A National Library of Electronic Clinical Templates for Nursing in the Community - a Feasibility Study

Status: FINAL, FOR CIRCULATION

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1 Summary

This report describes a project for the National Health Service in Scotland, titled 'a National Library of Clinical Templates for Community Nursing in Scotland: a Feasibility Study'. The project started in November 2005, and ended in May 2007. It was commissioned by the Scottish Executive Health Department, funded by the Primary Care Division, and sponsored by the Community Nursing Network and the Chief Nurse.

The project defined a clinical template as a clinical information model, which could be used to define a form in a health record system, for example a continence assessment.

NHS Scotland eHealth policy is to move towards national systems where appropriate, and these systems will both require and encourage national collaboration over content.

The potential benefits of national collaboration in developing clinical templates are:

- reducing development effort, particularly by clinical staff;
- promoting clinical standards by enhancing the evidence base in record systems;
- promoting implementation and supporting development of national data standards;
- increasing consistency of clinical system content, to enable the development of other tools, for example decision support or skill mix analysis;
- stimulating new information systems or enhancing existing systems, by making a library of clinical templates easily available to developers; and
- increasing consistency and usability of information for secondary purposes, such as caseload management, audit, locality profiling, or service management.

The project explored options for supporting clinical involvement in the process of development and maintenance of shareable clinical information tools. A project web site at http://www.clintemplate.org supported 109 subscribers in 15 clinical groups in developing 27 templates from new or existing sources. A more technical strand explored the development outputs to produce clinical domain models, candidate templates/archetypes, and prototype tools and architectures for maintenance and electronic publishing.

The recommendations are:

1. Further development should focus on agreement and use of standardised ‘building blocks’ which can be combined and re-used in templates. This should be based on the preferred data standards under development by ISD (eg archetypes, or compound clinical concepts).

2. Further work is required to ensure effective management and governance of large collections of templates.

3. Agreeing models for the clinical record suitable for NMAHP practice would help guide template development. These should reflect the differing requirements between differing levels of practice, and use by patients and carers.

4. Content in use in existing systems is an un-tapped resource and should be used as the basis for new template development.

5. Existing clinical groups and communities of practice should be the starting point for further clinical template development.

6. Clinical template development should be one source of content for ISD data standards development.
7. Templates developed by the project should be migrated to standards as agreed with NHS Scotland Data Standards.

8. Further development should use similar methods to the project web site, based on openness and transparency, and promoting peer review. It should be discipline and application-neutral (ie, capable of use in any system or on paper).

9. Clinical templates developed by the project should be indexed and integrated with the NHS Scotland e-Library.

10. National projects involving content development for NMAHP eHealth or clinical standards should be required to make that content available using archetypes or templates that are compatible with national resources.

11. It is essential that continuing work on clinical templates develop best practice in linking supporting guidance on use of templates, and in particular, any logic associated with decision-making.

Although there is growing interest in this area, with work by national and international standards bodies (such as HL7, CEN, ISO, OpenEHR), this project is unique in terms of its focus on clinical information standards, and the processes that have been developed. It has therefore attracted interest from related projects in the Netherlands, Australia, England and the USA.
2 Introduction

The NHS is changing at an unprecedented rate, and there is continuing pressure for more radical reform. Paradoxically, organisational change disrupts existing information systems at a time when there is increasing demand for information to evaluate that change.

Recently the Kerr Report recommended: 'A common information and communications technology system is essential if the NHS is to deliver the integrated continuous care required of it'. [1] There are two main routes to a 'common system': develop and enforce standards to ensure interoperability of diverse systems; or enforce a 'single system'. Even a single system solution is likely to be a hybrid to cover an organisation as diverse as the NHS. Either way, standardisation will result, either to enable interoperability, or in an ad hoc manner due to single system implementation.

The service must tackle the issues of standardisation in order to be ready for such major change, and, for that reason, the Scottish Executive commissioned this project.

2.1 Background

Many information systems now use ‘forms’ (sometimes called ‘screens’) to collect or present information. By arranging the data on the screens, it’s easier to find what you are looking for, rather than read and type lots of text.

In this project, we consider a template to be:

- the clinical information model that a form is based on;
- a description of all the data items that might be used, how they need to be grouped together, and possible values for items;
- built from components, for example a Body Mass Index component can be defined once, but reused in a nutrition assessment and a pressure area assessment;
- usable in many different formats, for example on paper, in desktop computers, on mobile devices, etc, so a template will not contain any information relating to its appearance; and
- the result of a process of collaboration by informed practitioners.

