

# A Review on Interoperability Challenges between the Electronic Medical records System (Micro level) And the Electronic Health Record System: Ayushman Bharat Digital Mission (Macro level)

**T.K. PradeepKumar**  
Research Scholar, IIHMR University,  
Jaipur, India  
[tkpradeep.it@gmail.com](mailto:tkpradeep.it@gmail.com)

**Ritu Vashista**  
Assistant Professor,  
IIHMR University, Jaipur, India  
[ritu@iihmr.edu.in](mailto:ritu@iihmr.edu.in)

**Kumar KV**  
Chief Information Officer,  
Narayana Health, Bangalore, India  
[kumar.kv@narayanahealth.org](mailto:kumar.kv@narayanahealth.org)



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**BibTeX** [Pradeepkumar@2025Review](mailto:Pradeepkumar@2025Review)



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**Abstract:** Interoperability has made it easier to implement EHR Systems by connecting with multiple EMR systems. To improve the exchange of health data seamlessly, as well as analysis, learning, and decision-making, Ayushman Bharat Digital Mission, the integrating platform from India, plays a vital role. This study analyses different types of interoperability, advantages of ABDM, implementation and adoption factors, and interoperability challenges between EMR and EHR Systems in detail. The findings showed that the interoperability, ABDM and EMR systems are integrated and the comparison of the micro, meso and macro levels adopted in different healthcare settings. This study attempts to show the EMR System at the micro level, ABDM as the EHR System at the macro level and the practitioners at the meso level.

**Keywords:** EMR, EHR, ABDM, Interoperability, Micro, Meso, Macro

## I. INTRODUCTION

When we look back, the medical records of patients are based on paper records because of this lot of bundles of papers and reports to be assessed manually. From 1865 the healthcare/medical field understood the importance of storing & retrieving information[1] and introduced to use of electronic medical record systems in the 1980's[2]. The cons of using the EMR System have partially transitioned towards paperless records and a patient visiting many healthcare settings, for better care, has to carry paper records[3] or electronic records using storage devices. The pros of using an EHR System are the transition from paperless to electronic record, provides all the needs to the engaged parties (patients, doctors, staff, insurance, providers, policymakers), the quality of care expected to be improved, no need to carry any paper records, finally helps the practitioners through the automatic decision and self-learning[3].

## INTEROPERABILITY

Interoperability refers as per the Glossary of IEEE (Software Engineering), to the ability between the ISs to exchange information. Interoperability among the EMR Systems plays the biggest role across multiple healthcare settings. The advancement in technology made the EMR System, to exchange data seamlessly, through the interoperable platform ABDM in India.

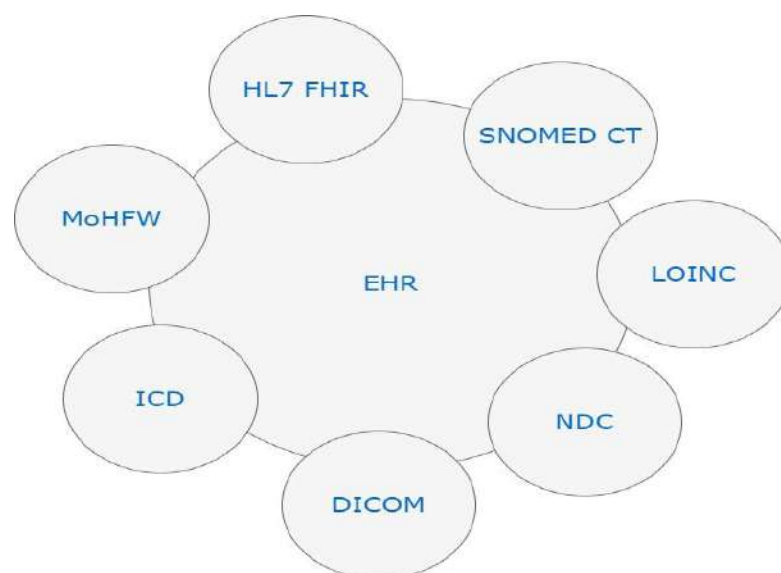
**Table I.** Types of Interoperability

S.No	Author	Year	Different types/ Levels of Interoperability
1	Walker et al.	2005	Non- electronic data, Machine Transportable data, Machine Organizable data, Machine Interpretable data[4]

2	Tolk	2006	No Interoperability, Technical , Syntactic, Semantic, Pragmatic, Dynamic, Conceptual[4]
3	Garde et al	2007	Syntactic (data), Structural, Semantic [4]
4	Lewis et al	2008	Machine, Syntactic, Semantic and organizational [4]
5	Lopez and Bloded	2009	Technical, Structural, Syntactic, Semantic, Organisation / Service Interoperability [4]
6	Stegemann & Gersh[5]	2019	Organisational / Pragmatic, Semantic, Syntactic, Structural and Technical - levels, examined in terms of business, economic and health
7	Tarob-Miandoab et al [6]	2023	Technical, Syntactic, Pragmatic, Dynamic, Conceptual, Structural, functional, Semantic
8	Palojoki et al[7]	2024	Legal, Organisational, Semantic, Technical

