

Integrating SAP S/4HANA and Artificial Intelligence for Secure Data Exchange Across Mobile Healthcare Applications

Jalal Yusuf

University of Ilorin Teaching Hospital, Ilorin, Nigeria

Email ID: habee_byd@gmail.com

Abstract

Healthcare organizations increasingly rely on mobile applications for patients, clinicians, pharmacists, and field staff, while their business operations, including procurement, inventory, billing, claims, and workforce management, run on enterprise resource planning (ERP) systems such as SAP S/4HANA. Exchanging data between these mobile applications and the ERP core creates value, for example by connecting medication use to replenishment or service delivery to billing, but it also exposes sensitive patient and financial information to new risks. This article proposes a framework that integrates SAP S/4HANA with artificial intelligence (AI) to enable secure data exchange across mobile healthcare applications. The framework combines a clean S/4HANA core, a governed integration and event layer, scalable web services, distributed analytics, and AI capabilities for risk-based access control, anomaly detection, intelligent workflow automation, and decision support. It is protected by data minimization, encryption, consent enforcement, and tested business continuity. Building on research into clean-core modernization, intelligent enterprise frameworks, workflow automation with machine learning, scalable and distributed healthcare data processing, event-driven claims processing, and disaster recovery, the article describes the framework's architecture, security mechanisms, AI capabilities, use cases, evaluation metrics, and implementation roadmap.

1. Introduction

Healthcare is delivered increasingly through mobile channels. Patients use applications to book appointments, view bills, and submit insurance documents. Nurses record medication administration and supply usage on handheld devices. Pharmacists scan stock in dispensaries, community care teams log home visits, and procurement staff approve urgent purchases from their phones. Each of these activities generates data that matters not only clinically but also operationally and financially.

Behind the scenes, many hospitals and healthcare networks run their business operations on SAP S/4HANA. The ERP system manages purchasing of medicines and medical devices, inventory across wards and pharmacies, equipment maintenance, patient billing and receivables, insurance claims, finance, and human resources. When mobile applications and S/4HANA exchange data effectively, organizations can replenish supplies automatically as they are consumed, bill

accurately for services delivered at the bedside or at home, process claims faster, and schedule staff according to real demand.

This integration, however, raises serious security concerns. Mobile devices are lost, shared, and attacked. Data passing between applications and the ERP may include patient identifiers, diagnoses implied by medications or procedures, insurance details, and payment information. A breach can harm patients, violate health privacy regulations, and disrupt operations. Security therefore cannot be an afterthought added to an integration project; it must shape the architecture from the beginning.

AI strengthens both sides of this challenge. It can make security adaptive, by assessing the risk of each request and detecting abnormal behavior, and it can make operations intelligent, by automating workflows, forecasting demand, and flagging suspicious claims. Asuri (2022) describes how S/4HANA and SAP Analytics Cloud can underpin an intelligent enterprise framework for real-time decision intelligence, digital innovation, and sustainable business value creation. This article applies that vision to healthcare, with secure mobile data exchange as its foundation.

Section 2 explains the role of S/4HANA in healthcare data exchange, and Section 3 sets out security requirements. Section 4 presents the framework, followed by its security mechanisms, AI capabilities, scalable processing, and resilience in Sections 5 to 8. Sections 9 to 12 cover use cases, evaluation, a roadmap, and challenges, and Section 13 concludes.

2. The Role of SAP S/4HANA in Healthcare Data Exchange

S/4HANA is not a clinical record system, and the framework does not treat it as one. Electronic health record (EHR) systems remain the authoritative source of clinical data. S/4HANA is the system of record for the business of healthcare: what was purchased, consumed, delivered, billed, and paid, and by whom. Much of this business data is nonetheless sensitive, because it can reveal or imply health information. A record that a particular patient was billed for an oncology drug, for example, discloses a diagnosis.

S/4HANA brings several strengths to healthcare data exchange. Its in-memory architecture allows transactional and analytical processing on the same current data, so stock levels, open claims, and receivables are visible in real time. Core Data Services (CDS) views expose business entities in a consistent, semantically meaningful form, and released APIs provide governed access for external applications. Asuri (2022) emphasizes that real-time decision intelligence built on S/4HANA allows organizations to act on current information rather than delayed reports, which in healthcare can mean avoiding a stock-out of a critical medicine or catching a billing error before a claim is rejected.