Of great importance to healthcare professionals is not just what is in the template, but where it has come from, and how it should be used. For example, what is the evidence-base for an assessment template, and are there recommendations on how it should be used in practice? Who has developed it, and when was it last reviewed?

This project was commissioned by the Scottish Executive Health Department’s (SEHD) electronic Community Health Information Project (eCHIP) [2] in December 2005. eCHIP was subsequently replaced by the NMAHP eHealth Programme Board which assumed ownership of the project.

The project was funded by the SEHD Primary Care Division, and sponsored by the Community Nursing Network [3] and the Chief Nurse for Scotland. It started in November 2005, running until May 2007 and was delivered by the Centre for Nursing and Midwifery Research at Glasgow Caledonian University.
The project was commissioned to deliver one of the recommendations from the eCHIP report 'Community Nursing Care Programme Development: a Formative Evaluation' to '...test the feasibility of a national library of 'clinical templates’ for Community Nursing in Scotland.' [4]

2.2 Aims of the feasibility study
The project aimed to describe the options for developing and implementing a National Library of electronic Clinical Templates for Nursing in the Community in Scotland and evaluate the benefits to clinical care and secondary information users.

The objectives were to:

• identify the extent of commonality in the structure and content of community nursing records in Scotland;
• prototype and test a method of collecting record content, evidence-based, and other expert sources to develop and maintain templates;
• evaluate options for template types;
• prototype and evaluate an option for publication of templates, including information on sources and levels of authority of content;
• examine the use of template-driven data entry for community nurses to identify models of integration with clinical practice; and
• evaluate the implications of these models to produce implementation guidance.

The desired outcomes were to have:

• a clinically-owned reliable methodology for getting nationally standardised templates that support care delivery processes into electronic records and updating them; and
• a sustainable mechanism, the national library, for maintaining the templates.

This emphasis on clinical involvement was key in shaping the approach taken by the project.

3 Approach
Feasibility is similar to evaluation but with one key difference: the subject under investigation does not exist. In this case, the subject (a National Library of Clinical Templates for Nursing in the Community) does not exist in Scotland or any other country at the time of writing.

If the subject does not exist, we can use two strategies: develop prototypes for testing; or look for evidence in existing projects that are similar in some respects to what is proposed. This study used both approaches.

3.1 Project design
The project comprised three phases: template development, template management, and implementation.

The template development phase explored options for supporting clinical involvement in the process of development and maintenance of shareable clinical information tools.

Existing national groups of Tissue Viability Nurses, Continence specialists and a Health and Well-being Network (concerning the physical health of people with serious mental health problems) were approached and cooperated over the development of national standard templates. Other ad hoc groups formed over the course of the project. In addition some
standardised tools have been included. A third source was content from existing community information systems in NHS Scotland.

Collaboration within and between these groups was done through a public web site described below, which supported on-line collaboration on template development and publication using an approach based on the Open Source movement. Face-to-face meetings were also used when requested by groups.

The template management phase explored the development outputs to produce clinical domain models, candidate templates/archetypes, and prototype tools and architectures for maintenance and electronic publishing.

Owing to uncertainty over standards for archetypes, the project used simple XML mark-up, with a schema that supported metadata, individual items, and groups, which could be nested to an arbitrary level.

The implementation phase was to include evaluation of user experience with form-based systems at existing sites, for 'professional' acceptability. However, a survey of expert practitioners could not be completed due to problems recruiting a research assistant. It will be completed over the summer of 2007, within existing project resources, and the results will form the basis of a separate report.

### 3.2 Scope

The project began with a broad scope covering clinical content development, through template development, management and implementation, and exploration of current national and international standards.

Over the course of the work, the scope was narrowed as the openEHR specification gained momentum and ISD developed an active interest in this area and began scoping work itself. The GCS project also undertook some scoping work on a National Forms Library for that toolset.

The project scope was therefore focussed on the more clinical aspects of the project, and aimed at contributing to, and supporting, emerging standards work.

Community nursing was the main source of content, but it was the intention to explore the potential for clinical templates to be a generic approach. Content from non-nursing and acute sources was therefore included.

### 3.3 Project team

The project was delivered by a team from the Centre for Nursing and Midwifery Research, Glasgow Caledonian University: Derek Hoy, Prof Jean McIntosh, Dr Alison Bryans, Laura McMillan (until Dec 2006) and Jamila Abu Idhail.

External consultancy was provided by Dr Nick Hardiker (Salford Health Informatics Research Environment, University of Salford).

