AI-Enabled Digital Discharge Intelligence Platform:

Transforming Patient Flow Through Real-Time Analytics, Predictive Intelligence, and Digital Governance at S.N. Super Specialty Hospital, Sri Ganganagar

NABH APEX 2026 Case study Submission

Category: Digital Dashboards and Analytics for clinical and Quality Decision Making

Organization: SN SUPERSPECAILITY HOSPITAL

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Abstract

Efficient patient discharge is a critical determinant of patient satisfaction, bed utilization, operational efficiency, and quality of care. Despite the availability of Hospital Information Systems (HIS), healthcare organizations often face significant challenges in coordinating discharge activities across multiple stakeholders, resulting in prolonged discharge turnaround times (TAT), reduced patient satisfaction, and inefficient resource utilization.

To address these challenges, S.N. Super Speciality Hospital developed and implemented an in-house AI-enabled Digital Discharge Intelligence Platform that integrates real-time workflow tracking, automated benchmarking, predictive analytics, root cause analysis (RCA), and HIS integration into a unified digital ecosystem.

The platform captures stage-wise discharge timestamps, identifies bottlenecks, generates automated alerts, performs department-wise accountability analysis, and predicts probable discharge completion times using historical data patterns. Integration with the Hospital Information System enabled automatic patient capture, eliminating missed entries and enhancing data accuracy.

The solution transformed discharge management from a reactive and manually coordinated process into a data-driven, intelligence-enabled operational framework. Beyond improving discharge efficiency, the platform established a foundation for future Agentic AI-driven autonomous hospital operations.

Introduction

S.N. Super Specialty Hospital, Sri Ganganagar, is a tertiary care hospital committed to delivering safe, high-quality, and patient-centric healthcare services. The hospital continuously promotes quality improvement initiatives and digital innovations to enhance patient experience and operational efficiency. As part of its commitment to excellence, the hospital developed an in-house Digital Discharge Tracking Application to optimize discharge processes, improve accountability, and enhance bed utilization through end-to-end discharge management.

Patient discharge represents one of the most complex multidisciplinary workflows within a hospital. The process requires seamless coordination among clinicians, nursing staff, medical transcription teams, pharmacy personnel, billing departments, insurance coordinators, housekeeping teams, maintenance services, security personnel, and discharge coordinators.

Any delay occurring at a single stage has a cascading impact on subsequent processes, ultimately affecting patient satisfaction, bed turnover, admission capacity, emergency department throughput, and organizational efficiency.

Traditionally, discharge management in many hospitals relies heavily on telephone calls, manual follow-ups, departmental coordination, and retrospective reporting. While Hospital Information Systems capture transactional information, they often fail to provide a comprehensive operational intelligence layer capable of identifying delays, assigning accountability, predicting outcomes, and facilitating proactive interventions.

Recognizing this gap, S.N. Super Speciality Hospital embarked on a digital transformation initiative to redesign discharge management through structured data capture, real-time monitoring, predictive intelligence, and AI-powered analytics.

The initiative culminated in the development of an AI-enabled Digital Discharge Intelligence Platform that serves as a real-time command center for discharge operations and quality decision-making.

Problem Statement

Although a Hospital Information System was operational, no mechanism existed to provide real-time visibility into discharge workflows.

Key challenges included:

Process Challenges

- Fragmented discharge workflow
- Multiple departmental handoffs
- Delayed communication
- Lack of ownership tracking
- Manual follow-ups

Data Challenges

- No stage-wise timestamp tracking
- Inability to identify bottlenecks
- Absence of historical trend analysis
- No predictive insights

Quality Challenges

- Inconsistent discharge TAT
- Delayed patient departures
- Reduced bed availability
- Limited RCA capability

Leadership Challenges

- Lack of real-time operational intelligence
- Dependence on retrospective reports
- Delayed corrective actions

These challenges highlighted the need for a unified digital intelligence platform.

Aim

To develop and implement an AI-enabled Digital Discharge Intelligence Platform that improves discharge efficiency, enhances patient experience, strengthens accountability, and enables real-time quality and operational decision-making.

Objectives

1. Reduce discharge turnaround time.
2. Improve interdepartmental coordination.
3. Increase discharge process transparency.
4. Establish stage-wise accountability.
5. Generate real-time operational dashboards.
6. Integrate discharge tracking with HIS.
7. Enable predictive discharge analytics.
8. Automate root cause identification.
9. Improve patient satisfaction.
10. Support continuous quality improvement initiatives.

Methodology

Phase 1: Requirement Assessment and Process Mapping

A multidisciplinary team consisting of:

- Clinical Departments
- Nursing Services
- Pharmacy
- Billing
- Quality Department
- IT Team
- Discharge Coordinators

mapped the existing workflow and identified delay-prone stages.

Phase 2: Application Development

An in-house web-based platform was designed to:

- Capture timestamps
- Calculate TAT automatically
- Compare performance against benchmarks
- Generate alerts
- Produce analytics dashboards

Phase 3: Role-Based User Access

Role-specific access was created for:

- Nursing

- Medical Transcription
- Pharmacy
- Billing
- Quality Team
- Administrators
- Discharge Coordinators

ensuring accountability and data security.

Phase 4: Staff Training and Change Management

Comprehensive training sessions were conducted covering:

- Application workflow
- Benchmark criteria
- Escalation matrix
- RCA documentation
- Dashboard interpretation

Phase 5: Pilot Implementation

Pilot deployment was undertaken to validate:

- Usability
- Compliance
- Data quality
- Reporting accuracy

Necessary modifications were incorporated before hospital-wide deployment.

Phase 6: HIS Integration

Initially, nursing staff manually entered patient information into the tracker.