The quality of the ERP core matters as much as its capabilities. Asuri (2021) shows how modernizing processes through clean-core architecture, using supplier relationship management as an example, improves S/4HANA transition readiness and business process excellence. For healthcare, clean-core principles have a security dimension as well. When custom code is minimized and external applications connect only through released APIs, the attack surface shrinks, authorizations are enforced consistently, and integrations remain stable through upgrades. Procurement of pharmaceuticals and medical devices is a particularly important area: modern,

standardized supplier processes support traceability, recall management, and compliance with regulatory requirements for medical products.

3. Security and Privacy Requirements

Secure data exchange between mobile healthcare applications and S/4HANA must satisfy the following requirements.

- **Confidentiality:** patient, financial, and employee data is readable only by authorized users and systems, on devices, in transit, and at rest.
- **Integrity:** transactions such as goods issues, service confirmations, and claims cannot be altered undetected, since errors affect patient safety and revenue.
- **Data minimization:** each application receives only the data it needs, and the ERP receives only the patient information required for its business purpose.
- **Fine-grained authorization:** access reflects role, organizational unit, care or business relationship, and patient consent.
- **Accountability:** every access and transaction is logged and traceable to a user, device, and purpose.
- **Availability:** supply, billing, and staffing processes continue during failures, because disruption can affect care.

These requirements apply across very different users. A patient viewing an invoice, a nurse recording medication use, a pharmacist adjusting stock, and an insurer receiving a claim each need different data and present different risks.

4. Framework Architecture

The framework organizes secure data exchange into four layers, supported by an AI security and resilience plane.

Requests from mobile applications pass through a secure access layer and a governed integration layer before reaching S/4HANA, and only the minimum necessary data returns to each application.

1. **Mobile application layer.** Patient, clinician, pharmacy, and field-staff applications protect data on the device with hardware-backed keys, encrypted local storage, and integrity checks.
2. **Secure access layer.** An API gateway authenticates users and devices, enforces encryption, applies consent and authorization policies, and consults an AI risk engine before granting access.
3. **Integration and event layer.** Scalable web services and event streams connect mobile applications, the EHR, insurers, and suppliers to S/4HANA, transforming and minimizing data along the way.
4. **S/4HANA core.** A clean-core S/4HANA system runs procurement, inventory, maintenance, billing, claims, finance, and human resources, accessed only through released APIs and CDS views.

The **AI security and resilience plane** spans all layers. It provides anomaly detection, intelligent workflow automation, distributed analytics, audit, and disaster recovery.

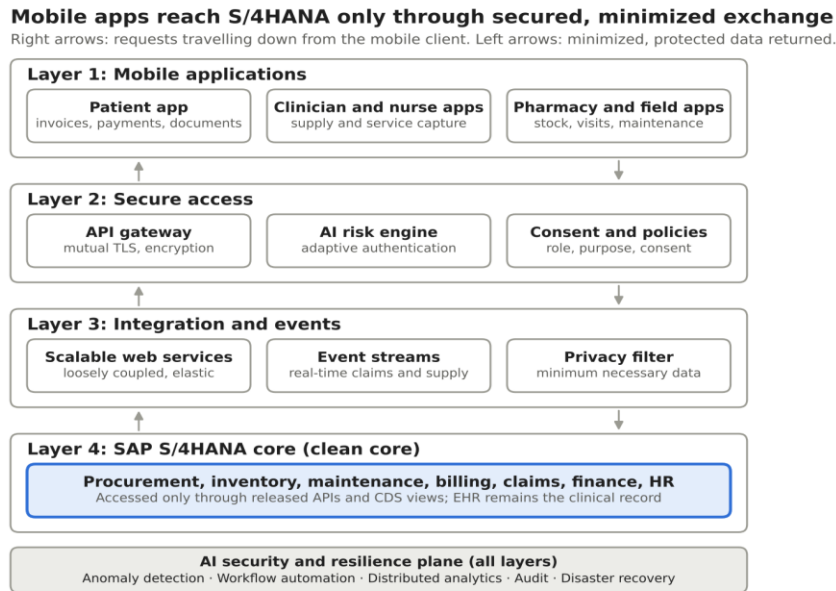


Figure 1. Framework integrating SAP S/4HANA and artificial intelligence for secure data exchange across mobile healthcare applications