The Scottish Executive Project Board consisted of: Alan Hyslop, Heather Strachan, Jane Walker, Kate Harley (ISD), Dr Lorna Ramsay (ISD), Alma Robb (QIS), Eileen Moir (QIS), and Kathy Dallest as eCHIP Project Manager.

The project team is extremely grateful for the excellent support of a number of advisors.

The project technical advisors comprised Dr Nick Hardiker, Dr Ian McNicoll (MCMI, SCIMP) and Phil Westwell (NHS Orkney, GCS National Forms Library).

We also had external advisors: Anne Casey (RCN, NHS England Information Standards Board, SNOMED-CT Editorial Board), Dr William Goossen (Dutch National Project and HL7).
3.4 Consultation
The following people and/or organisations were consulted:
Scottish Executive Data Sharing project (Kerr Donaldson), ISD Improving Mental Health Information Programme, Director of Nursing for National Services Scotland, QIS, NHSS eHealth Strategy leads, Perinatal Telehealth Project, openEHR/Ocean Informatics, and clinical groups involved.
Community Nursing Network (CNNet) at several meetings.
NCDDP team and attendance at initial meetings of community nursing dataset working groups. Meetings with Alison Wallis, Lee Davies, Dr Paul Woolman and Dr Lorna Ramsay. NCDDP was concurrently undertaking a one year review of clinical models at the same time as this project, involving review of HL7 templates and OpenEHR archetypes, pilot development of clinical content using the archetypes approach and open source tools, detailed exploration of the content aspects of archetypes and commissioned a report on the technical aspects of using the archetypes approach from Dr Ian McNicoll, who was also a member of our technical advisory group.
Generic Clinical System (GCS) workshop and developer day, (the toolset was not available over the course of the project). Phil Westwell who did scoping work for GCS National Forms Library, was also a member of our technical advisory group.
Presentations included:
NCDDP Community Nursing Datasets roadshow (Shetland, Orkney, Western Isles, Glasgow, Borders, West Lothian, Lanarkshire), Rcn (UK), CNNet, NMAHP eHealth Leads, Association of Continence Advisors, ACENDIO 2007 (International conference on nursing terminology), SCIMP, Association of Continence Advisors annual conference, BCS Health Informatics Scotland conference 2006, and on-line screencasts.
A paper was presented at MEDINFO 2007, and a presentation given to post-conference workshop for members of HL7, CEN and ISO working groups.

3.5 Resources
The project has developed and tested on-line collaboration for working groups, using an approach based on the Open Source movement [5] at a public web site http://clinicaltemplates.org.
The site gives news and background information on the project (including RSS feeds) and supports working groups on clinical topics. Groups can have their own web pages, put up documents and links to other resources, and post messages to the group page.
Templates for a group are displayed as simple forms, and any visitor can leave comments attached in-situ to items in a template (formative evaluation) or post a review of a template (summative evaluation). Users can register with the site, and subscribe to any groups. Once subscribed, they receive email alerts with links to any new comments or other postings to the group discussion area.
Changes to templates are controlled by a group of core developers, and membership is restricted to those approved by the core group itself.
The web site has not been publicised beyond those invited to participate in the project, but had 159 unique visitors and 824 page views in April 2007.
At August 20 2007, the web site had: 98 registered users; 13 groups with 18 'core developers'; and 27 templates. Some of these templates are components of other
templates, and are therefore candidates for archetypes. A number of other templates are in preparation.

A fuller description of the web site is in Appendix B.

4 Findings

4.1 Assessing the potential benefit

Figure 1 shows the current situation for most clinical content in NHS information systems. The few exceptions, such as SCI-DC, prove the rule.

Figure 1: Content development in NHS Scotland

The diagram is numbered to show how the current situation affects various user groups:

1. **clinical users**
   Practitioners give time to develop content locally, while similar content already exists, having been developed elsewhere. Practitioners also expect content to be evidence-based and updated promptly. Smaller organisations may not have local specialist practitioners or resources for training.

2. **clinical communities**
   Clinical communities produce the evidence base, but this will rarely be published with usable tools allowing integration in the record. Where it is published, it may be
hard to find and, except for some national projects, is unlikely to be based on, or linked to, national information standards.

3. **System content developers**
   Local development teams may re-use content offered by system suppliers, but will often develop their own content, involving considerable effort. Content development requires specialist skills (a mix of clinical and informatics experience), which are reported to be in short supply.

