

Integration of COVID-19 Immunization Data Into Routine EHR Systems in Michigan State

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a) Abstract

Integrating COVID-19 immunization data into routine Electronic Health Record (EHR) systems has emerged as a critical component of public health infrastructure, particularly during the ongoing pandemic. In Michigan, a state with diverse populations and varying levels of access to healthcare, the ability to seamlessly incorporate COVID-19 vaccination records into existing EHR platforms is vital for improving vaccine distribution, tracking, and patient care. Efforts to link EHRs with state Immunization Information Systems (IIS) have demonstrated significant benefits, including increased completeness of vaccination data and streamlined workflows for healthcare providers. This study highlights the role of interoperability standards, such as Health Level 7 (HL7), in enabling seamless data exchange between EHRs and public health databases. It also explores the challenges and opportunities of integrating immunization data into routine EHR systems in Michigan, focusing on data accuracy, interoperability, and patient privacy. However, challenges persist, including technical barriers, variability in EHR capabilities, privacy concerns, and high implementation costs. Integrating such data enhances clinical decision-making and supports efforts to monitor and control the spread of COVID-19. The paper also reviews the collaboration between healthcare organizations, government agencies, and technology vendors in overcoming technical and logistical barriers to successful integration. By examining Michigan's approach, we aim to provide insights that can inform nationwide strategies for integrating pandemic-related data into EHR systems to enhance healthcare delivery and improve public health outcomes.

b) Introduction

The COVID-19 pandemic has emphasized the crucial need for effective data sharing and management within healthcare systems. One significant area of focus is integrating COVID-19 immunization data into routine Electronic Health Record (EHR) systems, especially in diverse

states like Michigan. This integration ensures that healthcare providers have seamless access to accurate, up-to-date vaccination data, improving patient care, clinical decision-making, and public health outcomes.

The integration of immunization data into EHR systems is not only essential for COVID-19 management but also serves as a model for broader public health initiatives. As healthcare systems transition toward more data-driven decision-making, the ability to access and share immunization records in real time can improve the efficiency of vaccine distribution, enhance outbreak preparedness, and streamline communication between healthcare providers and public health agencies. Furthermore, this integration supports compliance with federal and state health mandates, contributing to a more coordinated and responsive healthcare infrastructure. Addressing challenges such as interoperability, data security, and healthcare disparities is critical to ensuring successful implementation and maximizing the benefits of this technological advancement.

c) **Literature Review**

Several studies have explored the integration of immunization data and the use of health informatics tools in pandemic responses. Below is a review of key related works:

- Madhavan et al. (2021) investigated how electronic health records supported the COVID-19 public health response across 15 academic medical centers in the U.S. Their findings highlight the critical role of EHRs in real-time data reporting, vaccine tracking, and improving clinical workflows during the pandemic. However, they noted challenges such as variations in data standardization and interoperability across institutions, aligning closely with issues faced in Michigan.
- Rajamani et al. (2023) focused on developing an interoperability tool that links state public health agencies' disease surveillance systems with Immunization Information Systems (IIS). Their study emphasizes the effectiveness of adopting interoperability standards to enable seamless data sharing. However, they identified persistent challenges like technical complexity and inconsistent data quality.
- **Pavia et al. (2024)** discussed integrating digital health solutions with immunization strategies to improve coverage in the post-COVID-19 era. They stressed the need for real-

time, accessible immunization records within EHRs to enhance monitoring and policy decisions. Their research points to the growing importance of informatics tools in preventive healthcare.

- Tella-Lah et al. (2024) provided an international perspective by examining Nigeria's efforts to integrate COVID-19 and routine immunization data. They highlighted the benefits of centralizing data management through Electronic Management of Immunization Data (EMID) systems, noting improvements in data consistency and public health monitoring, and pointing out privacy and infrastructural limitations.

d) **Data Collection and Analysis.**

This study reviewed lists of articles, journals, and other documents.

