Interoperability between Health Systems

Posted on September 17, 2018

Healthcare interoperability is the ability of information systems, devices, applications, and organizations to access, exchange, interpret, and use electronic health information appropriately. The original essay correctly describes a connected flow among clinicians, laboratories, pharmacies, hospitals, and patients. Modern interoperability is more than moving a document from one department to another. The receiving system must understand the meaning of the data, preserve context and provenance, protect privacy, reconcile conflicting information, and make the information usable in a safe clinical workflow (Office of the National Coordinator for Health Information Technology, 2026).

Interoperability can improve speed, coordination, medication safety, diagnostic continuity, patient access, and population-health reporting. It can also create new risks if incorrect, duplicated, incomplete, or mismatched information spreads rapidly. A successful project therefore combines standards, governance, identity matching, cybersecurity, workflow redesign, training, and measurement. Installing an interface does not by itself create an interoperable organization (Office of the National Coordinator for Health Information Technology, 2026; Ledlow & Coppola, 2013).

Levels of Interoperability

Foundational Interoperability

Foundational interoperability allows one system to send data to another. The receiving system may display or store the information without fully interpreting its structure. A scanned laboratory report sent through a secure channel is an example. It is useful, but the result may not automatically populate a trend graph or clinical decision rule (Office of the National Coordinator for Health Information Technology, 2026).

Structural Interoperability

Structural interoperability defines the format and organization of exchanged data. The receiving system knows where a patient name, test value, unit, medication, or date appears. Standards such as HL7 messages, Consolidated Clinical Document Architecture, and FHIR resources support structural exchange (Office of the National Coordinator for Health Information Technology, 2026).

Semantic Interoperability

Semantic interoperability enables systems to interpret meaning consistently. A laboratory test should use a standard code and unit; a diagnosis should map to a recognized terminology; a medication should be identified precisely. Without semantic consistency, two systems may exchange data while understanding it differently (Office of the National Coordinator for Health Information Technology, 2026).

Organizational Interoperability

Organizational interoperability includes governance, law, policy, trust, consent, business agreements, workflow, and accountability. Two technically compatible systems may still fail to exchange because institutions lack agreements, identity confidence, or operational responsibility. This level is often the most difficult because it involves people and incentives rather than software alone (Office of the National Coordinator for Health Information Technology, 2026; Ledlow & Coppola, 2013).

Clinical Areas to Integrate

The original proposal focuses on clinician services, laboratories, pharmacies, and hospitals. These remain appropriate starting points because each creates information used by the others. Integration should follow the patient's care journey rather than department boundaries (Office of the National

Coordinator for Health Information Technology, 2026).

Registration and Patient Identity

Registration creates the demographic foundation for exchange. Misspelled names, outdated addresses, duplicate records, and inconsistent identifiers can attach data to the wrong person or divide one person's history among several records. The organization needs matching rules, duplicate-resolution procedures, and staff training (Office of the National Coordinator for Health Information Technology, 2026).

Identity management should accommodate name changes, multiple addresses, cultural naming patterns, newborns, unconscious patients, and people without standard identification. Matching should not depend on one field alone. Incorrect merging can be more dangerous than a duplicate because it combines two patients' data.

Clinician Documentation

Clinicians record symptoms, examination, assessment, plan, allergies, medications, problems, procedures, and follow-up. Interoperability allows this information to reach consultants, emergency departments, primary care, and patients. Notes should preserve authorship, time, status, and corrections (Office of the National Coordinator for Health Information Technology, 2026).

More information is not always better. Copying every note can overwhelm users and hide critical changes. Systems should support summaries, filtering, and reconciliation while retaining access to the source.

Laboratory

Laboratory interoperability begins with a correctly ordered test linked to the correct patient and specimen. The laboratory receives the order, records collection and processing, and returns a result with value, unit, reference range, method, status, and time. Critical results require acknowledgement workflows rather than electronic delivery alone (Office of the National Coordinator for Health Information Technology, 2026).