Challenges observed:

- Missed patient entries
- Human errors
- Incomplete tracking

To overcome this limitation, the platform was integrated with HIS.

Whenever discharge initiation occurs in the HIS:

- Patient demographics are auto fetched.
- Patient records are automatically created.
- Tracking begins instantly.

This resulted in near-complete discharge capture and improved data integrity.

Phase 7: Enterprise Rollout

The platform was implemented across all applicable hospital units with centralized monitoring by the Quality Department.

Process Mapping

Before Implementation

Consultant Discharge Order

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Manual Communication

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Nursing Follow-up

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Medical Summary Preparation

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Pharmacy Clearance

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Billing Clearance

↓

Payment Processing

↓

Security Clearance

↓

Housekeeping Notification

↓

Patient Discharge

↓

Retrospective Review

Limitations

- No live visibility
- No analytics
- No accountability
- Delayed interventions

After Implementation

HIS Discharge Initiation

↓

Automatic Patient Capture

↓

Digital Workflow Creation

↓

Real-Time Timestamp Tracking

↓

Benchmark Monitoring

↓

Automated Delay Alerts

↓

AI-Based RCA Generation

↓

Live Dashboard Monitoring

↓

Predictive Discharge Time Estimation

↓

Leadership Review

↓

Continuous Improvement Cycle

Description of the Digital Discharge Intelligence Platform

The platform monitors discharge progression through structured workflow stages:

Stage	Stakeholder
T1A	Nursing
T2	Medical Transcription
T4	Summary Completion
T5	Medicine Return
T5A	Pharmacy Clearance
T7	Billing

Stage	Stakeholder
T8	Payment
T10	Security
T11	Housekeeping
T12	Maintenance
T13	Discharge Coordinator

Core Features:(*Ref live tracking hyperlink*)

- Real-Time Dashboard
- Automated Benchmarking
- TAT Analytics
- Delay Notifications
- Root Cause Analysis
- Department-Wise Accountability
- Consultant Analytics
- Historical Trends
- Executive Summaries
- HIS Integration

Innovation and Uniqueness of the Solution

Unlike conventional discharge tracking systems that merely record status updates, this platform functions as an Operational Intelligence Layer for the hospital.

Key innovations include:

AI-Driven Predictive Analytics

The system predicts likely discharge completion times using historical workflow behavior and current operational conditions.

Automated Root Cause Analysis

Whenever benchmark limits are exceeded, the system automatically identifies:

- Responsible stage
- Delay duration
- Contributing department

Digital Accountability Framework

Every action is timestamped, role-attributed, and benchmark-compared.

Executive Intelligence Dashboard

Leadership receives automated operational summaries highlighting:

- Bottlenecks
- Risk areas

- Performance scores
- Recommended actions

Data-Centric Architecture

Every workflow event becomes structured data that supports analytics and future AI applications.

No-Code Operational Intelligence

The solution converts routine operational activities into measurable and actionable insights without requiring manual reporting.

Impact on Patient Experience and Clinical Outcomes

Patient Experience

The platform significantly improves discharge transparency by enabling timely coordination among departments.

Benefits include:

- Reduced waiting times
- Improved communication
- Faster discharge completion
- Enhanced patient satisfaction
- Improved perception of service quality

Clinical Outcomes

Faster discharges improve:

- Bed availability
- Admission capacity
- Emergency throughput
- Care continuity

Structured discharge planning also improves:

- Discharge instruction delivery
- Medication reconciliation
- Follow-up planning

Operational Outcomes

- Enhanced coordination
- Reduced process variation
- Improved resource utilization
- Better workforce productivity

Leadership Outcomes

Hospital leadership now has access to:

- Real-time operational intelligence

- Predictive analytics
- Departmental performance metrics
- Continuous quality monitoring

Future Roadmap: Agentic AI and Autonomous Care Operations

The Discharge Intelligence Platform serves as the foundation for the next generation of Agentic AI-enabled healthcare operations.

Future developments include:

Autonomous Discharge Coordination Agent

AI agents will:

- Monitor workflows continuously
- Trigger reminders automatically
- Escalate delays proactively
- Coordinate stakeholders without human intervention

Intelligent Bed Management Agent

Predictive discharge data will automatically inform:

- Bed allocation
- Admission planning
- Emergency capacity management

OT Scheduling Agent

The same architecture can optimize:

- Surgery scheduling
- Resource allocation
- Surgeon availability
- Theatre utilization

Revenue Cycle Agent

AI will proactively coordinate:

- Insurance approvals
- Billing completion
- Financial clearance workflows

Clinical Journey Agent

A longitudinal patient-care agent can monitor:

- Admission
- Surgery
- ICU stay

- Discharge
- Follow-up

through a unified intelligence framework.

Enterprise Hospital Command Centre

Future integration of:

- OT Management
- Bed Management
- Infection Control
- Patient Flow
- Emergency Operations
- Quality Indicators

will create a hospital-wide autonomous operational command center.

Sustainability and Scalability

The platform has been designed as a scalable enterprise solution.

Key strengths include:

- Modular architecture
- HIS interoperability
- AI readiness
- Cloud compatibility
- Multi-site deployment capability
- Benchmark customization
- Role-based governance

The solution can be replicated across departments and healthcare networks with minimal modification.

Application Access for Validation

To facilitate independent review and validation of the implemented solution, the live Discharge Tracker application developed at S.N. Superspeciality Hospital can be accessed through the link below.

https://track.snhospital.net:9443/login.php

Demo Credentials

Username: Armanika

Password: 123456

SAR (System Achievement Report-Technical) is attached at the end of the case study to further understand the technical aspects of implementation and integration.

