

# Driving healthcare intelligence throughout the continuum of care with standards-based interoperability

Philips supports improving care through clinical intelligence

## Summary

Initiatives around the globe involve healthcare reform to help manage patient care more effectively and affordably. Predictive modeling provides the potential to intervene before patients become critically or chronically ill to help save lives and manage resources effectively. New healthcare delivery models based on knowledge management use clinical information to provide clinical intelligence to reach a number of goals. These goals include improving the health of populations, advancing patient-centered continuity of care, improving the efficiency of providing care, and reducing healthcare costs through such steps as reducing patient readmissions. Interoperability is essential to the smooth flow of data that makes this possible. This paper reviews some basic concepts of interoperability with a focus on IHE (Integrating the Healthcare Enterprise) and examples of how interoperability can be used to facilitate the exchange of clinical information across the continuum of care.

## Background

Sophisticated data mining and health informatics depend on accurate, private, secure, and cost-effective sharing of clinical data among various systems and enterprises. Initiatives such as the Care Connectivity Consortium, which includes Kaiser Permanente, Mayo Clinic, Geisinger Health System, Intermountain Health, and Group Health Cooperative focus on sharing and accessing real time data about patients to help caregivers provide better and more effective care. In Europe, epSOS (European Patients-Smart Open Services) concentrates on advancing the ability to share patient information among different European healthcare systems to improve the quality and safety of healthcare. NEHTA Limited (National E-Health Transition Authority), a not-for-profit company established by the Australian government, seeks to develop better ways to electronically collect and securely exchange health information. A major objective of the HITECH Act in the United States involves the exchange

and use of health information. These initiatives, and others around the world, have in common the need to reduce healthcare costs and transform patient care.

The interchange and management of meaningful clinical data as part of an integrated process across the continuum of care and clinical research can help facilitate early diagnosis, reduce readmissions, better manage population health, and improve the operational efficiency of patient care. Predictive modeling and comparative effectiveness research integrated with daily patient care can help better manage patients before they experience critical or chronic illnesses. Virtual and remote monitoring of the patient during home recovery can assist in interventions to reduce readmissions. Linking community and rural providers and specialists can help better manage population health. Better coordination of care facilitates the best possible outcome for the patient faster and more efficiently.

## Interoperability considerations

Two key levels of interoperability to consider are syntactic (functional), which is the ability of two or more systems to exchange information, and semantic, which is the ability to use the information exchanged.

## Standards and initiatives

Standards designed for patient-focused, as well as population-focused, objectives can help systems reach the semantic level of interoperability. Standards such as ICD-10 for disease classification or CDISC for clinical research data element definitions help facilitate a semantic level of interoperability. As more patient health information is collected, stored, and transmitted electronically the concern for patient privacy and security grows on a global basis. Governments around the world have enacted legislation to protect individually identifiable health information (e.g., USA-HIPAA, Canada-PIPEDA, general privacy legislation under the European Directive 95/46/EC, Japan-PIPA, and others). IEC 80001-1 is a standard for the purpose of risk management of IT-networks incorporating medical devices to address safety, effectiveness, and data and system security.

In addition to standards development activities, initiatives such as IHE and Continua Health Alliance leverage multiple industry and cross-industry standards for practical system-to-system sharing of data. These initiatives facilitate the syntactic level of interoperability and help pave the way for semantic interoperability.

The sidebar gives a brief description of some key standards and initiatives. They focus on different aspects of interoperability that together, when widely adopted by the healthcare industry, can contribute to a harmonized approach to interoperability to help advance healthcare intelligence.

The remainder of this paper will focus on IHE.

## Integrating the Healthcare Enterprise

IHE uses a “best practices” approach to solving interoperability issues associated with multiple, heterogeneous information systems to help resolve ambiguities and conflicting interpretations. It coordinates the use of established standards such as DICOM and HL7 and also answers issues that remain unresolved even with the use of these standards. As members of IHE, industry subject experts--both vendor and healthcare institutions--collaborate and develop detailed implementations of standards to provide consistency for integrations.