**Interoperability Standards, Terminologies:**

- Patient Identifiers: UIDAI, Government issued Photo Identity Card number
- Functional Requirements: ISO/HL7 (Health Level Seven), widely used to resolve challenges of interoperability
- Terminology: SNOMED Clinical Terms (SNOMED CT)
- Coding System: Logical Observation Identifiers Names and Codes (LOINC), WHO ICD-10
- Message standard for Imaging: Digital Imaging and Communication in medicine (DICOM)
- NDC: National Drug Code, as shown in Fig 1.



**Fig 1. Electronic Health Record Standards**

**ABDM– Ayushman Bharat Digital Mission:**

The digitized healthcare system, ABDM, in India, launched in Sep 2021, to enable the national digital health ecosystem. The digitization enabled using frameworks, open protocols and the consent(patients), healthcare providers (public and private), and other stakeholders working together to achieve interoperability. The purpose of ABDM is to increase the accessibility, affordability, availability and acceptability of healthcare using different building blocks such as ABHA, HPR, HFR, UHI, Payers and Drug Registry.

**Advantages of ABDM – Ayushman Bharat Digital Mission:**

ABDM is rapidly growing to connect multiple EMR systems. ABDM's widespread acceptability may enable the data/medical records to be exchanged seamlessly. The researchers, public health professionals, government, providers, and engineers tirelessly working to improve the interoperability among the EMR System.

- Accessibility to Healthcare
- Quality of care
- Human resources
- Out-of-pocket expenditure and private-sector engagement
- Quality of public health data, and the impact of ABDM on existing healthcare system as shown in Fig 2.

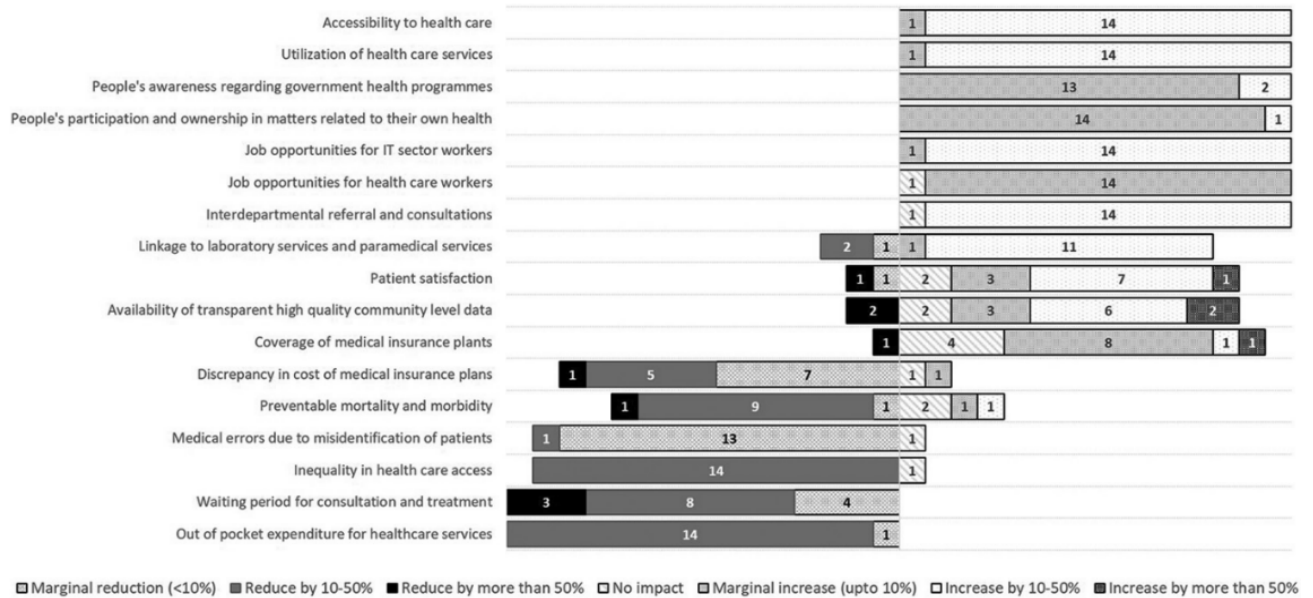


Fig 2: Impact of ABDM on existing healthcare system - Source

### Implementation and Adoption efforts - ABDM:

The ABDM requires maximum support from the stakeholders, to integrate the EMR Systems, to build the digital health ecosystem. The stakeholders who play a vital role are:

- Citizen/Patient
- Healthcare Services Providers.
- Direct Providers
  - Public Sector
  - Private Sector
- Indirect providers
- Health care payers
- Policy Makers

These stakeholders find value in the contributions of building the ABDM ecosystem to enlighten the adoption of ABDM. Effective and efficient, ABDM adoption of the scheme across all sectors, will improve the ABDM ecosystem. The delivery of quality care, held by the union territories and state government, they are driving the operations to register with ABHA, HPR, and HFR and spreading the importance of ABDM [9].

