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WHITE PAPER

The HL7 Evolution

Comparing HL7 Versions 2 and 3

Executive Summary

HL7 Version 3 was released for clinical application use in 2005 and medical informaticists began using it as a vocabulary to discuss worldwide healthcare issues. Government entities have utilized Version 3 to create interfaces between previously separate systems. Healthcare entities in Europe, Canada, Germany, and several others launched initiatives to implement Version 3. Even with these activities, HL7 V3 remains in the infant maturity stage, especially within the United States, where HL7 V2 is the preferred version (see Figure 1).

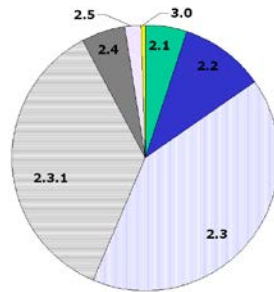


Figure 1: Real-world usage of HL7 messaging standards (approximate). The vast majority of HL7 messaging is done using HL7 2.3 or HL7 2.3.1. Newer releases of HL7 (2.6, 2.7, and 3.0) represent a very small portion of interfaces.

HL7 V3 addresses some of the problems inherent in HL7 V2 while creating its own set of challenges. HL7 V3 builds upon much of what was learned during the development of V2, but without the burden of V2 legacy issues.

This article provides a background on HL7 and highlights the key differences between HL7 V3 and V2.

What is HL7?

Health Level 7 (HL7) is a Standards Developing Organization accredited by the American National Standards Institute to author consensus-based standards representing a broad view from healthcare system stakeholders. What this definition means from a practical standpoint is that HL7 has compiled a collection of message formats and related clinical standards that loosely define an ideal presentation of clinical information, and together the standards provide a framework in which data may be exchanged.

[The HL7 standard](#) is often called the “non-standard standard.” While not entirely fair, it does reflect the fact that almost every hospital, clinic, imaging center, lab, and care facility is “special” and, therefore, there is no such thing as a standard business or clinical model for interacting with patients, clinical data, or related personnel.

Who uses HL7?

To set the context for both HL7 V2 and V3, it is important to understand the user types and how they influence both the development and use of the standard. Users can be divided into three segments:

1. **Clinical interface specialists** who are tasked with moving clinical data, creating tools to move such data, or creating clinical applications that need to share or exchange data with other systems. These users are responsible for moving clinical data between applications or between healthcare providers.
2. **Government or other politically homogeneous entities** that are looking to share data across multiple entities in support of government initiatives or population health. Generally, few legacy systems are present. These users have the ability to move clinical data without being constrained by current [interfaces](#). They have greater opportunity to adopt the most recent messaging standards.
3. **Medical informaticists** who work within the field of health informatics, which is the study of the logic of healthcare and how clinical knowledge is created. These users seek to create or adopt a clinical ontology – a sort of hierarchical structure of healthcare knowledge (a data model), terminology (a vocabulary), and workflow (how things get done). An informatist is interested in the theoretical representation, semantic interoperability, and extensive modeling of the acts and actors of healthcare.

Why was HL7 created?

Before HL7 V2, every interface between systems was custom designed and required programming from both the sending application and the receiving application. Interfaces were expensive because there was no standard collection of patient attributes or standard set of “interesting events.”

As shown in Figure 2, in the 1980s the number of clinical interfaces in a typical hospital was small, and the cost per interface was very high.

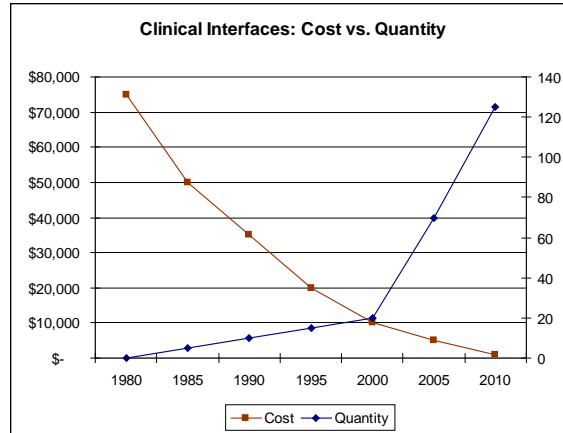


Figure 2: The cost and quantity of application interfaces at a typical hospital over time. Early clinical interfacing was very costly, and HL7 was formed to reduce the expense of building interfaces. The number of interfaces at a typical facility slowly grew during the 1980s and early 1990s. Since the late 1990s, interface counts have grown more quickly and costs have declined, although not as significantly since the year 2000.