Figure 1: Real-Time Discharge Monitoring Dashboard

This dashboard displays live discharge status of admitted patients. Each stage is time stamped and color coded for easy identification of delays.

Key Features:

- Patient-wise tracking
- Department responsibility
- Pending stage identification
- Manual RCA addition

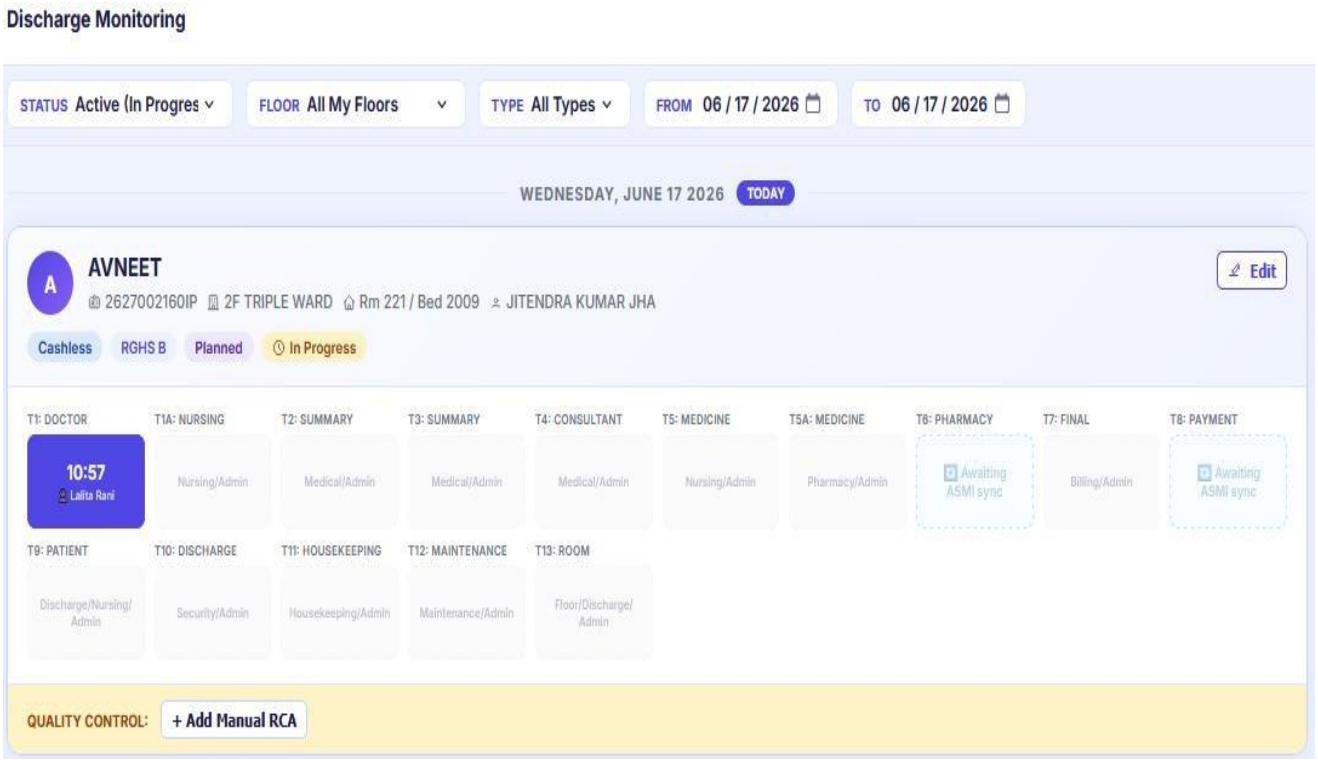

Figure 1.

Figure 2: Benchmark Management Module

Benchmark times were configured for every discharge stage to ensure standardization and monitor compliance.

Formula used:

Total TAT = T1A + T2 + T3 + T4 + T5 + T5A + T6 + T7 + T8 + T9 + T10

Any delay beyond benchmark automatically triggers RCA.