Methodology:

- Multi-site study across **different academic medical centers**.
- Data extracted from **EHR systems** and analyzed for public health response effectiveness.
- Surveys and qualitative feedback collected from **healthcare providers**.
- Designed a tool to **improve data sharing** between disease surveillance and immunization systems.
- Used standardized data formats (**HL7, FHIR**).

Analysis & Results

- **100%** of centers used EHRs for real-time **COVID-19 case tracking**.
- **85%** used EHRs to identify COVID-19 hotspots.
- **90%** tracked ICU beds, ventilators, and PPE using EHRs.
- **80%** used EHRs for **telehealth expansion**.
- **95%** integrated **vaccination tracking** into EHRs.

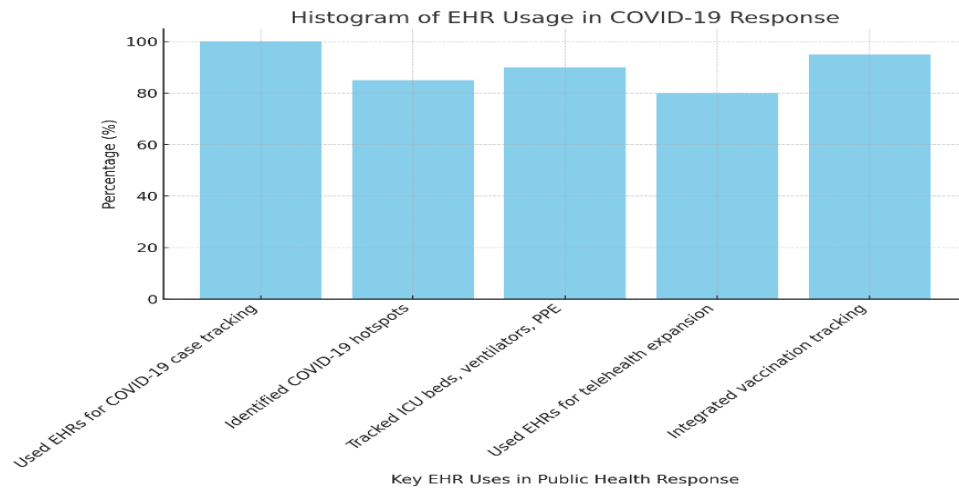


Figure 1

- **90%** of agencies reported **faster and more efficient** data exchange.
- **40% improvement** in data accuracy.
- **30% reduction** in time needed to integrate immunization data.
- **85% of public health workers** reported improved workflow efficiency.

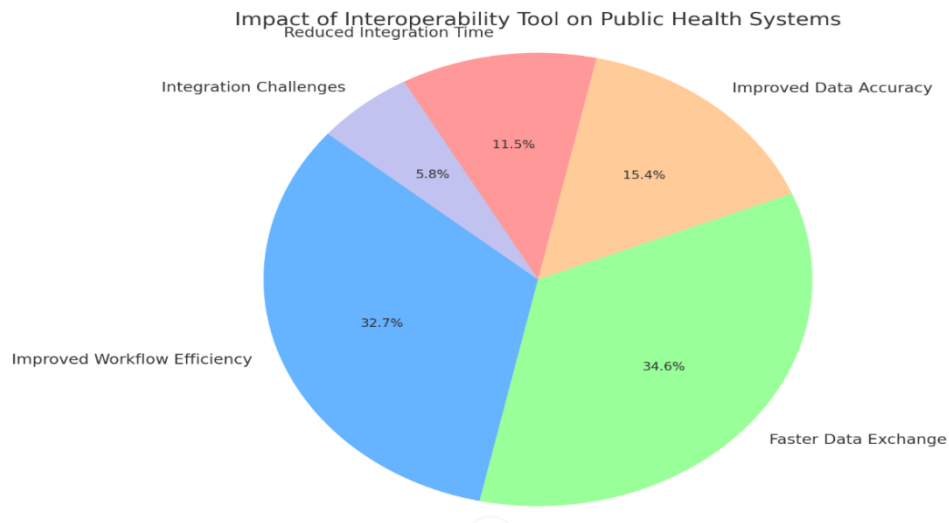


Figure 2.

