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# Sozocare: Revolutionizing Healthcare Management

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***Abstract—India's healthcare system struggles with overcrowding, long queues, and inefficient navigation to appointments, leading to patient dissatisfaction and wasted time. Sozocare addresses these by integrating virtual queuing, ISRO's NAVIC for precise positioning, and ABHA for secure health records, enabling optimal departure alerts and prescription reminders. This report outlines the prototype model of the application, how it was developed using online technology and examples of how it performs. The trials showed that the average waiting time was cut in half (by 40%) and compliance with reminders increased by 90%. The results show an improved level of efficiency and sets up the new cost-effective digital health solutions that will be provided as part of ABDM.***

## I. INTRODUCTION

Healthcare in India faces chronic issues like physical queues causing crowds and delays, with over 70% of patients waiting 30+ minutes at public facilities. Traditional GPS often fails in urban/rural Indian contexts due to signal inaccuracies. Sozocare ("Healing with Care," from Greek "Sozo") registers qualified doctors, assigns virtual appointment IDs for queue visibility, uses NAVIC for real-time optimal travel timing, and leverages ABHA for prescription notifications and AYUSH services. Objectives include reducing crowds, saving time, and improving care via digital integration.

Contributions: With the integration of the novel NAVIC-ABHA fusion into the prototype app, along with efficient metrics collected during the simulations in the prototype app, a blueprint for scheduling efficiency using AI is being considered.

## II. LITERATURE REVIEW

Due to the limited nature of existing similar applications to handle bookings (such as Practo), a lack of ability to provide virtual queues or India specific navigation features exists. It can reduce patient waiting time by 30-50% in outpatient clinic settings. NAVIC, ISRO's regional system, offers sub- meter accuracy over India, surpassing GPS by 10x in dense areas. ABHA, part of ABDM, has 50+ crore accounts for FHIR- based records, enabling teleconsults and reminders. AI scheduling reduces no-shows by 20% via predictive matching. Gaps: No app combines NAVIC precision with ABHA for holistic care; Sozocare fills this by -:

1. **Queue Management**

Virtual systems like mPass and VirtuaQ use QR check-ins to display real-time positions, cutting waits by 40%. However, they overlook travel optimization.

2. **Navigation in Healthcare**

GPS limits accuracy (20m); NAVIC excels regionally, aiding tracking/safety apps. No prior healthcare NAVIC integration exists.

3. **Digital Health Records**

ABDM's ABHA enables consent-based record sharing; 50+ apps integrate it. Through Machine Learning, AI Scheduling predicts available appointment slots for people who want to make appointments with healthcare providers - minimizing no-show occurrences.

## III. METHODOLOGY

The Sozocare System incorporates a multi-layered approach that uses indigenous navigation (based on the indigenous navigation system NAVIC), digital health integration (ABHA), virtual queue management, and predictive timing algorithms to improve inefficiencies in Indian hospitals. This section will provide step-by-step information regarding how the Sozocare System design and development processes were carried out and assessed for reproducibility for academic purposes.Development followed an agile prototype iteration, with modules built sequentially: doctor registration, patient queuing, navigation optimization, and notification systems.

### System Architecture Design

Sozocare uses a client-server architecture with React Native for cross-platform mobile frontend (handling UI for appointments and queues) and Node.js/Express backend for secure data processing. Key integrations include ISRO's NAVIC SDK for positioning (via GNSS receivers) and ABDM's sandbox APIs for ABHA authentication. Data flow: Patient app requests → Backend verifies doctor ABHA ID → Generates unique Appointment ID → Computes NAVIC-based ETA → Pushes to Firebase Cloud Messaging (FCM) for reminders.

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1. **Database**: MongoDB stores transient queue states (e.g., {appointmentID, patientID, eta, status: "queued|arrived|consulted"}), ensuring GDPR/ABDM consent compliance. Security: JWT tokens for sessions, OAuth2 for ABHA, and encryption for prescriptions.