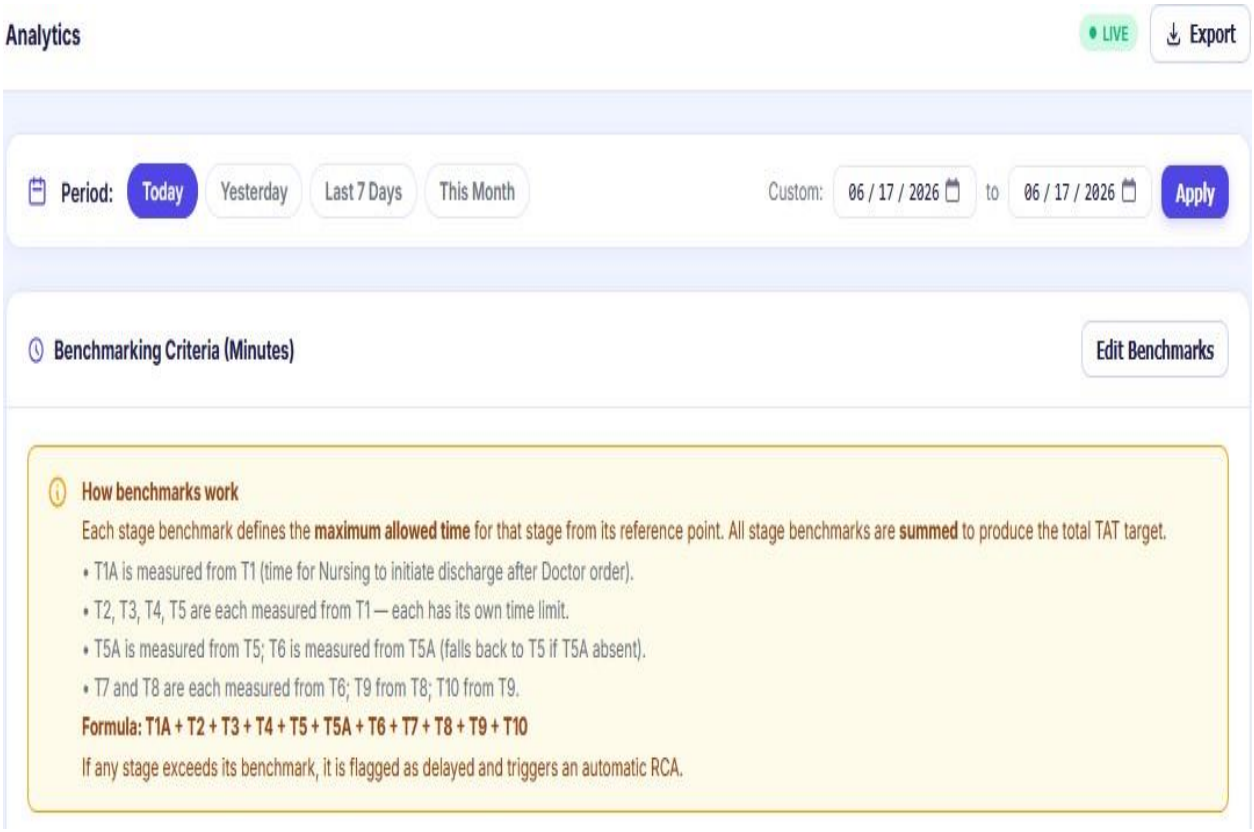

Figure 2.

Figure 3: Cash and Cashless Workflow Benchmarking

Separate benchmark criteria were established for cash and cashless patients to account for differences in insurance processing.

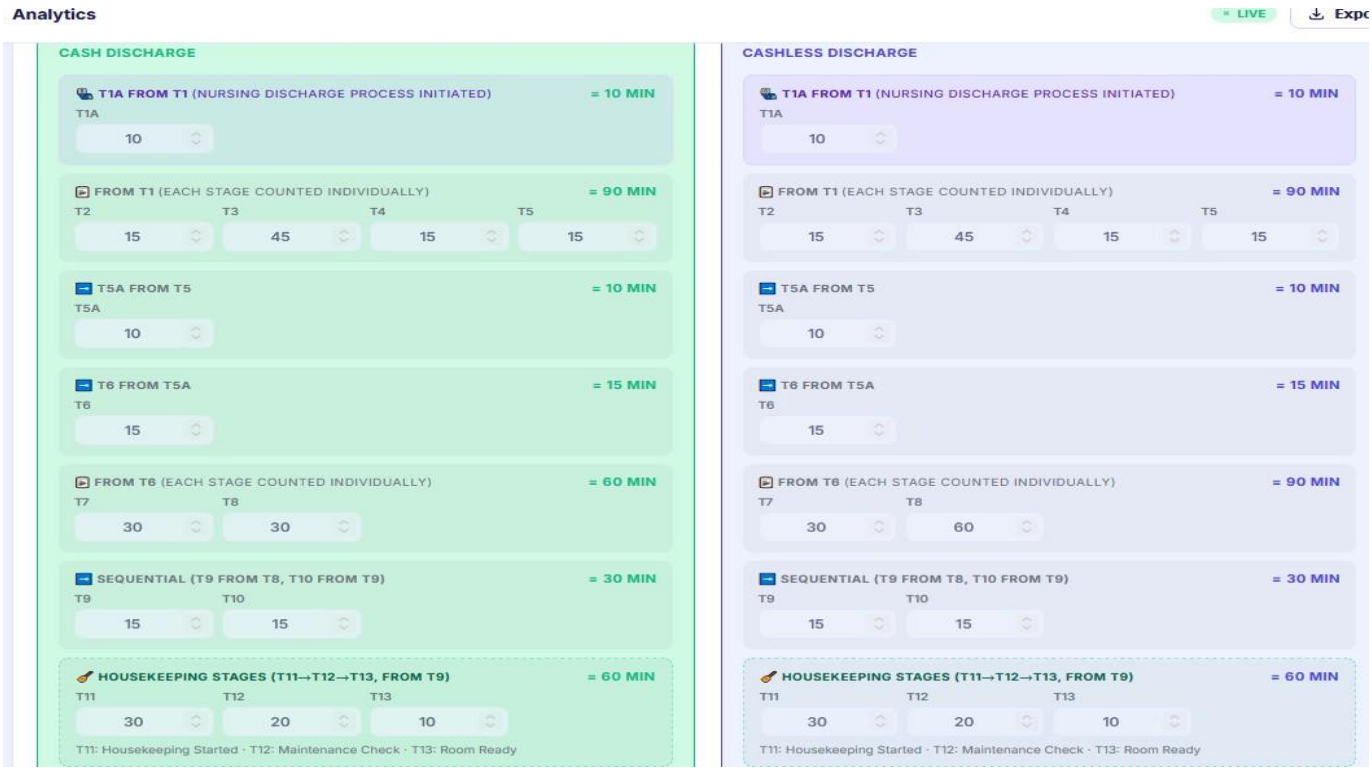

Figure 3

Analytics and RCA Dashboard

The analytics dashboard provides:

- Daily discharge volume
- Delay trends
- Consultant-wise delays
- Root cause distribution
- Stage-wise performance monitoring