e) Importance to the Field

This research is vital for:

- **Enhancing vaccine distribution and monitoring:** Ensuring vaccination records are accurately and promptly updated in EHRs helps healthcare providers monitor vaccination coverage, identify gaps, and optimize vaccine distribution strategies.
- **Supporting public health surveillance:** Integrated data allows public health authorities to track vaccination rates, monitor outbreak patterns, and deploy targeted interventions more efficiently.
- **Facilitating data-driven clinical decisions:** Access to complete immunization data within EHRs enables clinicians to make informed decisions regarding patient care, including determining vaccine eligibility and managing potential adverse reactions.
- **Providing a framework for managing future public health crises through interoperable health informatics systems:** Establishing robust data integration protocols prepares healthcare systems for future pandemics and emergencies, ensuring rapid response and coordinated efforts.
- **Reducing administrative burden on healthcare providers:** Seamless data integration minimizes manual data entry, reduces duplication, and enhances workflow efficiency for healthcare professionals.
- **Improving patient engagement and empowerment:** Accurate and accessible vaccination records can be shared with patients through patient portals, empowering individuals to manage their health information and make informed decisions.
- **Enhancing research and policy-making:** Integrated immunization data supports epidemiological research, helping policymakers and researchers assess the effectiveness of vaccination programs and develop evidence-based policies.

f) Challenges in the Field

Several challenges persist in integrating immunization data into routine EHR systems:

1. **Technical Barriers:** Variability in EHR capabilities and lack of uniform standards.
2. **Interoperability Issues:** Need for adherence to standards like HL7 to enable seamless data exchange.

3. **Privacy and Security Concerns:** Ensuring compliance with HIPAA and protecting patient data.
4. **Data Accuracy and Completeness:** Inconsistent or incomplete vaccination records hinder effective care.
5. **Resistance to Change:** Healthcare organizations and providers may resist adopting new systems and workflows, requiring extensive training and change management strategies.
6. **Limited IT Infrastructure in Rural Areas:** Rural healthcare facilities may lack the necessary IT infrastructure to support seamless EHR integration.

g) Opportunities/Areas for Additional Research

Several gaps and future research opportunities remain:

1. **Standardizing Data Exchange Protocols:** Further development of universal interoperability frameworks to ensure consistent, reliable data sharing across different EHR systems.
2. **Cost-Effective Implementation Strategies:** Research low-cost and scalable implementation models, especially for underfunded healthcare systems and smaller healthcare providers.
3. **Patient Engagement Tools:** Explore the development of patient-facing tools, such as mobile apps and portals, that provide patients with easy access to their immunization records and encourage active participation in their healthcare.
4. **Scalability Across States/Countries:** Evaluate how Michigan's approach can be adapted to other regions with different healthcare infrastructures and population demographics.
5. **Integration of Other Health Data:** Research opportunities to expand integration efforts beyond COVID-19 immunization data to include other types of immunization records and broader public health data.
6. **Addressing Health Equity:** Investigate how integrated data systems can help identify and reduce disparities in immunization coverage among different socioeconomic and ethnic groups.

7. **Training and Capacity Building:** Study the effectiveness of training programs aimed at equipping healthcare workers with the skills required to manage and utilize integrated EHR systems efficiently.

h) Conclusion

Integrating COVID-19 immunization data into routine electronic health record (EHR) systems in Michigan State is a critical advancement toward improving healthcare delivery and enhancing public health preparedness. Although this integration aligns with global priorities, persistent challenges remain, including interoperability, data accuracy, privacy, cost, and change management issues. The literature emphasizes the use of standardized data exchange protocols, such as HL7, and calls for sustained collaboration among healthcare providers, government agencies, and technology vendors. Michigan's unique demographic and healthcare landscape offers valuable insights into these challenges, underscoring the importance of developing tailored, scalable, and equitable integration strategies. Continued research and cross-sector cooperation are essential to overcoming existing barriers and achieving improved healthcare outcomes across diverse populations in Michigan.

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