Interfacing is a challenge for internal hospital teams and software vendors because applications are developed without input or collaboration with other application development teams. In other words, commercial development teams rarely share proprietary data about how their applications are built, which makes it difficult for other teams to build compatible applications.

HL7 was born after forward-thinking healthcare community members formed a volunteer group to make interfacing “easier.”

How was HL7 V2 created?

It is important to recognize that HL7 V2 was created by clinical interface specialists and V3 was created mostly by medical informaticists. Consequently, the initial use and focus for each standard is unique.

As noted earlier, there are three types of HL7 users – clinical interface specialists, government entities, and medical informaticists. HL7 V2 was mostly created by the users of applications, or the clinical interface specialists. Therefore, the development approach for HL7 V2 is considered to be “real-world focused.”

A small number of clinical interface specialists from acute care hospitals and software vendors formed a volunteer group called Health Level 7, or HL7, with the goal of creating an easier, more standardized way of building healthcare interfaces to substantially reduce programming costs.

Without a standards history to rely upon, but with a goal to limit 100 percent customized interfaces, the group began loosely defining an implied data model and messaging “touch points” between applications.

To develop a standardized format that allowed room for customization by skeptical vendors and healthcare providers, the group adopted an 80/20 approach.

To meet their vision of significantly reduce interfacing costs, the group found it was only necessary to predefine 80 percent of the interface framework. They left the remaining 20 percent open for customization, which allows a facility or vendor to reflect unique business, clinical, and workflow rules.

This 80/20 approach was practical in meeting the requirements of clinical specialization and application uniqueness, which bring so many challenges across the continuum of care. This practical solution led to widespread acceptance of the HL7 standard.

What is HL7 V2's value?

The value of the HL7 standard is driven by the user type. For a clinical interface specialist, evaluating the power of any new technology or IT standard requires understanding the “Network Effect” – in other words, the standard’s value vastly increases as it is adopted by more sites and vendors.

Consider any of the popular standards in use today: TCP, IP, HTTP, HTML, POP, telnet, Windows, or even the ASCII character set. They are all valuable because they have a widespread user base and because the standards work in the real world.

Ultimately, HL7 achieved the Network Effect by using a balanced approach that made it easy to adopt – solve 80 percent of the clinical interfacing problems in a flexible manner using a consensus- and volunteer-driven process.

The result: HL7 V2

Early releases of HL7 (V2.1 and V2.2) were vague and poorly documented when compared to later releases. In early V2, little was formally specified for a number of reasons:

- The community needed more users and vendors to adopt the standard.
- The more flexible and vague the standard, the easier it would be to adopt.
- A rigid standard would be easy to dismiss as “unworkable” because every healthcare entity and application is considered special or unique.
- Early versions of HL7 only needed to specify about 80 percent of the interface in the framework.

The tipping point for HL7 V2 acceptance came in 1998, when it became advantageous for new applications to utilize the 80 percent standard because

enough vendors and healthcare providers had already implemented HL7. Building a 100 percent custom interface was no longer justifiable or needed.

The V2 standard grew over time as it became more defined and included more information. The first usable version was 2.1 (released in 1990) with minor additions in 2.2 (1994) and ultimately 2.3 (1997) and 2.3.1 (1999).

The exact version of HL7 used by an application is not critical since the V2 versions are mostly compatible with one another. Said another way, HL7's V2 philosophy is that newer versions of HL7 V2 should be backwards compatible with older versions of 2.X.

As data elements and messages are added to new V2 releases, they are marked as optional elements. The backwards compatibility means that, in general, a newer application can process a message from an older application and an older application can process a newer message. This is a very attractive idea but can be challenging to implement.

In the late 1990s as vendors began the HL7 adoption cycle, most chose which HL7 version to support by using one of the following approaches:

- The current version of HL7 (V2.3 or V2.3.1)
- The version of HL7 that their first healthcare application or vendor already implemented (typically versions 2.2, 2.3, or 2.3.1)

The Network Effect drives almost all users to adopt the *de facto* standard of HL7. As shown previously in Figure 1, the majority of applications use HL7 V2.3 or V2.3.1.