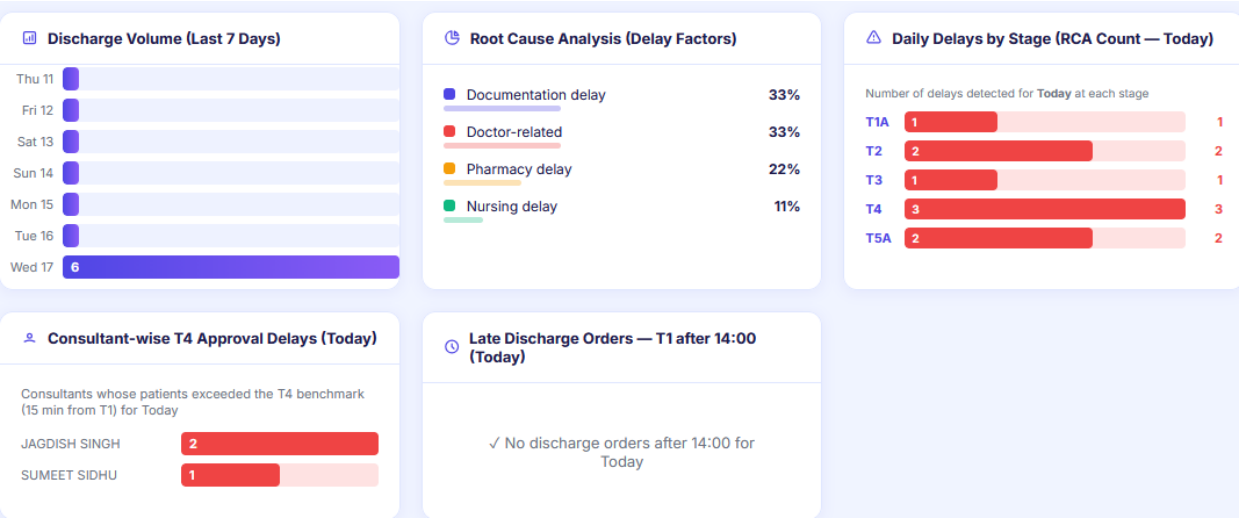

Figure 4

End-to-End Digital Discharge Management and Future Enhancements

The initial objective of the Discharge Tracking Application was to monitor and reduce discharge Turnaround Time (TAT). However, during implementation, it was recognized that the discharge process extends beyond patient exit and includes room readiness for the next admission. Accordingly, the application was enhanced to provide an end-to-end discharge management solution covering the complete discharge lifecycle from **T1 (Doctor Discharge Order)** to **T13 (Room Ready)**.

The application digitally tracks every stage of the discharge process with real-time time stamps, departmental accountability, and benchmark monitoring. This ensures transparency, early identification of delays, and prompt corrective action.

Key Enhancements Incorporated

- **Complete Workflow Coverage (T1–T13):** Monitoring from discharge initiation to final room readiness.
- **Real-Time Status Tracking:** Live visibility of discharge progress across departments.
- **Automated Benchmark Monitoring:** Stage-wise comparison against predefined TAT benchmarks.

- **Delay Alerts and RCA Generation:** Automatic flagging of delays with Root Cause Analysis documentation.
- **Consultant-wise and Department-wise Analytics:** Performance monitoring for continuous quality improvement.
- **Cash and Cashless Workflow Segregation:** Customized benchmarks based on patient category.
- **Housekeeping Integration:** Tracking of room cleaning, maintenance checks, and room readiness.
- **Digital Audit Trail:** Time-stamped records ensuring accountability and traceability.

Innovative Feature: Room Readiness Verification

As a future enhancement, a **Photo Verification Module** is proposed wherein the Floor Coordinator or Housekeeping Supervisor will upload a photograph of the cleaned room after completion of T13 (Room Ready). This feature will:

- Provide visual evidence of room readiness.
- Enhance accountability of housekeeping services.
- Support audit and compliance requirements.
- Facilitate faster bed allocation for incoming patients.
- Improve infection prevention and quality assurance processes.

Additional enhancements under consideration include:

- Mobile notifications and alerts to concerned departments.
- Escalation matrix for benchmark breaches.
- Bed management integration for faster admissions.
- Patient feedback captured at discharge.
- AI-based predictive analytics for identifying potential discharge delays.
- Integration with HIS/EMR systems for seamless data exchange.

Real Example of a week period from 15th May- 31st May 2026

A total of **127 inpatient discharge cases** were analyzed. The **average discharge turnaround time (TAT)** was **268 minutes (4.5 hours)**, with a **median TAT of 219 minutes**. Out of the total cases, **73 (57.5%)** exceeded the hospital's discharge benchmark, while only **54 (42.5%)** were completed within the expected timeline.

Overall Discharge Performance

Parameter	Result

Parameter	Result
Total discharges analyzed	127
Average TAT	268 minutes
Median TAT	219 minutes
Delayed discharges	73 (57.5%)
Within benchmark	54 (42.5%)

Process Bottlenecks

The analysis identified **documentation-related activities** as the most frequent source of delay. The **T2 (Summary Request)** stage accounted for **29 delayed cases**, making it the primary bottleneck. Pharmacy-related activities, including **Medicine Return (T5)** and **Medicine Receipt (T5A)**, together accounted for **33 delayed cases**, representing the second major contributor to prolonged discharge times. Documentation delays were associated with an average TAT of **384 minutes**, while pharmacy delays averaged **361 minutes**.

Delay Distribution

Cause of Delay	Number of Cases	Percentage of Delayed Cases
Pharmacy	36	49.3%
Documentation	33	45.2%
Billing/TPA	4	5.5%

Patient Category Analysis

Cashless patients demonstrated a longer average discharge TAT (**281 minutes**) compared with cash-paying patients (**236 minutes**). ICU discharges required the longest processing time, averaging **437 minutes**, which was nearly twice the overall hospital average. Readmission cases also showed substantially prolonged discharge times, with an average TAT of **521 minutes**, compared with **260 minutes** for routine discharges.