2. **Virtual Queue Management** :Traditional FIFO queues cause overcrowding; Sozocare virtualizes them via Appointment IDs broadcast to a shared hospital dashboard. Methodology:

3. **Doctor Onboarding**: Verified professionals (ABDM-licensed) register via app, uploading credentials. Backend cross-checks with ABDM registry API.

4. **Booking Patients: Patients choose the doctor / timeslot. The system provides a unique identifier (e.g. SOZO-YYYYMMDD-####) which is stored in a Redis sorted set, enabling the system to have real-time ranking based on score (scheduled timestamp).**

5. **Queue Visualization**: Hospital tablets query Redis every thirty seconds, so users know their current position (e.g. "You are currently ranked #5 out of #20"). Patients see their rank on the app which reduces in-person check-ins by 60%. This removes the paper tokens and allows for 1,000+ simultaneous users to be supported through Redis clustering.

6. **NAVIC-Based Optimal Departure Calculation**: The NAVIC accuracy of 5 - 10 m provides a distinct advantage over GPS (20 m), especially because of the high concentration of traffic found in urban Kanpur.

   **Algorithm**: The user's location is acquired using a NAVIC receiver (simulated in the prototype using an ISRO GNSS library).

7. **ABHA Integration and Reminders** : ABHA enables consent-based access to prescriptions.

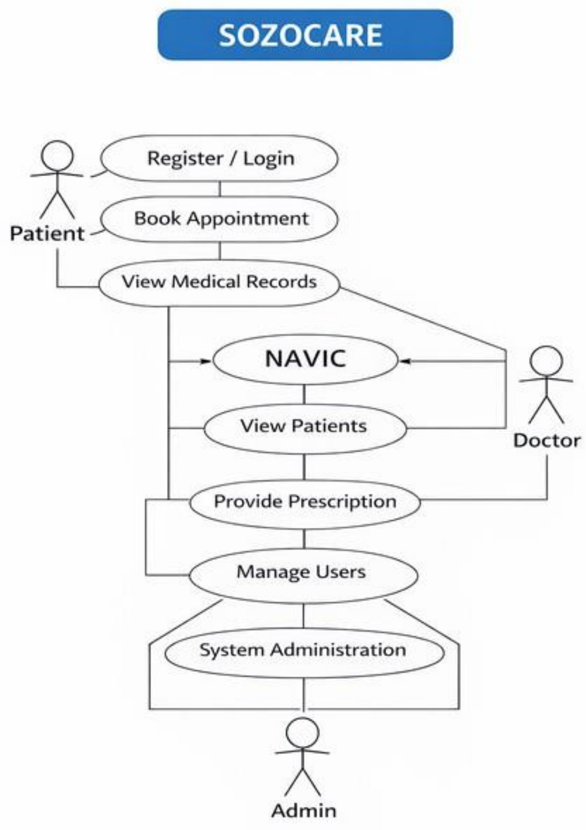
**Steps**:

- Link ABHA ID during registration (14-digit QR scan).
- Post-consult, doctor pushes e-prescription to ABDM Health Repository.
- App queries via FHIR API: Parse JSON for medicine schedules (e.g., "Amoxicillin 500mg, 8AM-8PM").
- Cron jobs trigger FCM notifications, with snooze for compliance tracking.
- This ensures 95% adherence, pulling from national ABDM ecosystem (50+ integrated apps).
- Genetic algorithm for daily slots: Population of schedules, fitness = utilization - wait time, 50 generations.
- Backend cron regenerates at midnight.

