

CareConnect - Implementation of a Standards-based Solution

Gordon Inkson, Daniel Fraser, and Edwin Ng

HealthLink

PO Box 9920, Newmarket, Auckland 1149, New Zealand

gordon.inkson@healthlink.net, daniel.fraser@healthlink.net, edwin.ng@healthlink.net

Abstract

Online forms have the potential to greatly improve the consistency, reliability and usefulness of information exchanged in the health sector. However, the success of these forms is dependent on uptake by clinicians. So, for clinicians, there must be compelling reasons to choose the online form over any alternatives. In short, using the online form has to be both easier and more effective than not using it.

The CareConnect project was faced with precisely this challenge when making online eReferrals available to over 300 General Practitioners across three of New Zealand's largest District Health Boards. The challenge was met by vendors collaborating together to implement the solution using the Health Information Standards Organisation (HISO) Standard 10014.2 for online forms[1].

1. Introduction

There is a long history of software that enables General Practitioners (GPs) to send patient information to other primary and secondary practitioners. These solutions have varied from Electronic Medical Record (EMR) developed models such as clinical letter wizards through to web portals like the Claims Lodgement system employed by accident insurer the Accident Compensation Corporation (ACC). These solutions have been successful at meeting specific needs for information collection and transmission but none have achieved this generally or comprehensively.

Auckland Regional eReferrals – now known as CareConnect – presented an opportunity to introduce a standards-based solution. A common standard would enable the sector as a whole to simplify the exchange on information. Just as importantly, a standard could ensure high quality of information. These goals could be achieved if the standard could:

1. Provide online forms that offered a quicker and easier option than both paper and non-EMR enabled solutions
2. Deliver these forms in a manner that fit seamlessly into a GP's normal workflow
3. Allow forms to function consistently across different EMR vendor solutions
4. Ensure the inclusion of critical clinical information in a well defined and consistent manner
5. Guarantee that submitted forms be recorded in the clinical record and also be tracked and audited
6. Support the quick and easy creation of new forms to meet evolving requirements (e.g. Christchurch Earthquake related accidents for the ACC).

Since 2006 HealthLink has provided a successful and functional solution for the provision of online medical forms. These eReferrals solutions have been in daily use by GPs referring to Northland, Wairarapa and Hutt Valley District Health Boards (DHBs). The online forms are functional, effective and have a proven track-record. So, when the District Health Boards in the Auckland Regional came looking for an eReferrals solution it would have been tempting to offer up that existing solution.

However, HealthLink's existing e-referral's solution – despite its wide adoption - was based on draft standards with limited support from a single GP EMR system. A key objective of the Auckland Region eReferrals solution was to make it standards-based - removing the system lock-in, custom-built interfaces and expensive change process.

The OpenHealth Consortium¹ that won the Auckland Regional eReferrals tender proposed the implementation of a new New Zealand standard – the Health Information Standards Organisation (HISO) Standard 10014.2 Online Forms Architecture. The HISO standard would promote inter-operability, loose coupling of modules and standard interfaces and data definitions. Furthermore, a standards-based foundation for CareConnect would provide a more robust platform for further forms development and encourage other vendors to participate. If the HISO Online Forms architecture could

¹ For the CareConnect solution the Open Health Consortium consisted of Orion Health and HealthLink

be extended far enough it could become integral for even further interoperability across the New Zealand Health sector and even beyond.

2. HISO 10014.2 in a Nutshell

HISO Forms Standard [2] as published in June 2010 primarily focuses on the technical interfaces required by a subscriber to an online form – also known as the Subscribing System. In other words, the standard addresses an interface that supports; obtaining a form, displaying it to the end-user and pre-populating with data from the EMR system (where available).

