International Journal of Leading Research Publication (IJLRP)

E-ISSN: 2582-8010 ● Website: www.ijlrp.com ● Email: editor@ijlrp.com

Building a Seamless Healthcare Data Fabric: Zero-Touch Integration and Scalable Mapping Across Provider, Claims, Recipient, and Pharmacy Source Systems for State Medicaid

Mani Kanta Pothuri

Manikantpothuri1@gmail.com

Abstract:

Medicaid programs implemented by states encounter challenges in unifying content in different systems, service vendors, claim processing units, pharmacies, and assessing eligibility sof beneficiaries in various platforms. All these processes are decentralized with fragmented systems resulting in data silos with inconsistencies. These further delay the content access, impeding healthcare collaboration efficiency. Data-motivated decisions and policies are hindered by such instances. This paper attempts to present an advanced solution for a continuous healthcare data management system exclusively supporting Medicaid. The process uses zero-touch integration and develops scalable maps. The framework proposed in this paper allows intelligent data inputs and harmonizes different healthcare data resources with basic processes and minimizing human efforts. Intelligent data mapping, real-time event handling, and addressing health information record management standards to comply with regulations are important capabilities of this technology. This could be achieved using phase-wise implementation with an architecture to support Medicaid agencies in integrating data flow, increasing process integrity, and encouraging value-based healthcare services to maximize population health results. Outlook regarding the adoption of Modular APIs, adding data steward features, and aligning with data strategies of different agencies collaboratively are discussed in paper. Finally, the approach acts as guidance for Medicaid to shift from reactive methods to practice and insight-activated stages for prevention of existing system overhaul.

Keywords: Medicaid programs, Decentralized systems, Zero-touch integration, Scalable maps, Modular APIs, Data steward features, Value-based healthcare.

Introduction

Medicaid is country's biggest health insurance provision, facilitating above 90 million people from diverse groups, including children, women, people with disabilities, and geriatric healthcare claim services. The systems are commonly prone to data silos due to obsolete and decentralized storage configurations across different functional units and external vendors [1]. Service providers, claim processing professionals, pharmacy benefit departments, and claim departments use exclusive healthcare services for managing exclusive standards and following regulations that make continuous data exchange challenging.

Absence of integration results in ineffective member records, service delays, decreased visibility, and missed intervening opportunities. Medicaid agencies aim to build an advanced system using Intelligent technologies and an integrated data architecture for seamless content access and management across different stakeholders. The research explores a futuristic approach to healthcare data management, specifically addressing the unique challenges encountered by Medicaid data processing [2]. Using Zero-touch integration empowers scalable service mapping capabilities by offering an effective choice to mitigate costs incurred for legacy system

overhauling by effectively connecting data silos across service provider claims, pharma, and user systems with omitted human intervention.

State Medicaid data systems

Medicaid systems are implemented through a complicated network with interconnected data storage systems. These systems were developed distinctly with diversified rules and configurations. This results in inconsistencies for systems to operate with integrity. Perceptions regarding this granular landscape are important before designing an integrated solution [3]. The healthcare landscape of the modern era needs an integrated and accessible dimension for managing patient claims. The state Medicaid requires expediting its operation with smart processing to manage huge volumes of diversified content in claim processing. The healthcare landscape of the modern era needs an integrated and accessible dimension for managing patient claims. The state Medicaid requires expediting its operation with smart processing to manage huge volumes of diversified content in claim processing. Healthcare data is sensitive, leading to management silos while operating through conventional node-based integration [4]. The current situation of this data architecture could be characterized by different elements.

- Manual data reconciliation, delayed processes, and redundant data entry.
- Inabilities in conducting comprehensive analytics for population health management, fraud detection, and program evaluation.
- Absence of comprehensive membership is impeding integrated care delivery.
- Hiccups in consolidating data for reporting and auditing requirements, such as HIPAA.
- Issues with quick onboard of new data sources or adapting to increasing data volumes.

Developing and implementing healthcare data consolidation works as a meaningful change for policy claims by breaking down challenges due to traditional data lake systems. This allows setting up an integrated virtual level connected with AI to govern data from various sources [5]. This is further made accessible to use by different authenticated and authorized users through secure APIs. This makes the Medicaid system and processes a single cohesive entity.