IHE is organized across a growing number of clinical and operational domains. Each domain produces its own set of technical framework documents, in close coordination with other IHE domains. Domains include:

- Cardiology
- IT Infrastructure
- Patient Care Coordination
- Patient Care Device
- Radiology
- Quality, Research, and Public Health
- Anatomic Pathology
- Radiation Oncology

Global deployment and promotion is supported by a product registry of several hundred vendor systems supporting use cases and a network of affiliated national and regional organizations that coordinate testing and interoperability demonstrations such as the Healthcare Information and Management Systems Society (HIMSS) annual Interoperability Showcase.

IHE runs an annual Connectathon, which is the healthcare IT industry’s only large-scale international interoperability validation testing event. During the event multi-vendor systems exchange information, performing all the transactions required in support of defined clinical use cases, removing barriers to integration that would otherwise have to be dealt with repeatedly, and using proprietary approaches, at customer sites during installation.

# A brief guide to some key health care standards and initiatives

(Note: Not a comprehensive guide)

## Standards:

### **HL7 (Health Level Seven International)**

Clinical data: Standards for healthcare informatics interoperability including the exchange of clinical, financial, and administrative data. [www.hl7.org](http://www.hl7.org)

### **DICOM (Digital Imaging and Communications in Medicine)**

Image data: Standards for handling, storing, printing, and transmitting information in medical imaging. [www.rsna.org/Technology/DICOM](http://www.rsna.org/Technology/DICOM)

### **SNOMED CT (Systematized Nomenclature of Medicine – Clinical Terms)**

Clinical terms: Standards for computerized clinical terminology covering clinical data for diseases, clinical findings, and procedures. [www.ihtsdo.org](http://www.ihtsdo.org)

### **LOINC (Logical Observation Identifiers Names and Codes)**

Lab terms: LOINC offers universal names and codes for identifying lab results to support the exchange of lab information between separate systems. [www.loinc.org](http://www.loinc.org)

### **ASTM CCR (Continuity of Care Record)**

Health summary: Standards for the patient health summary to support capture and exchange of an individual's most relevant personal health information. [www.ccrstandard.com](http://www.ccrstandard.com) and [www.astm.org/standards/E2369](http://www.astm.org/standards/E2369)

## Initiatives:

### **Continua Health Alliance**

Continua is a non-profit industry alliance to develop interoperable personal connected health solutions in the home. The Alliance operates a testing and certification program to validate interoperability of certified products. [www.continuaalliance.org](http://www.continuaalliance.org)

### **ICD-9/10 (International Classification of Diseases)**

Disease names: ICD-9/10 code and classify morbidity data from inpatient and outpatient records, physician offices, and most National Center for Health Statistics (NCHS) surveys. [www.cdc.gov/nchs/icd](http://www.cdc.gov/nchs/icd)

### **CDISC (Clinical Data Interchange Standards Consortium)**

CDISC and HL7 together develop standards for clinical data to enable information system interoperability used in medical research and related areas of healthcare. These standards support the acquisition, exchange, submission, and archive of clinical research data and metadata. [www.cdisc.org](http://www.cdisc.org)

### **ISO/IEC 11179**

Repository metadata: ISO/IEC 11179 provides a standard grammar and syntax for describing data elements and associated metadata that results in unambiguous representation and interpretation of the data. [www.metadata-standards.org](http://www.metadata-standards.org)

### **CEN ISO/IEEE P11073**

Medical device communication: Standards for device communication between agents (e.g., blood pressure monitors, weighing scales) that collect information about a person and manager (e.g., cell phone, health appliance, or personal computer) for collection, display, and possible later re-transmission. [ieeexplore.ieee.org](http://ieeexplore.ieee.org)

### **IHE (Integrating the Healthcare Enterprise)**

IHE leverages established healthcare integration standards to create best practices for integrating applications, systems, and settings across the entire healthcare enterprise. IHE organizes, manages and publishes results of Connectathon annual interoperability validation testing events for multiple vendor systems. [www.ihe.net](http://www.ihe.net)

## IHE compliant systems help facilitate exchange of information throughout the continuum of care

As a patient moves among care areas, IHE compliant systems help facilitate a smooth flow of information. To describe examples of integration across the continuum of care, we will explore a scenario of a patient experiencing a heart condition:

### Emergency department treatment room

A patient with a possible heart condition is under evaluation in the treatment room of the emergency department (ED) where a device is used to monitor his vital signs. He undergoes continuous physiological data monitoring with observation reporting in support of IHE Integration Profile Device Enterprise Communication (DEC). Transmitting information such as complete waveforms, trends, alarms, and numerics from medical devices at the point of care to enterprise applications in a consistent way using DEC can help shorten clinician decision time, increase productivity, minimize transcription errors, and facilitate increased contextual information of the data in the electronic health record (EHR), clinical data repository (CDR), or other enterprise systems.