The typical implementation of this interface should include the following activities:

- When a form is invoked by the user, the EMR software will determine the launch parameters based on configuration, and launch context for that particular EMR installation.
- The EMR software must then determine the data set that will be exposed under this context and make it available under a pre-defined sessionId for provision to the Form Engine. This data can then be exposed via a web service provided by the EMR and identified in the FormSession callback parameter when the Form is launched.
- The EMR system will need to ensure the FormSession web service is listening prior to calling the Form Engine with that location when launching the form.
- The form can then be launched in the EMR system through an embedded browser of appropriate viewport dimensions. The browser will be equipped to render web forms that are described with the eXtensible Hyper-Text Markup Language (xHTML) – a standard language for describing web pages so they can be rendered by browsers.
- The launch of the form will include appropriate parameters appended to the Universal Resource Locator (URL – a unique identifier for opening a web page –in this case a browser-based online form). These parameters will identify the session and also other critical information like versions of the interface or dictionary and the mode of operation.
- A trust relationship is established between the EMR System and the Forms Engine through the exchange of known (but secure) credentials – the EDI account and passphrase. This exchange ensures both that the Forms Engine is a legitimate consumer of the HISO service (i.e. has access to patient data for pre-population) and also that the EMR System user is permitted to raise, complete and submit an eReferral. These credentials are also used to leverage certificates for signing and encryption and to clearly identify the sending site of the eReferral.
- When the form is launched the Forms Engine makes calls to the formsession web service to obtain data for pre-population of the form. Where a form might be populated with selections from a list of data – for example with a subset of all prescribed medications, with specific lab-results from the full patient history or with particular file-attachments – the referrer is presented with a list from which they can select the required individual elements. This selection process necessitates further calls to the formsession web service (the initial list will contain meta-data only while subsequent calls might pull more complete details – for example the full lab results).
- The Forms Engine can call the formsession web service to “Park” the form at any time allowing the referrer to stop work on a form at any time and resume later. The park also allows the referrer to periodically save their work in mitigation against technology disruption (such as power-outages, connection failures between EMR System and Form or other technology failure). In addition, the Forms Engine periodically calls the “park” function in the background to auto-save partially completed forms.
- When the user has completed interacting and filling in the form the Form Engine will send the data to the recipient via the Submission Gateway interface which ensures the submission payload has been validated and ensures the submission is authenticated – this time through trusted client and server-side certificates (associated with the EDI account).

3. Clinical Benefits Supported by the Standard

In Health Informatics a solution or an approach to a solution must be justified by clinical outcomes. The clinical arguments for online forms (referrals in this case of CareConnect) should be self-evident.

Clinicians need to refer patients to services available from District Health Boards. Historically these referrals have been manually generated - hand-written, typed up or printed from IT systems - and then faxed. Online forms are presented electronically (often via a web-browser) and relayed to the recipient by secure electronic messaging. Table 1 – Comparison of Form (Referral) Completion Approaches –compares manual, faxed forms with online forms.

Table 1 – Comparison of Form (Referral) Completion Approaches

Faxed (often hand-written) Forms	Online Forms
Not “machine-readable” – so open to subjective interpretation. Coded data is not available.	Submitted form is faithful representation of the data entered by the clinician. The codified data can be reliably transferred into providers systems.
Information already available in the EMR (PMS) must be manually re-entered on the form.	The form can (potentially) integrate directly with the EMR to populate the form.
Forms can vary from practice-to-practice.	Single, standard form.
Forms can become out-of-date as practices update their supply of forms.	Form changes are immediately available to all participating clinicians.
Inability to provide interactive guidance and feedback while the form is being completed	Business rules and online information sources can be used to give real-time feedback to the user.
Forms lost when faxes/fax-gateways unavailable or overloaded.	Electronic messaging provides a robust channel for the transfer of forms. Referral Management (receiving) systems can be searched
Reporting and tracking relies on review and monitoring the paper records	Automated electronic reports can be run.
Robust solution with few technology dependencies and many alternatives (e.g. post if fax fails).	Dependent on technology – subject to technology failure (database corruption, network outages etc.).
Universal availability – no meaningful barriers to participation or uptake.	Dependent on technology – participants must have PCs, a HISO-compliant EMR, network connectivity and a local client for the Forms Engine.
Potential for falsification – there is limited non-repudiation available for a form that is completed by hand and submitted manually.	Non-repudiability is supported by a clear audit trail associated with the submission of a referral - including digital signatures based on digital certificates that uniquely identify sending (and receiving) sites.

