Health Information and Quality Authority

An tÚdarás Um Fhaisnéis agus Cáilíocht Sláinte

Guidance on Messaging Standards for Ireland

June 2017

Safer Better Care

About the Health Information and Quality Authority

The Health Information and Quality Authority (HIQA) is an independent authority established to drive high-quality and safe care for people using our health and social care services in Ireland. HIQA's role is to develop standards, inspect and review health and social care services and support informed decisions on how services are delivered. HIQA's ultimate aim is to safeguard people using services and improve the safety and quality of health and social care services across its full range of functions.

HIQA's mandate to date extends across a specified range of public, private and voluntary sector services. Reporting to the Minister for Health and the Minister for Children and Youth Affairs, HIQA has statutory responsibility for:

- **Setting Standards for Health and Social Services —** Developing person-centred standards, based on evidence and best international practice, for health and social care services in Ireland.
- **Regulation —** Registering and inspecting designated centres.
- **Monitoring Children's Services —** Monitoring and inspecting children's social services.
- **Monitoring Healthcare Safety and Quality —** Monitoring the safety and quality of health services and investigating as necessary serious concerns about the health and welfare of people who use these services.
- **Health Technology Assessment —** Providing advice that enables the best outcome for people who use our health service and the best use of resources by evaluating the clinical effectiveness and cost-effectiveness of drugs, equipment, diagnostic techniques and health promotion and protection activities.
- **Health Information —** Advising on the efficient and secure collection and sharing of health information, setting standards, evaluating information resources and publishing information about the delivery and performance of Ireland's health and social care services.

Overview of the Health Information function of HIQA

Healthcare is information-intensive, generating huge volumes of data every day. Health and social care workers spend a significant amount of their time handling information, collecting it, looking for it and storing it. It is, therefore, imperative that information is managed in the most effective way possible in order to ensure a high-quality, safe service.

Safe, reliable healthcare depends on access to, and the use of, information that is accurate, valid, reliable, timely, relevant, legible and complete. For example, when giving a patient a drug, a nurse needs to be sure that they are administering the appropriate dose of the correct drug to the right patient and that the patient is not allergic to it.

Similarly, lack of up-to-date information can lead to the unnecessary duplication of tests — if critical diagnostic results are missing or overlooked, tests have to be repeated unnecessarily and, at best, appropriate treatment is delayed or at worst not given.

In addition, health information has a key role to play in healthcare planning decisions — where to locate a new service, whether or not to introduce a new national screening programme and decisions on best value for money in health and social care provision.

Under section (8)(1)(k) of the Health Act 2007, the Health Information and Quality Authority (HIQA) has responsibility for setting standards for all aspects of health information and monitoring compliance with those standards. In addition, under section 8(1)(j), HIQA is charged with evaluating the quality of the information available on health and social care and making recommendations in relation to improving the quality and filling in gaps where information is needed but is not currently available.

Information and communications technology (ICT) has a critical role to play in ensuring that information to drive quality and safety in health and social care settings is available when and where it is required. For example, it can generate alerts in the

event that a patient is prescribed medication to which they are allergic. Further to this, it can support a much faster, more reliable and safer referral system between the patient's general practitioner and hospitals.

Although there are a number of examples of good practice, the current ICT infrastructure in Ireland's health and social care sector is highly fragmented with major gaps and silos of information which prevents the safe, effective transfer of information. This results in people using services being asked to provide the same information on multiple occasions.

In Ireland, information can be lost, documentation is poor, and there is over-reliance on memory. Equally, those responsible for planning our services experience great difficulty in bringing together information in order to make informed decisions. Variability in practice leads to variability in outcomes and cost of care. Furthermore, we are all being encouraged to take more responsibility for our own health and wellbeing, yet it can be very difficult to find consistent, understandable and trustworthy information on which to base our decisions.

As a result of these deficiencies, there is a clear and pressing need to develop a coherent and integrated approach to health information, based on standards and international best practice. A robust health information environment will allow all stakeholders — the general public, patients and service users, health professionals and policy makers — to make choices or decisions based on the best available information. This is a fundamental requirement for a high reliability healthcare system.

Through its health information function, HIQA is addressing these issues and working to ensure that high quality health and social care information is available to support the delivery, planning and monitoring of services.

One of the areas currently being addressed through this work programme is the need to set standards to enable information to be shared electronically. These standards are commonly referred to as interoperability standards, which includes messaging and classification and terminology standards. This document outlines

specific guidance regarding the approach to be adopted to support messaging standards for existing and future messaging projects in Ireland. This is a revision of the guidance published by HIQA in 2012[*] and includes information on a new standard called the HL7 Fast Healthcare Interoperability Resources (FHIR).

[*] The Guidance document published in 2012 has been superseded by this document and the previous versions have been removed from HIQA website. The previous version is available on request from HIQA.

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1. Introduction

Safe, reliable healthcare depends on access to and use of information that is accurate, valid, reliable, timely, relevant, legible and complete. Ensuring that information can be shared efficiently and effectively and in a manner which protects the privacy and confidentiality of patients is critical. eHealth can enhance the quality, accessibility and efficiency of all healthcare services through the secure, timely, accurate and comprehensive exchange of clinical and administrative data.(1) Its benefits include:

- better and safer patient care
- improved integration and sharing of health information to enable patient-centred integrated care
- more cost-effective delivery of healthcare
- more efficient national planning
- improved research through the provision of more timely and higher quality information
- reduced medication errors through ePrescribing
- more timely access by health professionals to the right medical information at the right time
- improved support for patient self-management.

In the Irish context, many reports and strategies have highlighted the need for a national electronic health record, including the Commission for Patient Safety and Quality Assurance(2) and the *eHealth Strategy for Ireland*.(3) The Health Service Executive (HSE) has established the Office of the Chief Information Officer, which is responsible for implementing Ireland's eHealth Strategy. The Office of the Chief Information Officer is responsible for the delivery of technology to support healthcare across Ireland and have published the *Knowledge and Information Strategy*(4) in this regard. One of the key building blocks central to any eHealth programme is a set of eHealth interoperability standards, including messaging and terminology standards based on widely available and implemented international standards.

1.1 Background

This guidance document updates the original guidance document on messaging standards published by HIQA in 2012. Under the Health Act 2007**,** HIQA has a statutory remit to develop standards, evaluate information and make recommendations about deficiencies in health information. The responsibilities of HIQA in relation to its health information function are outlined in the following sections of the Act:

- Section 8(1)(i): to evaluate available information respecting the services and the health and welfare of the population
- Section 8(1)(j): to provide advice and make recommendations to the Minister for Health and the HSE about deficiencies identified by HIQA in respect of the information referred to in paragraph (i)
- Section 8(1)(k): to set standards as HIQA considers appropriate for the HSE and service providers respecting data and information in their possession in relation to services and the health and welfare of the population.
- Section 8(1)(l): to advise the Minister for Health and the HSE as to the level of compliance by the HSE and service providers with the standards referred to in paragraph (k).

