Electronic transfer of radiology reports to other hospitals and general practitioners

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Introduction

Compared to most clinical specialities, radiology has extensive, mature and sophisticated information technology support. Given this, it is perhaps surprising that transmission of radiology reports is not yet a routine electronic process. In fact, the only information flow in the UK from hospitals to general practitioners that is universally and exclusively electronic is for laboratory results (specifically haematology, biochemistry and microbiology). This has been operational since 1999-2000 and is based on EDIFACT messaging.[1] Numerous NHS trusts have implemented local or regional electronic solutions for discharge summaries and outpatient letters, in some cases using the NHS Interoperability Toolkit (ITK) message specifications.[2] However, there does not yet exist a nationally available generic document sharing capability between NHS primary and secondary care. This article is based on a presentation given at UKRC 2013 and specifically addresses transfer of radiology reports to general practitioners, with some consideration of inter-hospital report communication.

Healthcare interoperability – the bigger picture

Interoperability is defined as "the ability of two or more systems or components to exchange information and to use the information that has been exchanged".[3] The absence of general interoperability in healthcare has been lamented, especially in the US health system, as part of the failure to achieve necessary efficiency and safety improvements.[4]

Efforts to develop and implement standards for interoperability are almost as old as the first generation of health information technology (HIT).[5,6] Much progress has been made with intra-organisational interoperability. Most NHS hospitals have a common index for patient demographics, typically in the patient administration system (PAS), which is shared by departmental and central diagnostic systems such as PACS and the radiology information system (RIS). The protocols and capabilities are there for wider information sharing, but their usage and configuration has depended on local leadership, so diverse solutions have evolved to fit particular health 'ecologies'. The implementation challenge is primarily human and organisational, not technological.

As with any significant organisational change, substantial resources are needed to generate progress.[7] Unlike hospital clinicians, general practitioners were given financial incentives to move to electronic patient records (EPRs).[8] This is now institutionalised in that the whole payment system for GPs as independent contractors is driven by information supply, usually at aggregate population level, derived from their EPRs. An additional problem with implementing interoperable solutions is that the costs and benefits often fall in different places – each node in the information network (GP, radiology, laboratory and so forth) will typically need some upgrade to participate in a new exchange standard, but which users actually get the benefits? Efficiency and financial savings often arise solely for consumers rather than providers in healthcare information communities. For example, for GP reporting the laboratory or radiology department still has to produce reports in the same way so there is only minimal, if any, cost reduction whereas the general practice will have both process efficiency improvements and potentially cash-releasing benefits from reduction in scanning workload. Therefore, incentives have to be devised at a regional level as shared community benefits and usually require some 'market management' from healthcare commissioners.

Radiology reporting in the UK

An informal survey of health IT vendors and NHS trusts identified five different configurations of electronic radiology report transmission in the UK. The following sections describe each category of solution and briefly evaluate their relative merits.

1. Hospital EPR viewer

This 'portal' approach is simply a GP view of the hospital patient record, usually restricted to patients registered with the given practice. Typically this is only available when the trust has a hospital-wide EPR, although in some cases GPs are given portal access to PACS. This is arguably the least useful solution for the GP as it requires learning how to use a different EPR and having to navigate large amounts of irrelevant detail. Also, it still requires the practice to process the paper report into the GP EPR through a scanning and coding workflow.

2. Shared repository

A shared repository, or 'data warehouse', aggregates multiple data sources into a virtual EPR. This often includes various types of primary care data, hospital correspondence, diagnostic reports and administrative data such as scheduled clinic appointments. This approach enables the GP and the hospital clinician to see a fairly complete picture of the entire patient journey through various clinics, wards and diagnostic services. This is particularly helpful when implemented as a regional shared record that incorporates data from several hospitals. The disadvantages are the same as the portal.

3. Direct messaging

Direct messaging of reports into GP systems from the RIS is typically achieved by generating HL7 version 2 messages. HL7 is the dominant international standard for health information exchange. While the ability to generate HL7 v2 output is usually native to the RIS, the capability to receive and process these messages is not standard in UK GP systems. Therefore 'middleware' of some kind is generally needed to translate the HL7 format into a structure that the GP system can understand, sometimes using the EDIFACT laboratory reporting mechanism described in the introduction. This approach has the major advantage of integration with the GP system and hence with the practice

workflow. The disadvantage is the need for a translation layer, however that is also usually implicit in all the solution categories except the simplistic GP portal.

