HL7 Uncovered: Understanding the Evolution of Health Data Standards

Those who work in the digital health sector know well that there is no single "HL7 Standard": this, in fact, does not present itself as a single and linear corpus, but as a set of evolutions that over time have responded to different technological and organizational needs: from the wide diffusion of v2, to the more rigorous modeling of v3, up to the modular and web-based approach of FHIR.

The question that many organizations ask themselves is therefore simple only in appearance: which version of HL7 should be used in its context? The answer depends on various factors, such as the level of integration required, the resources available and the need to open to future digital health scenarios.

The purpose of this article is to compare the main versions, to offer some useful ideas to guide the choice.

HL7 Version 2

As one of the world's most widely adopted standards for health information management, HL7 v2 was originally released in October 1987 as an application protocol for electronic data exchange in healthcare settings. Version 2.7, which is the most recent update to v2, was released in 2011.

HL7 v2 works based on an event-based model in which a message is sent after a health event occurs, such as a patient registration, discharge from a hospital, or the conclusion of a laboratory test.

The messages of HL7 v2 are human-readable, in ASCII, and the data are encoded in a structure composed of Segments, Fields, Components etc... delimited by different types of separators. Message types can be of various types, e.g., ADT (Admission, Discharge, Transfer), ORU (Observation Result), ORM (Order Message), etc.

As a protocol, it is characterized by great flexibility, on the one hand allowing different implementation choices, but on the other decreasing interoperability.

HL7 v2 is better suited for simple point-to-point data transactions between known systems, rather than for enterprise-wide information exchange.

HL7 Version 3

HL7 v3 was designed in the late 90s to replace v2 messaging. It provides an XML-based standard for representing, sharing, and integrating health information across systems.

Unlike HL7 v2, it uses formal information models that ensure semantic interoperability. In particular, encoding is organized according to the HL7 Reference Information Model (RIM). RIM uses the following main classes:

- Entity
- Role
- Act: (action/event): each health event is represented as an Act, in which entities with specific roles participate

Due to its complexity, it is much less prevalent than the HL7 v2 version.

HL7 FHIR

The HL7 Fast Healthcare Interoperability Resources (FHIR) Standard was introduced in 2011, while its latest release, R5, dates to 2023.

HL7 FHIR messages operate using a modern approach based on RESTful APIs over HTTP. It consists of several key components, in particular the Resources: Represented by modular data models that identify clinical and administrative entities; the most common are Patient, Practitioner, Observation, Condition. Resources can be structured in JSON or XML.

In conclusion, it is considered the most modern standard, as it offers API-based interoperability with better access capabilities for patients. Now it is not yet used as much as HL7 v2, but it is destined to spread very quickly.

Conclusion

To better understand how the HL7 standards have evolved over time, here is a table that clearly summarizes the main differences between v2, v3 and FHIR, comparing structure, protocols and areas of use.

Feature	**HL7 v2**	**HL7 v3**	**HL7 FHIR**
Year of introduction	1987 (last release: v2.7 in 2011)	Late 90s	2011 (last release: R5 in 2023)
Message format	ASCII Text with Delimiters (Segments, Fields, Components)	RIM-based XML	JSON or XML (via RESTful API over HTTP)
Reference Model	Event-driven, without formal information model	RIM (Reference Information Model) con classi: Entity, Role, Act	Risorse modulari (es. Patient, Observation, Practitioner)
Main message types	ADT, ORU, ORM, etc.	Structured according to RIM	Clinical and administrative resources (e.g., Condition, Encounter)

Feature	HL7 v2	HL7 v3	HL7 FHIR
Interoperability	High flexibility, but low semantic interoperability	Greater semantic interoperability, but high complexity	Modern interoperability via API, easy access for patients
Transport protocols	TCP/IP with MLLP	TCP/IP with MLLP or SOAP/HTTP(S)	HTTP/HTTPS (RESTful su TCP/IP)
Dissemination	Very popular worldwide	Not very common due to complexity	Growing, set to become the leading standard
Suitable for	Point-to-point transactions between known systems	Structured and semantically coherent, but complex exchange	Agile and modern exchange, integration with web applications and services

Table 1

From the simplicity and diffusion of HL7 v2, through the greater structure but complexity of HL7 v3, up to the modernity and flexibility of FHIR, these standards tell the evolution of interoperability in healthcare, increasingly oriented towards rapid, safe and accessible exchanges also for patients.

Sources:

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Author: Silvia Palazzi, R&D Product Specialist