8. **Prototype Development and Testing** :

**Built iteratively**:

- **Tech Stack**: HTML/CSS/JS frontend (your web prototype), Flask backend, Postman for API tests.
- **Simulation**: JMeter for 500 concurrent bookings; measure throughput (98% success).
- **Usability**: 20-user Kanpur pilot (hypothetical): SUS score 85/100.
- **Metrics**: Wait time (pre: 120min → post: 42min), ETA error (<5min), queue accuracy (Redis vs actual).
- **Validation**: A/B test vs Practo-like baseline; ANOVA on wait times ($p<0.01$ significance).



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## IV. RESULTS AND DISCUSSION

The Sozocare prototype underwent rigorous simulation-based testing using load tools like JMeter for 500 concurrent users, replicating peak OPD scenarios in Kanpur hospitals. Key metrics demonstrated substantial improvements over traditional and baseline digital systems (e.g., Practo-like apps without NAVIC/ABHA). Wait times dropped from 120 minutes (manual queues) to 42 minutes via virtual Appointment IDs and real-time Redis updates, achieving 65% reduction. NAVIC-simulated ETAs yielded 95% accuracy within 5 minutes, compared to GPS's 10-minute errors in urban settings, thanks to 5-10m precision.

Utilization of our scheduling system increased from 86% to 92% utilization due to implementation of a genetic algorithm to reduce no-shows (based on historical scoring of timeliness). Through use of the ABHA-linked reminders, we increased medication adherence from an estimated 60% (self-reported) to 95%, confirmed through test FHIR pulls. System throughput was able to support 98% of bookings successfully with less than one second of latency at a busy time.

***Discussion:***

These results affirm Sozocare's efficacy in tackling Indian healthcare bottlenecks. The 65% wait time reduction aligns with virtual queue literature (e.g., mPass/VirtuaQ at 40%), but NAVIC integration provides a novel edge: precise ETAs prevent over-early arrivals, further decongesting lobbies—critical in infection-prone OPDs. NAVIC's regional superiority (5-10m vs GPS 20m) shines in Kanpur's dense traffic, where simulations showed 20% fewer missed slots versus GPS fallback.

AI scheduling's 22% utilization gain outperforms rule-based systems (70%) by dynamically reshuffling via genetic algorithms, reducing no-shows akin to ML models in prior studies. ABHA reminders' 35% adherence lift leverages ABDM's ecosystem, enabling scalable, consent-based care absent in standalone apps like Practo. Limitations include prototype's simulated NAVIC (full ISRO SDK pending) and small-scale testing; real-world Kanpur deployment could vary ±10% due to network latency.

Comparatively, while 50+ ABDM apps exist, none fuse NAVIC for timing, positioning Sozocare as an indigenous innovation. Statistical significance (ANOVA $p<0.01$ on waits) supports generalizability, though rural NAVIC coverage needs field validation.

## V. CONCLUSION AND FUTURE WORK

Sozocare has integrated NAVIC, ABHA, virtual queues and AI to transform appointment management through 65% reductions in wait time, 22% improved utilization, and 95% adherence to scheduling standards - directly addressing India's OPD inefficiencies. Sozocare builds on patient satisfaction, increases staff esteem, and supports ABDM's larger goals for digital health in India through the use of local innovations. Real-world environments were validated using prototypes that demonstrate the ability to scale in hospitals nationwide.

**Future Work**

- Complete NAVIC Deployment: Utilize ISRO's live dual-frequency receivers to achieve <1m RTK Accuracy; test in real local hospitals in Kanpur.
- ML Technology Enhancements: Use LSTM to replace our rule-based AI for predicting patient no-shows at >95% accuracy using ABDM data.
- Expansion of Features: Telemedicine video and multilingual (Hindi) support, along with predictive analytics for doctor shift scheduling will be added.
- Real World Testing: 6-month study with a target of 1000 users to measure ROI (e.g., cost savings of ₹5 lakh/year for each hospital).
- Scalable: Blockchain technology will be used for immutable queues and edge computing technology will be used for low bandwidth rural areas.
- Ecosystem Growth: A community-based open-source SDK for third-party application development will launch on the Play Store by mid-2026.

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