Service providers and data systems

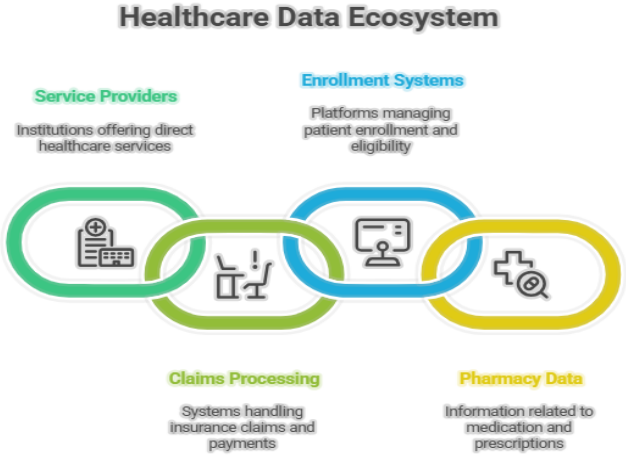

Figure 1 depicts different Service providers involved in the Medicaid data framework, along with data systems to process the content and conduct analytics.

Healthcare service providing institutions: Healthcare providing institutions, along with management systems, depend on electronic records (EHR), providing patient data to required stakeholders. The systems are capable of accessing and managing different content formats [6]. Various service providers and intermediaries follow th standards with inconsistences. These leads to changes in data architecture and semantics leading to ambiguities.

Claims data processing: The data involved with claim processing using Medicaid's exclusive management information systems (MIS), along with external service intermediaries, critically depend on ANSI(American National Standards Institute) guidelines. The content comes to systems in huge batches after the clinical process. Care organizations also share this data with states, including supplementary material or mismatched codes [7]. This potentially results in the duplication of storage of patient information.

Recipients and enrollment systems: Authentication and enrollment systems contain demographic information, status of insurance, and claim facilities. Different interoperable systems and platforms, along with state-level insurance, provide access to this site. The systems work by accuracy to various identifiers and update schedules, resulting in different rules.

Pharmacy data: The content generated by pharmacy management and retailing systems uses the NCPDP format using proprietary flat file frameworks, which involve prescriptions, refilling alignment, and handling drug formulary [8]. On-time updates and accuracy changes according to integration advancements used by these systems.

The following high-level challenges occur while the department uses data interchangeably.

- Inconsistencies in patient identification occur due to the absence of common data standards.
- Absence of standard entries in the race or SOH fields.
- Delays in data accessibility due to batchwise entries and file transfers.
- Duplicate data occurrence leads to limitations for real-time data analytics.

Creation of healthcare data fabric

The fragmented infrastructure of current Medicaid systems, due to data storage in lakes, warehouses, and other node-to-node connectors, has been observed to be insufficient for integrated management [6]. These are expensive for each of the entities involved to manage separately and create challenges to conduct analytics and generate precise solutions [9]. Developing a healthcare data fabric acts as an advanced paradigm to address the above challenges.

Data fabric

Data fabric works as a dynamic data architecture with intelligent unification capabilities across various systems. The system develops a distinctive layer for the concision of content accessibility, ingestion, conversion, and governance [5]. These processes operate regardless of the physical positioning of the data. The process allows connecting content using metadata advancements, thereby avoiding adding all data to one central storage system.

- Exclusive benefits for Medicaid using the data fabric
- The new data resources are conveniently added through organizational or service-based networks.
- Content quality sufficiency is enhanced using entity-level AI solutions.
- Real and event-motivated data configurations allow noticing the issues, gaps in therapy, and fraudulent claims.
- The processes encourage flexibility in supporting batch-wise workflows.
- Data fabric is a future-proof mechanism for increasing claim process value and protecting regulations.

Critical abilities of the Medicaid data fabric

Zero touch integration: Common data access and analytics work based on hard-coded extracting, transmitting, and loading (ETL) process flows. This Zero-Touch process can support schematic and automated data discovery according to new ingestions. This can configure connectors for all formats such as JSON, HL7, FHIR, and others [9]. This is a metadata-motivated approach promoting parsing, mapping, and authentication. The automated data management version allows tracking and detecting changes conveniently. These functionalities expedite customized development and decrease risks of feeding errors.

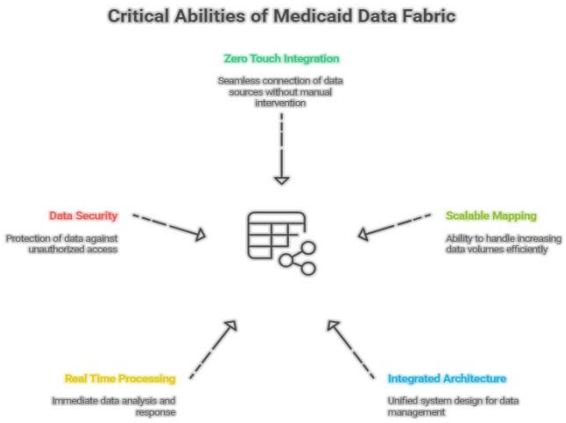

Figure 2 depicts the critical abilities of the Medicaid data fabric

Scalable mapping: Data fabric works with AI capabilities for seamless mapping. Data normalizations are motivated by ontology with regular vocabularies. This is capable of a dynamic version controlling architecture, Cretan, by keeping users in the loop to seek reviews in areas with less factual evidence.