4. **Secondary information users**
   Where content is developed independently for each individual system, the clinical data that results will not be consistently structured or coded, making retrieval for analysis difficult or impossible without considerable resources, locally and nationally.

5. **NHS information standards developers**
   ISD through NCDDP set up working groups of clinicians for national clinical data standard development informed by best practice, clinical guidelines, existing systems and local practice. This process involves considerable effort. These are then consulted upon, the results published in the Health and Social Care Data Dictionary and support provided for implementation within national systems. It can be difficult to know where and how the standards are being used out-with national projects. The NCDDP has been an important step forward in supporting implementation of clinical information standards and it is important to maintain the momentum achieved to date. The implementation of SNOMED-CT has been slower than expected, and will require very specialist skills which will not always be available to local developers.

The key to the current situation is that there is still a mismatch between the content sources and local developers, resulting in considerable local effort being required to build systems. The burden of developing high quality content based on best practice and current information standards is falling on local staff who may or may not have the skills, experience and resources to cope.

NHS Scotland eHealth policy is to move towards national systems where appropriate, and these systems will both require and encourage national collaboration over content.

Collaborative development at a national level has the potential to deliver benefits in four key areas, by:

1. **Reducing overall effort**;
2. **Improving the quality of content**;
3. **Supporting delivery of clinical standards, and comparison of standards of care**; and
4. **Contributing to, and implementing, current national information standards**.
4.2 Clinical content development

Figure 2 illustrates how clinical templates as a national resource would impact on the current situation in NHS Scotland described above. By supporting clinical content development at a national level we have the potential to:

1. share the burden of development;
2. support implementation and maintenance of evidence-based content, and test it in practice;
3. provide content that is useful for information standards development; and
4. integrate current information standards in a consistent way.

Please see Appendix E for discussion on how a template library can be integrated with the NHS e-Library.

Figure 2: Clinical templates as a national resource
4.3 Practitioner interest

At many meetings over the course of the project, the author found the idea of shareable clinical templates to be of great interest to practitioners. A previous CNNet survey in 2003 [6] captured the dissatisfaction shown by many about the state of community information systems over much of NHS Scotland.

It is often assumed that dissatisfaction is based on lack of access to systems, but it seems practitioners are just as concerned about having to use too many different systems, often entering the same data more than once.

Standardised clinical templates are viewed positively for their potential to speed system development and introduce consistency across systems.

Clinical templates are very easily understood by practitioners, a point made by a NHS Connecting for Health pilot in England into the development of archetypes and templates. [7]

There seems to be a general acceptance that standardisation is a ‘good thing’. When the issue was raised with groups, it was seen positively, although, with encouragement, the caveats were acknowledged:

- the templates must be fit for use; and
- local customisation will often be required.

There is also interest in templates having links back to their source (via metadata) so that users can give feedback, or access the supporting evidence-base, guidance on use, or educational material.

It seems a universal problem that clinical staff who become involved in development activity in addition to their practice have difficulty getting adequate protected time - their time is a precious resource. This is a strong motivation in support of collaboration and re-use of good-quality resources, especially if on-line tools support this.

4.4 Clinical communities

The project approached a sample of existing national expert groups who agreed to participate: National Association of Tissue Viability Nurse Specialists (Scotland), Scottish Continence Advisory Group, and the Scottish Health and Wellbeing Interest Group. Other ad hoc groups formed round clinical topics and all these groups were given an area on the web site, which was then open for anyone with an interest to subscribe (see Appendix B for more detail).

Content was taken from tools published by other expert groups, for example the Malnutrition Universal Screening Tool (MUST) of the British Association for Parenteral and Enteral Nutrition (BAPEN).

The project therefore acknowledged and supported the work of existing groups, but was open to anyone with an interest in developing and/or using the content of clinical information systems.
Knowledge management in the NHS
There has been considerable investment in knowledge management services within NHS Scotland, increasingly through the e-Library [8], which ‘... is the primary vehicle for delivery of NHS Education’s national strategy for NHS Scotland Knowledge Services Exploiting the Power of Knowledge in NHS Scotland.’ [9]

In England, Connecting for Health included the ‘Do Once and Share’ programme [10], which: reviewed system specifications to take account of clinical trends and practice and care processes; worked on inclusion of care processes and pathways into national systems; revised datasets; advised on requirements for the Common User Interface; made recommendations about training; and identified the potential for IT facilitating research.

Over the early part of the project, the NHS e-Library had limited support for collaboration on knowledge management. The e-Library Knowledge Exchanges were used by the CNNet and NCDDP Community Nursing working groups, but were not well used by participants.

