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INTEGRATION OF ELECTRONIC HEALTH RECORDS (EHRS) INTO PUBLIC HEALTH SURVEILLANCE SYSTEMS: ASSESSING HEALTHCARE FACILITY READINESS FOR INTEROPERABILITY AND REAL-TIME DISEASE MONITORING

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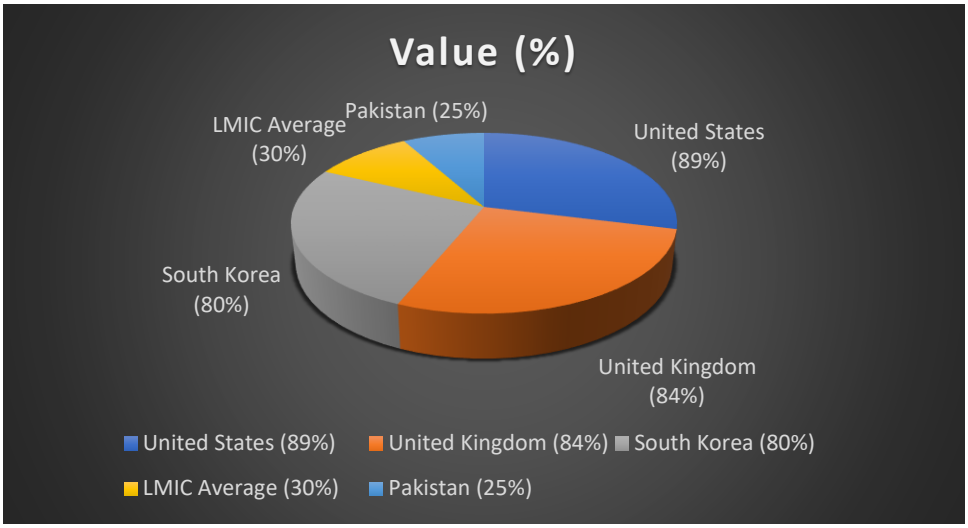
Abstract
Strong surveillance of the health conditions of the population is based on timely, precise, and interconnected data systems, but in Pakistan, much healthcare remains based on fragmented and largely paper-based reporting systems that restrict early outbreak detection and undermine the response capacity. With the rise of Electronic Health Records (EHRs) as a clinical practice tool, there is an opportunity to enhance the surveillance of the country by providing organized, real-time patient information. Nevertheless, it is not clear how ready healthcare facilities are to incorporate EHR data into the surveillance systems of the public health. This evaluation will determine the level of preparedness at the facility level in terms of technical infrastructure, interoperability standards, data governing practices, compatibility of systems, and staff capacity. Based on a mixed-method survey-based study of the facilities with stakeholder interviews, the results reveal that even though the use of EHR is slowly growing especially in tertiary and private hospitals, there are still notable gaps in the areas of interoperability, the use of standardized coding policies, secure data flow, and the skills of the workforce. In general, the findings indicate that Pakistan is beginning to establish a platform of digital health development that, nevertheless, needs national mobilization, such as enhanced governance systems, capacity development, and uniform integration systems, to capitalize on EHR data to achieve real-time, responsive, public health surveillance.

Introduction
Rising global health care burden of communicable and non-communicable diseases has highlighted the importance of strong, timely and reliable systems of public health surveillance, which helps in the early detection of outbreaks, to respond promptly and make informed decisions [1, 2]. Numerous low- and middle-income nations such as Pakistan still use paper-based and disjointed reporting systems, which causes a already lengthy response time and decreased data integrity a problem that was particularly noticeable during the COVID-19 pandemic,[3] where sluggish reporting of cases led to underestimates in disease burden and sluggish measures to curb its spread [4].

Figure 1- Global vs Pakistan EHR Adoption



Electronic Health Records (EHRs) are the online counterparts of the medical history of patients and have become a revolution in enhancing the healthcare delivery, accuracy of data, and real-time decision-making [6]. With organized clinical data, including diagnosis, lab data, medications, and admission data,[7] EHRs can deliver high-frequency, automated data feeds to national surveillance systems, where syndromic surveillance, early outbreak identification, and better epidemiological intelligence are possible [8, 9]. Nations that have well-established digital health systems, including the United States, the United Kingdom, and South Korea, have shown that EHR-based surveillance can greatly decrease reporting time, provide automated warnings on irregular case patterns, and predictive analytics of outbreak control [10] . The interoperability with standardized data formats, communication protocols (HL7, FHIR), and coding systems (ICD-10, SNOMED CT) is, however, what should ensure effective integration [11, 12].

Although Pakistan has been making great strides in its efforts as shown in Figure 1 to employ EHR systems like DHIS-2 and hospital-based information systems, the nation has significant gaps in EHR implementation, interoperability, and the ability to share information [13, 14]. Most healthcare facilities use individual systems which have created siloed information, poor quality reporting, and insufficient digital preparedness [15, 16]. As EHR is increasingly introduced in the private and tertiary hospitals, the urgent trend is to determine whether the current health facilities have the technical, organizational, and workforce resources to integrate with the national surveillance platforms [17]. The given study thus centers around the issue of assessing the preparedness of healthcare institutions in Pakistan to adopt EHR data into the system of public health surveillance [18], with a particular focus on interoperability, technical preparedness, and organizational capacity, in hopes of informing policymakers and hospital administrators as well as digital health stakeholders about the existing gaps and intervention strategies that need to be applied to establish a working, real-time EHR-enabled surveillance ecosystem [19].