The HL7 community grows

From 1998 to 2002, the HL7 grew and the value of HL7 V2 increased. As newer versions of HL7 were released, the community ultimately achieved the goal of defining 80 percent of an interface and created a framework for negotiation to resolve the remaining 20 percent on an interface-by-interface basis.

With market success, the community began to struggle with the challenge that, with an 80 percent standard, substantial work is still needed to construct an [interface](#). The growing user base was often frustrated with the “non-standard” HL7 standard.

The V2 standard was being reviewed for the first time by the government and medical informatists. These new users placed strong demands on HL7 that stretched its patchwork data model.

HL7's widespread adoption brought significant changes:

- The V2 standard became better refined.
- The volunteers creating the standard increased in size, including users from government entities and medical informaticists.
- The international community began to use HL7 and extended V2 to support healthcare environments and business rules outside of the U.S.

With these changes, there was disagreement between clinical interface specialists and those who want to adopt a new HL7 approach. In general, the healthcare application users and vendors who implemented an 80 percent standard interface had little motivation to replace it with something new, especially if it would only establish an 82 percent or 94 percent standard.

Nevertheless, V3 efforts began in earnest, and a new HL7 standard emerged.

Philosophy of V3

HL7 V2 is a market success, yet it continues to be refined. Many HL7 community members volunteer to enhance HL7 messaging and improve the methods used to define it. Most agree that the main HL7 V2 challenges include:

- **Lack of a consistent application data model.** The display/storage of data by a clinical application directly impacts what portions of HL7 it can successfully implement.
- **Lack of formal methodologies to model data elements and messages.** This causes inconsistencies within the standard and difficulties understanding how message elements relate to each other.
- **Lack of well-defined application and user roles.** Without defined roles, vendors can choose which portions of HL7 to support, causing variation of messages for a given set of clinical functions when two applications attempt to use the V2 standard.
- **Lack of precision in the standard.** The very vagueness and flexibility that led to “simple adoption” of HL7 V2 causes it to be exactly what it was intended to be: an 80 percent solution.

In the late 1990s, a subset of the HL7 standards community decided to address V2 challenges by creating a new V3 standard, with the following goals:

- **Internationalization.** HL7 V3 needs to be able to be used by the worldwide HL7 organization while supporting the need for local variants.
- **Consistent data model.** HL7 V3 needs to define the data model used by HL7 applications for implementation.

- **Precise standard.** HL7 V3 needs to take the information learned from all V2 versions and create a rigid standard containing all the necessary data.
- **New standard.** As the community began to define V3, it decided that the new standard would not be compatible with V2 for a number of reasons. Primarily, if V3 was backwards compatible with V2, the newer standard would be hamstrung with many legacy issues. Any attempt to retrofit an explicit data or application role model into V2 would be impossible if a precise standard is the goal. Finally, the V3 standard needed breathing room so it could radically change to improve the quality of clinical interfaces.

In late 2005, the HL7 community released the first version of HL7 V3, the Normative Edition 2005. Soon after, the Normative Edition 2006 was published. With these two initial releases, many sections of the standard were complete, yet many significant areas were defined in later releases. The V3 release cycle is four times a year, including three Implementation Editions for balloting and testing within the volunteer community and one Normative Edition for general use (released at the end of each year).

From the outset, V3 promises to be a brave new world with “90 percent or more” of the interface predefined. The primary value in the new standard will be an explicit data model, clear definitions, and more use cases that enable less flexibility in individual message elements. The tighter standard promises “easier” interfaces for users.

HL7 V3 vs. V2: A Comparison

While the HL7 V2 standard was created by clinical interface specialists, the V3 standard was influenced strongly by work from volunteers representing the government and medical informatist users. This means that the level of formal modeling, complexity, and internal consistency is radically higher in V3 when compared to V2. Figure 3 shows a sample of the message differences between V2 and V3 messages.

