Submission

AUTHORS:

Samuel Harrold

TITLE:

Healthcare Analytics Challenges: A Three-Pillar Framework Connecting Analytics Maturity, Workforce Agility, and Technical Enablement

ORIGINAL FILE

91493-1347180-2-SM.docx 2026-01-15

SUPP. FILES

Add a Supplementary File

SUPPLEMENTARY AND FIGURE/APPENDIX FILES

Figures

File	Date	Action	Thumbnail
1. **Figure 1**. Healthcare Analytics Architecture. Solid lines indicate the primary data flow from clinical user natural language queries through a conversational AI interface to a healthcare NLP engine for context-aware SQL generation. Bi-directional arrows at steps 5 and 8 represent the iterative 'Query & Refine' loop where users refine their intent based on delivered insights. The critical validation step (dotted bi-directional line) shows domain experts confirming or correcting generated SQL before results are trusted. Validated NL-SQL-Rationale triples flow to organizational memory (dashed line), where they persist independent of staff tenure and inform future query generation. architecture.mmd.png	2026-01-15	Edit | Delete Change to Figure Number: 1 Update	
2. **Figure 2**. The Validated Query Cycle, shown as six numbered steps in the diagram. (1) Domain experts ask natural	2026-01-15	Edit | Delete Change to Figure Number:	

provides a natural language explanation of the SQL logic; domain expert confirms the intent and results, (4) validated triples are stored, (5) future queries retrieve validated knowledge, and (6) expertise persists through staff turnover. This cycle breaks the compounding effect where turnover erases institutional memory. knowledge-cycle.mmd.png

Update

3. **Figure 3**. Literature Selection Flow Diagram. The diagram shows the progression from initial database search (n ≈ 570) through title/abstract screening, full-text review, and quality assessment (AACODS for grey literature) to the final corpus of 137 sources (125 academic, 12 industry). Diagram source available in figures/literature-flow.mmd. literature-flow.mmd.png

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Multimedia Appendices

File	Date	Action	Thumbnail
1. **Multimedia Appendix 1**. HIMSS Analytics Maturity Assessment Model (AMAM) stages. multimedia_appendix_1.docx	2026-01-15	Edit | Delete Change to Appendix Number: 1 Update	
2. **Multimedia Appendix 2**. Healthcare natural language to SQL (NL2SQL) query examples. multimedia_appendix_2.docx	2026-01-15	Edit | Delete Change to Appendix Number: 2 Update	

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Samuel Harrold [Change to another user]

DATE SUBMITTED

January 15, 2026 - 08:22 PM

SECTION

Reviews in Medical Informatics

EDITOR

None assigned

AUTHOR COMMENTS

Dear Editor,

I am pleased to submit the manuscript titled "Healthcare Analytics Challenges: A Three-Pillar Framework Connecting Analytics Maturity, Workforce Agility, and Technical Enablement" for consideration as a Review article in JMIR Medical Informatics.

Background and Significance

Healthcare organizations face three interconnected challenges that create a compounding cycle threatening data-driven transformation: low analytics maturity (only 39 organizations globally have achieved HIMSS AMAM Stage 6-7), systemic workforce instability, and technical barriers in natural language to SQL generation. This review identifies a critical gap in the literature: while single-domain studies exist for each challenge, few analyze how they interconnect to create institutional memory loss.

Methodology

This narrative review synthesizes peer-reviewed studies and industry reports from Crossref, PubMed, arXiv, and Semantic Scholar. Grey literature sources were assessed using the AACODS checklist. Evidence was integrated through an original three-pillar analytical framework examining how these challenges interconnect and compound each other.

Principal Findings

The review contributes an original three-pillar analytical framework revealing a self-reinforcing cycle: (1) Analytics Maturity: Low maturity leaves clinical decisions unsupported, correlating with higher turnover; (2) Workforce Impact: Turnover causes institutional memory loss that further degrades capabilities; and (3) Technical Enablement: Technical barriers prevent the capture of this knowledge, blocking recovery. The review also identifies Governance Necessity as a critical finding, arguing that democratization through NL2SQL requires stricter governance ("Golden Queries") to move from ad-hoc reporting to trusted AI deployment.

Conflicts of Interest

The author declares competing interests: Samuel T Harrold is a contract product advisor at Yuimedi, Inc., which develops healthcare analytics software, and is employed as a Data Scientist at Indiana University Health. This paper presents an analytical framework derived from published literature and does not evaluate or recommend specific commercial products.

Generative AI Disclosure

Gemini CLI (Gemini 3, Google) assisted with manuscript editing and refinement. The author takes full responsibility for the final content.

Corresponding Author

Samuel T Harrold
Email: samuel.harrold@yuimedi.com

Article Processing Fee

I acknowledge the applicable article processing fee (APF) if this manuscript is accepted after peer review.

Thank you for considering this manuscript. I believe it will be of significant interest to JMIR Medical Informatics readers working in healthcare informatics, clinical decision support, and healthcare analytics.

Sincerely,

Samuel T Harrold
Yuimedi, Inc.

Status

Unassigned

STATUS LAST MODIFIED

2026-01-15

Submission Metadata

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Authors

NAME

Samuel Harrold, MBA

ROLE

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AUTHOR INFOMATION

**Principal contact for editorial correspondence.*

Affiliations

INSTITUTION

, Yuimedi, Inc

ADDRESS

240 Elm Street, 2nd Floor

CITY

Somerville, MA, 02144

COUNTRY

US

PHONE NUMBER

1 512-516-3464

***PRINCIPAL ADDRESS FOR EDITORIAL CORRESPONDENCE.**

Yes

Title and Abstract

Title	Healthcare Analytics Challenges: A Three-Pillar Framework Connecting Analytics Maturity, Workforce Agility, and Technical Enablement
Abstract	

shortages, and technical barriers in natural language to SQL generation. When these challenges interact, they create institutional memory loss that threatens data-driven healthcare transformation.

Objective: This research develops a three-pillar analytical framework connecting analytics maturity, workforce agility, and technical enablement. The framework reveals how these capabilities interconnect and compound each other.

Methods: We conducted a narrative literature review of peer-reviewed studies and industry reports on natural language to SQL (NL2SQL) generation, healthcare analytics maturity, and workforce turnover. Grey literature was assessed using the AACODS checklist. Evidence was synthesized through the three-pillar analytical framework to examine how these challenges interconnect and compound.

Results: Healthcare-specific text-to-SQL benchmarks show significant progress, though current models are "not yet sufficiently accurate for unsupervised use" in clinical settings. Most healthcare organizations remain at HIMSS AMAM Stages 0-3 with limited predictive capabilities. Healthcare IT turnover significantly exceeds other IT sectors, creating measurable institutional memory loss. The framework reveals a compounding dynamic: low-maturity organizations experience higher turnover, which degrades the institutional knowledge needed for maturity advancement, while technical barriers prevent the capture of expertise before it is lost.

Conclusions: We contribute a three-pillar analytical framework synthesizing evidence on analytics maturity, workforce agility, and technical enablement. The framework reveals a compounding effect: low maturity accelerates turnover, which degrades maturity, and low enablement prevents recovery. This analytical lens enables organizational self-assessment and informs future research on technological interventions, such as conversational AI platforms.

Journal Transfer Preferences

Journal Name	Author Preferences	Primary Section

Indexing

Keywords	Healthcare Analytics; Analytics Maturity; Workforce Agility; NL2SQL; Institutional Memory; Medical Informatics; Large Language Models; Data Governance; Conversational AI; HIMSS AMAM
Language	en

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