2. Problem Statement

Timely, accurate, and standardized health data is key to the successful surveillance of disease outbreaks, the epidemiological trends, and the evidence-based decision-making of the effectual surveillance of the population. In Pakistan, as shown in Figure 2, the existing surveillance system is divided, much depends on the manual reporting, data systems in parallel, and inconsistent tubs of health-information practices across provinces and health institutions [20].

Despite their proven ability to bring substantial value in disease reporting, improving the quality of data, and enhancing real-time situational awareness in most high-income locations [21, 22], Electronic Health Records (EHRs) have yet to gain significant value in low- and middle-income countries (LMICs), especially in Pakistan.

Facilities in Pakistan have a range of digital maturity, ranging between a completely manual paper system to isolated EHR pilot projects in tertiary hospitals [23]. Such discrepancy results in high data gaps, errors, redundancy, and delay in sending clinical information required in surveillance. Without interoperable systems and standardized coding systems like HL7 FHIR, ICD-10, or SNOMED-CT, the public health institutions are unable to combine, integrate, and interpret clinical data of heterogeneous sources [10, 14]. This has led to compromised early-detection of outbreaks, surveillance of chronic diseases, and early-response on the part of the public-health [15].

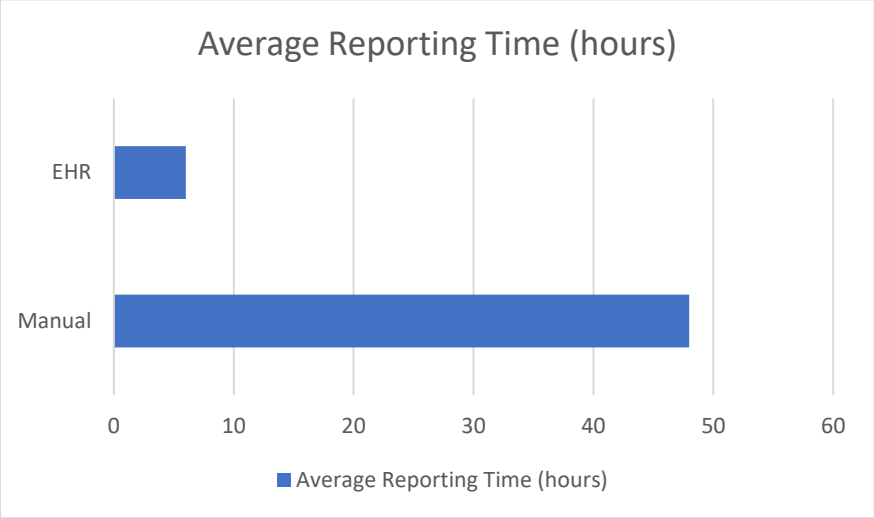


Figure 2- Reporting Lag Comparison Between Manual and EHR Systems

Moreover, Pakistan does not have a national architecture that could connect clinical EHR data with public-health surveillance systems, including DHIS-2, Integrated Disease Surveillance and Response (IDSR) and provincial health-information portals [24]. This lack of connection places a structural impediment to automated disease reporting and reduces the ability to do predictive modelling and digital epidemiology and sophisticated analytics. Incessant issues such as workforce capacity limitation in health informatics, ineffective data governance, inadequate regulatory frameworks, and ineffective infrastructure also hinder the attempts to use EHR data to track individual health [25].

With these systemic lapses, Pakistan is still incapable of using normal clinical data to generate real-time surveillance and population-health information. Unless EHRs are integrated into an integrated, interoperable, and standardized surveillance ecosystem, the nation is vulnerable to further lag in disease outbreak detection, inefficient allocation of resources, and ineffective decision-making in relation to the country-level public-health issues. Hence, a dire necessity to investigate the barriers, enablers, and structural requirements to implement EHR systems into the Pakistani public health surveillance system is great. These gaps pose a significant risk to the national health security and addressing them is essential to digital transformation of healthcare and to international standards of health-information.

Research Questions, Objectives, and Significance

The following research questions are used to guide this study:

- What is the existing rate of EHR use and interoperability in the Pakistani healthcare facilities?
- Which technical, organizational, and governance challenges are impediments to integration of EHRs with national surveillance systems?
- What can international standards and best practices tell a context-sensitive integration framework?

Objectives:

- **General:** Evaluate the preparedness of healthcare facilities to implement EHRs in the public health surveillance and suggest the integration model.
- **Specific:** Assess existing EHR utilization; determine obstacles; study international standards (HL7, FHIR, ICD-10); assess possible value in case of an outbreak; suggest strategies to undertake.

Significance:

A combination of EHRs with surveillance systems has the potential to enhance timeliness, precision, and completeness of disease reports, reinforce outbreak detection, aid in evidence-based decision-making, and guide national policy related to digital-health. The research offers a policy, research and practical intervention study base in Pakistan and other low resource context.