Figure 3:
HL7 V2.X message (below)

```
MSH|^~\ & |AcmeHIS|StJohn|ADT|StJohn|20060307110111||ADT^A04|MSGID20060307110111|P|2.4
EVN|A04
PID|||12001||Jones^John||19670824|M|||123 West St.^Denver^CO^80020^USA
PV1||O|OP^PAREG^|||2342^Jones^Bob|||OP|||||||2|||||||20060307110111|
AL1|1||3123^Penicillin|Produces hives~Rash~Loss of appetite
```

HL7 V3 message (right)

```
- <author>
- <assignedEntity>
  <id root="2.16.840.1.113883.9876.210.3"
  extension="5332443" />
  <telecom value="tel:+1(317)630-7960" />
- <assigneePerson>
- <name>
  <given>Keiko</given>
  <family>Jones</family>
  <suffix>MD</suffix>
</name>
</assigneePerson>
</assignedEntity>
</author>
<!-- Removed consumable -->
- <patientSubject>
- <patient>
  <id root="2.16.840.1.113883.9876.211"
  extension="344253425" />
+ <addr>
  <telecom value="tel:213-555-4344" />
- <patientPerson>
  <id root="2.16.840.1.113883.4.1"
  extension="333224444" />
- <name>
  <given>George</given>
  <given>Simon</given>
  <family>Wigny</family>
```

Outlined below is a summary assessment of the two HL7 versions.

Standard	Benefits	Challenges
HL7 V2	<p>Reflects the complex “everyone is special” world of healthcare.</p> <p>Much less expensive to build HL7 interfaces compared to custom interfaces.</p> <p>Provides 80 percent of the interface and a framework to negotiate the remaining 20 percent on an interface-by-interface basis.</p> <p>Historically built in an <i>ad hoc</i> way, allowing the most critical areas to be pre-defined.</p> <p>Generally provides compatibility between 2.X versions.</p>	<p>Provides a “one-size-fits-none” standard.</p> <p>“Loose and optional ridden” HL7 definitions lead to discrepancies in HL7 interfaces.</p> <p>Not inclusive of international needs.</p> <p>No compatibility with HL7 V3.</p> <p>Requires defining a detailed list of items to be discussed and negotiated before interfacing.</p> <p>Application vendors do not support the latest and best-defined versions of HL7.</p>
HL7 V3	<p>More of a “true standard” and less of a “framework for negotiation.”</p> <p>Model-based standard provides consistency across the entire standard.</p> <p>Application roles well defined.</p>	<p>No compatibility with HL7 V2.</p> <p>Adoption will be expensive and requires time.</p> <p>Long adoption cycle unless strong business case or regulatory requirement</p>

Standard	Benefits	Challenges
	<p>Fewer message options.</p> <p>Less expensive to build and maintain mid- to long-term interfaces.</p> <p>Efforts during a 10-year period reflect a “best and brightest” thinking.</p>	<p>changes.</p> <p>Retraining and retooling necessary.</p> <p>Applications will have to support both V2 and V3 in the foreseeable future.</p>

The early decision to make V3 non-compatible with V2 means that existing V2 interfaces will not, without considerable modification, be able to communicate with newer V3 interfaces. This will create a new “digital divide” where applications that need to speak V3 will also need to speak V2. Early to mid-term adopters of V3 will need both V2 and V3 interfaces to communicate between applications and healthcare providers. The double expense of implementing two HL7 versions likely will deter or delay V3 adoption.

V3 Status and Direction

The adoption of V3 has been in the following areas:

- **Many early adopters were applications without legacy communication requirements.** These applications exist in environments where each end of the interface can be tightly controlled and where the exchange of data with legacy applications is not required. Examples include the U.S. Centers for Disease Control with state-level reporting for the National Electronic Disease Surveillance System and the U.S. Food and Drug Administration’s clinical trial reporting of electrocardiograms.

New communication environments. Regions where HL7 V2 was never or rarely used historically. (e.g., The Netherlands for physician-to-physician communication.)

Politically homogeneous deployments. In locations/regions of the world where one government agency can focus the efforts and force the use of V3. (e.g., The Canadian Institute for Health Information has some localization standards produced for V3 primarily in the area of Claims and Reimbursements.)

- **Use cases where a “snapshot of time” is preferred over messages.** HL7 V3 is both a message standard and a document standard. The HL7 V3 documents are called CDA (Clinical Document Architecture) and can provide a collection of clinical data over an interval of time. This is particularly useful in continuum-of-care scenarios. (e.g. [Meaningful Use](#) mandates for exchanging and viewing clinical documents.)