5. Secure Data Exchange Mechanisms

Strong, adaptive authentication. Users sign in with phishing-resistant, device-bound credentials unlocked by biometrics. Devices are registered and checked for integrity before they can connect. Rather than applying the same checks to every request, the gateway consults an AI risk engine (Section 6), so routine actions proceed smoothly while unusual ones require additional verification.

Encryption in depth. All traffic uses modern transport encryption with certificate pinning and mutual authentication between application and gateway. Particularly sensitive payloads, such as insurance claims or billing details linked to procedures, are additionally encrypted and signed at the application layer, so they remain protected through intermediate systems and recipients can verify their integrity. Data at rest in S/4HANA, integration services, and analytics stores is encrypted with centrally managed keys.

Data minimization by design. The integration layer acts as a privacy filter. A nurse's supply-usage app sends S/4HANA a material number, quantity, cost center, and a pseudonymous encounter reference rather than the patient's name or diagnosis. Billing services retrieve the identifiers they need from the EHR only at the point of invoicing. Mobile applications receive only the fields their users require: a ward stock app sees quantities and storage locations, not supplier contract prices.

Authorization and consent. Access combines S/4HANA's role-based authorizations with attribute-based rules evaluated at the gateway, such as ward, shift, organizational unit, and purpose. Patient-facing applications respect consent preferences, for example whether an insurer or family member may view billing information. Emergency or exceptional access is permitted where required but is logged and reviewed.

Audit and traceability. Every exchange is recorded with user, device, purpose, data category, and outcome. These logs support privacy investigations and regulatory reporting, and they provide the raw material for the AI models that detect misuse.

6. AI Capabilities

AI contributes to the framework in two complementary ways: protecting the exchange and improving the operations it supports.

Risk-based access control. A machine learning model scores each request using device integrity, network context, time and location relative to the user's normal pattern, the sensitivity of the data requested, and recent activity. The gateway uses the score to permit, require step-up verification, restrict, or deny access. For example, a pharmacist adjusting stock from a registered device during a shift receives seamless access, while a bulk export of patient billing data from a new device at night is blocked pending verification.

Anomaly detection. Models learn normal patterns of access and transactions and flag deviations, such as a user viewing many unrelated patients' invoices, unusual adjustments to controlled-drug inventory, or a surge in claim submissions from a single source. Detections raise the risk score for affected users in real time and alert security or compliance teams. Sannidhanam (2019) examines distributed data processing frameworks for large-scale healthcare analytics; the framework uses such processing to analyze the large volumes of access logs, transactions, and device telemetry needed to train and run these models.

Intelligent workflow automation. Many processes connecting mobile applications and S/4HANA are repetitive: matching supplier invoices to deliveries, processing reimbursement documents uploaded by patients, or reconciling consumption records with stock. Asuri (2020) presents an intelligent enterprise workflow automation framework that integrates robotic process automation with machine learning for standard business processes. Applied here, software automation handles routine steps, while machine learning classifies documents, extracts data, and predicts exceptions, routing only unusual cases to staff. Automation also improves security, because fewer manual touchpoints mean fewer opportunities for error or misuse.

Operational decision support. AI also turns the exchanged data into better decisions. Consumption data from ward and pharmacy apps feeds demand forecasts for medicines and supplies, helping S/4HANA plan replenishment and avoid both shortages and waste. Claims data supports models that predict denials before submission, so errors can be corrected. Following the decision-intelligence approach of Asuri (2022), these predictions are delivered to planners and finance teams in analytics dashboards connected to live S/4HANA data, where people review and act on them.

Governance of AI. Every AI decision that affects access or transactions is logged with its main contributing factors, so it can be explained and challenged. Models are validated before deployment, monitored for drift and false positives, and tested for unfair impact on particular user groups. Training data is pseudonymized and protected like the operational data it is derived from.