4. Messaging hub

The messaging hub (sometimes called health information exchange (HIE)) solution is illustrated in **figure 1**. In effect, this is a 'clearing house' that manages requests, reports and billing (or activity reporting in the NHS) between multiple requesters and reporters. This architecture would incorporate the translation layer required for GP direct messaging, but has the additional advantages of multi-organisational interoperability and support for the whole business process, not just the report transmission. The disadvantages are the complexity of supporting the multiple message types, and consequent higher deployment cost, and the risk inherent in wide area dependency on a single point of failure. The latter point can be addressed by using a resilient design such as a cloud service or locally clustered servers with failover.

5. Integrated requesting and reporting

Integrated requesting and reporting (in the UK often called order communications) can link to an HIE, or can function as a direct collaboration between a group of GPs and a diagnostic provider. The requesting and reporting functionality can be accessed from a link in the main GP system, but there is not usually full integration with routine general practice operations. This category can offer additional features such as checking the status of outstanding requests and structuring requests to meet local referral guidelines. The obvious limitation of this solution is that its scope is, by definition, restricted to one component (albeit a crucial one) of the healthcare information ecosystem. Another potential weakness of this solution category is that some implementations use proprietary rather than international standards.

6. Comparison

Figure 2 compares and contrasts the relative degrees of workflow integration and use of international standards found in each of the solution categories. This is not to say that one solution is always the best, or that there is necessarily a wrong answer. Any improvement in healthcare interoperability is to be welcomed, but a strategic approach that is both standards-based and integrated with requester and provider business processes clearly offers the greatest potential benefit to the greatest number of users. The more sophisticated approaches normally require proportionately higher initial expense, but also offer the maximum potential for quality improvement and process efficiencies. The choice between solution architectures is fundamentally about what business problem a health community is trying to solve.

Opportunities for the future

Another HL7 standard that has obvious potential for use in radiology report transmission is clinical document architecture (CDA), and its simplified version 'greenCDA'.[9-11] CDA is an XML document format that specifies the structure and semantics of clinical documents. **Figure 3** shows a mind-map of the logical structure of CDA. CDA is widely used in numerous national and regional health information programmes, including the NHS in England, the US federal programme and Australia, Austria, Brazil, Canada and China to give an indicative ABC selection of other implementers.

Part of the attraction of CDA is that clinicians are comfortable with the concept of documents as the unit of information exchange. Whereas messaging seems like a complex technical process, document exchange is readily comprehensible. Another advantage is that CDA allows for varying degrees of sophistication in its usage. Entry-level CDA can be as simple as a digital blob (binary large object – perhaps a PDF file attachment) with a structured header. **Figure 4** illustrates a minimal CDA structure, which is no more than a text file with the machine-processable header.

CDA would seem to be an obvious design candidate in a strategic architecture for radiology communications.

Conclusions

The NHS is known to tolerate unsafe processes to a level that would be inconceivable in most service industries.[12] Arguably, the absence of a national architecture for radiology information exchange is an instance of this problem. As the second NHS and social care information governance review concluded, the motto for better care services should be: "To care appropriately, you must share appropriately".[13]

The technology and the standards exist to support safe and usable solutions. Primarily, what is needed is leadership and standardisation,[14] though finding sufficient resources for either of these is challenging in the continuing austerity climate.

Views expressed in this article are personal judgements and do not represent HL7 UK.

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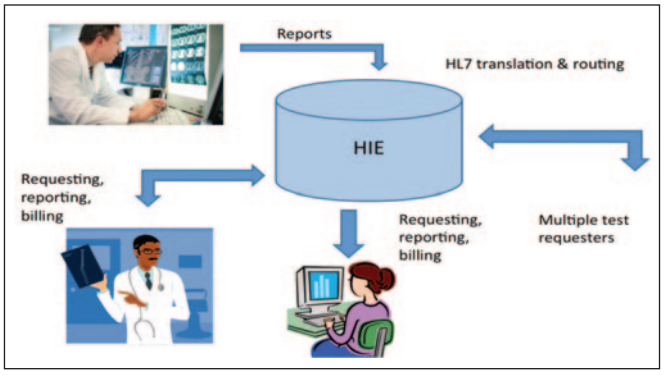

Figure 1
Typical messaging hub architecture. *(Clip art ©Microsoft).*

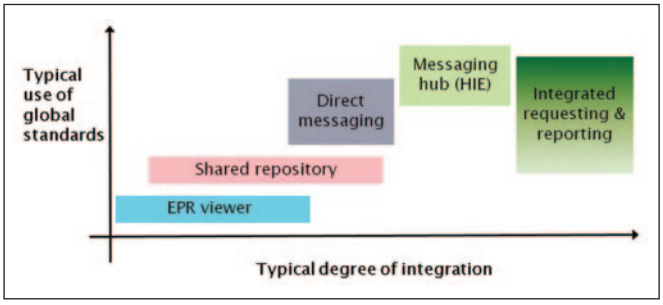

Figure 2
Comparison of report communication methods.