Standard coding such as LOINC can help identify tests, while controlled units and terminology support comparison. A glucose value without a unit or specimen context can be misinterpreted. Revised or corrected results must replace or clearly qualify earlier versions.

Pharmacy

Pharmacy integration includes medication orders, dispensing, formulary, allergies, interactions, substitutions, prior authorization, administration, and reconciliation. The original essay says a pharmacist recommends appropriate medication after diagnosis. In practice, prescribing authority and collaborative roles vary by profession and jurisdiction. Pharmacists review therapy, identify problems, counsel patients, and sometimes prescribe under authorized arrangements.

Interoperability can reduce transcription errors and reveal duplicate or interacting therapy, but alerts must be designed carefully. Excessive low-value warnings produce alert fatigue. Medication lists also require reconciliation because a prescription record does not prove that the patient takes the medicine (Office of the National Coordinator for Health Information Technology, 2026).

Specialists and Referrals

A referral should include the clinical question, relevant history, tests, medications, urgency, and requested action. The specialist should return findings and recommendations to the referring clinician. Many referral failures occur because the request is sent but no one confirms appointment, completion, or response.

A closed-loop referral process tracks status from order through scheduling, visit, report, and follow-up. Responsibility should be clear when a patient does not attend or a serious result requires action.

Imaging

Radiology interoperability includes orders, scheduling, images, reports, and comparison with earlier studies. DICOM supports image exchange, while clinical reports may travel through HL7 or FHIR. Large files require reliable storage and network capacity (Office of the National Coordinator for Health Information Technology, 2026).

Access to prior images can prevent unnecessary repetition and radiation exposure. External studies should be verified and linked correctly before clinical use.

Patient Access

Patients are participants in interoperability, not merely subjects of exchange. Portals and standardized application programming interfaces can allow people to view, download, and share records. Access can improve medication accuracy, appointment preparation, and care coordination (Office of the National Coordinator for Health Information Technology, 2026).

Information should be understandable and accessible. A raw laboratory code does not create

meaningful access without explanation. Proxy access, adolescent confidentiality, caregivers, disability, language, and digital inequality require careful design.

Standards

HL7 FHIR

Fast Healthcare Interoperability Resources, or FHIR, is an HL7 standard using modular resources and modern web approaches for health-data exchange. Resources represent items such as Patient, Observation, Medication, Condition, Encounter, and DiagnosticReport. APIs can allow authorized applications to request or transmit specific information rather than exchanging one large document (Office of the National Coordinator for Health Information Technology, 2026).

FHIR is flexible, which is both a strength and a challenge. Organizations need common implementation guides, profiles, terminology, and testing. Two products claiming FHIR support may still differ unless they implement the same version and constraints.

USCDI

In the United States, the United States Core Data for Interoperability defines standardized data classes and elements for nationwide exchange. It includes areas such as allergies, medications, laboratory results, clinical notes, procedures, problems, and provenance. ONC updates the standard as policy and clinical needs evolve (Office of the National Coordinator for Health Information Technology, 2026).

USCDI establishes a baseline, not the entire patient record. Specialized fields may require USCDI+ or domain implementation guides. Organizations should plan version adoption rather than assume standards remain static.

Terminology Standards

LOINC supports laboratory and clinical observation identification, SNOMED CT supports clinical concepts, RxNorm supports normalized medication names in the United States, and ICD classifications support reporting and billing. Correct mapping requires governance and review (Office of the National Coordinator for Health Information Technology, 2026).

Local codes may remain necessary, but they should be mapped to standard concepts where exchange requires it. A mapping should preserve specificity and identify uncertainty rather than force an incorrect equivalent.

TEFCA and Exchange Networks

The Trusted Exchange Framework and Common Agreement provides a governance and technical floor for nationwide exchange through qualified networks in the United States. It aims to reduce the need for separate agreements among every organization (Office of the National Coordinator for Health Information Technology, 2026).