7. Scalable and Event-Driven Processing

Scalable web services. Mobile demand in healthcare varies sharply with shift changes, clinic hours, and seasonal surges. Sannidhanam (2020) describes a scalable web services architecture for healthcare data processing built on loosely coupled services, load balancing, and horizontal scaling. The framework follows this design: authentication, consent, supply, billing, and claims services are deployed independently, scale according to their own demand, and communicate through authenticated internal APIs. This keeps peak mobile traffic away from the S/4HANA core and prevents a failure in one service from affecting others.

Event-driven exchange. Many healthcare workflows benefit from reacting to events as they happen rather than waiting for batch jobs. Sannidhanam (2021) shows how event-driven architectures enable real-time claims processing, replacing batch cycles with streams of events that are validated, enriched, and routed as they occur. In the framework, events such as a medication administered, a supply consumed, a service completed, or a payment received are published to secure event streams. Subscribers react independently: S/4HANA updates inventory and billing, claims services prepare submissions, analytics refresh dashboards, and anomaly detection evaluates each event for risk. Each event carries integrity protection and only the minimum data its subscribers need.

Real-time claims. Claims illustrate the benefit clearly. When a home-care visit is completed on a mobile app, an event triggers billing in S/4HANA, eligibility checks with the insurer, AI-based denial prediction, and claim submission, all within minutes and without manual re-entry. Faster, more accurate claims improve cash flow, while the event trail provides a complete audit record.

8. Resilience and Business Continuity

Healthcare operations cannot stop when systems fail. Pharmacies must dispense, wards must restock, and patients must be billed correctly. Lakavath (2022) analyzes disaster recovery and business continuity in Microsoft Azure cloud environments, emphasizing clearly defined recovery time and recovery point objectives, geo-redundant storage, cross-region replication, and regularly tested failover. The framework applies these principles across all layers:

- S/4HANA uses database replication across availability zones for high availability and to a secondary region for disaster recovery.
- Integration services, event streams, and gateways are deployed redundantly, and events are stored durably so they can be replayed after an outage.
- Mobile applications support safe offline operation for critical tasks, such as recording supply usage, queuing encrypted transactions for later synchronization.
- Encryption keys and consent records are replicated with the same rigor as the data they protect, since data that cannot be decrypted or authorized is effectively unavailable.

- Failover is tested regularly, and degraded modes are defined so that essential clinical and supply processes continue while non-critical functions are restored.

9. Use Cases

Use case	Mobile application	S/4HANA process	AI contribution	Security emphasis
Ward supply replenishment	Nurse supply-usage app	Inventory and purchasing	Demand forecasting	Pseudonymous encounter references
Pharmacy stock control	Pharmacist scanning app	Inventory and batch traceability	Anomaly detection on controlled drugs	Step-up authentication for adjustments
Home-care billing	Field-staff visit app	Service billing and receivables	Denial prediction	Signed, encrypted service records
Patient invoices and payments	Patient app	Receivables and payments	Risk-based access	Consent for shared viewing
Reimbursement documents	Patient and staff apps	Accounts payable and claims	Document classification and extraction	Minimal data retention
Equipment maintenance	Technician app	Plant maintenance	Failure prediction	Device integrity checks

These use cases share a pattern: mobile applications capture events at the point of care or service, the integration layer secures and minimizes the data, S/4HANA executes the business process, and AI both protects the exchange and improves the resulting decisions.

10. Evaluation Metrics

Category	Metric	Purpose
Security	Blocked unauthorized attempts; time to detect and contain misuse	Measures protection
Privacy	Share of exchanges carrying only minimum necessary data	Verifies minimization
AI accuracy	False positive and false negative rates of risk decisions	Balances security and usability
Operations	Stock-outs, claim denial rate, days to bill	Shows business value
Automation	Share of documents processed without manual handling	Measures workflow efficiency
Performance	Mobile response time at peak load	Confirms usability
Resilience	Achieved recovery time in failover tests	Validates continuity