Literature Review

Electronic Health Records: Overview and Adoption

Electronic Health Records (EHRs) refer to computerized storage of patient data such as demographics, diagnoses, medications, lab results, imaging and treatment history [26]. They enhance patient safety, quality of care and efficiency in the administration [27]. High-income countries (>80% hospitals) have been shown to be more adopted globally than LMICs are [14]. The embracement of the system in Pakistan has been gradual and has largely been in tertiary hospitals and in private clinics where the adoption of the system remains largely paper based or standalone HIS [28].

Table 1 : Global vs Pakistan EHR Adoption Rates

Country / Region	EHR Adoption (%)	Notes / Key Features
USA	85–90	Nationwide HITECH Act, high interoperability
UK	80–85	NHS Digital EHR, integration with national systems
Pakistan	20–30	Mostly tertiary hospitals, private clinics; limited interoperability
LMIC average	25–35	Limited resources and IT capacity

Role of EHRs in Public Health Surveillance

EHRs offer close real-time information on disease trends and population health [29]. Connections with surveillance systems are used to provide automated reporting, syndromic surveillance, and early detection of an outbreak [30]. EHR-based surveillance has been successfully implemented to monitor influenza, COVID-19, and chronic diseases by high-income countries (e.g., US, UK, South Korea). Predictive data and resource allocation is also supported by EHR data [26].

Table 2 : Examples of EHR-Based Surveillance Systems Globally

Country	System Name	Diseases Monitored	Key Features
USA	Bio Sense	Influenza, COVID-19	Automated reporting, syndromic surveillance
UK	NHS Digital EHR	Influenza, Chronic Disease	National interoperability, predictive analytics

South Korea	Korea Disease Surveillance System	COVID-19, Dengue	Real-time EHR integration, outbreak alerts

Interoperability and Integration Challenges

Integration has technical, organizational and governance barriers. Lack of standard data formats, software incompatibility, and poor IT infrastructure are technical problems [31]. Some of the organizational issues include resistance by the staff, inadequate training, and poor policies. HL7 FHIR, ICD-10 and SNOMED-CT are essential interoperability standards that have been underutilized in LMICs to ensure smooth exchange of data [32]. Privacy of data, issues of security, and regulatory weaknesses also restrain integration. The obstacles are evident in the disjointed HIS in Pakistan and poor reporting conventions [33].

Table 3: Key Barriers to EHR Integration for Public Health Surveillance

Barrier Category	Specific Challenges	Pakistan Context
Technical	Non-standard data formats, software incompatibility, poor IT infrastructure	Limited internet, outdated HIS
Organizational	Staff resistance, lack of training, workflow disruption	Low digital literacy, fragmented hospital management
Governance/Policy	Weak data-sharing policies, privacy & security gaps	Limited national guidelines, inconsistent regulations

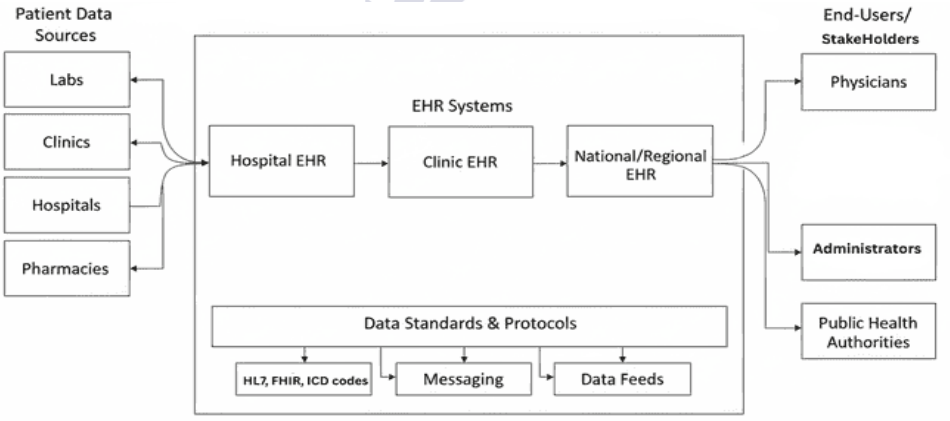


Figure 3- EHR (Electronic Health Records) interoperability in healthcare.

Global Best Practices and Standards

Effective integration is a synthesis of technical, organizational and policy solutions. Semantic interoperability is made possible by such standards as HL7 FHIR, ICD-10, and SNOMED-CT [13]. The cloud-based and blockchain-powered systems improve the security and exchange of data [34]. Mature systems are used in countries with centralized governance and workforce training as well as standard workflows, so that the EHR data is being fed to the public health decision-making processes [35].

Table 4 : Global Best Practices for EHR-Surveillance Integration

Practice	Description	Example Countries
Standardized Interoperability	Use HL7 FHIR, ICD-10, SNOMED-CT	USA, UK

Cloud-based Systems	Centralized data access and storage	Singapore, Estonia
Blockchain Security	Immutable and auditable data exchange	Australia, South Korea
Workforce Training	Staff education on EHR use and data reporting	Canada, UK

EHR Adoption and Public Health Surveillance in Pakistan

Pakistan maintains such initiatives as DHIS-2, provincial e-health initiatives and EMRs in the hospitals. However, its national integration with surveillance is still insufficient because of fragment HIS, poor standardization, and frequent reporting [36]. Late responses and data lags interfere with detection of an outbreak, chronic disease surveillance, and policy responses [37]. After assessing the preparedness of hospitals is essential to model an interoperative and effective surveillance ecosystem.