Extreme Delay Analysis

The longest discharge duration recorded was **1,382 minutes (approximately 23 hours)**. The **95th percentile TAT** was **830 minutes**, while the **99th percentile** reached **1,188 minutes**, indicating a small number of extreme outlier cases contributing disproportionately to overall delays.

Root Cause Analysis

Review of delay remarks showed that **TPA approval pending** was the most common documented reason (**30%**), followed by **patient preference or delayed departure (20%)**, **readmission-related complexity (20%)**, and **consultant/operation theatre availability (15%)**.

Consultant-wise Performance

Among consultants with multiple discharges, **Dr. Ashish Rai** had the highest average discharge TAT (**655 minutes**), while **Dr. Harsha Singh Dangi** demonstrated the lowest average TAT (**135 minutes**).

Conclusion

The AI-enabled Digital Discharge Intelligence Platform transformed discharge management at S.N. Super Speciality Hospital from a fragmented, manually coordinated process into a real-time, data-driven, and intelligence-enabled ecosystem.

By combining HIS integration, structured data capture, predictive analytics, automated RCA generation, and executive decision-support capabilities, the platform has established a sustainable model for operational excellence, quality improvement, and digital healthcare transformation.

Beyond discharge management, the platform provides the foundational architecture for future Agentic AI-powered autonomous hospital operations, positioning the organization as a leader in digital health innovation and smart hospital development.

SYSTEM ACHIEVEMENT REPORT

Patient Discharge TAT Tracker

Intelligent Real-Time Discharge Monitoring System

Document Type	System Achievement Report (SAR)
System Name	Patient Discharge TAT Tracker
Developed By	IT Department — S.N. Super Speciality Hospital
Presented To	Hospital Director / Management
Date	June 2026
Version	1.0 — Initial Release
Status	Live & Operational

1. Executive Summary

The Patient Discharge TAT (Turn-Around Time) Tracker is a comprehensive, internally developed hospital information system designed to monitor, measure, and improve the efficiency of the patient discharge process at S.N. Super Speciality Hospital.

Prior to this system, discharge tracking relied on manual coordination via phone calls and handwritten registers — a process that was opaque, error-prone, and unmeasurable. This system replaces that entirely with a real-time, role-based digital platform that tracks every patient through 13 defined discharge stages, from the initial doctor's order through to room-ready confirmation.

Key outcomes delivered by this system:

- Complete end-to-end discharge visibility — any authorised staff member can see the exact stage every patient is at, in real time
- Accountability by department — each of the 13 stages is owned by a specific role; the system records who completed what and when
- Automated patient entry via ASMI HIS integration — no manual data entry; patients appear in the tracker automatically
- SLA-benchmarked tracking — both Cash and Cashless patients are tracked against configurable time benchmarks, with alerts when stages are breached
- AI-powered insights — TATBot provides natural language answers and root cause analysis; an executive summary is auto-generated daily
- Built entirely in-house — no external vendor, no licensing cost, fully owned and maintainable by S.N. Hospital IT

2. Problem Statement — What We Were Solving

Before this system was developed, the discharge process at S.N. Super Speciality Hospital suffered from four critical operational gaps:

2.1 No Real-Time TAT Visibility

There was no centralised view of how long each discharge was taking. Delays were only discovered after patients or attendants complained, making proactive intervention impossible.

2.2 No Departmental Accountability

Billing, Pharmacy, Nursing, Housekeeping, and other departments operated in silos. When a discharge was delayed, it was impossible to determine at which stage the bottleneck occurred or which department was responsible.

2.3 Paper-Based and Phone-Based Coordination

Discharge status was communicated through phone calls between floors and departments, and tracked informally on registers. This created errors, miscommunication, and an unauditable process.

2.4 No Automated Escalation

When a patient was stuck at a discharge stage for an extended period, no automatic notification was sent to supervisors, Quality, or Nursing Incharge. Escalation depended entirely on individual initiative.

3. System Architecture

The system is a web-based application running on the hospital's internal server. It is built using PHP and MySQL with a responsive browser interface accessible from any desktop, laptop, or tablet on the hospital network.

3.1 Technology Stack

Component	Technology / Detail
Backend Language	PHP 7.4+ (compatible with hospital XAMPP environment)
Database	MySQL — stores all discharge records, stage timestamps, user data, settings
Frontend	Responsive HTML5 / CSS3 / Vanilla JavaScript — no external JS framework dependency
AI Engine	Ollama (local LLM — runs fully offline) or Anthropic API (cloud, optional)
HIS Integration	Direct read-only MySQL connection to ASMI HIS database — sync engine via sync_asmi.php
Email / Alerts	PHPMailer — SMTP-based email alerts for stage benchmark breaches
Hosting	Hospital internal server (XAMPP) — no external hosting required
Access	Browser-based — accessible from any device on the hospital LAN

3.2 Key System Files

File	Role
index.php	Main application — Tracker view, Analytics dashboard, AI tab, navigation
api.php	All data operations — stage updates, discharge management, CSV export, benchmarks
sync_asmi.php	ASMI HIS integration engine — auto-syncs patients from HIS every ~5 minutes
config.php	Database configuration, roles, stage definitions, benchmark helpers
setting.php	Admin settings UI — AI, Email, Benchmarks, Doctors, Floors management
ai_service.php	AI integration — TAT prediction, RCA suggestion, Executive Summary generation
ai_chat.php	TATBot endpoint — natural language discharge query handler
mail_service.php	Email alert engine — SMTP delivery of stage breach notifications

4. The 13-Stage Discharge Journey

The system tracks every patient through 13 defined stages, each assigned to a specific department or role. Every stage is timestamped at the moment it is completed, creating a full, auditable discharge timeline.