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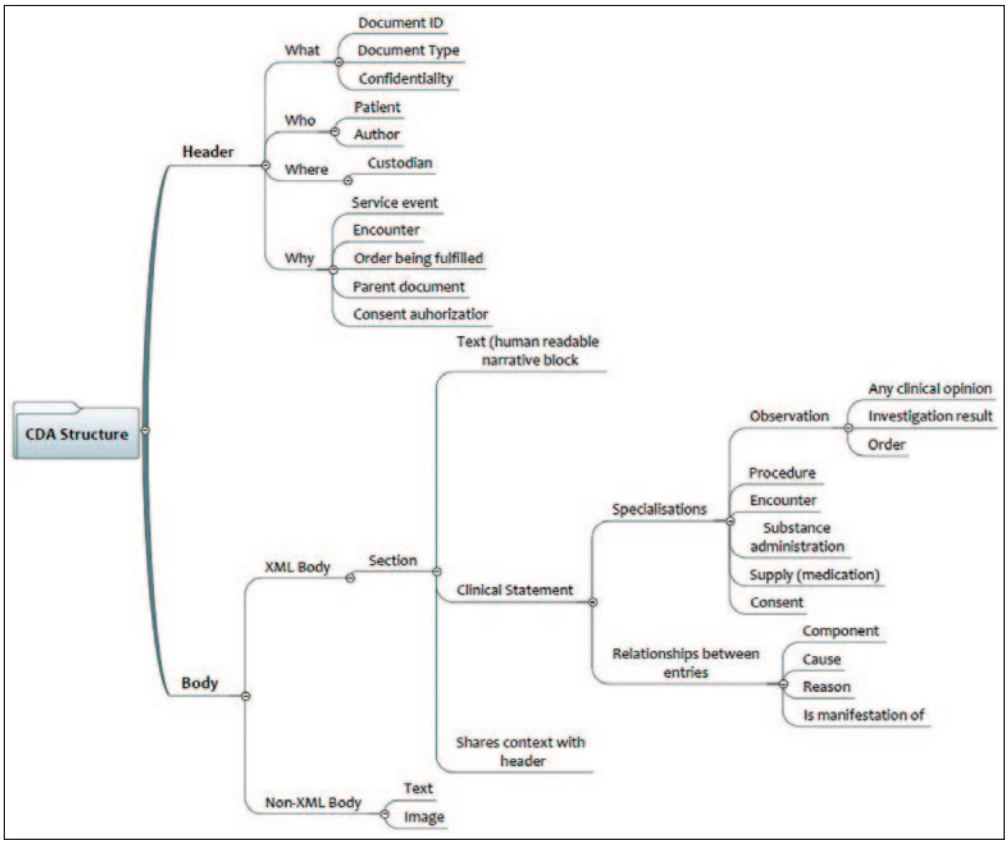

Figure 3
CDA logical structure (based on Benson 2012,[15] with permission).

```
<?xml version="1.0" encoding="UTF-8"?>
<ClinicalDocument xmlns="urn:hl7-org:v3" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
classCode="DOCCLIN" moodCode="EVN">
<!-- CDA Header -->
        <typeId root="2.16.840.1.113883.1.3" extension="POCD_HD000040"/>
        <id root="2.16.840.1.113883.19.4"/>
        <code code="11488-4" codeSystem="2.16.840.1.113883.6.1"/>
        <effectiveTime value="20140407"/>
        <confidentialityCode code="N" codeSystem="2.16.840.1.113883.5.25"/>
        <recordTarget>
                <patientRole>
                        <id root="2.16.840.1.113883.19.5"/>
                </patientRole>
        </recordTarget>
        <author>
                <time value="2014040714"/>
                        <assignedAuthor>
                                <id root="2.16.840.1.113883.19.5"/>
                        </assignedAuthor>
        </author>
        <custodian>
                <assignedCustodian>
                        <representedCustodianOrganization>
                                <id root="2.16.840.1.113883.19.5"/>
                        </representedCustodianOrganization>
                </assignedCustodian>
        </custodian>
        <legalAuthenticator>
                <time value="20140408"/>
                <signatureCode code="S"/>
                <assignedEntity>
                        <id root="2.16.840.1.113883.19.5"/>
                </assignedEntity>
        </legalAuthenticator>

<!-- CDA Body -->

        <component>
                <nonXMLBody>
                        <text mediaType="text/plain"><reference value="somefile.txt"/></text>
                </nonXMLBody>
        </component>

</ClinicalDocument>
```

Figure 4
Example minimal CDA structure (based on Dolin 2013[16]).