Integrated architecture: The infrastructure works based on an integrated architecture for data preparation, authentication, and accessibility. Implementing a modular design is effective for scalable system development in on-premise cloud scenarios [9]. These empower central and disparate governance models with continuous processing flow using technologies like Apache Kafka, Spark, and others.

Real-time processing: Data processing using a data fabric generates alerts in case of anomalies in access and issues in care processes are identified. These alerts are triggered according to eligibility and re-validation status, based on external events [10]. The process allows member-wise notifications and case-management processes.

Data security, privacy, and regulatory compliance
HIPAA and State Regulations

- Encryption of data both in transit and at rest
- Securing role-based access with fine-grained data masking
- Policy-based controls for data residency and sharing
- Integrating with state IAM systems and audit tools

CMS Certification and MITA (Medicaid IT architecture) Alignment

- Modular services support the MITA 3.0 maturity goals
- Documentation and traceability support for Medicare and Medicaid Service centers and advanced planning documentation reviews
- Compatibility with T-MSIS(Medicaid Statistical Information System), MACRA (Medicare Access and CHIP Reauthorization Act), and other federal reporting standards

Implementing strategy

Phase 1: Readiness Assessment: Data inventory and source systems are profiled. Technology readiness and vendor landscape are assessed. Data governance and security policies are studied.

Phase 2: Pilot Implementation: The high data flow units, like the pharmacy, are selected**. The** core ingestion, mapping, and visualization infrastructure is established. Data quality and completeness are validated for successful implementation.

Phase 3: Expansion: Extra resources needed, such as EHR and other requirements, are added [9]. Cross-domain analytics and reporting are included. Real-time triggers and alerts are thus generated continuously.

Phase 4: Optimization and Governance: The system performance is continuously monitored for making changes in mapping. Finalized stewardship tools are rolled out for continuous improvement [12]**.** This allows **for** establishing long-term ownership models across enterprise-level applications.

Use cases and benefits.

Population Health Management: Data fabric inclusion enables the combination of therapeutic, clinical, and claims data to identify high-risk patients for targeted interventions and analyze chronic disease trends and hotspots**.** These support case managers with unified patient views.

Value-Based Payment: The advancements generate real-time performance metrics for operations [13]**.** These
Align service provider incentives with results using trusted data
Reduce delays in calculating shared savings or penalties

Program Integrity and Fraud Detection: Data fabric detects duplicate billing, phantom providers, or upcoding**.** These allow cross- reference claims with provider rosters, and recipient eligibility [13]. The process enables near-real-time anomaly detection

CMS Reporting and Compliance: Tedious tasks like automation of complex reports like T-MSIS or CMS 64 are performed. These support in improving completeness and timeliness. Automated and accurate audit reports are generated with this process.

Future recommendations
Ensuring extended sustainability and innovation requires Medicaid agencies to take needed strides towards modernizing infrastructure and data management processes. The following elements depict the outlook of these processes.

Promoting interoperability: Embracing API motivated architectures to empower seamless data interchange across different systems and beneficiaries involved [3]. Implementing flexible upgrades with advanced modules allows the development of independent and monolithic vendor solutions.

Using open APIs: Empowering the growth of ecosystem using Open APIs allows unifying the platform with evolving technologies and implementing third-party tools to increase innovation.

Developing shared infrastructure among agencies: Creating a shared infrastructure through the establishment of common data platforms and protected communication channels supports federated access and analytics.
Prioritizing data equity: Access strategies are important for the incorporation of measures to identify and address disparities [13]. Using tools across various backgrounds is effective for continuous prototyping, testing, and refining processes according to real-world use.

AI: Using AI-supported enterprise solutions, dynamic data discovery schema, and real-time data processing increases the efficiency of Medicaid programs in a rapid transition into an adaptive and intelligent data framework.

Conclusion

Healthcare processes are continuously shifting towards value creation by implementing data-based and user-centric models. The shortfalls of Medicaid data systems are highly unsustainable. Decentralized service provides records, claims details, and pharmacy data, as well as patient insurance eligibility checking systems, which reduce accuracy and delays in the complete use of data needed for supporting healthcare across service coordination, operations oversight, and detecting fraud to proactively generate equitable health outcomes.

This paper outlined a futuristic solution to integrate Zero-touch into the healthcare data fabric, exclusively developed for the disbursement of State Medicaid benefits. Executing scalable and automated integration across various data sources allows the architecture to exclude conventional barriers such as sensitive data pipelines, manual process mapping, and extended onboarding schedules.

The approach depicted has both a technical and strategic edge, aligning with current and upcoming federal requirements. The systems emphasize the criticality of modular processing, using standards for developing solutions and enhancing interoperability. These generate continuous insights with Medicaid data fabric as a holistic system substitution rather than extending investment to leverage existing data architecture in MMIS, health data exchange, and other public health programs.