### Interoperability challenges between the EMR System and EHR System:

EHR Systems, enabled using interoperability, alter the way the treatment is practised in general. EHR is possible using interoperable standards such as HL7 FHIR, DICOM, SNOMED CT, LOINC, etc. Healthcare professionals & patients can get the medical data and thoroughly understand the treatment process. Additionally, without experiencing delays the patients/doctors can learn in accordance with their needs. Also, there were a few more challenges, data sharing incentives and supports, heterogeneous organisations & information systems, data storage and management, available information & functionalities, data formats and standards, identification of individuals, user access, control & consent and security & privacy [10] technological – implementation challenges, mismatches in interoperability capabilities across stakeholders, opportunities to leverage new technology, integrate determinants of health data, organisational facilitators of interoperability and strategic alignment of participation in value-based payment programs with interoperability and environmental such as policy [11].

### Solution:

The proposed solution is in the context of a comparison between Micro, Meso, and Macro levels in different settings. In social analysis, "micro" refers to the individual level, "meso" represents the group or organizational level, and "macro" examines large-scale societal structures and patterns, essentially meaning micro focuses on small-scale interactions between individuals, meso looks at interactions between groups, and macro analyses broad social systems and policies impacting entire societies; essentially, it's a scale of analysis from the smallest unit (individual) to the largest (society) with meso bridging the gap between the two.

Table II. Comparison of Micro, Meso and Macro – Levels adopted in different settings

S.No	Author	Published Year	Micro level	Meso level	Macro level
1	Ahmadi et al.[12]	2014	Not Discussed	Not Discussed	Standards, Legislation, Policy

					governance, Funding Incentives, Social, pol-economic trends, As per Physical Adoption Model
2	Randhawa [13]	2019	System quality Information Quality Service Quality as per EAU Models	People, Standardization Organization Implementation As per EAU Models	HealthCare Standards, Legislation Policy Governance, Funding Incentives, Social Political & Economic Trends as per EAU Models
3	Mata et al[14]	2019	Residents – Treat Patients, Self-Evaluate	Supervisor Coordinate Training	Program Coordinators Oversees
4	Watson et al[15]	2021	Individual – Centered Care is targeted to a person	Clinic Program for Staff	Program Capacity Planning
5	Perugu MBA et al[16]	2023	Point of care interoperability	Intra Facility Interoperability	Inter Facility Interoperability
6	Miraza et.al 2024[17]	2024	Triple Layered Concentric Circle and Three Door OPD Concept	Bucket Overflow Model	Central Gateway Control Room

As per the data in the table no 2, according to different studies, the micro, meso and macro levels have been observed in different ways. Based on the data available in the table, the micro, meso and macro levels, are not the same for all the cases. Hence for the review of interoperability challenges, it has been proposed to observe the EMR System at the micro level, People, practice and implementation at the meso level, and the EHR System, ABDM at the macro level.

## II. CONCLUSION

This study highlights the crucial role of interoperability in enhancing the integration of EMR and EHR systems, with a specific focus on India's Ayushman Bharat Digital Mission (ABDM). By analyzing different types of interoperability, implementation efforts, and challenges, the findings indicate that ABDM serves as a robust national platform enabling seamless health data exchange. The comparison of micro, meso, and macro levels demonstrates how interoperability operates across different healthcare settings, with EMR systems at the micro level, healthcare practitioners at the meso level, and ABDM as the EHR system at the macro level. Despite advancements, challenges related to data standardization, security, privacy, and stakeholder alignment persist. Addressing these issues through effective policy interventions, technological improvements, and stakeholder engagement will be essential to fully realize the potential of a connected digital health ecosystem.

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### Abbreviations:

ABDM – Ayushman Bharat Digital Mission  
 ABHA – Ayushman Bharat Health Account  
 DICOM – Digital Imaging and Communication in Medicine  
 EAU – EHR Adoption and Use  
 EHR – Electronic Health Record  
 EMR – Electronic Medical Record  
 FHIR – Fast Healthcare Interoperability Resource  
 HFR – Health Facility Registry  
 HL7 – Health Level Seven  
 HPR – Health Professional Registry  
 ICD - International Classification of Diseases  
 IEEE – Institute of Electrical and Electronics Engineers  
 IS – Information System  
 ISO – International Organisation for Standardisation  
 LOINC - Logical Observation Identifiers Names and Codes  
 NDC – National Drug Code  
 OPD – Out Patient Department  
 SNOMED CT - Systematized Nomenclature of Medicine – Clinical Terms  
 UHI - Unified Health Interface  
 UIDAI - Unique Identification Authority of India  
 WHO – World Health Organisation

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