The patient vital signs indicate a need for the physician to order an immediate CT. The patient then moves to the imaging department.

### Imaging department

The imaging department personnel process the physician's order and supportive material from the ED complying with IHE Integration Profile Scheduled Workflow (SWF) for order filling. Systems that support SWF reduce manual data entry to a single incidence, which can reduce errors and save time identifying and correcting them. It also facilitates study identification and status are accurately tracked throughout the department to help minimize "lost" studies.

The patient undergoes scanning in the imaging department where images are captured and stored. Based on IHE Integration Profiles XDS.b and XDS-I.b, the radiology report and the images are made available in a consistent way to physicians in the ED and ICU as well as to the cardiologist treating the patient. XDS.b enables consistent sharing of EHR documents between healthcare enterprises, physician offices, clinics, acute care inpatient facilities, and personal health records. Systems that support XDS-b help facilitate registration, distribution, and access across health enterprises. XDS-I.b enables consistent sharing of images, diagnostic reports, and related information across a group of care sites.

The patient then moves to the intensive care unit for treatment.

### Intensive care unit (ICU)

In the ICU, physicians are able to view all prior documentation and images by discovering and retrieving this information with their XDS.b compliant registry and repository. The patient may be put on an infusion pump to administer required medication to treat a diagnosed heart condition. He is monitored by a bedside device compliant with the DEC integration profile. The monitor may be integrated with an alarm manager that conforms to IHE Integration Profile Alarm Communication Management (ACM) for communicating alarms to a portable device such as a mobile phone. This provides a secondary means for notifying the appropriate person for a condition needing timely human intervention. It also automates an otherwise manual workflow notification process.

The patient condition stabilizes and the patient then moves to the general medical-surgical unit for general oversight during recovery.

### Medical-surgical unit

In the Med-surg unit, a medical device monitors the patient's vital signs and displays them on the hospital information system (HIS) consistent with the IHE Integration Profile DEC.

Over time, the patient continues to be stable and is discharged. He later sees his primary care physician for a follow-up visit.

### Primary care physician (PCP) office

The hospital has provided a discharge summary reflecting the care provided and makes this available to the patient's PCP in a consistent manner using IHE Integration Profile XDS.b for cross enterprise document sharing. The PCP conducts a resting ECG. The electrocardiograph generates ECGs and distributes them, such as to a community health information exchange (HIE) in support of IHE Integration Profile REWF for resting ECG Workflow. Systems that conform to REWF allow users to register a patient, order a test, perform the test (acquiring the waveforms), and interpret the results (reporting) in an interoperable way. It can handle unordered tests, urgent cases, and ECGs acquired in both hospital and office settings.

The results of the ECG show that the patient is responding well to treatment. The patient goes home until his next follow-up visit with his PCP.

### Research

While it is uncommon to consider research institutions as a care area, one can consider predictive modeling efforts and comparative effectiveness research as an extended care area. This is where a continuous flow of data from patients with conditions relevant to ongoing research can help develop new and more effective healthcare delivery models and standards of care based on realistic clinical conditions. The IHE integration profiles identified in this scenario as well as other profiles can be applied to integrate data between patient care enterprises and research institutions.

## Philips champions standards-based interoperable solutions for patient care and clinical informatics

Philips is deeply committed and actively involved in driving interoperability industry standards. We currently chair or co-chair approximately 20 different standards committees and actively participate in many more, with the mindset that greater interoperability promotes better patient care.

### Philips strongly supports IHE

Since 2003 Philips Healthcare has issued more than 105 integration statements, evidence that we have consistently supported IHE and other standards in very practical ways.

In radiology and cardiology, for example, Philips solutions such as our image acquisition systems, image management systems, and workstations have supported IHE integration profiles for many years.