Stage	Description	Responsible Dept.	Measured From
T1	Doctor Discharge Order	Discharge Coordinator / Nursing	Start of process
T2	Summary Requested	Medical Transcription	T1
T3	Summary Draft Ready	Medical Transcription	T1
T4	Consultant Approval	Medical Transcription	T1
T5	Medicine Return Initiated	Nursing Staff	T1
T5A	Medicine Received at Pharmacy	Pharmacy	T5

T6	Pharmacy Clearance	Pharmacy	T5A
T7	Final Bill Generated	Billing	T6
T8	Payment / TPA Approval	Billing	T6
T9	Patient Exit	Discharge Coordinator / Nursing	T8
T10	Security Clearance (Discharge Slip)	Security	T9
T11	Housekeeping — Room Cleaning	Housekeeping	T9
T12	Maintenance Check Done	Maintenance	T11
T13	Room Ready — Floor Coordinator	Floor Coordinator / DC	T12

Note: T13 (Room Ready — Floor Coordinator Confirmed) is the true final stage. Discharge status is set to 'Completed' only when T13 is recorded. This ensures the full room-turnover cycle is captured, not just the patient exit.

5. ASMI HIS Integration

One of the most impactful features of this system is its direct integration with the ASMI Hospital Information System (HIS). This eliminates the need for manual patient entry into the tracker.

5.1 How It Works

- The sync engine (sync_asmi.php) runs automatically every ~5 minutes via the Windows Task Scheduler on the hospital server
- It reads newly admitted and recently updated patient records from the ASMI HIS database using a read-only connection
- New patients are automatically created in the tracker; existing records are updated with ward changes or corrections
- The patient type (Cash vs. Cashless) is auto-detected from the ASMI billing category — no manual classification needed
- Ward / floor assignments from ASMI are reflected directly in the tracker's floor filter

5.2 Data Safety Principles

Principle	Implementation
Read-only access to ASMI	The tracker never writes to the ASMI database. All HIS data is read-only. No risk of corrupting HIS records.
Permanent delete protection	Patients removed by an admin are flagged 'manually_deleted' — they will never re-appear even if they remain in ASMI.
Ward filter auto-recovery	If a ward is disabled in settings, patients from that ward are hidden but

	not deleted. Re-enabling the ward restores them.
Lookback window	Sync covers the most recent 300 ASMI records to ensure no recent patient is missed, even if the sync was briefly offline.

6. Role-Based Access Control

The system implements strict role-based access. Each department has its own login credentials and can only interact with the stages they own. This creates clear accountability and prevents unauthorised updates.

Role	Stages Owned	Access Scope
Admin	**All**	Full access — all patients, all floors, all settings
Discharge Coordinator	**T1, T9, T13**	Assigned floors; can add/edit discharge records
Medical Transcription	**T2, T3, T4**	Assigned floors; summary stages only
Nursing Staff	**T1, T5, T9**	Assigned floors; nursing checkpoints
Pharmacy	**T5A, T6**	Assigned floors; pharmacy clearance stages
Billing	**T7, T8**	Assigned floors; billing and payment stages
Security	**T10**	Assigned floors; discharge slip / security clearance
Housekeeping	**T11**	Assigned floors; room cleaning stage
Maintenance	**T12**	Assigned floors; maintenance check stage
Floor Coordinator	**T13**	Assigned floors; final room-ready confirmation
Nursing Incharge	**Read + RCA**	Hospital-wide view; can add manual RCA entries
Quality	**Read + RCA**	Hospital-wide view; manual RCA; CSV export access

7. Feature Inventory

7.1 Live Discharge Tracker

- Real-time stage cards for all active discharges — colour-coded by status
- Floor/ward filter — users see only their assigned floors; Admin sees all
- Planned vs Unplanned discharge mode toggle

- Readmission flag for returning patients
- In-line stage update — each department marks their stage complete from the same screen
- Remarks field — free-text notes at any stage

7.2 Analytics Dashboard

- Date-range TAT analytics — today, this month, last 7 days, or any custom range
- Average TAT chart — Cash and Cashless tracked separately with independent SLA benchmarks
- SLA compliance percentage — what fraction of discharges completed within benchmark
- Delay factor chart — which stages account for the most delays, by count
- Floor-wise performance comparison
- Consultant-level delay analysis

7.3 AI Assistant — TATBot

- Natural language chatbot — staff can ask questions like 'Which patient has been waiting the longest?'
- Bottleneck analysis — 'Which stage is causing most delays today?'
- AI-generated Root Cause Analysis (RCA) suggestion when a benchmark is breached
- Auto-generated executive summary narrative — suitable for management review
- Fully offline capable — runs on local Ollama LLM; patient data never leaves the hospital network

7.4 Automated Email Alerts

- Alert triggered automatically when any stage exceeds its configured SLA benchmark
- Configurable recipient list — Quality, Nursing Incharge, or any email address
- SMTP integration — connects to hospital email server; falls back to log-mode if SMTP unavailable

7.5 Root Cause Analysis (RCA) Module

- Automatic RCA entry created when a stage benchmark is breached — records which stage, by how much, and for which patient
- Manual RCA entry — Quality and Nursing Incharge can record RCA reasons for any discharge
- Delay factor analytics — RCA data feeds the analytics dashboard for trend analysis