Subsequently, Shared Spaces [11] were developed with more flexible and comprehensive facilities. The NMAHP eHealth Programme has commissioned the development of a Managed Knowledge Network, which is under development by the e-Library.

Despite the excellent access to the clinical evidence-base, there is still a gap between electronic publication of printed documents, and tools that can be directly implemented in information systems, although the gap is now narrowing as it becomes recognised.

Template development requires specialist tools, particularly if NHS Scotland adopts the openEHR toolset (see later). Appendix E describes the e-Library Metadata Management Services, which offer an ideal way forward: development can be done within a specialist environment, and the results published via standardised metadata to allow it to be indexed and accessed within the more general e-Library environment. In this way, anyone searching within the e-Library on ‘continence assessment’ will find content including journal articles, guidelines, and clinical templates. Clicking on a template would take the user into the template web site for more detail or to download the template.

Motivation for development of clinical templates
The groups approached were keen to be involved with the project, although unsure about the more technical aspects of template development. There was recognition that it is difficult to get evidence-based tools into practice, and not every tool developed is published.

For example, the Tissue Viability Nurse Specialists had developed a national standard wound assessment tool. This had been circulated within the group, and implemented on paper in some areas of Scotland. But at the start of the project, the tool was not accessible through on-line searches in publication databases or web search engines like Google™.

Since it has been published on the ClinicalTemplates.org web site, it appears in web searches (a Google™ search for "wound assessment" template shows their template on the second page of results) and the web site has received a number of contacts for further information.

In the longer term, by integrating these in template-based information systems, there is the prospect of getting feedback from practitioners who actually use the tools, and validation if data is then collected for secondary uses.

Clinical Templates have the potential both to publish content so it can be pulled into information systems, with information standards, for example SNOMED-CT coding, already built-in, and also to provide links back to content providers.
Methods of collaboration

The web site used a number of increasingly common techniques used by 'social networking' sites [12], including open registration, open comments on content, email alerts and RSS news feeds and, of course, 'user-generated content'.

Given the large number of practitioners in the NHS, and the clinical nature of the project, there is potential for high numbers to be involved, but realistically, only a small minority engages in activity beyond their workplace. This is one argument for keeping the open nature of the site- requiring a log in just to browse content is a disincentive for the casual visitor.

The groups that undertook new development moved very slowly, and some not at all. It may be that the perception they had to produce national standard tools was off-putting and reduced the confidence of people to participate. For many it was also a new experience, and something they associated with formal groups of 'experts', rather than groups of clued-up practitioners.

For that reason, it was important to capture existing system content, and not focus only on newly-developed and validated content. In this way, the project established the process for gathering up tools that are in use, and subjecting them to informal peer review and continuous improvement.

Clinical template metadata included, for example, information on sources, contributing groups, and ownership. A national repository would require more formal peer review and governance processes.

Re-use and development of standard models

A key factor in the standards movement round clinical templates is not just re-use of complete templates on their own, but the re-use of templates in combination to make new templates. So a Body Mass Index template could be used in multiple other templates. This is how the openEHR approach works: the components are 'archetypes' which are then combined and specialised in a template.

The project explored the idea more from the aspect of clinical acceptability than from a technical point of view. Would groups accept that parts of their content were owned and developed by other groups? In practice, the reaction was positive. The Health and Wellbeing working group wanted to work on a general physical health screening tool. Their examples included content that would be commonly used in other primary care settings, including sections on smoking and alcohol use. The project invited experts on these topics to set up their own working groups, which would produce the component templates that the Health and Wellbeing group would re-use.

The benefits of this are even greater levels of re-use, and maximising the contribution of specialist clinical expertise. Our limited testing of this was positive, however it is inevitable that this approach would require an agreed approach to conflict resolution at some stage.

Decision support

Current standards in archetypes and/or templates do not support the kind of logic which is often present in clinical tools, for example, add the scores in these four items, and if the total is greater than 10, put 'at risk' in item five. This is a deliberate design decision, that such logic is best handled by a separate mechanism.

For the purposes of this work on gathering clinical templates, it is essential to capture this. The project used metadata to attach notes and provide links to supporting material. It is proposed to move to including this by using annotations in W3C XML Schema, or using openEHR-compatible methods if these are adopted by NHS Scotland.
Once again, the consistent structuring and coding of clinical models in templates offers the potential for stable targets for decision support material. In other words, guidance can be more reliably offered by systems if the context of a user’s actions and requirements can be identified predictably. A simple example is given in Appendix A.