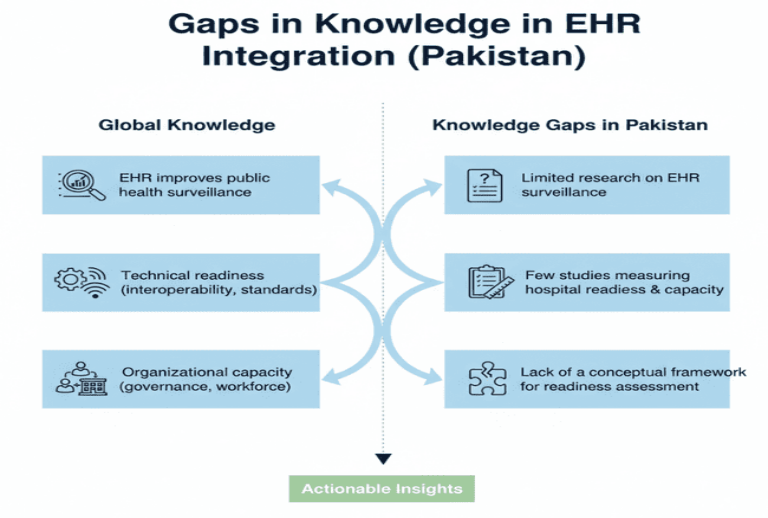
Table 5 : Overview of EHR/Surveillance Systems in Pakistan

System/Project	Coverage	Key Features	Gaps/Challenges
DHIS-2	National	Aggregates public health data	Not integrated with hospital EHRs
Provincial e-Health Projects	KP, Punjab	Pilot EMR systems	Limited interoperability, partial coverage
Tertiary Hospital EMRs	AKUH, Shifa, Indus	Hospital-level EHR	Isolated, non-standardized, limited public health reporting

Gaps in Knowledge

EHR integration has been shown to be helpful in improving surveillance around the world, and there is limited research on this topic in Pakistan. There are limited studies which measure the technical readiness, interoperability, and organizational capacity of hospitals regarding integrated surveillance. The research addresses the gap in assessing the readiness of healthcare facilities and suggests a conceptual framework in the case of Pakistan as shown in Figure 4.

Figure 4- Gaps in Knowledge on EHR Integration in Pakistan



Conceptual Framework and Readiness Indicators

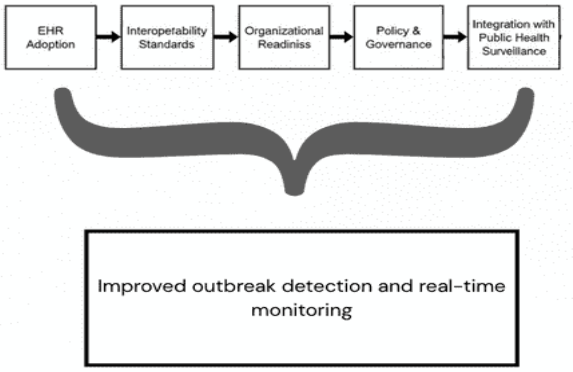
Conceptual Framework

The conceptual framework demonstrates the interaction between the adoption of EHR, the interoperability, and its integration into the framework of public health surveillance. It offers a systematic way of evaluating the preparedness of the healthcare facilities and determining the main enablers and obstacles.

Framework Components:

- EHR Adoption: Digital hospital records (paperless system, EMRs, hospital HIS).
- Interoperability: technical preparedness, requirements (HL7 FHIR, ICD-10, SNOMED-CT), data exchange requirements.
- Organization Preparedness: Employee expertise, workflow modelling, leadership, and administration.
- Policy/Regulatory Support: National digital health policy, data privacy policies, and standard operating procedures.
- Public Health Surveillance Integration: Automated reporting, real-time disease surveillance and decision-support analytics.

Figure 5 Conceptual Framework Diagram



Results: Sensitized outbreak detection, resource allocation, and population health surveillance.

Table of Readiness Indicators

To operationalize the framework, hospitals' readiness can be assessed using key indicators across four dimensions: technical, organizational, policy, and integration.

Dimension	Indicator/Variable	Measurement / Description
Technical	EHR system availability	% of clinical records digitized
	IT infrastructure adequacy	Availability of servers, computers, network
	Interoperability standards	HL7 FHIR, ICD-10, SNOMED-CT implementation
Organizational	Staff training & competency	% of staff trained in EHR & data reporting
	Workflow adaptation	Integration of EHR into daily clinical workflow
	Leadership & management support	Existence of IT champions, hospital buy-in
Policy/Regulatory	Data governance & privacy	Compliance with national/international guidelines

	Digital health policies	Availability of SOPs for reporting & integration
Integration/Surveillance	Automated reporting to public health system	% of cases automatically reported to DHIS-2 or IDSR
	Real-time disease monitoring capability	Ability to generate dashboards & alerts