Under Section 8(1) (k) of the Health Act 2007, HIQA is charged with setting standards for health information. This includes standards for the communication of health information between healthcare providers. Some of the most recent standards that HIQA has published in this regard include:

- *National Standard for a Dispensing Note including a Clinical Document Architecture specification*[5]
- *National Standard for a Procedure Dataset including a Clinical Document Architecture specification*[6]
- *National Standard Diagnosis Dataset and Clinical Document Architecture (CDA) template*[7]

- *National Standard Adverse Reaction Dataset and Clinical Document Architecture (CDA) template*[8]
- *ePrescription Dataset and Clinical Document Architecture Standard*[9]
- *General Practice Messaging Standard version 3.0*[10]

Under Section 8(1) (j) of the Act HIQA has the responsibility to provide advice and make recommendations to the Minister for Health and the HSE about deficiencies identified by HIQA in respect of the information referred to in paragraph (i). HIQA is charged with undertaking guidance in relation to gaps in the health information community. The *Guidance on Messaging Standards for Ireland* is part of a suite of guidance documents that HIQA has previously published including an *Overview of Healthcare Interoperability Standards*[11] and *Guidance on Classification and Terminology Standards for Ireland.*[12]

1.2 Methodology

In order to consult with stakeholders on the development of eHealth standards, HIQA produced the consultation document *Developing National eHealth Interoperability Standards for Ireland: A Consultation Document*[13]. This consultation identified the need for guidance documents in three areas — general interoperability standards, terminology standards and messaging standards — to ensure that information can be exchanged electronically in a safe and efficient way.

In November 2012, HIQA published its original *Guidance on Messaging Standards for Ireland*.[14] This document is a revision of the Guidance on Messaging Standards for Ireland published in 2012. During the development of this Guidance document, a review of international and national best practice was undertaken. The review identified the emergence of an emerging standard called Fast Healthcare Interoperability Resources (FHIR),[15] which was developed by the Health Level 7 standards development organisation. A draft Guidance document for consultation was developed and a targeted consultation was undertaken. The Guidance document was updated following the targeted consultation.

1.2 Purpose

The purpose of this guidance is to provide direction on healthcare messaging standards in Ireland for the short to medium term. HIQA has developed this guidance to provide the eHealth community in Ireland with the direction of standards development that HIQA endorses and to support better decision making and consistency around future eHealth investments.

This guidance was developed to inform key stakeholders, including public and private service users, vendors, purchasers and implementers of health information systems, healthcare providers, the wider health informatics community and any other interested parties, about the proposed future direction of messaging standards in Ireland and to encourage wider participation in standards development. The guidance is targeted principally at those involved in specifying the requirements for and the development and implementation of new eHealth applications, both locally and nationally.

The document provides an overview of messaging standards and provides a comparison between the electronic messaging and electronic document standards in Section 2 of the document. Section 3 identifies and provides details on five candidate messaging standards which have been developed by international standards body and are specific to electronic healthcare messaging. An overview of international and national implementation is provided for each. Following this, a detail optional analysis assessment of each of the standards and their relevance to Ireland in provided in Section 4 of the document. Section 5 provides HIQA's conclusions and updated Guidance on messaging standards for Ireland.

2. Overview of Messaging Standards

Messaging standards outline the structure, content and data requirements of electronic messages to enable the effective and accurate sharing of information. The term 'message' refers to a unit of information that is sent from one system to another, such as between a laboratory information system and a general practitioner's clinical information system.

HIQA emphasise that eHealth initiatives should be underpinned by internationally proven standards. HIQA identified five candidate messaging standards which support electronic messaging in healthcare:

- HL7 version 2.x (v2.x)[16]
- HL7 version 3 messaging (v3)[17]
- the Clinical Document Architecture (CDA) standard[18]
- the United Nations Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) standard[19]
- the recent HL7 standard, Fast Healthcare Interoperability Resources (FHIR).[15]

A messaging standard specifies the structure and order of the elements that make up a message such as the patient information, the laboratory information, the test undertaken and the results. It defines which elements are required and which are optional. Coding systems such as the International Classification of Diseases revision 10 (ICD-10)[20] and Logical Observation Identifiers Names and Codes (LOINC)[21] assign meaning to the characters in the message (the semantics). As a result, two distinct groups of standards are required — one for defining a common syntax and the other for defining common semantics.

Specific messaging standards for the healthcare context, such as the General Practice Messaging Specification (GPMS) Version 3.0[10] published by HIQA, are an essential way of improving how we use technology to enable safe and effective

information exchange, including the exchange of clinical, administrative and patient information, for the benefit of the quality and safety of patient care. Messaging standards have the potential to enable the following benefits to patients:

- Speeding up the patient referral process to enable the patient to start on their journey of care more quickly.
- Reducing the need for duplicate and repeat diagnostic testing.
- Speeding up the sharing of patient discharge details and facilitating continuing care for patients during transfer between secondary care and primary care.
- Complete, accurate and searchable health information, available at the point of diagnosis and care, allowing for more informed decision making to enhance the quality and reliability of healthcare delivery.
- More efficient and convenient delivery of care, without having to wait for the exchange of records or paperwork and without requiring unnecessary or repetitive tests or procedures.
- Earlier diagnosis of disease, with the potential to improve outcomes and reduce costs.
- Reductions in adverse events through an improved understanding of each patient's particular medical history, reducing the potential for harmful drug interactions in the course of treatment.
- The outcome of patients' out-of-hours consultations are available to the GP, thus facilitating continuity of care for the patient.[10]

Messaging versus document paradigm

One of the limitations of messaging standards is that there is not a clear differentiation between process (services) and content (documents). A common uncertainty for implementers is to know when to use an electronic message or an electronic clinical document for a given use case, otherwise known as the messaging versus document paradigm. Table 1 shows a comparison of some key characteristics and usage between messaging and clinical documents.

