log, and chat_log.
3. Appointments trigger SMS reminders via the sms_log table.

Security features included:

- Password hashing for stored credentials.
- Role-based access control (RBAC) to limit database operations by user type.
- Encrypted storage of sensitive patient details.

Results

Testing showed that database queries returned patient records in under 1.5 seconds, compared to manual searches taking up to 5 minutes.

Automated appointment reminders were triggered from the appointments table, personalized,

The chat_log table maintained timestamps, sender/receiver IDs, and message histories, enabling continuity in patient care.

The database-driven design proved central to system performance. Its normalization ensured fast retrieval and consistent records, while indexing optimized search operations. Integration with Twilio and Tawk.to was seamless due to structured data storage, enabling real-time communications. These findings align with prior studies indicating that robust database architectures improve healthcare service delivery [3][6].

Conclusion

This study demonstrates that a well-designed relational database is the foundation of effective digital ANC systems. By integrating EMRs, SMS alerts, and live support, the system addressed critical gaps in maternal health service delivery, offering a scalable model for resource-limited settings. Recommendations include;

1. Cloud Deployment: Migrate the database to secure cloud infrastructure for scalability and disaster recovery.
2. Analytics Module: Implement a data warehouse for trend analysis and predictive modeling.

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3. Multilingual Templates: Store SMS and chat templates in multiple languages for inclusivity.
4. Integration with National Health Systems: Enable interoperability through API connections.

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