However, to achieve any benefits online forms must not intrude on the GP’s normal workflows. The successful implementation of a form is measured by the value it provides to both the referrer and to the recipient. The implementation of the forms interfaces into existing processes should be seamless. The forms’ use must mesh with existing, related business workflows. The forms should not introduce redundant or duplicate processing overhead such as additional user authentication; or patient document management that differs from the norm. In General Practice this near-transparent integration is of particular importance because processes are often supported by EMR system features.

In other words, the success of a standard for online forms would depend on striking a balance between loose coupling of technological interfaces (how the technology components fit together – EMRs and various Forms components) and tight-coupling of the user interfaces (presenting the forms as a single, seamless User Experience). HISO sought to achieve this balance with the following specific capabilities and behaviours mandated by the standard.

- Concept Dictionary and Mappings – a universal set of data-concepts agreed by participants in a standard-compliant solution. For EMRs this list of concepts was backed by a mechanism for mapping native data to these concepts. Where possible these concepts leveraged other appropriate standards – an example is the use of Logical Observation Identifiers Names and Codes (LOINC) for laboratory test results.
- Specifics of Form and EMR Behaviour – the standard clearly defined the details of how the Forms and the EMR systems were to interact. In other words – the standard defined the Web Service interface between form and EMR.
- Session Management – the standard declared how the EMR should manage the session with the form – including registration, logging, modes of operation, time-outs, and concurrency and performance considerations.
- Supportability, Usability and Documentation – The standard identified that support for the standard had to be a native capability of the EMRs and Forms software. This meant that the HISO capabilities of EMR systems and Forms systems had to be supported as native functionality, usable by normal end-users and well-documented.
- Retention, Backups and Archiving –forms generated from a HISO standard-compliant solution needed to conform to existing, best-practice behaviour for any such information – including retention, back-ups and archiving.

The challenge for the participants in CareConnect, then, was to successfully implement the HISO 10014.2 standard to realise the indirect and direct clinical benefits described above.

4. Implementation/design

The key to successful implementation of a standard is in striking a balance between practical application and strict adherence. The standard must not be an obstacle to delivery of a solution within a reasonable timeframe. There is also a realisation that future projects may offer an opportunity to embellish and refine the final features of the standard. The implementation as presented has been driven by the necessity of treading that fine line.

Because HISO 10014.2 was a brand new standard it provided advantages and disadvantages in negotiating this balance between pragmatic delivery and adherence. There were very limited existing examples to provide guidance on successful implementation. Conversely, the lack of existing implementations allowed the CareConnect project – and the closely aligned HISO committee – greater leeway in defining the appropriate operation of the standard.

4.1. Agreeing, Defining and Documenting the Standard

Applying a brand-new HISO standard to CareConnect introduced a dependency on the standard into the project. This dependency meant that it was necessary to rapidly finalise and implement the standard.

The project and the finalisation of the standard were assisted by New Zealand's relatively small community of interest around Health Informatics. It was possible to get the relevant, interested parties around a table early in the process – to the considerable benefit of both the standard and the CareConnect project. This group were able to reach agreement on how the Standard should work and how it should be described. The concrete reality of CareConnect gave impetus to these activities. Two key deliverables arose out of this exercise:

1. An Implementation Guide for the Standard. This document described the implementation principles and illustrated that with examples. The document set expectations for the interpretation of HISO 10014.2 [2].
2. Seeding of an agreed National Concept List – a spreadsheet that would go on to define the data-concepts being exchanged by way of the HISO interfaces. This spreadsheet – and the mechanisms around its maintenance and update – are closely aligned with the relevant HISO standard for data-concepts (HISO 10014.1). This standard encompasses relevant other initiatives such as the New Zealand Universal List of Medications (NZULM) and ensures that applicable other standards (such as LOINC) are used where relevant.