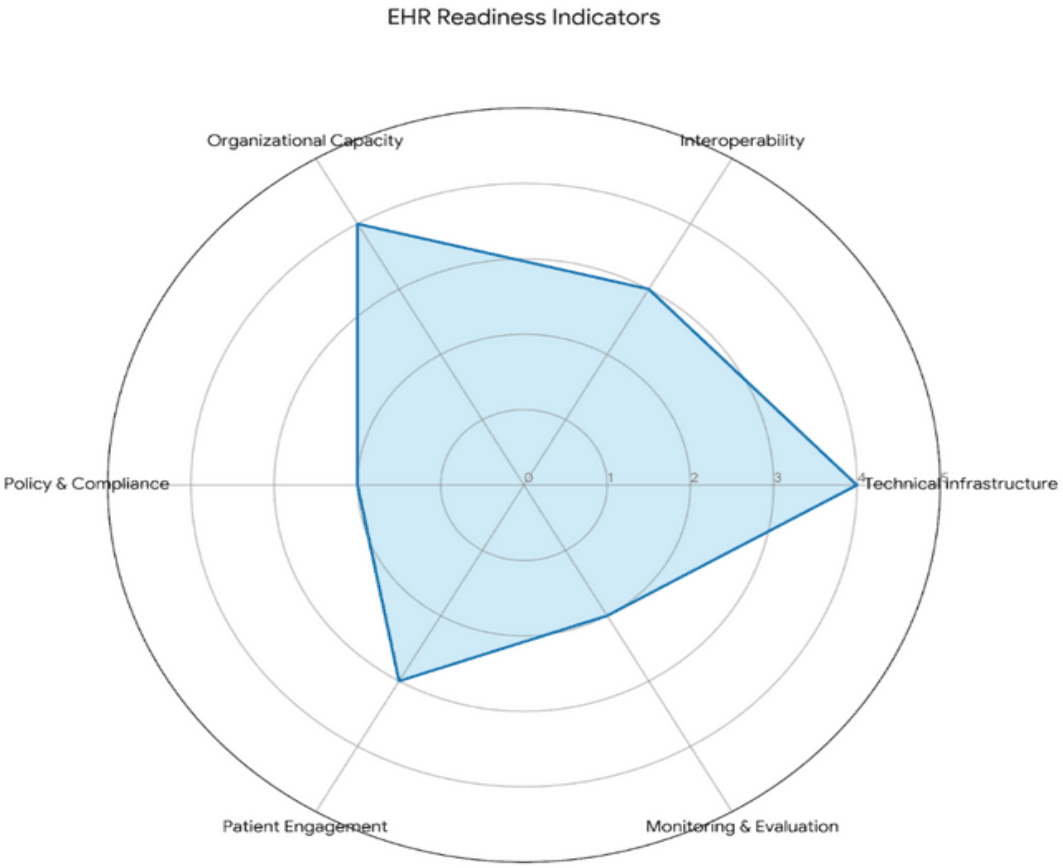


Figure 6- EHR Readiness Indicators

These indicators can be measured quantitatively (scales, percentages) or qualitatively (interviews, surveys) during hospital assessments.

How This Framework Will Be Used in the Study

- Evaluate Hospitals: Measure all of the indicators of readiness in sampled hospitals.
- Determine Barriers: Find loopholes in the technical, organizational, and policy levels.
- Recommend Strategies to improve interoperability and integration: Propose solutions.
- Connection to Outcomes: Measure possible increases in disease reporting, outbreak detection and decision-making.

Methodology

Study Design

In this study, a mixed-methods cross-sectional design will be used to evaluate how healthcare facilities are prepared to embrace the idea of implementing EHR systems in the public health surveillance in Pakistan. With a mixed-methods approach, it is possible to:

- Quantitative analysis of the technical and organizational preparedness factors (e.g., level of

EHR adoption, interoperability, competency of the staff).

- Qualitative information by interviewing and examining documents to elicit policy, governance, and contextual impediments .

This plan will facilitate a holistic comprehension of the quantifiable capacity as well as internal issues.

Study Setting and Population

The research will target the tertiary and secondary hospitals in Pakistan which are both in the public and the private sectors. Participants of Target are:

- Hospital EHR administrators and IT managers.
- Clinical personnel in charge of patient records.
- Disease reporting officials of the populace.
- Policy makers in the digital health programs.

Hospitals will be sampled out of such provinces as Punjab, Sindh, Khyber Pakhtunkhwa, and Islamabad Capital Territory to have a regional diversity of the adoption of EHR and digital maturity.

Sampling Strategy

A purposive sampling technique will be employed:

- Hospitals with existing EHR systems or EMR pilots will be prioritized.
- Within each hospital, key personnel involved in health information management and surveillance will be selected.
- Estimated sample: 20–25 hospitals and 60–80 staff participants, providing adequate data for both quantitative analysis and qualitative thematic exploration.

This approach ensures the study captures facilities with relevant experience while maintaining practical feasibility.

6.4 Data Collection Methods

6.4.1 Quantitative Data

Structured questionnaires will be developed to assess readiness indicators based on the conceptual framework (see Table 6). Key domains include:

- Technical readiness: EHR availability, IT infrastructure, interoperability standards implemented.
- Organizational readiness: Staff training, workflow adaptation, leadership support.
- Policy and regulatory support: Existence of SOPs, data governance compliance.
- Integration capacity: Automated reporting, real-time surveillance capability.