Table 1 - Comparison between electronic messages and electronic documents[22]

Criteria	Message	Document
Characteristics	Messages support information which is required to be machine processable, required in real time and which may change over time. Messages can have receiver responsibilities requiring activity to be undertaken by the receiving systems as a result of receiving the messages. Messages may require that a response message is sent.	Documents are human-readable, persistent, self-contained and may also be machine processable.
Usage	Messages support ongoing process in real time. Requests transmitted in messages may be accepted or rejected by a system, thereby providing a degree of control to the receiving system. Messages contain current data and are more appropriate to use when there is tight communication processes between systems.	Documents are passive, contain static content and may not necessarily drive activity. Documents can be superseded (replaced) and corrected (appended) during their lifecycle. Documents are generally used 'post occurrence' of a healthcare event and are generated after the process is complete.

		Documents contain data 'as it was' when the document was originally completed.

There are no definitive rules to mandate the use of either a message or a document, and the choice will depend on the clinical scenario in question. If the information to be exchanged is a summary or snapshot in time, such as a discharge summary that needs to be human-readable, then an electronic document could be the most appropriate choice. If the information is suitable for transmission in real time, such as appointment scheduling, and is transaction-based, such as an acknowledgement to a query message, then a message will be the best solution.

3. Messaging standards

The approach used for the development of this guidance on messaging standards is outlined below:

- examine existing standards currently used for messaging initiatives in Ireland
- identify key drivers for messaging standards, including work emerging from HIQA's business plan on technical standards, the priority areas identified through the eHealth strategy and the HSE knowledge and information plan and developments in international experiences with messaging standards
- identify potential candidate messaging standards
- document a set of principles and criteria and assess the candidate standards against these.

3.1 Candidate standards

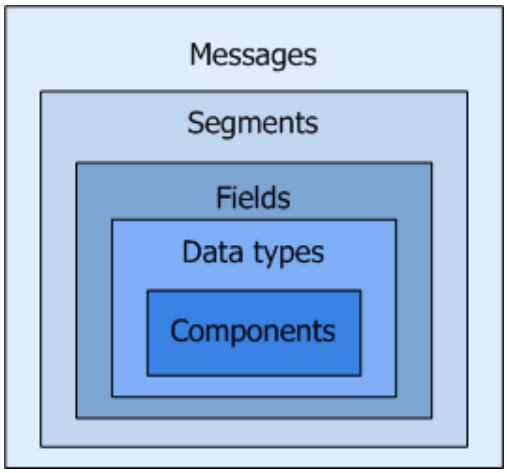
The five candidate standards identified as potential messaging standards in Ireland are Health Level 7 version 2.x (v2.x); Health Level 7 version 3 (v3); Health Level 7 Clinical Document Architecture (CDA); United Nations Electronic Data Interchange for Administration, Commerce and Transport; and Health Level 7 Fast Healthcare Interoperability Resources (FHIR). In order to inform the selection process, an overview of each standard is described below.

3.1.1 Health Level 7 version 2.x

The v2.x standard provides specifications for messages to support the sharing of information on admission to and transfer within and between healthcare facilities. It provides messages to support many scenarios, including the ordering of laboratory investigations, radiology tests and medications for patients and sending the results of the tests ordered to the ordering clinicians. It can support transmission of referrals and discharge summaries between clinicians and sharing of appointment scheduling information.

In order to define messages for different contexts, the standard specifies a set of building blocks for messages known as message segments which may be reused when constructing messages (see Figure 2). Each segment consists of multiple fields which are constructed using pre-defined data types.

Figure 2 - Structure of a v2.x message[23]



HL7 v2.x was not originally designed for inter-organisational communication and lacks some functions and features needed to support large scale implementations. The strength of the v2.x standard is its ability to support the exchange of information within a single organisation or site because the standard is localised for specific implementations, thereby ensuring that information can be correctly interpreted. Some shortfalls with v2.x include the following:

- It is not based on an explicit underlying information model. An information model is important because it is an effective means of documenting assumptions about data and provides a language that allows the unambiguous expression of information in a particular domain.
- It does not have an explicit methodology for developing messaging specifications.
- Relationships are not defined formally between fields and events in v2.x.
- Messages do not inform a receiving application what to do having received a message.

- A feature of the v2.x standards is the high degree of flexibility the specification offers as there are a large number of optional fields. On the one hand, the benefits of such flexibility allow local implementations to constrain or modify the specification to meet their own needs. However, without appropriate guidance and requirements for use, the standard may be open to misinterpretation in its structure and format. Consequently v2.x is sometimes referred to as the 'non-standard standard'.[24]

The HL7 v2.4 standard is the predominant messaging standard used in Ireland for communicating health information and is an effective solution for traditional message-based interconnectivity between systems within hospitals. The standard has gained widespread adoption internationally and is one of the most widely used standards for communicating clinical data among clinical information systems in hospitals and general practice worldwide.[25] This success is demonstrated by the large number of v2.x implementations in existence internationally, with good support for tooling, implementation guides and extensive experience and knowledge of the standard.

3.1.2 Health Level 7 version 3

The HL7 v3 messaging standard was created to support large scale health information systems[23] and attempts to support all healthcare workflows. Benefits include reduced ambiguity, maximum reuse and increased consistency in HL7 messages.[26] The HL7 v3 standard is published as a large web-based document that contains specific subject areas, also known as domains, such as laboratory, pharmacy, medications and patient administration.[23]

The v3 messaging standard uses the Reference Information Model (RIM) and a formal methodology called the HL7 Development Framework (HDF) to increase the detail, clarity and precision of message specifications.[23] HL7 v3 messaging combines a formal methodology with established models and value sets needed to express the full range of specifications for eHealth interoperability, including specifications for

prescribing, referrals, and discharge summaries. Other beneficial features inherent in the standard include its ability to integrate seamlessly with clinical terminologies such as LOINC[21] or Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT)[27] and easy alignment with structured documents as both CDA and the v3 standard are derived from the same Reference Information Model.

Some criticisms raised regarding the technical aspects of v3 messaging include the structure of its data types, complexity of its clinical information representation and the size of its messages. There are increasing levels of technical support and tooling available for v3 messaging in the international community,[28] although, as yet, there are no v3 messaging implementations and very little experience of this in Ireland.

3.1.3 Health Level 7 Clinical Document Architecture

In addition to creating messaging standards, HL7 also develop standards for representing clinical documents, such as referrals and discharge summaries, known as the Clinical Document Architecture (CDA) standard. CDA is a good option for countries who have limited resources as they can adopt simple CDA-based architectures. CDA is regarded as a standard that is easier to implement than the v3 standard. The normative version of the CDA, release two, was published in 2005.[18] CDA has the benefit of being based on a common information model known as the Reference Information Model (RIM). An information model provides a framework for organising data so that it can be delivered and re-used in a variety of different ways. CDA ultimately allows for shared information at the point of care and promotes reusability across a sufficiently wide range of documents.