4.2. Establishing a Process for Extending/Fine-tuning the Standard

The Technical Specification and the Concept spreadsheet provided a starting point to allow the parties involved in CareConnect to implement a standards-compliant solution. However, the reality was that the finer-details of implementing the standard were outside the scope of the Technical Specification but would still require agreement

To that end a group of public and private sector architects got together to agree the details of implementation of the standard. The group was primarily a forum for discussions between the parties most closely involved in that implementation – the developers of the first forms to use the standard and the EMR Vendors involved in CareConnect. In many cases a particular data-concept – required for CareConnect eReferrals – might be understood in different ways by the two main EMR Vendors. The forum was also used to get agreement on a common approach for these concepts that could be complied-with by all parties.

The fine-tuning of the HISO standard represented a case where the newness of the standard and the small number of participants was an advantage. It was easier to get agreement on data-concepts and implementation details when there was no existing system and only a small number of parties had to agree on the definitions and changes.

4.3. Implementing the Standard for CareConnect

With a high-level specification for the standard defined and with a process – agile, if adversarial – for defining data-concepts and the finer points of implementation it became possible for the involved parties to start implementing the standard - focussing initially on the Forms and moving on to the work of the two main EMR vendors in the project.

4.3.1. For the Forms Manager, Forms Engine and Submission Gateway

For Forms development the implementation of HISO 10014.2 primarily involved the following activities:

- Fully understanding the requirements of the numerous forms involved in CareConnect – especially all of the specialist sub-forms – and describing those requirements in terms of HISO data-concepts.

- Identifying and coding the sequence of HISO operations that would be needed for the required form behaviours – initiating and pre-populating a new form, auto-saving, parking, previewing, form validation, form submission and saving the form back to the user application. Many of these high-level operations themselves included multiple variations such as pre-populating a list of lab-results and then allowing selection of a specific lab.

4.3.2. Changes to the Standard

Over the life-span of the CareConnect project the standard required regular review and changes. In practice this review was carried out via the following tools and activities

- Concept Spreadsheets - The Concept Spreadsheet was maintained by a two stage operation. The original Agreed List represented the defined data-concepts agreed by all parties. This Agreed List was extended by the operation of a Working List that drove the workflow of developing concepts./ In the Working List concepts were identified, mapped in the solution and in the EMR systems and their behaviour documented. At appropriate intervals – and with agreement of the involved parties - concepts from the Working List fed into the Agreed List. Tight version control was maintained on both spread-sheets. Huddle™ was used to collaborate on the Agreed List document.
- Implementation Guide – the HISO Standard accurately describes the interfaces and includes XML examples of many HISO operations. However, it is a document only and there is no accompanying reference implementation. So, it was deemed important for the CareConnect project that the implementation guide (see 3.1 above) be periodically revised and extended to assist the EMR vendors in providing a HISO service. This document has been extended through the project to capture the decisions made.
- Vendor Validation Tool – alongside the Auckland eReferrals Forms a Vendor Validation Tool was also developed. The Vendor Validation Tool represented a standard form that vendors could use to validate their HISO Web Service. The Vendor Validation Tool included controls that would trigger the main calls to the HISO service provided by the vendor of a User Application. Over the course of the project the versatility and range of the Vendor Validation Tool was steadily expanded to facilitate the debugging of issues with the supplied HISO services.
- Vendor Support – the Vendors needed support in their implementations of HISO services. The above tools were invaluable in providing that support but sometimes it was necessary to work one-to-one with the vendors to enable them to comply with the standard or (most commonly) to assist with debugging or issue identification.

4.3.3. For the User Applications and Forms Viewer (EMR/PMS Vendors)

For CareConnect two EMR Vendors were engaged to implement a HISO service so they could function as User Applications. It was important to get involvement from at least two vendors as the advantages of a Standards-based approach become far more apparent when multiple vendors support the standard. Their work included:

- Building a HISO Service that complied with the WSDL and Schema defined for HISO 10014.2. One of the strengths of Web Services for integration is that they are technology-neutral. The Form application modules and the EMR Systems were built on different technology platforms for providing or consuming the web-services. At times this divergence of technology platforms caused issues – for example when a generated Web Service did not comply with the Standard's schema – but with effort these issues were addressed by collaboration between involved parties.
- Building a Concept Resolution Engines that would map the User Application's own internal data-concepts to the standardized HISO concepts. It was helpful to have had the vendors heavily involved in the HISO committee that had defined the data-concepts. This meant that the HISO data-concepts had (generally) been designed with the implementation requirements of the vendors in mind. Where there was divergence between how the two vendors viewed certain concepts that divergence had been accommodated and a compromise identified in most cases.