To date, HL7 V3 messages have not been widely adopted within the United States as a means to exchange clinical data. Current HL7 V2 vendors are generally in a “wait-and-see” mode until their customers demand V3. Regulatory agencies are one exception.

An obvious question can be asked: “Will HL7 V2 simply disappear now that V3 is released?”

We believe the answer is “Not anytime soon.” Millions of dollars and countless hours have gone into developing and maintaining HL7 V2 interfaces. From a financial perspective alone, it is inconceivable that HL7 V2 will quickly disappear.

Another common question is: “When will clinical interfacing switch to HL7 V3?”

The likely answer to this question is: “When the buyers of interfaces demand it and when the dollars are available to make the transition.”

In the U.S., barring a regulatory change, HL7 V2 and V3 will coexist. This is already happening with the use of HL7 V2 messages being used in conjunction with HL7 V3 documents, driven by Meaningful Use legislation. In other countries, adoption will likely continue to unfold.

V3 adoption likely will occur in a slow and methodical fashion. For healthcare professionals, it will be essential to continue to gain education on V3 and become involved in HL7 Working Groups. Sharing lessons learned, watching trends, and evaluating early implementations will assist in determining the next prudent step for your organization.

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Suggested Next Steps

For software vendors:

- Remember that V3's use of XML is only 5 percent of the value of the standard.
- Discuss with your clients (buyers) their needs for HL7 V3. Often users ask for V3 interfaces without an understanding of the scope of the standard or the costs incurred to implement V3.
- Review the HL7 Reference Information Model (RIM) and study the explicit data model.
- Compare the relationships stored in your application database with those modeled in the RIM.

If building a new application, use the RIM's basic concepts and relationships. Early experience shows that you cannot use the exact RIM model as a database schema because performance is too slow.

- Understand that almost all applications that speak V3 must also speak V2.
- Review the application roles in V3 to see what additional application functionality will be needed to support V3.
- Educate your users around HL7 V3 and your plans to support the V3 standard or plans to continue with only V2 messages and V3 documents (a common approach for U.S.-based users).
- Gain education on the HL7 V3 standard and start to understand the impact it will have on your application. Depending on the application, there could be many changes required to adopt V3.
- Become involved in the HL7 organization – this will keep you up-to-date on the most recent developments and allow you to be part of the process.

For healthcare providers:

- Decide if V3 has true value in your environment. What do you expect V3 to do that existing V2 interfaces are not already doing? Do you only want V3 documents while maintain V2 messages?
- Discuss interfacing strategy with your vendors. If you are moving towards V3, review existing vendors' development plans to add V3 or pick new vendors with V3 interfaces.

- Demand V3 from vendors only when there is a solid business or clinical motivation because the costs will be high.
- Expect that mapping between V2 and V3 will be challenging and expensive. [Interface engines](#) must be augmented with substantial data repository functionality to provide mapping.
- Weigh the costs of continuing to build “80 percent standard” HL7 V2 interfaces against entering the expensive world of V3.
- Understand how early your site will be in the V3 learning curve. Ask any vendor who proposed a V3 interface how many other sites have the same V3 interface running and how many different applications are communicating using the interface.
- Consider if your site should become an early adopter of the V3 standard. How much local interface expertise do you have? What is the backlog of interfaces? How will V3 help solve your business requirements short and long term?
- Gain education on the HL7 V3 standard and start to understand the impact it will have on your interfacing environment.
- Become involved in the HL7 organization to stay current on the most recent developments.

To learn more about HL7 V3 and CCD documents, please read:

[Continuity of Care Document \(CCD\): Changing The Landscape of Healthcare Information Exchanges](#)

About Corepoint Health

Corepoint Health solutions deliver interoperability for healthcare organizations and simplify the complexities of healthcare data through practical software applications, consulting and training. Our innovative and proven software solutions leverage clinical data flow efficiently for a diverse group of healthcare entities including hospitals, imaging centers, laboratories, clinics and healthcare vendors. This next generation approach to healthcare data and streamlined workflow is where Corepoint Health specializes in helping customers discover the power of integration.

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