The development of CDA was driven by the need for clinical information to be interpreted by both human readers and computer systems. CDA supports a combination of free text for human readability and adds structure and coding to the document to enable machine processing. CDA provides for different levels of conformance to the standard. The different levels enable implementers to develop simple documents, known as level 1, that are displayed and presented to clinicians in

a readable format or more complex documents that are coded for machine processing, known as level 2 and 3. This feature is referred to as the 'migration path' and enables significant flexibility for implementers giving them the option to decide what content can be exchanged while still remaining compliant with the standard. CDA is attractive to implementers because it uses a single fixed 'one model and one schema' with well-documented templates that can be reused throughout different types of documents.

3.1.4 United Nations Electronic Data Interchange for Administration, Commerce and Transport

The United Nations Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) messaging standard was developed by the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) and was adopted by the International Organization for Standardization (ISO) as the ISO 9735 standard.(19) It provides a set of syntax rules to structure data, an interactive exchange protocol≠ and standard messages which allow multi-country and multi-industry exchange. EDIFACT is a generic standard and is widely used internationally for eBusiness outside of eHealth whereas the other candidate standards reviewed are specifically tailored for healthcare.

EDIFACT is a text delimited syntax for electronic exchange that was popular before XML† came to the fore. EDIFACT is similar in structure to v2.x in that it is composed of building blocks known as segments, further divided into fields, which contain a value with a data type specified by the standard. In some cases, fields can be further subdivided into components and subcomponents.(29) Similar to v2.x, EDIFACT does not define the exchange mechanism or communication protocol between messages. EDIFACT defines only the messages and their content. Similar to the HL7 family of

≠ The interactive exchange protocol (I-EDI) is defined as the exchange of messages from computer application to computer application, using structures based on national or international standards, such as the EDIFACT standard

† A mark-up language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

standards, the EDIFACT organisation has developed a methodology around message design which promotes the reuse of existing segments and data elements when developing new messages.[30]

3.1.5 Health Level 7 Fast Healthcare Interoperability Resources

FHIR[15] is the most recent standard created by the HL7 organisation. FHIR is a standard that enables the secure electronic sharing of health information and the real-time exchange of information using web technologies. FHIR is suitable for use in a wide variety of contexts, including data sharing between electronic health records, mobile phone applications, cloud communications and server communication in large institutional healthcare providers.

FHIR was first proposed in July 2011 and is currently a standard for trial use. HL7 anticipate that a normative version[‡] of the FHIR standard will be balloted on in late 2017. There are two distinctive features that the FHIR standard has focused on compared to other HL7 standards — security and the use of resources. FHIR is considered more secure than previous standards as all health data exchanged using FHIR is required to be transmitted using secure protocols.

The basic building blocks in FHIR are called resources. There are various types of resources defined in the standard, including clinical, identification, workflow, administrative, infrastructure, conformance and financial resources. The philosophy behind FHIR is to build a base set of resources that, either by themselves or when combined, satisfy the majority of common information exchange scenarios in healthcare. FHIR also supports resource profiles. Profiles describe the information handled/produced by the system on a per use case. They define a series of variations on the same set of resources for different scenarios.[15]

The primary objective of FHIR is to ensure that it is easy to implement and that it provides a rigorous mechanism for exchanging data between healthcare applications.

[‡] A version of the standard that prescribes what has to be achieved to be compliant with the standard.

FHIR is based on existing models (clinical, logical and theoretical), and it does not require implementers to understand specific details of the models. FHIR has built-in mechanisms for traceability to the v3 or CDA RIM.[15] This ensures alignment to HL7's previously defined patterns and best practices without requiring the implementer to have intimate knowledge of the RIM or any HL7 v3 derivations.

FHIR must work in a wide variety of environments. FHIR was also designed to cover a wide range of interoperability scenarios. This includes enabling interoperability between different environments from small clinics within a single institution through to sharing data at a national and international level.

FHIR also defines a set of interfaces by which systems actually share information, these four mechanisms for information exchange are known as paradigms [15] and each is a distinct method of exchanging information. The four paradigms and when they might be used are:

- **rest** — small, light-weight exchanges with low coupling between systems
- **messages** — communicate multiple resources in a single exchange
- **documents** — focus is on persistence when data spans multiple resources
- **services** — use a custom service when capabilities of other paradigms do not fit requirement

FHIR takes advantage of and has a strong foundation in web services.[§] Web-based technologies are well understood and widely supported by the implementation community. Examples of technologies endorsed by FHIR include HTML and Cascading Style Sheets for user interface integration, either JSON[**] or XML[††] for data representation and OAuth[‡‡] for authorization.[31] Other features that the FHIR

[§] A web service is a service offered by an electronic device to another electronic device, communicating with each other via the World Wide Web.
[**] JavaScript Object Notation – a standard for representing data.
[††] Extensible Mark-up Language (XML) is a mark-up language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable
[‡‡] An industry-standard protocol for authorization

framework are that it is forward and backward compatible, uses off-the-shelf (and free) tooling where possible and is free to use.

In summary, FHIR has many advantages over other comparable standards, and, as the standard reuses modern web technologies software developers are familiar with, it more cost-effective than other standards. Although the status of FHIR is currently a standard for trial use, there is sizeable interest in implementing the standard internationally.

3.3 Summary of messaging standards implemented internationally

There are important lessons for Ireland to learn from international experience regarding the use of messaging standards. The HL7 standards are the leading health messaging standards in many countries. Internationally, v2.x is by far the most widely used standard for exchanging healthcare messages and continues to be supported by the software and healthcare industry. More than 35 countries have v2.x implementations and over 95% of US healthcare organisations use v2.x.[16]

Furthermore, Canada, England and the Netherlands embarked on large scale national health IT programs using v3 messaging solutions.[32] According to HL7.org, 'the NHS uses specifications based on the HL7 v3 Reference Information Model, data types and methodology in nearly 2 million v3 transactions per day.[17] In addition, HL7 v3 messaging is at the core of the Dutch national health infrastructure, focused on medication information and general practitioner (GP) records. The Netherlands also recommends the use of v2.x for local and regional projects, and v3 messaging was recommended for use in national projects.[33]

In Canada, v3 messaging is a central part of the Electronic Health Record Solution Blueprint.[17] The Blueprint is a technology framework that guides the sustainable development of interoperable electronic health record systems across Canada. Almost every jurisdiction in Canada has implemented v3 pharmacy messages, and many of them have implemented v3 laboratory messages. Ontario has developed v3

messages for referrals. The western provinces have developed chronic disease management v3 messages and many of them have implemented them.[17]

The benefits of v3 messaging, compared to v2.x messaging, include a top down design approach using the Reference Information Model to give better consistency and extensibility.[34] However, implementers have encountered several problems with the v3 standard and its uptake has declined. This is mainly due to the cost of implementation as the design process, or more specifically the interpretation of the RIM model, is difficult to implement. Therefore, the HL7 v2.x standard remains a successfully implemented worldwide and works well for specific use cases such as laboratory or radiology messages. Therefore, countries do not generally seek to replace existing v2.x systems with v3 systems as the considerable costs involved in such replacement cannot be justified.

