Department of Healthcare Management & Health Economics

ASSIGNMENT REPORT

INFORMATION SYSTEMS AND TECHNOLOGIES: OPTION 1 - EHR MODERNISATION, SYSTEM INTEROPERABILITY, AND OPERATIONAL EFFICIENCY

Student Name:	Vaghani Paras Hareshbhai
Student ID:	DE240399
Programme:	Healthcare Management & Health Economics
Module:	Information Systems and Technologies
Submission Date:	19 / 10 / 2026
Institution:	EIIET (European Institute of Innovation)

Table of Contents

1. Abstract Page 2

2. Introduction Page 3

3. Literature Review Page 3

4. Methodology Page 4

5. Technical Workflow & Interoperability Standards Page 5

6. Discussion & Case Study Analysis Page 6

7. Proposed Evaluation Schema for Managers Page 7

8. Conclusion & Recommendations Page 7

9. References Page 8

10. Appendices Page 8

1. Abstract

This report evaluates how healthcare organisations can plan and implement Electronic Health Record (EHR) systems and Health Information Systems (HIS) to improve operational efficiency and care quality. In modern healthcare environments, switching from paper-based or isolated legacy software to modernized EHR systems is essential for smooth clinical workflows and better patient safety.

The study examines major healthcare technologies, including patient portals and Computerized Provider Order Entry (CPOE), and analyses the key data interoperability standards such as HL7, FHIR, and DICOM. Using enterprise case studies like the NHS Summary Care Record in the UK and Kaiser Permanente in the USA, this paper discusses both benefits and integration complexities. Finally, a practical evaluation framework is presented to help healthcare managers measure improvements in administrative speed, clinical accuracy, and patient care quality.

2. Introduction

Healthcare organisations today face rising patient numbers, higher operational costs, and increasing demands for safety and treatment quality. To manage these pressures, hospitals and clinics are adopting advanced digital tools and Health Information Systems (HIS). Among these technologies, Electronic Health Records (EHR) serve as the backbone of digital healthcare infrastructure (Blumenthal & Tavenner, 2010).

However, implementing modern EHR platforms is not an easy task. Many healthcare providers still struggle with fragmented data systems, old legacy software, and a lack of data exchange standards among different departments and external clinics. When patient records cannot flow freely and securely, clinicians spend unnecessary time collecting paper notes, re-ordering duplicate laboratory tests, and managing manual paperwork. This report explores how EHR modernization and system interoperability can streamline clinical and administrative operations, reduce treatment errors, and improve patient experience across care settings.

3. Literature Review

Academic literature on health informatics highlights that digital transformation in healthcare relies on both technology tools and human adoption. According to Shortliffe and Cimino (2014), Health Information Systems (HIS) include all automated solutions that process clinical, administrative, and financial data in healthcare facilities.

Core Components of Modern EHR Technologies:
Modern EHR platforms incorporate several specialized sub-modules that support daily clinical operations:

1. *Computerized Provider Order Entry (CPOE):* Enables doctors to send medication prescriptions, laboratory tests, and radiology orders digitally, reducing handwriting mistakes and adverse drug events (Bates et al., 1999).
2. *Clinical Decision Support Systems (CDSS):* Provides automated alerts for allergy warnings, drug interactions, and clinical practice guidelines at the point of care.
3. *Patient Portals:* Secure web interfaces that allow patients to view lab results, schedule appointments, and request prescription refills, improving patient engagement.

Despite these benefits, researchers note that if EHR systems do not communicate effectively with other systems, they create "digital silos." As noted by Adler-Milstein et al. (2015), interoperability—the ability of different software systems and devices to exchange and interpret data—is necessary to unlock the full strategic value of digital healthcare investment.

Healthcare Technology	Primary Operational Focus	Clinical & Administrative Benefits
Electronic Health Record (EHR)	Centralized Patient Data Management	Eliminates paper files; provides real-time access to complete medical histories.
CPOE & CDSS	Clinical Order Entry & Safety Alerts	Prevents drug interaction errors; standardizes clinical care protocols.
Picture Archiving (PACS)	Digital Radiology Image Storage	Instant sharing of X-rays and MRI scans between departments and specialists.
Patient Portals	Outpatient Communication & Self-Service	Reduces administrative call volume; improves patient self-management.
Enterprise Resource Planning (ERP)	Supply Chain, HR, and Billing	Automates hospital inventory tracking, staffing shifts, and financial claims.

4. Methodology

This project report uses a secondary research approach based on qualitative review of academic health informatics literature, published clinical case studies, and healthcare technology guidelines. Data and evidence were collected from sources such as *Journal of the American Medical Informatics Association (JAMIA)*, *BMJ Health & Care Informatics*, and industry reports from WHO and HIMSS.

The research methodology involved evaluating technical data standards (HL7, FHIR, DICOM), examining real-world national implementation cases, and designing an operational evaluation schema to measure gains in administrative speed, clinical procedure accuracy, and care quality.

5. Technical Workflow & Interoperability Standards

Achieving seamless data flow across disparate healthcare settings requires strict technical standards. Without uniform data protocols, medical information cannot be safely interpreted when transferred between different hospital systems.

Key Data Interoperability Standards:

1. *HL7 (Health Level Seven) v2/v3:* Traditional messaging standards used to exchange patient demographic, admission, and billing data between hospital systems.
2. *FHIR (Fast Healthcare Interoperability Resources):* A modern, web-based standard developed by HL7 that uses RESTful APIs and JSON/XML data formats, allowing quick mobile and web app integrations (Mandel et al., 2016).
3. *DICOM:* The global standard for storing and transferring digital medical images across radiology systems.
4. *SNOMED CT & LOINC:* Standardized medical vocabularies that ensure clinical terminology (diagnoses, symptoms, lab tests) maintains exact meaning across all IT systems.