### 4.5 System content developers

This is a key group because they are most actively involved in content development. The project found evidence that there is considerable duplication of effort round NHS Scotland in the development of clinical content for record systems, whether paper-based or on computer.

For example, three sample forms included a general assessment of a person’s abilities. They covered the same topic in slightly different ways:

1. Dressing, bathing, and grooming (‘dressing’ included an additional ‘assistance’ item), all in free text;
2. Dressing and personal care/hygiene, with fixed optional values for each;
3. Washing and dressing, with free text entry.

It is likely that this kind of content could be standardised, but that a small amount of local customisation would be necessary to fit variations in the context of care. This suggests that there is greater scope for standardising the component parts of this kind of tool rather than the complete assessment.

Other sample forms showed that local developers are using the same sources anyway, for example the MUST tool mentioned earlier has become the recommended basis for nutritional assessment, but has been implemented in slightly different ways.

None of the community system examples provided had bindings to terminologies, but if SNOMED-CT is to be successfully implemented, it may only be feasible through the development of shareable template resources with the terminology bindings done once and shared.

Clinical templates offer one way to implement SNOMED-CT consistently across the clinical content of NHS Scotland information systems.

Some of the tools used in community systems may be the subject of copyright but the providers were unsure. Dealing with copyright issues centrally is another potential benefit of national libraries of templates.

The last section described the importance of decision support in clinical tools. For system developers, the management of this ‘logic’ can be tricky. For example, form-based systems can include fragments of logic dispersed over form control event handlers, scripts, workflow facilities, and stored procedures in the database. Developing best practice in this is a high priority.

And finally, templates may be useful to local developers for use outside of ‘big’ clinical systems. For example, a continence specialist could open a word processing document, click a link to load a template into a form, fill it in, save a copy to file and send it off as a referral letter.
4.6 Secondary information users

Secondary uses require data to be available and comparable. Availability depends on support for search and retrieval, while comparability depends on consistency in data definitions.

Clinical templates, in conjunction with other clinical information standards, have the potential to support these requirements, by enabling consistency of data structures, data items, and clinical coding and classification.

Consistency of structure gives context to data. Anyone who has had to search on data in clinical systems will know the problems of searching purely on the presence of coded terms. Relevant data may be coded in different ways, and it may be qualified by other data round about it. For example, the presence of a code for ‘incontinence’ in a record could mean that the patient is experiencing it, experienced it 20 years ago, has not experienced it, has a fear of it, is at risk of it, has cared for a family member who has experienced it, and etc.

Knowing that coded item is a finding for that patient in an assessment that was done within the last six months allows it to be included with confidence.

Within NHS Scotland, SCI-DC is an example of what can be achieved by the use of clinically agreed national data standards developed through NCDDP, embedded in forms, used in information systems and collected nationally. The Scottish Diabetes Survey illustrates the outputs of the system. [13]

The Platform project included a Nursing Interest Group to explore the availability and potential for such national data for nursing, but the results showed that there was very little relevant data in existence. [14]

The EPPIC project in the 1990s was only partly implemented mainly by areas involved in the project itself. The results provided information for secondary purposes, but it was poorly integrated with local record systems, and was seen as being irrelevant and/or an added administrative burden by clinical users. [4]

The WISECARE project [15] is one example of what could be done. Several hospital sites across Europe adopted standard assessment tools for recording symptoms of fatigue, oral problems, nausea and vomiting. These tools were modelled as templates and loaded dynamically into a simple electronic record system. The system showed local patient data, fed it back to a central database, and retrieved benchmarked data allowing comparison between the clinical units. The project demonstrated improvements in care by introducing changes in practice as a result of the information.
Figure 3: WISECARE used standardised assessment templates

4.7 Information standards development

During the 1990s, in the UK there was a large investment in terminology as an essential clinical information standard. There may be many reasons why this did not give the anticipated return on investment, but one explanation is that standardised terminology systems do not give enough support to developers and users who do not want to interact with terminology browsers, but with data items structured in ways that fit well with the context of the user at a particular point in time. [16]

The NHS Clinical Terms Project subsequently became part of SNOMED-CT, and the NHS around the UK has adopted this as a standard for clinical terminology, however progress with implementation has been slower than expected.

Other standards work has included the Health and Social Care Data Dictionary, and the National Clinical Datasets Development Programme. [17] The NCDDP has made a big step forward in moving information standards closer to the requirements of clinical systems. Depending on the purpose, data standards may be developed round particular contexts of use, such as referrals, domains of care, such as continence services, specialities such as maternity, care settings such as A&E, common aspects of care such as consent or legislative requirements such as equality and diversity.