The success story of the HL7 v3 standard is the Clinical Document Architecture (CDA) standard. Countries who have undertaken CDA projects include Australia, Canada, Germany, Greece, Finland, Japan, UK and US.[35] Canada and England embarked on large scale national health information technology projects that warranted the use of v3 messaging solutions.[32] In the UK, the NHS Connecting for Health programme adopted CDA for its national summary care record and has gained considerable experience working with CDA.[36]

In the US, the CDA standard is probably best known as the basis for the Continuity of Care Document (CCD)[37] specification, which is based on the data model as specified by American Society for Testing and Materials International Continuity of Care Record. The US Healthcare Information Technology Standards Panel has selected the CCD as one of its standards. In Australia, the Personally Controlled Electronic Health Record uses the CDA standard to transfer information between different healthcare clinical systems whilst still allowing information to be accessed and viewed.[38]

EDIFACT implementations include projects in the UK and Denmark. The UK's National Health Service (NHS) uses EDIFACT messaging for transferring electronic pathology results between laboratory information systems and GPs' practice management systems.[39] The Danish health sector made the decision to adopt EDIFACT in 1994 as part of their national messaging project for message types such as prescriptions, discharge summaries and laboratory results.[40]

In 2014, there were 70 implementations of FHIR across 20 countries.[41] In the UK, NHS Digital is working on several FHIR projects, including collaboration with the Professional Record Standards Body (PRSB) and the INTEROpen vendor group to provide clinical validation of FHIR profiles for use in the NHS and social care.[42] Other examples of FHIR based projects in the UK include GP Connect and the Diagnostic Data Service. The GP connect project allows general practice and other systems to work together opening up information and data held within GP Practice IT systems for use across health and social care.[43] Additionally, The NHS Digital has decided to replace the national primary care pathology report message currently implement using EDIFACT messaging with a FHIR messaging specification.[44]

In the US, a number of high-profile players in the health informatics field, including CommonWell Health Alliance[45] and Substitutable Medical Applications, reusable technologies (SMArt),[46] have undertaken FHIR-related projects. FHIR has attracted interest in the health IT vendor community largely because FHIR builds on the success of existing web technologies. For example, the Argonaut Project[47] is a private sector initiative to advance the adoption of open interoperability standards. The purpose of the project is to develop FHIR-based methods of communication between software systems to enable information sharing for electronic health records and other health information technology based on Internet standards.

Furthermore, Integrating the Healthcare Enterprise (IHE)[48] is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE develops profiles such as the IHE Patient Care Coordination framework. The Care Record message (FHIR profile) has been

implemented in an IHE Patient Care Coordination framework in Ontario Health, Canada, Norway, Germany and several clinical domains in the Netherlands.

3.3.1 Messaging in Ireland

Healthlink[49] is a major player in messaging in Ireland. The National Healthlink Project provides a web-based messaging service which allows the secure transmission of clinical patient information between hospitals, healthcare agencies and general practitioners. The project has been in operation since 1995 and has developed considerably since that time to its current status as national messaging broker. Healthlink works in partnership with national boards, professional organisations and software vendors and has a proven track record in delivering information technology solutions to general practitioners and hospitals.

Healthlink is now under the remit of Access to Information within eHealth Ireland, which is in the process of creating an integration platform for all eHealth initiatives. The v2.x standards continue to be supported for existing projects. v3 messaging is not currently used, but this will be considered on a case by case basis. The FHIR standard is currently being used for the national individual health identifier programme, and an FHIR interface has been developed. The intention is that in the future FHIR will be considered for other eHealth projects depending on the suitability of FHIR and the specific use case.

4. Assessment approach

In order to provide guidance on the appropriate messaging standards to use in Ireland in the short to medium term, each of the candidate standards were assessed using an options analysis tool. The tool was developed by HIQA and is based on a Canadian model that was used for the selection and approval of their health information standards.[50] It is comprised of five principles, with each principle consisting of multiple criteria. An explanation of the option analysis tool can be found in Appendix 1. All five candidate standards were assessed against each principle and criteria. See Appendix 2 for a detailed analysis of each of the candidate standards.

The following options were identified as potential approaches for messaging standards in Ireland:

- Continue with v2.x for existing projects. This involves maintaining and extending v2.x by defining extensions to meet local requirements.
- Develop new specifications using v3 messaging.
- Migrate to a document approach to share structured documents using CDA and transport the documents using a v2.x message.
- Migrate to the EDICFACT messaging standard.
- Undertake FHIR proof of concepts/projects.

4.1 Options analysis tool

A detailed assessment was carried out whereby each of the five candidate standards was assessed against the options analysis tool. The principles and criteria are outlined below in Table 3, alongside the results for each of the candidate standards. All of the candidate standards were measured against each principle and corresponding criteria and subsequently awarded a pass (P) or fail (F).

Table 3: Options analysis tool for messaging standards

No.	Criteria/Principle	v2.x	v3 messaging	CDA	EDIFACT	FHIR
1. Standards must be clinically relevant						
1.1	Clinical appropriateness	P	P	P	P	P
1.2	Cross discipline	P	P	P	P	P
1.3	Cross healthcare delivery setting	P	P	P	P	P
1.4	Clinical outcomes	P	P	P	P	P
2. Standards must meet specific business needs						
2.1	Business need	P	P	P	P	P
2.2	Maturity/stability	P	P	P	P	F
2.3	Feasibility	P	F	P	F	P
2.4	Workflow	P	P	P	P	P
3. Standards must be vendor neutral and backward compatible						
3.1	Vendor neutral	P	P	P	P	P
3.2	Backward compatibility	P	P	P	P	P
4. Standards must be financially viable						
4.1	Affordability	P	P	P	P	P
4.1	Implementation costs	P	F	P	F	P
5. Standards must have established governance and processes						
5.1	Intellectual property	P	P	P	P	P
5.2	Governance structure	P	P	P	P	P
5.3	Irish influence	P	P	P	P	P
5.4	Sustainability	P	P	P	P	P

4.2 Analysis

The outcome of the analysis is presented in terms of differentiating and non-differentiating principles. Two of the five principles are consider differentiating principles as candidate standards were deemed to have failed against one or more of the criteria associated with the principal. The remaining three principles offer similar outcomes across the five candidate standards and do not suggest a preferred candidate and are, therefore, considered non-differentiating principles.