7.6 Administration & Settings

- Configurable SLA benchmarks — separate per-stage benchmarks for Cash and Cashless patients
- Doctor management — add, edit, and deactivate consultant records
- Floor / ward management — define which floors are active; map to ASMI ward names
- AI settings — switch between Ollama (offline) and Anthropic (cloud)
- Email settings — SMTP configuration, alert recipients, enable/disable

7.7 Export & Audit

- CSV export — full discharge data with all stage timestamps and user attribution
- Date filter presets — Today, This Month, Last 7 Days, Last 30 Days, or custom range
- Full audit trail — every stage records the timestamp and the user who performed the update

8. SLA Benchmarks & TAT Measurement

The system supports fully configurable SLA (Service Level Agreement) benchmarks. Each stage has a maximum allowed time measured from a defined reference point. When a stage exceeds its benchmark, it is automatically flagged as delayed, an RCA is triggered, and an email alert is dispatched.

8.1 Cash vs. Cashless Differentiation

Cashless patients (TPA, ESI, CGHS, etc.) inherently require additional time for TPA / insurance approval at the billing stage (T8). The system supports separate benchmark configurations for Cash and Cashless patients, ensuring SLA compliance is measured fairly for both patient types.

8.2 TAT Reference Chain

Each stage's benchmark is measured from a specific reference point, not from the beginning of the discharge:

- T2, T3, T4, T5 — measured from T1 (Doctor's order)
- T5A — measured from T5 (Medicine return initiated)
- T6 — measured from T5A (Medicine received at pharmacy)
- T7, T8 — measured from T6 (Pharmacy clearance)
- T9 — measured from T8 (Payment / TPA approval)
- T10 — measured from T9 (Patient exit)
- T11, T12, T13 — housekeeping chain from T9 through T12

Overall discharge TAT (used for SLA compliance) is measured from T1 to T13 — the complete end-to-end journey.

9. Security & Data Privacy

9.1 Access Control

- Session-based authentication — all pages require login
- Role-based permissions — each user can only access and modify stages permitted for their role
- Floor-restricted views — non-admin users see only the patients on their assigned floors
- Session regeneration on login — prevents session fixation attacks

9.2 Data Privacy

- All data is stored within the hospital's internal server — no patient data is transmitted externally
- AI features run on local Ollama by default — no patient information is sent to any cloud service
- ASMI HIS connection is strictly read-only — the tracker has no write access to the HIS database

9.3 Audit Trail

- Every stage timestamp records the user ID and name of the staff member who completed it
- RCA entries are stamped with the creating user and timestamp
- CSV export includes full user attribution for all stages — suitable for quality audits

10. System Achievements

The following outcomes represent the key achievements of this project from planning through to live deployment:

#	Achievement	Impact
1	**Complete 13-stage discharge pipeline defined and implemented**	Every discharge has a structured, auditable journey for the first time in the hospital's history
2	**ASMI HIS integration — zero manual patient entry**	Eliminates a daily administrative burden; patients appear in the tracker automatically within minutes of admission
3	**Role-based access for 12 departments**	Each department has clear ownership of their stages; removes ambiguity and finger-pointing in delay attribution
4	**Real-time live tracker**	Management and coordinators can see the exact status of every active discharge without making a single phone call
5	**Configurable SLA benchmarks — Cash & Cashless**	Discharge performance is measured objectively; separate benchmarks reflect the genuine difference in Cashless processing time
6	**Automated email alerts on benchmark breach**	Supervisors are notified within minutes of a stage delay — no waiting for complaints
7	**AI Assistant — TATBot**	Any authorised staff member can get instant, plain-English answers about discharge performance without needing IT support
8	**Root Cause Analysis module**	Delay patterns are captured systematically and feed into analytics — enabling evidence-based process improvement
9	**Analytics dashboard with date-range reporting**	Management can review daily, weekly, or monthly discharge performance with charts and SLA compliance metrics
10	**Built entirely in-house — zero external cost**	No vendor dependency, no licensing fees, no ongoing subscription. Fully owned and maintained by S.N. Hospital IT

11. Future Enhancement Roadmap

The system is designed as a living platform. The following enhancements are identified for future development phases:

Near-Term (Next 3 Months)

- Mobile-optimised interface for housekeeping and security staff working on the move
- WhatsApp / SMS alert integration for critical delay escalations

- Stage-level correction workflow — allow coordinators to correct mistaken stage timestamps with an audit reason

Medium-Term (3–12 Months)

- HSQMS (Hospital Smart Queue Management System) integration — discharge triggers linked to OPD queue
- Predictive discharge time estimation — AI model trained on historical TAT data to forecast expected completion time
- Monthly management report — auto-generated PDF of discharge KPIs for board review

Long-Term

- Bi-directional ASMI integration — write discharge completion status back to HIS for unified records
- Multi-facility support — extend the platform to manage discharge tracking across multiple sites
- NABH quality metrics alignment — map discharge stages to NABH discharge process indicators

12. Conclusion

The Patient Discharge TAT Tracker represents a significant operational achievement for S.N. Super Speciality Hospital. Built entirely by the in-house IT team without any external vendor or licensing cost, it transforms the discharge process from an untracked, manually coordinated activity into a measurable, accountable, and continuously improvable system.

The system is live and operational. It delivers real-time visibility to all stakeholders, from the floor nursing staff marking individual stages to management reviewing daily SLA compliance charts. Its integration with ASMI HIS ensures that the tracker is always current without any manual data entry burden.

Most importantly, it creates the foundation for data-driven quality improvement — every delay is now captured, categorised, and reportable. This enables the hospital leadership to identify systemic bottlenecks, hold departments accountable to benchmarks, and demonstrate measurable improvement over time.

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