Participation does not remove local responsibilities. Organizations still need patient matching, privacy, appropriate use, response workflows, and security. Network connectivity is infrastructure, not the complete clinical process.

Proposed Information Flow

A patient presents to a clinician, who records history and orders laboratory tests. The order travels electronically with the necessary patient, specimen, and clinical information. The laboratory returns coded results to the record. The clinician reviews and acknowledges the results, updates the diagnosis, and sends an electronic prescription if appropriate.

The pharmacy receives the prescription, checks allergies and interactions, clarifies questions, dispenses the medication, and makes dispensing information available. If specialist consultation is required, the referral includes relevant notes and results. The specialist returns a report, and the primary clinician incorporates the plan.

The patient receives understandable access to instructions, results, medication information, and follow-up. Every exchange records provenance so users know who created the information and when (Office of the National Coordinator for Health Information Technology, 2026).

Clinical Benefits

Safety

Interoperability can identify allergies, duplicate medications, previous reactions, abnormal trends, and recent procedures. Emergency clinicians can make better decisions when reliable history is available (Office of the National Coordinator for Health Information Technology, 2026).

Safety improves only when data are current and reconciled. An outdated allergy or incorrectly merged record can produce harm. The system should display source and confidence.

Efficiency

Electronic exchange can reduce calls, faxing, repeated data entry, and duplicate tests. Staff can spend less time locating information. Patients may avoid carrying paper records among departments (Office of the National Coordinator for Health Information Technology, 2026).

Efficiency gains require workflow redesign. If staff must enter the same data into multiple screens or manually scan every message, the interface has shifted rather than removed work.

Continuity

Patients often move among primary care, specialists, hospitals, laboratories, pharmacies, rehabilitation, and home services. Interoperability preserves continuity across transitions where medication discrepancies and missed follow-up frequently occur (Office of the National Coordinator for Health Information Technology, 2026).

Population Health

Standardized data support public-health reporting, quality measurement, disease surveillance, and identification of care gaps. Data should be complete enough to evaluate equity across populations without exposing individuals unnecessarily (Office of the National Coordinator for Health Information Technology, 2026).

Risks

Privacy

More connected data can reach more authorized users but also creates more opportunities for inappropriate access. Role-based controls, consent management, minimum necessary use, auditing, and sanctions are essential. Sensitive information may require segmentation according to law and patient expectation (Office of the National Coordinator for Health Information Technology, 2026).

Cybersecurity

Interfaces, APIs, third-party applications, and exchange networks expand the attack surface. Security includes authentication, encryption, patching, monitoring, backup, incident response, and vendor management. An unavailable system can interrupt care even when no data are stolen (Office of the National Coordinator for Health Information Technology, 2026).

Information Overload

Importing an entire external record can create duplicates and make important information harder to find. Systems need reconciliation and intelligent presentation, not indiscriminate copying.

Incorrect Data

Interoperability spreads errors as efficiently as correct information. Users need mechanisms to correct records, preserve audit history, and notify downstream recipients of significant changes (Office of the National Coordinator for Health Information Technology, 2026).

Leadership and Governance

The original essay correctly assigns management a major role. Leaders set the purpose, fund implementation, resolve cross-department conflict, monitor risk, and hold vendors accountable. The project should have an executive sponsor, clinical leadership, technical architecture, privacy and security representation, patient input, and operational owners (Ledlow & Coppola, 2013).

Governance should decide which data are exchanged, who can access them, how identity is matched, how errors are corrected, and how standards are maintained. A project cannot rely on the information-technology department to make clinical and ethical decisions alone (Ledlow & Coppola, 2013).

Implementation Phases

Current-State Assessment

The organization should map existing systems, interfaces, paper processes, data ownership, pain points, and regulatory requirements. Interviews and observation reveal hidden workarounds (Ledlow & Coppola, 2013).

Use-Case Selection

Implementation should begin with a defined use case such as electronic laboratory results, medication reconciliation, or closed-loop referral. Trying to integrate every process at once increases risk (Ledlow & Coppola, 2013).