4.3.1 Differentiating principles

Standards must meet specific business needs (feasibility)

Feasibility has been defined as the ability to implement a standard within a reasonable time, budget and resource skill set. To develop new v3 specifications would require significant up skilling, resources and education and there is little expertise or experience of implementation in Ireland.

To retrofit EDIFACT to existing v2.x solutions would provide little added value because v2.x and EDIFACT are similar in structure and purpose. Both standards are suited to traditional message-based interconnectivity between clinical and administrative systems within hospitals, for example, transaction-based messaging such as real-time laboratory messaging. Although it is feasible to provide up-skilling in EDIFACT given the knowledge and experience that already exists with v2.x implementations, there is little to be gained from replacing v2.x with EDIFACT.

FHIR is a next generation standards framework created by HL7 which combines features of HL7's v2.x, HL7 v3 and CDA product lines while leveraging the latest web standards and applying a tight focus on implementation. As of March 2017, FHIR is published as a standard for trial use.[15] During the trial use phase, HL7 is actively monitoring implementations in order to continue to improve the specification and is

able to be responsive to their needs. It is anticipated that FHIR will attain normative status in 2017.

Standards must be financially viable (implementation costs)

Feasibility and implementation costs are very much interlinked. In order for a standard to be implementable, it must be financially viable. To implement a messaging solution based on v3 messaging solutions would require significant investment in the skills to develop v3 specifications and re-engineering of current v2.x implementations, and it would accrue significant costs when the testing, training and development costs are considered. HIQA would suggest that the development and widespread implementation of a new messaging specification based on the v3 messaging reference models and methodologies would not be considered a viable solution.

Similarly HIQA would advise that to replace existing v2.x solutions with EDIFACT would not be cost effective given the resources and development required.

4.3.2 Non-differentiating principles

Non-differentiating principles, which are principles where each of the candidate standards pass all of the related criteria, are clinical relevance, interoperability with an EHR and established governance and processes.

Standards must be clinically relevant

The v3 messaging and CDA standard have advantages over v2.x and EDIFACT as they are based on a healthcare specific information model. FHIR defines a series of different types of resource that can be used to exchange and or store data in order to solve a wide range of healthcare related problems, both clinical and administrative. Previous guidance anticipated a messaging specification based on the v3 messaging standard may be the preferred choice, given its reference model, methodology and how it is designed to support all healthcare workflows providing domain specific models supporting all clinical and patient care. However, the financial

implications of implementing v3 are significant and, hence, it is not considered a viable option.

Standards must be vendor neutral and backward compatible

All candidate standards are vendor neutral or non-proprietary. All five candidate standards are backward compatible with previous versions of their own standard. A standard is backward compatible if it is compatible with earlier versions of the same standard. However, it is sometimes necessary to sacrifice backward compatibility to take advantage of a new improved standard with a completely different architecture. For example, v3 messaging was not designed to be backward compatible with v2.x and they are, therefore, considered separate standards.

Standards must have established governance and processes

HIQA will develop specifications based on standards that have been derived from an international standards development organisation. It will be responsible for reviewing and maintaining any localised standards.

5. Conclusions

The purpose of this guidance is to provide direction on healthcare messaging standards in Ireland for the short to medium term. HIQA previously published *Guidance on Messaging Standards for Ireland* in 2012 and, in light of recent developments, it is timely we update the guidance.

Across Ireland, the exchange of administrative and clinical information is managed using many different types of systems and computer software. The standards used to communicate information unambiguously between different systems vary and may include bespoke, proprietary standards or commonly used international messaging standards. To safely send and receive information such as referrals and laboratory orders and results between different types of systems, a standard exchange format is required.

Given that v2.4 XML encoded messages are widely used in Ireland presently, the preferred approach to cover all requirements is one based on a combination of messaging and structured documents whereby the CDA document can be transported within either a v2.x or v3 message. On the basis of this assessment and given the dominance of the v2.4 standards in Ireland, continued support for the v2.4 standard was selected as the preferred candidate standard for the exchange of health information in the short to medium term. This is complemented by an endorsement to combine the use of the CDA for the exchange of structured clinical documents. The v2.x standard can be used to transport CDA documents.

To provide direction and to assist the health IT community to make decisions in relation to health messaging standards, HIQA makes the following recommendations.

Guidance

1. The v2.4 XML encoded messaging standard should continue to be supported as it is the most extensively used health messaging standard in Ireland and is delivering substantial benefits.

2. Where HL7 v2.x or CDA are not currently supported by a system, consideration should be given to providing such support when major upgrades are taking place.

3. The CDA standard should be used for the development and exchange of documents.

4. The General Practice Messaging Specification (GPMS) should be included in specifications for new health IT systems or procurement of future health IT systems where it is relevant.

5. The FHIR standard should be considered for new initiatives on a use case by use case basis when it becomes a normative standard and is mature enough for implementation.

This guidance is based on the existing extensive use of v2.x encoded messaging standards in Ireland and the need to up skill in newer technologies such as HL7 CDA and FHIR so as to take advantage of the opportunities they offer. The need for CDA is driven by the fact that clinical documents are used widely to facilitate clinical activities. CDA supports a combination of free text for human readability and adds structure and coding to the document to enable machine processing. FHIR has gained much support internationally, and a normative edition of the standard is scheduled for 2017. Once the standard is finalised and passed all of the approval steps, it should be consider for new initiatives on a use case basis. This approach will keep all options open in relation to standards implementation for eHealth initiatives such as ePrescribing and electronic patient/health records.

HIQA will regularly review this guidance and will continue to engage and consult with stakeholders and keep abreast of developments in the standards landscape internationally. HIQA will continue to maintain and expand the GPMS and will

develop messaging specifications to support other prioritized use cases. HIQA will continue to work with the health informatics community to analyze use cases, select the most appropriate standard to use and develop specifications based on project requirements.

Appendix 1 – Summary of principles for options analysis

1. Standards must be clinically relevant

1.1. *Clinical appropriateness* — where relevant, the standard must support clinical practice.

1.2. *Cross discipline* — where relevant, the standard should be used across disciplines (physicians, nurses, pharmacists, laboratory professionals, allied health professionals etc.).

1.3. *Cross-healthcare delivery setting* — the standard should be healthcare-delivery-setting independent, that is, appropriate for use across health sectors (acute care, community, long-term care, etc.).