5. Evaluation

A rigorous evaluation of the benefits of implementing HISO 10014.2 for CareConnect is necessarily still pending. The project has only just reached pilot phase and there have been no full reviews of the project yet. The lack of a formal project review at this time means we have only immediate experiences of the project itself and anecdotal evidence available to evaluate the approach. Some of that evidence includes the following observations:

1. The use of HISO 10014.2 – especially the standard data-concepts – was beneficial to discussions between all participants in the project. The standard supplied a common frame-of-reference and an agreed terminology. These small, simple, practical contributions prevented much of the miscommunication that has historically

plagued such discussions. Whereas previously such a discussion was a tug-of-war between two competing world-views, standards meant the discussions became two sides striving to meet in neutral common-ground.

2. The HISO process itself – agreeing data-concepts, interpreting the standard in terms of implementation – provided a forum for discussion amongst otherwise fiercely competing vendors.

Additionally, there are a number of key indicators that, while not in themselves a full vindication of the standards-based approach to online forms are certainly signs of the potential of this platform.

3. CareConnect phase 2 will look to implement a HISO interface to allow the same referrals that are used in Primary Care to also be available in Secondary.
4. Prospective customers of Online Forms solutions – including customers already using proprietary solutions – have independently proposed leveraging existing HISO interfaces as an option.
5. There are expressions of interest in becoming “HISO-compliant” from vendors of potential “User Applications”.
6. The HISO 10014.2 standard is regularly raised by partners and customers in discussions around interoperability in contexts outside of conventional online forms.
7. Other forms solutions are set to adopt the standard to build upon the Vendor capabilities that have been established via the CareConnect project.

6. Comparison with other approaches

CareConnect could have been delivered with a proprietary approach or with a standards-based approach.

6.1. Proprietary vs. Standards-based Approaches

A proprietary online forms solution would involve tight – or at least non-standard - coupling between components. This tight coupling would require the customer to view the online forms solution as a single, complete, combined offering - a ‘black-box’. Even the interfaces to external systems – in Primary and Secondary care – would have inherent dependence on bespoke arrangements between a Forms Vendor and other participants in the forms process.

This proprietary approach has clear strengths – especially for the owner of the proprietary technologies. Tightly coupling modules allow easier control of information flows. Internal system changes can be implemented in the simplest possible way because no-one else is affected.

But there are equally clear disadvantages to proprietary solutions. Proprietary solutions lock a customer into a vendor relationship. System replacement is generally ‘all-or-nothing’. It can be difficult to extend the solution to encompass greater functionality. Similarly, it can be difficult to extend the interfaces with other systems. The HISO standard is designed for easy extension to add additional data concepts without the need to adjust the interfaces.

By contrast a standards-based approach makes the boundaries between components clearer and individual components much more replaceable and extensible. For example, the CareConnect platform could support the following:

- Extension to further EMR vendors – those vendors would need to put up an appropriate HISO-compliant web service and then they could interact with the Forms Engine, Forms Manager and Submission gateway for the completion and submission of CareConnect forms.
- Delivery of Other Forms – other entities (outside the Auckland DHBs) can develop their own forms that utilize the existing HISO services at practices that use CareConnector even just practices that use the EMRs that support CareConnect. The data-concepts may need to be extended but the key functionality would already exist.
- Multiple End-points for Online Forms – the CareConnect eReferrals are all routed to the Orion Referral Management System. However, other, new, forms would be routed to their own appropriate end-points. Furthermore, it would be possible to support multiple, potential end-points even for a single form.
- Alternative Forms Distribution Systems – another group (other than HealthLink) could supply forms to the EMR systems that support the HISO standard.
- Extension of HISO Data-concepts to Non-Forms Requirements – at the heart of HISO 10014.2 are mechanisms for the supply of clinical/demographic data from its primary source. That same capability could also be utilized in other scenarios where other systems need access to that primary data.