Data and Standards Design

The team defines required data, codes, mappings, consent, identity, and interface behavior. Test cases should include missing, corrected, duplicate, and unusual data (Office of the National Coordinator for Health Information Technology, 2026).

Build and Testing

Testing includes technical conformance, clinical accuracy, security, load, downtime, and usability. Clinicians should verify that meaning survives exchange. A successful message transmission is not enough if the result appears in the wrong place (Office of the National Coordinator for Health Information Technology, 2026).

Pilot and Deployment

A controlled pilot allows correction before organization-wide rollout. Support staff should monitor issues in real time. Deployment may be phased by department, site, or transaction type (Ledlow & Coppola, 2013).

Training and Change Management

The original essay proposes memos, meetings, and interdepartmental training. These are useful but insufficient alone. Training should be role-specific and scenario-based. A laboratory employee, pharmacist, physician, registration clerk, and privacy officer need different skills (Ledlow & Coppola, 2013).

Staff should understand why the workflow changed, how to identify errors, and whom to contact. Super-users and floor support help after launch. Training should continue when standards or software change (Ledlow & Coppola, 2013).

Patient Engagement

Patients can identify errors that institutions miss. The project should include a process for requesting correction and explaining how records are shared. Consent language should be understandable (Office of the National Coordinator for Health Information Technology, 2026).

Not every patient has broadband, a smartphone, English fluency, or digital confidence. Interoperability should improve access without eliminating human and paper alternatives.

Measuring Success

Measures can include time to result availability, duplicate-test rate, medication discrepancies, referral closure, record-match errors, user satisfaction, portal access, downtime, security incidents, and clinical outcomes. Volume of messages is not a sufficient success measure (Ledlow & Coppola, 2013).

Baseline data should be collected before implementation. Measures should be stratified where appropriate to determine whether benefits reach rural, low-income, disabled, and language-minority patients.

Downtime and Continuity

Hospitals must be able to function when interfaces or networks fail. Downtime procedures should define how orders, results, medications, and identity are handled and later reconciled. Paper fallback forms, local read-only access, backup communication, and recovery testing may be necessary (Office of the National Coordinator for Health Information Technology, 2026).

Restoration must avoid duplicating transactions created during downtime. Reconciliation is part of recovery.

Vendor Management

Contracts should define standards, data ownership, export, uptime, support, security, incident notification, testing, and termination. Proprietary barriers can trap information and increase cost (Ledlow & Coppola, 2013).

The organization should verify actual interoperability rather than rely on marketing claims. Demonstrations should use realistic data and external systems.

Conclusion

Interoperability enables clinicians, laboratories, pharmacies, specialists, hospitals, and patients to exchange and use health information across organizational boundaries. The original proposed flow remains valuable: consultation creates information, the laboratory contributes diagnostic results, the clinician makes decisions, and the pharmacy supports safe medication use (Office of the National Coordinator for Health Information Technology, 2026).

Modern implementation requires more than connecting departments. FHIR, USCDI, clinical terminology, exchange networks, identity matching, provenance, privacy, and cybersecurity provide the technical and policy foundation. Governance and workflow determine whether the exchanged

information improves care (Office of the National Coordinator for Health Information Technology, 2026).

Leadership should begin with a defined use case, involve clinicians and patients, test meaning and safety, train staff, and measure outcomes. The goal is not the largest possible amount of data movement. It is the right information, about the right patient, reaching the right authorized person, in a usable form, at the time it is needed (Ledlow & Coppola, 2013; Office of the National Coordinator for Health Information Technology, 2026).

References

Office of the National Coordinator for Health Information Technology. (2026). *Interoperability*.

Office of the National Coordinator for Health Information Technology. (2026). *HL7 FHIR resources and federal action planning*.

Office of the National Coordinator for Health Information Technology. (2026). *United States Core Data for Interoperability*.

Ledlow, G. J. R., & Coppola, M. N. (2013). *Leadership for health professionals*. Jones & Bartlett Learning.