1.4 *Clinical outcomes* — the standard should support patient care. Message types should be defined across administrative, clinical, requesting and prescribing use cases, support the carrying of clinical information and requests for results and services.

2. Standards must meet specific Irish business needs

2.1. *Business need* — the standard should be developed based on a defined business requirement and should be validated to ensure it meets the business requirements.

2.2. *Maturity/Stability* — the standard must be assessed to determine how widely it has been implemented and tested as well as to determine if it requires further development.

2.3. *Feasibility* — it should be possible to implement the standard within a reasonable time, budget, and resource skill set. Known critical dependencies impacting implementation must be identified (for example, other components or standards that are not yet developed).

2.4. *Workflow* — the use of this standard must be assessed in regard to the user's workflow or workload. Impact to workflow must be balanced with improvements to patient care either directly or indirectly.

3. Standards must be vendor neutral and backward compatible

3.1. *Vendor neutral* — the standard should be vendor independent.

3.2. *Backward compatibility* — where appropriate, the standard should be backward compatible and interoperable with previous versions of the standard.

4. Standards must be financially viable

4.1. *Affordability* — the standard should have viable licensing and maintenance fees as well as a feasible funding strategy.

4.2. *Implementation costs* — the implementation of the standard should be financially viable.

5. Standards must have established governance and processes

5.1. *Intellectual property* — the intellectual property or licensing issues relating to the standard should be documented.

5.2. *Governance structure* — Based on HIQA's standards decision-making process, the designation of a standard as a HIQA standard is governed by HIQA's standards development process.

5.3. *Irish influence* — the standards should have been developed and maintained through an open and transparent process with opportunity for Irish stakeholders to be engaged.

5.4. *Sustainability* — the established or planned processes and resources to maintain this standard are documented in order to enhance the standard when necessary and monitor conformance to the standard.

Appendix 2 – Options analysis for candidate standards

Health Level 7 version 2.x

v2.x passes all principles and criteria, making it a suitable approach for the short to medium term.

1 **Clinical relevance:** From a clinically relevant perspective, a new or existing specification based on v2.x would support clinical practice of physicians, nurses, pharmacists, laboratory professionals and allied health professionals. V2.x supports the transmission of messages and clinical documents from primary care, community care, long-term care and acute care and defines message types across administrative, clinical, requesting and prescribing use cases and ultimately supports clinical outcomes and patient care.

2. **Meet specific business needs**: In the Irish context, v2.x can meet current business needs and covers the current scope of business requirements, including patient administration (admission, discharge, transfer and registration), accounting systems and clinical data, such as referrals, discharge summaries, laboratory orders and reports. It is a mature standard, with a recognised governance structure and a wide scale implementation base. The v2.x standard is now implemented in many countries including the US, Canada, Australia, Germany, the Netherlands and Japan. Much knowledge and experience exists for implementing interfaces to support messaging based on v2.4 in Ireland, enhancing its feasibility.

3. **Vendor neutral and backward compatible:** v2.x is vendor neutral and backward compatible.

4. **Financially viable**: The level of resources to develop and maintain a standard based on v2.x is achievable as the level of expertise required to form a working group to develop a v2.x based specification currently exists and can be leveraged. Also, Healthlink, the national messaging broker, has vast experience with v2.4 messaging.

5. **Established governance and processes**: A key consideration for an appropriate standard is that it has established governance and processes. In terms of intellectual property rights, it is possible to access HL7 standards by obtaining an individual membership. However, it is necessary to have an organisational HL7 membership in order to circulate excerpts of the HL7 material.

Health Level 7 version 3

v3 messaging has many attractive features, including a healthcare-specific reference model, domain specific reference model, reusable artefacts and a methodology for further defining clinical artefacts specific to the use case. However, as evidenced below, v3 messaging fails on the following principles — feasibility, affordability and implementation costs. The following points outline the main principles and how v3 messaging measures against them.

1. **Clinical relevance**: Similar to v2.x, a new or existing specification based on v3 messaging supports the clinical practice of physicians, nurses, pharmacists, laboratory professionals and allied health professionals standard and supports the transmission of messages and clinical documents from primary care, community care, long-term care and acute care. A messaging specification based on a version of the v3 messaging standard gains all the benefits offered by the standard, including the Reference Information Model (RIM), use of existing and future messaging artefacts published within the model and a standard designed to support both the messaging and clinical documents use cases. Regarding clinical outcomes, v3 messaging has domain-specific models supporting clinical and patient care. Messaging specification and common message element types (CMET) are defined and usable in messages conformant to the standards and support the transmission of detailed clinical information in a standard and reusable manner.

2. **Meet specific business needs**: v3 messaging meets the current Irish business need for messaging as the standard has vast coverage, spanning all healthcare domains. It consists of an elaborate set of ready-to-implement models (for messages, documents, or services) created using the HL7 Development Framework (HDF), which is an integral part of the standard. The HDF documents the processes, tools, actors, rules and artefacts relevant to the development of all v3 standard specifications. In terms of maturity and stability, there is very little user penetration of v3 messaging in Ireland to date. Internationally there are numerous projects implementing this technology, for example, the UK National Programme for Information Technology and the Canadian provider registry. Vendors are also gaining experience internationally but the level of vendor support nationally is minimal and many of the legacy laboratory systems would not support the new v3 messaging solution. With respect to the feasibility of the standard, currently there is very little expertise or experience with v3 messaging in Ireland and implementation of the standards would be constrained by the budget required to increase knowledge, re-engineer interfaces and upgrade source and consumer software, test and deploy the solution. To develop a v3-messaging-based specification would require much initial funding to increase the knowledge base. v3 messaging has a formal methodology and supports workflow.

3. **Vendor neutral and backward compatible:** v3 messaging is vendor neutral. When v3 was being developed, it was agreed that new versions of the v3 standard must be semantically backward compatible. This means that the information in a new version should contain the same information as the old

version; however, there is no requirement that this information be communicated in the same way or even using the same data type.

4. **Financially viable**: A new specification based on v3 messaging would be expensive to develop, requiring technical expertise, knowledge and up skilling locally before the project could be undertaken. Development and implementation of new interfaces to support a new messaging specification based on v3 messaging specifications would cost considerably more, and, to gain a similar coverage as the existing interfaces, would be expensive when the testing, training and development costs are considered. Given the cost, v3 messaging is not considered viable.

5. **Established governance and processes**: In terms of intellectual property rights, it is possible to access HL7 standards by obtaining an individual membership. However, it is necessary to have an organisational HL7 membership in order to circulate excerpts of the HL7 material.