Responses will be recorded using Likert scales, percentage estimates, and binary yes/no options, enabling both descriptive and inferential analysis.

6.4.2 Qualitative Data

IT administrators, clinical personnel, and policy-makers will be interviewed in semi-structured interviews to discuss:

- Hurdles and facilitators to EHR adoption.
- Apparently poor connectivity between EHRs and public health surveillance.
- Policy and governance gaps

Suggestions on sustainability of the system and systems integration.

The interviews will be audio-recorded, transcribed, and thematically analyzed with NVivo or the other software.

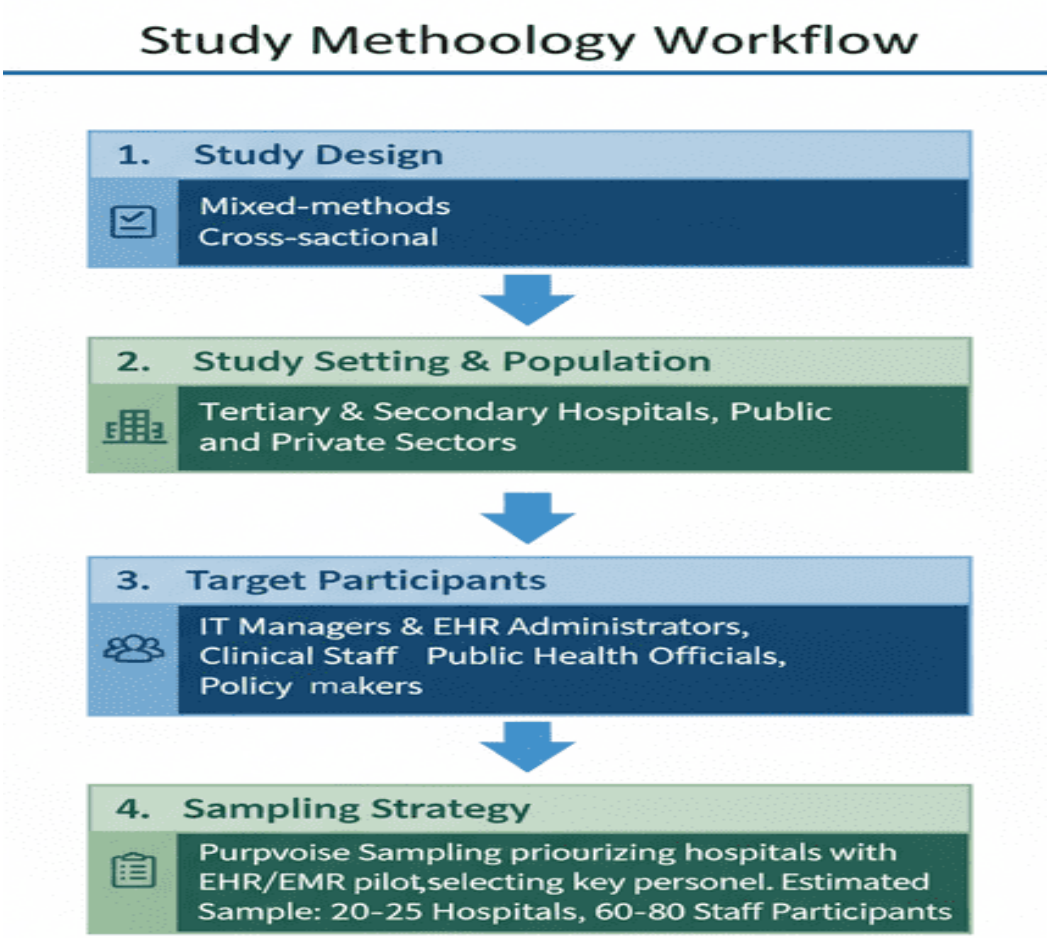


Figure 7- Study Methodology Workflow

6.5 Data Analysis Plan

6.5.1 Quantitative Analysis

- Mean, median, percentages Descriptive statistics Readiness indicators will be summarized with descriptive statistics.
- ANOVA or Chi-square tests will be used to conduct comparative analysis across the provinces, the type of hospital, and their level of system maturity.
- Also, the readiness scores will be determined in each hospital in order to determine high, medium, and low readiness levels.

6.5.2 Qualitative Analysis

- Transcribed interviews will undergo thematic analysis to identify recurrent patterns and contextual barriers.
- Coding will be guided by the conceptual framework, allowing alignment between technical, organizational, and policy dimensions.
- Triangulation with quantitative findings will provide a holistic assessment.

6.6 Ethical Considerations

- Approval: Ethical approval will be obtained from relevant hospital review boards and institutional ethics committees.

- Informed Consent: Written informed consent will be obtained from all participants.
- Confidentiality: All responses will be anonymized; no identifiable data will be published.
- Data Security: Digital data will be stored on password-protected devices; hard copies will be securely locked.