In conclusion, the proposed approach practically supports phase-use implementation and inter-departmental collaboration for enabling states to initiate minimally and generate maximum dataflow value. These enable managing risks and delivering measurable returns at every stage in transformation journey.

REFERENCES:

[1] A. S. Ali, D. M. Manias, A. Shami and S. Muhaidat, "Leveraging Large Language Models for DRL-Based Anti-Jamming Strategies in Zero Touch Networks," Computation and Language, vol. 20, no. 10, pp. 1-7, 2023.

[2] G. S. Bolla, "Integration Architecture Fundamentals for Healthcare Systems: A Framework for Seamless Interoperability," Journal of Computer Science and Technology Studies, vol. 7, no. 3, pp. 106-111, 2025.

[3] N. Bugshan, I. Khalil, A. P. Kalapaaking and M. Atiquzzaman, "Intrusion Detection-Based Ensemble Learning and Microservices for Zero Touch Networks," IEEE Communications Magazine, vol. 61, no. 6, pp. 86 - 92, 2024.

[4] N. Chennupati, "Zero-touch transformation: AI-driven middleware for autonomous integration of," World Journal of Advanced Engineering Technology and Sciences, vol. 15, no. 2, pp. 1444-1453, 2025.

[5] T. Costa, T. Borges Tiago, F. Martins and F. Tiago, "System interoperability and data linkage in the era of health information management: A bibliometric analysis," Health Information Management Journal, vol. 1, no. 1, pp. 1-13, 2024.

[6] L. S. Datla and S. S. Malay, "Zero-Touch Decommissioning in Healthcare Clouds: An Automation Playbook with AWS Nuke and GuardRails," Los Angeles J Intell Syst Pattern Rec, vol. 5, no. 1, p. 1–24, 2025.

[7] Á. Díaz and H. Kaschel, "Scalable Electronic Health Record Management System Using a Dual-Channel Blockchain Hyperledger Fabric," Systems, vol. 11, no. 7, pp. 1-23, 2023.

[8] A. Hazra, A. Kalita, M. Gurusamy and D. K. Sah, "Potential of Zero-Touch Network Management in Industry 5.0: A Future Prospect," IEEE Internet Computing, vol. 28, no. 6, pp. 45-52, 2024.

[9] F. Yadegari and A. Asosheh, "A unified IoT architectural model for smart hospitals: enhancing interoperability, security, and efficiency through clinical information systems (CIS)," Journal of Big Data, vol. 12, no. 149, pp. 1-26, 2025.
[10] M. Mohammadi, R. Javan, M. Beheshti-Atashgah and M. R. Aref, "SCALHEALTH: Scalable Blockchain Integration for Secure IoT Healthcare Systems," Cryptography and Security, vol. 1, no. 1, pp. 1-8, 2024.
[11] A. Islam and H. Karimipour, "A Deep Learning-Based FDI Attack Detection Scheme for Secure Data Consolidation in Cooperative UxV Operations Using Zero Touch Networking," IEEE 10th World Forum on Internet of Things (WF-IoT), vol. 1, no. 1, pp. 882-887, 2024.
[12] A. Islam, H. Karimipour and T. R. Gadekallu, "An Explainable AutoML-Driven Meta-Learning Scheme for Intrusion Prevention in Zero-Touch Networks Within Carbon Intelligent IIoT," IEEE Internet of Things Journal, vol. 1, no. 1, pp. 1-22, 2025.
[13] S. K. Pendyala, "Cloud Driven Data Engineering: Multi Layered Architecture for Semantic Interoperability in Healthcare," J. Bus. Intell. Data Anal., vol. 1, no. 1, p. 1–12, 2023.
[14] S. Raj Mohan, "Designing Scalable and Interoperable Data Architectures for Seamless Healthcare Systems Integration and Real Time Clinical Decision Support," IJSRHIS, vol. 6, no. 2, pp. 1-6, 2025.
[15] S. Shakya, R. Abbas and S. Maric, "A Novel Zero-Touch, Zero-Trust, AI/ML Enablement Framework for IoT Network Security," Machine Learning, vol. 1, no. 1, pp. 1-10, 2025.
[16] S. Rani, H. Babbar, M. Krichen, K. Yu and F. H. Memon, "Network Slicing for Zero-Touch Networks: A Top-Notch Technology," IEEE Network, vol. 37, no. 5, pp. 16 - 24, 2023.
[17] E.-U.-H. Qazi, T. Zia, M. H. Faheem, K. Shahzad, M. Imran and Z. Ahmed, "Zero-Touch Network Security (ZTNS): A Network Intrusion Detection System Based on Deep Learning," IEEE Access, vol. 12, no. 1, pp. 141625-141638, 2024.