In the absence of standards in clinical models, there has been widespread ad hoc development within end-user applications such as GP systems, and, for example, in the national Scottish SCI XML messaging standards used for structured clinical communication. [18] Although the terminology concepts used are standardised, the contextual ‘wrappers’ around the terms are idiosyncratic.

The SCI Gateway project has developed web templates, but these include screen layout data in the model. The Generic Clinical System (GCS) also includes interface data in its forms, and there is no mechanism for re-use of forms as components, apart from those in toolset. GCS forms are stored and exported in a proprietary format. The GCS commissioned scoping work for a National Forms Library (by Phil Westwell, one of this project’s technical advisors) but at the time of writing, it is unclear whether this will be taken forward.
The greater the movement of clinical data around NHS Scotland rather than limited datasets the more difficult it will be to manage the explosion of datasets and their containers, and an alternative will be required.

The NCDDP team have described how they often note that items form natural clusters and have developed an interest in what they call ‘compound clinical concepts’. Over the past year, NCDDP has been reviewing the potential of clinical models at the same time as this project, involving review of HL7 templates and OpenEHR archetypes, pilot development of clinical content using the archetypes approach and open source tools, detailed exploration of the content aspects of archetypes and commissioned a report on the technical aspects of using the archetypes approach. [19]

This report (by Dr Ian McNicoll, one of this project’s technical advisors) states: ‘The information model is the crux of current electronic clinical records but by being application or message specific and usually proprietary, it hampers interoperability.’

There is therefore growing evidence of a need for standards beyond terminology or relatively unstructured sets of data items.

Archetypes and Templates as International Standards

The issues outlined above have motivated standards work in both openEHR and HL7.

An openEHR archetype is “a computable expression of a domain content model in the form of structured constraint statements, based on some reference model.” [20]

Archetypes are seen as a means of defining clinical knowledge in an explicit way, separating it out from the system software that uses it. This has dual benefits of enhancing clinical ownership and making system development and maintenance easier.

An openEHR template is “a directly, locally usable definition which composes archetypes into a larger structure logically corresponding to a screen form.” [20]

Templates have an important role in grouping and refining archetypes for specific local applications.

A HL7 Template is “... an expression of a set of constraints on the RIM which is used to apply additional constraints to a portion of an instance of data which is expressed in terms of some other Static Model. Templates are used to further define and refine these existing models within a narrower and more focused scope.” [21]

The most obvious difference between the two approaches is that HL7 starts with a highly abstracted pattern, the Reference Information Model (RIM) that is then constrained by templates that define the local content of the model. In contrast, openEHR uses a small, generic and granular information model. Archetypes specify instances based on and built up from objects in the model. It is argued that this latter approach is closer to development methods such as object-oriented techniques where generic objects are specialised until they are fit for purpose.

HL7 was primarily intended to support the modelling of messaging between clinical systems whereas openEHR’s design focus is on the clinical record itself, but both models intrude on the other’s natural territory. The HL7 Clinical Document Architecture (CDA) [22] is designed to model elements of the clinical record, whilst the openEHR EHR Extract provides the basis for constructing clinical messages.
There have been interesting ‘frank and open’ exchanges on email discussion lists as some proponents point out differences, while those interested in solutions search for the similarities. [23, 24]

**NHS adoption**

Given the need for standards in this area, and the response from standards organisations, NHS standards groups north and south of the border have begun to explore the use of clinical modelling as the basis of standards for content development.

NCDDP has decided to develop a core set of generic archetypes as prototypes over the next few months using the openEHR archetypes as the basis for their technical documentation, based on their one year review and pilot work.

Connecting for Health (CfH) has a Clinical Models Project, which has been piloting the openEHR architecture and tools. Part of this work has been the development of archetypes in workshops involving clinicians. This work will ‘... facilitate the development of a key cross-disciplinary clinical software application that will be used across six strategic health authorities in the north of England.’ [25]

CfH has now included a ‘Clinical Templates Board’ as part of its new Clinical Content Service [26], and its National Advisory Group has expressed an interest in exploring clinical templates for nursing, in the context of work on terminology and subsets of SNOMED-CT.

Standards in this area remain immature (the openEHR Template Specification remains incomplete at the time of writing). Until we have more experience in using the approach and tools are refined, current work must be regarded as prototyping, and may be replaced at some point in the future.