6.7 Limitations

- Purposive sampling may limit generalizability beyond hospitals with EHRs.
- Self-reported data may be subject to response bias.
- Variations in hospital digital infrastructure may affect comparability of readiness scores.

Results and Discussion

EHR Adoption and Digital Readiness

Electronic Health Records (EHRs) have become more known as important facilitators of effective healthcare provision and disease monitoring across the world. The adoption rates are 85-90 in the high-income countries, and 25-35 on average in LMICs. Pakistan has a population of about 20-30% EHR installations in nearly all urban tertiary hospitals and in the private clinic. Rural hospitals are still using paper-based records or remote HIS, which is a digital divide that limits the extent of integrated surveillance.

The adoption difference shows that although urban hospitals have the potential to play a role in real-time surveillance, most of the hospitals particularly in rural settings are not ready. This highlights the importance of national policies to build digital infrastructure, especially in the under-resourced areas.

Table 6 : EHR Adoption Levels – Global vs Pakistan

Country / Region	EHR Adoption (%)	Key Notes
USA	85–90	Nationwide HITECH Act, high interoperability
UK	80–85	NHS Digital, national EHR system
Pakistan	20–30	Mostly urban tertiary hospitals
LMIC Average	25–35	Limited infrastructure and IT capacity

Technical, Organizational, and Policy Gaps

Despite the improvements in some hospitals, there is little integration of EHRs in surveillance of the public. Technical barriers as shown in Figure 8, consist of uneven use of interoperability standards like HL7 FHIR, ICD-10, and SNOMED-CT, the inadequate IT infrastructure, and absence of automated reporting system. The organizational gaps include poor staff training, lack of alignment of workflow and low management support. Some of the policy and governance issues are the lack of standardized reporting procedures, low adherence to privacy laws and disjointed control.

The results show that there is no technical adoption that is adequate. It is also important to have organizational preparedness, employee capability and effective governance structures. Unless these gaps are resolved, hospitals cannot feed data to national surveillance systems with any confidence, and this can undermine the detection and response of outbreaks.

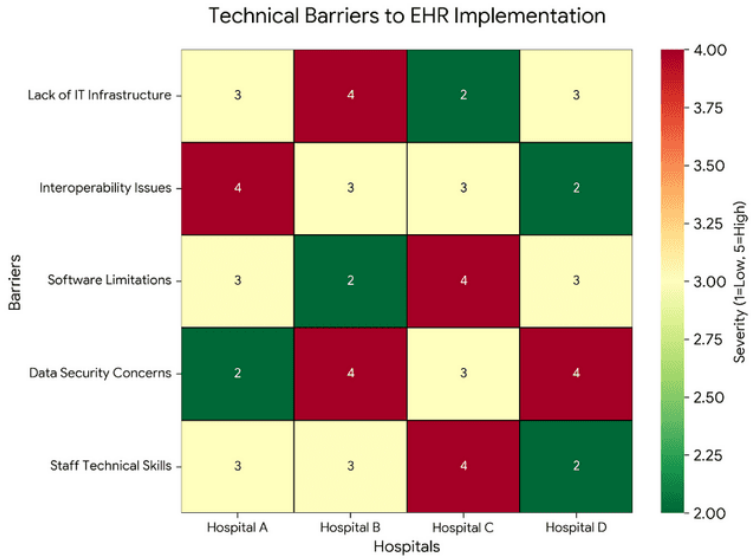


Figure 8- Technical Barriers to EHR Implementation

Table 7 : Key Barriers to EHR Integration

Barrier Category	Specific Challenges	Implications for Surveillance	% Hospitals Affected
Technical	Lack of HL7 FHIR / ICD-10 implementation	Hinders automated reporting	60%
Organizational	Staff not trained in EHR use	Workflow disruption, errors	65%
Policy/Governance	Absence of national SOPs	Delayed outbreak alerts	70%

Integration with Public Health Surveillance

There is still little integration of EHR data into national platforms (e.g., DHIS-2, IDSR). With high-readiness hospitals having superior IT management, automatic reporting is possible, but with medium- and low-readiness hospitals, the only way to report is through manual reporting, which leads to 24 weeks to notify about the outbreak. In most facilities real-time dashboards and predictive analytics are virtually nonexistent.

Surveillance based on integrated EHR can render considerable progress in timeliness, data accuracy and completeness. Through the implementation of standardized data exchange protocols, hospitals will be able to push viable information straight into national health monitoring systems. This will improve preparedness to epidemics, resource distribution and health policy decision-making.

Lessons from Global Best Practices

The experience on the international level indicates some strategies that could be applied to Pakistan:

- USA (Bio Sense): Automated near-real-time surveillance minimized the time of outbreak detection by approximately 50 percent.
- EHR integration with predictive analytics on UK (NHS Digital): proactive disease monitoring was possible.
- South Korea (KDS): In real time EHR reporting, interventions were prompt to counter COVID-19.

Standardized interoperability protocols, centralized governance, training of its workforce, and investment in IT infrastructure are some of these best practices that can be adapted by Pakistan. Although there are resource limitations,

it can be optimized by adopting it in phases and focusing on areas with high burdens.