ROLE OF HEALTH INFORMATION EXCHANGE (HIE)

Regional HIE platforms use standardized FHIR APIs to securely transmit emergency medical data, patient allergies, and medication history between independent healthcare providers, reducing clinical errors during emergency admissions.

6. Discussion & Case Study Analysis

To understand the practical impact of EHR implementations, it is valuable to examine enterprise deployment case studies from global healthcare settings.

Case Study 1: NHS Summary Care Record (SCR) - United Kingdom
The NHS introduced the Summary Care Record to provide clinicians across England with quick access to essential patient information (medications, allergies, and bad reactions). Studies by Greenhalgh et al. (2010) found that while the SCR improved safety in emergency departments and out-of-hours care, early adoption suffered from complex technical integration, varied local GP software formats, and patient privacy concerns. Successful nationwide rollout required significant investment in staff training and public privacy communication.

Case Study 2: Kaiser Permanente HealthConnect - United States
Kaiser Permanente executed one of the largest private enterprise EHR implementations in the world, connecting over 9 million members across hundreds of medical centers using an Epic-based enterprise system (Crosson, 2009). The system provided real-time clinical notes, integrated lab orders, and unified billing. Key outcomes included a 15% drop in duplicate laboratory testing, improved management of chronic diseases like diabetes, and shorter patient waiting times.

Lessons Learned on Integration Complexity:
Comparing these enterprise implementations shows that success depends not only on software quality, but also on managing user resistance, addressing staff workflow disruptions, and ensuring strict compliance with data privacy regulations like GDPR and HIPAA.

7. Proposed Evaluation Schema for Healthcare Managers

Healthcare managers require a structured evaluation tool to assess whether an EHR modernization project achieves its performance goals. Below is a workable evaluation framework across three primary domains.

EHR OPERATIONAL IMPACT EVALUATION FRAMEWORK

Domain 1: Administrative Speed & Efficiency

- *KPIs:* Average patient check-in time, prescription processing time, and billing claim rejection rates.
- *Target Outcome:* 30% reduction in administrative processing time within 6 months of deployment.

Domain 2: Accuracy of Clinical Procedures

- *KPIs:* Adverse Drug Event (ADE) rates, prescription error frequency, and duplicate lab test orders.
- *Target Outcome:* Near-zero handwriting transcription errors and >25% reduction in unneeded duplicate testing.

Domain 3: Quality of Patient Care & Satisfaction

- *KPIs:* Patient portal login activity, appointment no-show rates, and overall patient satisfaction scores.
- *Target Outcome:* Higher patient portal engagement and improved care continuity across care teams.

8. Conclusion & Recommendations

In conclusion, modernizing EHR systems and ensuring system interoperability through standards like FHIR and HL7 are critical steps for building efficient, high-quality healthcare organizations. While implementation challenges exist, proper change management and clear evaluation frameworks enable healthcare managers to maximize return on technology investment.

Key Recommendations for Healthcare Executives:

1. Mandate FHIR-based API adoption for all new healthcare software acquisitions.
2. Invest continuously in clinician training to prevent software burnout and lower user resistance.
3. Use the proposed evaluation schema to track administrative speed and clinical accuracy monthly.

9. References

Adler-Milstein, J., DesRoches, C. M., Furukawa, M. F., Worzala, C., Charles, D., Kralovec, P. D., & Jha, A. K. (2015). More than half of US hospitals have at least a basic EHR, but adoption has sloped in small and rural hospitals. *Health Affairs*, 34(8), 1274-1280.

Bates, D. W., Teich, J. M., Lee, J., Seger, D., Kuperman, G. J., Ma'Luf, N., & Leape, L. L. (1999). The impact of computerized physician order entry on medication error rates. *JAMA*, 281(14), 1311-1316.

Blumenthal, D., & Tavenner, M. (2010). The "meaningful use" regulation for electronic health records. *New England Journal of Medicine*, 363(6), 501-504.

Crosson, F. J. (2009). 21st-century medical care: delivery system reform and Kaiser Permanente. *Health Affairs*, 28(2), w380-w388.

Greenhalgh, T., Stramer, K., Bratan, T., Byrne, E., Mohammad, Y., & Russell, J. (2010). Introduction and use of summary care records in English primary care: qualitative study. *BMJ*, 340, c3111.

Mandel, J. C., Kreda, D. A., Mandl, K. D., Kohane, I. S., & Kohane, I. S. (2016). SMART on FHIR: a standards-based, open app platform for electronic health records. *Journal of the American Medical Informatics Association*, 23(5), 899-908.

Shortliffe, E. H., & Cimino, J. J. (Eds.). (2014). *Biomedical Informatics: Computer Applications in Health Care and Biomedicine* (4th ed.). Springer, New York.

10. Appendices

Appendix A: Technical Comparison of Interoperability Standards

Standard	Primary Usage	Data Format	Integration Complexity	Modern Compatibility
HL7 v2.x	Internal Hospital Messaging	Pipes & Carets (|)	Medium	Legacy Standard (Widespread)
HL7 FHIR	Web APIs & Mobile Apps	JSON / XML	Low	High (Modern Web Ready)
DICOM	Radiology Images & Scans	Binary Medical Image	Medium	High (Global Radiology Standard)
SNOMED CT	Clinical Terminology Coding	Coded Concepts	High	High (Essential for Semantic Care)