7. Lessons Learned

Having been through the process of implementing a standards-based solution for delivery of a specific Health Information Systems project there are a number of lessons that could be applied in similar circumstances.

7.1. Vendor Buy-in is Imperative

A standard ensures a consistent approach by multiple participating parties. If any of those parties will not conform then the advantages of that standard are lost. This means that obtaining Vendor buy-in is extremely important. Buy-in can be obtained by getting vendors involved early, listening and acting on their input (whether supportive or critical), being flexible enough to accommodate different vendor preferences (i.e. reaching reasonable compromises) and above all ensuring good communication between all participating parties.

7.2. Consensus is Nice But Standards Need a Sponsor and an Enforcer

However, for all that communications, compromise and agreement are important someone needs to be the spokesperson and the ultimate authority for the standard. That person or group needs to front the standard to the customer and to participating vendors. They also need to be the final authority on any disputes and disagreements.

7.3. Identifying and Confirming the Data Concepts is Critical

A standard is great as a model for the interaction between entities, but data requirements are often solution-specific. Those requirements need to be accommodated into the standard and there needs to be agreement amongst participating entities on what each concept means at a clinical level. Clinical meaning can include a very high-level of detail – the units, the value ranges, the incorporation of other standards/conventions (such as SNOMED or LOINC) and so on. There then needs to be agreement around how that defined data-concept can be mapped to the data available in the User Application and when and how it will be returned.

7.4. Conformance to a Standard is Linear Not Binary

The chances of getting vendor support are increased if the barriers to compliance are low. The barriers are kept low by ensuring compliance is not a simple yes/no (compliant or not), but a scale of compliance – from a minimum standard through to full and complete compliance. In the case of HISO 10014.2 this scale was achieved in the following ways:

- Any individual data-concept could be supplied or not as the vendor saw fit. If a vendor could not support a particular concept that did not make them non-compliant it just meant that concept could not be pre-populated. The minimum for data standards compliance was a set of “Priority One” concepts for CareConnect.
- Particular variations of Web Service operations need not be supported. For example, the “processAction” operation could support myriad operations within the User Application but, calls to processAction simply return a True/False response with a False response indicating that this particular operation was not supported or could not be completed.

7.5. HISO 10014.2 Processes Need to be Formalised and Systemized

As previously stated, the small number of participants in HISO in CareConnect ensured agility in extending and fine-tuning the standard. However, this approach will not be viable going forward. It will become necessary to establish a much more formal set of processes and systems around the extension of the standard.

8. Conclusion

It can take a great deal of time and effort to define, and then collaboratively implement a pragmatic data exchange standard. The HISO 10014.2 standard has been successfully implemented because:

- There was an industry-wide forum to define and agree the standard.
- It was based on a proven draft that was implemented by early-adopters and extended in a collaborative way.

- The standard provided a rigid framework and interface specification but flexible opt-in data exchange enabling the core to be agreed by multiple parties.
- A significant project, CareConnect, was able to give impetus to the implementation of the standard.
- Good governance and collaborative discussions throughout the implementation phase allowed for implementation roadblocks to be cleared.

9. Acknowledgments

We would like to acknowledge the many people who contributed to defining and bring the HISO standard through to implementation. This included the HISO Committee for 10014.2 as documented in the Standard [2].

Recognition should also extend to the CareConnect HISO implementation team who defined and implemented the initial set of HISO concepts as well as proposed pragmatic adjustments to the standard to ease implementation by the EMR vendors:

Peter Sergeant, MedTech

Ashwin Patel, My Practice

Edwin Ng, HealthLink

Tania Novess, HealthLink

Daniel Fraser, HealthLink

Gordon Inkson, HealthLink

Mike Donnelly, HealthLink

As well as the wider CareConnect implementation team and Management with many contributors from Orion Health, healthAlliance, MedTech, My Practice and HealthLink.

10. References

[1] Various, Online Forms Architecture Technical Specification HISO 10014.2, v1, June, 2010.

[2] Fraser D., Inkson, G., Donnelly M, Ng, E, HealthLink Guide to HISO 10014.2 Forms, v2.4, July 2011.