11. Implementation Roadmap

1. **Prepare a clean core.** Assess custom code and modernize key processes, such as medical procurement, using clean-core principles (Asuri, 2021). Expose S/4HANA only through released APIs and CDS views.
2. **Build secure access and integration.** Deploy the API gateway with strong authentication, encryption, and consent enforcement, and implement scalable integration services (Sannidhanam, 2020) that minimize data by design.
3. **Introduce event-driven exchange.** Publish key business events from mobile applications and S/4HANA, beginning with supply consumption and claims (Sannidhanam, 2021).
4. **Add AI for security.** Train risk and anomaly models on distributed analytics of access and transaction data (Sannidhanam, 2019), run them first in monitoring mode, and then activate adaptive responses.
5. **Add AI for operations.** Automate document-heavy workflows (Asuri, 2020) and deliver forecasts and denial predictions to decision-makers (Asuri, 2022).
6. **Assure continuity.** Implement multi-region recovery, offline-capable mobile workflows, and regular failover testing (Lakavath, 2022).

12. Challenges

Several challenges require attention. Healthcare organizations often run a mix of modern and legacy clinical systems, so integration with S/4HANA may need adapters and shared data standards. Determining the minimum necessary data for each process requires close collaboration between privacy, clinical, and finance teams. AI models need sufficient, representative data, and their false positives must be managed carefully so that security does not obstruct care. Regulations differ across jurisdictions, so consent, retention, and access policies must be configurable. Finally, clinicians and staff must find mobile workflows fast and simple, or they will look for workarounds that undermine security.

13. Conclusion

Mobile applications and SAP S/4HANA together can connect the point of care with the business of healthcare, linking what happens at the bedside, in the pharmacy, and in patients' homes to purchasing, inventory, billing, and claims. The framework presented here makes this connection secure by design. A clean S/4HANA core, governed integration, data minimization, encryption, and consent enforcement protect sensitive information, while AI adds adaptive access control, anomaly detection, workflow automation, and operational decision support.

The research drawn on throughout this article shows how each element can be realized: clean-core modernization (Asuri, 2021), real-time decision intelligence (Asuri, 2022), intelligent workflow automation (Asuri, 2020), scalable and distributed healthcare data processing (Sannidhanam, 2019, 2020), event-driven real-time claims processing (Sannidhanam, 2021), and tested business continuity (Lakavath, 2022). Adopted in phases and evaluated rigorously, the framework can help healthcare organizations operate more efficiently while protecting the trust that patients place in them.

References

1. Asuri, R. (2020). An intelligent enterprise workflow automation framework for SAP ECC standard business processes through the integration of robotic process automation and machine learning techniques. *SAMRIDDHI: A Journal of Physical Sciences, Engineering and Technology*, 12(02), 181–195. <https://doi.org/10.18090/samriddhi.v12i02.17>
2. Asuri, R. (2021). Advancing enterprise digital transformation by modernizing SAP supplier relationship management through clean core architecture for SAP S/4HANA transition readiness and business process excellence. *International Journal of Recent Advances in Science and Technology*, 8(04), 1–20. <https://doi.org/10.30750/ijarst.0804124>
3. Asuri, R. (2022). Leveraging SAP S/4HANA and SAP Analytics Cloud to build an intelligent enterprise framework for real-time decision intelligence, digital innovation, and sustainable business value creation. *International Journal of Science, Technology & Society*, 6(1), 85–100.
4. Lakavath, S. R. (2022). Disaster recovery and business continuity in Microsoft Azure cloud environments. *International Journal of Technology, Management and Humanities*, 8(4), 146–158. <https://doi.org/10.21590/ijtmh.8.4.419>
5. Sannidhanam, A. H. (2019). Distributed data processing frameworks for large-scale healthcare analytics. *International Journal of Advance Industrial Engineering*, 7(04), 1–10. <https://doi.org/10.14741/ijaie/v.7.4.01>
6. Sannidhanam, A. H. (2020). Scalable web services architecture for healthcare data processing. *International Journal of Recent Advances in Science and Technology*, 7(01), 1–14. <https://ijrast.in/index.php/ijrast/article/view/65>
7. Sannidhanam, A. H. (2021). Real-time claims processing using event-driven architectures. *International Journal of Technology, Management and Humanities*, 7(01), 36–50. <https://doi.org/10.21590/07.01.02>