Health Level 7 Clinical Document Architecture

Clinical activities are typically document driven making the use of structured documents, such as the Clinical Document Architecture (CDA), a more suitable approach for the mapping of real world requirements to electronic form easier than mapping to messages. The following shows how CDA measures up against the principles in the options analysis tool.

1. **Clinical relevance**: A structured document implies that health information can be more easily presented in a human readable form than it is in a message. The CDA standard is clinically appropriate, covers cross-discipline and healthcare delivery settings. Hence, it supports the clinical practice of physicians, nurses, pharmacists, laboratory professionals and allied health professionals through the transmission of clinical documents from primary care, community care, long-term care and acute care. Regarding clinical outcomes, CDA defines domain specific models such as medication and observations, supporting clinical and patient care.

2. **Meet specific business needs**: CDA meets the current Irish business need for specific use cases such as transmitting a clinical summary. In terms of maturity and stability, there is very little penetration of CDA in Ireland to date. However, internationally, CDA is the most widely utilised and best developed approach to structured documents and is now accepted as the norm in several national programmes. With respect to the feasibility of the standard, currently there is very little expertise or experience with CDA in Ireland; however, because of the migration path or the ability to implement CDA at different levels of conformance, it is deemed a more straightforward standard to migrate to rather than v3 messaging. In terms of workflow, CDA is very much aligned with clinical workflow, particularly for supporting clinicians and healthcare professionals with processes and tasks around referrals, discharge and producing clinical summaries.

3. **Vendor neutral and backward compatible**: CDA is vendor neutral and backward compatible.

4. **Financially viable**: A new specification based on the CDA would be less expensive to develop than v3 messaging, and although it would require technical expertise and knowledge and up skilling locally, there is evidence to suggest that it is a more cost-effective alternative than implementing v3 messaging.

5. **Established governance and processes**: A key consideration for an appropriate standard is that it has established governance and processes. In terms of intellectual property rights, it is possible to access HL7 standards by obtaining an individual membership. However, it is necessary to have an organisational HL7 membership in order to circulate excerpts of the HL7 material. It is a mature standard with a recognised governance structure and a wide implementation base.

United Nations Electronic Data Interchange for Administration, Commerce and Transport

As evidenced below, Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) fails on the following criteria: feasibility and implementation costs. The following shows how EDIFACT measure up against the principles in the options analysis tool.

1. **Clinical relevance**: EDIFACT supports the transmission of messages from primary care, community care, long-term care and acute care and defines message types across administrative, clinical, requesting and prescribing use cases and ultimately supports clinical outcomes and patient care. Although EDIFACT is a good choice of syntax to use in high volume, point-to-point exchanges within a confined setting such as a hospital, it is not the most suitable choice for inter-organisational exchange, for example, to facilitate messaging for a wider audience. The EDIFACT standard supports patient care, with the standard supporting major message types such as person identification, medical prescription, medical service request, medical service report, medical resource usage and cost, health insurance eligibility and benefit inquiry and healthcare claim or encounter request.

2. **Meet specific business needs**: EDIFACT meets current Irish business needs and covers a range of business requirements, including patient administration, healthcare insurance and claims data and clinical data such as prescribing. It is a mature standard and was adopted early in Europe, where consequently there is a large uptake of the EDIFACT standards. In Ireland, there is little penetration of EDIFACT messaging, except for communicating insurance forms from hospitals to insurance companies. The EDIFACT standard is released twice a year and can be downloaded as text files from the UN Economic Commission for Europe website, with message types and their components being added, modified, and sometimes removed. The structure and purpose of v2.x and EDIFACT are very similar; therefore, the learning curve involved would not be as substantial as migrating to a v3 messaging standard. It would be expensive to reengineer existing v2.x interfaces and upgrade source and consumer software, test and deploy an EDIFACT solution. It is questionable if the EDIFACT solution is justifiable as the standards are so similar.

3. **Vendor neutral and backward compatible:** EDIFACT is vendor neutral and backward compatible.

4. **Financially viable**: A new specification based on EDIFACT would be associated with development and implementation costs, requiring skilled technical expertise and up skilling locally before a project could be undertaken. Development and implementation of new interfaces to support a new messaging specification based on EDIFACT would be costly when the testing, training and development costs are considered, and widespread implementation of a new messaging specification based on the EDIFACT messaging is not considered viable.

5. Established governance and processes: There are no known intellectual property rights affecting an EDIFACT messaging specification implementation. The UN grants a licence to use the standard in the country where the organisation is located.

Health Level 7 Fast Healthcare Interoperability Resources

As evidenced below, Health Level 7 Fast Healthcare Interoperability Resources (FHIR) failed on the feasibility criteria. The following section shows how FHIR measure up against the principles in the options analysis tool.

1. **Clinical relevance:** From a clinically relevant perspective, a new messaging specification based on FHIR would support clinical practice of physicians, nurses, pharmacists, laboratory professionals and allied health professionals. FHIR supports the transmission of messages and clinical documents within and across organisational boundaries and is specifically designed for the healthcare arena. The standard supports clinical, identification, workflow, infrastructure, conformance and financial resources.

2. **Meet specific business needs:** FHIR resources cover a range of use cases and could be incorporated into messaging and document specifications as required for the Irish health and social care context. The FHIR standard has received much input and attention and have been used in a diverse number of implementations internationally but as yet it is not a normative standard. It is anticipated that it will acquire normative status through the HL7 governance processes in 2017. As FHIR used industry standards methodologies and architectures, up skilling to the standard is not a major issue and the learning curve involved would not be as substantial as migrating to a v3 messaging standard. FHIR's resources cover a broad spectrum from clinical (care provision, diagnostic), identification, workflow, infrastructure conformance and financial resources. Some localisation may be required for the Irish context; however, in its current state, FHIR would appear to provide good support for both clinical, administrative and financial workflows.

3. **Vendor neutral and backward compatible:** CDA is vendor neutral and backward compatible.

4. **Financially viable:** As FHIR utilises industry standard methodologies and architecture standards, the skills required to develop and implement FHIR-based solutions would be available with a degree of retraining in the standard. Though it may not be cost effective to rip and replace existing HL7 V2.x interfaces it may be appropriate to consider the use of FHIR in future implementation. Once FHIR becomes a normative standard use of it should be considered on a use case by use case basis.

5. **Established governance and processes:** FHIR has been developed by the HL7 organisation and the documentation is licensed under Creative Commons "No Rights Reserved"; therefore, all documentation is freely available and in the public domain. Organisations may distribute FHIR specifications, and derivative specifications may be developed.

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