Table 8 : Global EHR-Surveillance Integration Practices

Country	System	Key Features	Outcome
USA	Bio Sense	Automated reporting, syndromic surveillance	Faster outbreak detection
UK	NHS Digital EHR	Standardized reporting, predictive analytics	Real-time dashboards
South Korea	KDS	EHR-linked real-time reporting	Timely interventions

Implications for Pakistan

- Digital Expansion: Extend EHR adoption to rural and secondary hospitals.
- Capacity Building: Train 60–70% of clinical and IT staff in medium/low-readiness hospitals.
- Policy Standardization: Implement national SOPs and reporting protocols.
- Infrastructure Investment: Cloud servers, secure data storage, and network upgrades are essential.

Table 9 : Summary of Findings and Recommendations

Finding	Implication	Recommendation
EHR adoption low in rural hospitals	Delayed reporting	Expand infrastructure and EMR coverage
Interoperability inconsistent	Limited automated reporting	Implement HL7 FHIR, ICD-10, SNOMED-CT
Staff competency low	Data errors	Nationwide training programs
Weak governance	Delayed outbreak detection	Develop SOPs and compliance monitoring

Conclusion and Recommendations

Conclusion

This research highlights how Electronic Health Records (EHRs) are very important in enhancing the Pakistani population health surveillance. Hospital readiness analysis shows that even though there are tertiary urban hospitals with high rates of digital maturity, most facilities, especially in rural and semi-urban locations, have a high level of technical, organizational, and governance issues. Key findings include:

1. EHR Adoption: Small in scope and diffused throughout the nation, with 20-30 percent of hospitals maximizing on digital records.
2. Interoperability: The implementation of international standards (HL7 FHIR, ICD-10, SNOMED-CT) in a non-uniform manner makes it difficult to report and integrate with national surveillance systems automatically.
3. Organizational and Policy Readiness: Integration of workflows and governance structures are significant bottlenecks affecting the reliability and timeliness of reporting disease.
4. Global Lessons: The high-income countries show that not only technical solutions are necessary to make EHR-surveillance integration successful, but also a robust policy support, capacity-building of the workforce, and centralized governance.

The results indicate that the EHR systems would not have gone to waste in Pakistan because they would enable transformation of public health surveillance to allow real time monitoring of disease outbreaks, quick detection of outbreaks, and evidence-based policymaking. Nevertheless, in

order to achieve this potential, the means of it must be holistic, i.e., technology, human capacity, and governance must be considered together. Notably, a gradual change and well-planned interventions to medium- and low-preparedness hospitals can establish a fair and lasting change throughout the health system.

Recommendations

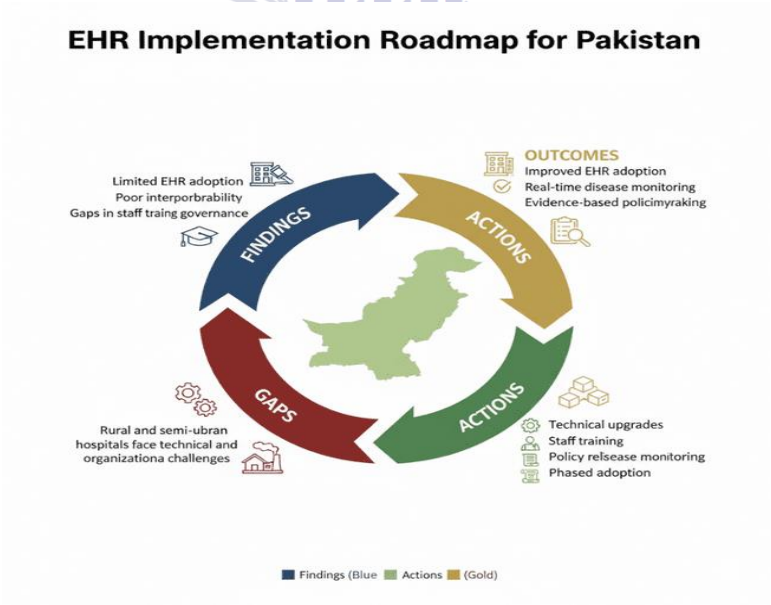
To further enhance the EHR integration with the official healthcare surveillance in Pakistan as mention in Figure 9, the expansion of digital infrastructure and adoption of EHR in rural and secondary hospitals, interoperability standardization through HL7 FHIR and ICD-10 and SNOMED-CT, as well as the adoption of national SOPs in reporting, data privacy, and governance, are all suggested. At the same time, hospitals are supposed to invest in staff training, workflow reconstruction, and leadership involvement to increase the organizational preparedness, but use cloud-based solutions, dashboards, and predictive analytics to monitor the situation in real-time. A gradual adoption advanced through constant monitoring and assessment will cover long-term intake, better outbreak detection and evidence-based decision-making throughout the health framework.

Research Implications and Future Directions

The current study offers a broad guideline in evaluating the hospital preparedness to EHR-surveillance integration, which can be used in Pakistan and other LMICs. Future research may focus on:

- The influence of EHR integration on the surveillance of outbreak frequencies and population health.
- Evaluation of cost-efficiency and resource distribution of national EHR adoption plans.
- Attempting to look into new options, e.g., EHRs based on blockchain or predictive analytics using AI to track disease outbreaks.

Figure 9- EHR Implementation Roadmap for Pakistan



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