Image acquisition systems	Philips products include
Computed Tomography	CT Brilliance, MX8000
Electrophysiology	EP Navigator
Fluoroscopy	EasyDiagnost Eleva, MultiDiagnost Eleva
Interventional X-ray	Allura Xper, Integris, Veradius, Pulsera
Magnetic Resonance Imaging	Intera, Achieva, Panorama
Nuclear Medicine	GEMINI, Odyssey
Radiography	Eleva Workspot, Digital Diagnost, MammoDiagnost
Ultrasound	iE33, iU22, HD11, HDI 5000
Image management systems	Philips products include
PACS Systems and Web Viewing	IntelliSpace PACS, IntelliSpace Portal, iSite, Xcelera
Patient Monitoring	IntelliVue Information Center, IntelliSpace Event Management
Applications and Workstations	Philips products include
Standalone Workstations	ViewForum, Extended Workspace EWS

Philips is also committed to providing new solutions for efficient and lower cost standards-based patient care and clinical informatics that are interoperable with multi-vendor medical devices and enterprise systems across the continuum of care.

## Some of the IHE integration profiles that Philips supports

IHE Integration Profile	Care area(s)
<p><b>Device Enterprise Communication (DEC)</b> For transmitting information from medical devices at the point of care to enterprise applications.</p>	<p><b>General floor</b> <i>Providing interoperability for sharing spot check vital signs:</i> SureSigns VS with IntelliBridge Enterprise* now conforms to IHE Integration Profile Device Enterprise Communication (DEC) to allow standards-based enterprise sharing of spot check monitoring data.</p> <p><b>Critical care</b> <i>Providing interoperability for sharing critical monitoring data:</i> IntelliVue Information Center with IntelliBridge Enterprise* supports the IHE DEC Integration Profile to allow standards-based enterprise sharing of complete waveforms, trends, alarms, and numerics from wired and wireless networked Philips patient monitors and telemetry systems, as well as the HeartStart MRx Monitor/Defibrillator.</p>
<p><b>Cross Enterprise Document Sharing (XDS.b)</b> For sharing and discovering EHR documents between healthcare enterprises, physician offices, clinics, acute care in-patient facilities and personal health records. Facilitates the registration, distribution, and access across health enterprises of patient EHRs.</p> <p><b>Cross Enterprise Document Sharing for Imaging (XDS-I.b)</b> For sharing images, diagnostic reports, and related information across a group of care sites. Provides an imaging component to the EHR, effective means to contribute and access imaging documents across health enterprises, scalable sharing of imaging documents, and easier access to imaging documents.</p> <p><b>Scheduled Workflow (SWF)</b> For integrating ordering, scheduling, imaging acquisition, storage, and viewing activities associated with radiology exams.</p>	<p><b>Radiology</b> <i>Providing interoperability for sharing radiology documents and images:</i> IntelliSpace PACS supports multiple IHE Integration Profiles, including SWF, XDS.b and XDS-I.b.</p>
<p><b>Alarm Communication Management (ACM)</b> For communicating alarms, allowing a patient care device to send a notification of an alert or alarm condition to a mobile device.</p>	<p><b>Multiple care areas</b> <i>Providing interoperability to manage event notifications:</i> IntelliSpace Event Management V10 conforms to IHE Integration Profile Alarm Communication Management (ACM) for a standards-based way to manage alerts from patient monitors, nurse calls, and clinician information systems to simplify complex input and output flow and provide meaningful alerts to caregivers on their communication devices. IEM helps provide better coordination of care by delivery meaningful information to caregivers where they need it, in the right format, at the exact point of care – regardless of a caregiver’s location.</p>

\* Philips new IntelliBridge Enterprise provides a single, standards-based, interface point for HL7 data between enterprise systems and Philips patient care and clinical informatics systems. This reduces the number of system connections to the EMR, ADT, CPOE, Lab or other system such as for clinical research. IntelliBridge Enterprise leverages the existing infrastructure and offers virtualization, high availability, disaster recovery, fully automated backups, and remote access and support. It is pretested, reliable, and repeatable to help reduce the cost of implementation. The goal is to help provide for a more affordable interoperable standards-based solution to interchange and manage meaningful clinical data across the continuum of care.

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Printed in The Netherlands.  
FEB 2012