Perhaps the most interesting question is the extent of coverage by archetype repositories. For example, Activities of Daily Living are a widely used assessment framework in UK nursing. Would a ‘mobility’ assessment be a template based on a generic ADL archetype, or an archetype itself?

Many templates could be constructed from a small set of generic archetypes, which would be easily managed. Alternatively, NHS repositories could contain generic archetypes and also specialised archetypes for commonly used concepts, so would have a ‘mobility’ assessment archetype. Once archetype repositories grow, management will become a major issue, and it is unlikely that this will be feasible without using formal systems with ontologies.

Appendix F describes some prototyping done by Dr Nick Hardiker to explore the use of OWL in managing the project templates, but the principles apply to archetype management.

Metadata standards will help in integrating multiple repositories of archetypes, and publication via other routes, for example, through the NHS e-Library

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The process of developing clinical templates could contribute to validation of NCDDP work on data standards and support a move to clinical modelling as the basis for future standards.
5 Conclusion

The project objectives are re-stated below.

5.1 Identify the extent of commonality in the structure and content of community nursing records in Scotland

There was considerable commonality in the sample forms/tools collected over the project, evident in three ways:

1. the use of standardised tools, for example the MUST nutritional assessment and the Waterlow score for pressure area risk assessment;
2. commonly used ‘components’ of forms, for example, Body Mass Index, Blood Pressure; and
3. common models of assessment, for example, most general assessments were based on variations of an activities of living approach, so had similar headings and data items.

A particularly common model is that of a general/immediate/summary/initial assessment, which covers a range of assessment areas in little detail. The practitioner uses this to indicate an issue in a particular area, for example a continence problem. A more detailed assessment is then completed.

There are other important dimensions to this: a less skilled or experienced practitioner, or a patient or carer, may use a tool which is more aimed at decision support, while a higher skilled, specialist practitioner will require a tool to support recording at a higher level of clinical detail.

There is therefore considerable variation across contexts of care and clinical practice, but within each context a high level of commonality and structure, and potential for sharing across all contexts at the level of a ‘component’.

5.2 Prototype and test a method of collecting record content, evidence-based, and other expert sources to develop and maintain templates

The ClinTemplate.org web site is described elsewhere in this report and has been the principal way of meeting this objective.

The project used three main sources of content:

1. expert groups, both existing and ad hoc groups which formed in the web site;
2. standardised tools, a few of which are in widespread use;
3. ‘grey content’, which was content in use in information systems within NHS Scotland.

This third source was the largest available to the project and is a considerable untapped resource. It is important, because it is what practitioners use every day, and it represents a hidden aspect of the clinical knowledge base of the NHS.

However, while there is evidence of commonality of structure and content (described above) it is sufficiently diverse that there is a need for communities of practice to form round clinical information models and collaborate on shared and shareable development.

The method was successful in meeting the requirements of the project and would be useful for further development.
5.3 Evaluate options for template types

The project templates are considered information models of use in clinical system development. They do not have any user interface elements beyond some simple defaults to help presentation on the web site.

This abstraction of a model from its presentation has been particularly difficult in working with practitioners. Many have found it difficult to work on a model without seeing it as a ‘form’ and considering layout, size of input areas, colour coding etc.

From the beginning of the project, the web site has generated a ‘plain vanilla’ form of each template to make the process of practitioner involvement easier.

The project has tracked the development of information standards in this area since its start. The most important development has been the interest in OpenEHR Archetypes and Templates, in ISD and NHS England’s Connecting for Health programme.

The project approach to template development is broadly compatible, but OpenEHR Templates require to be built from Archetypes, and there are no Archetype standards for NHS Scotland. However, by developing standardised content we will have a growing corpus of material that can contribute to archetype and other data standards development.

The project made an early decision not to develop Archetypes, and to consider our clinical templates as being built on data standards, rather than being data standards themselves.

Our templates have therefore been developed using a very simple XML schema. In the longer term, if NHS Scotland adopts OpenEHR standards for archetypes, these templates would be migrated to be based on these as part of a commitment to national data standards.

5.4 Prototype and evaluate an option for publication of templates, including information on sources and levels of authority of content

Each template includes some basic metadata giving its origin, version number, and background on its provenance, including in some cases, links to supporting material and copyright information. There was an intention to include a ‘level of authority’ indicator in the metadata, but this was not done as it was considered misleading.

A very small amount of the material collected could be considered validated, and these were mostly tools used in research studies. Most of the content could be shown to be evidence-based, but this was not done in an explicit way, for example by providing references to supporting literature. In this area it seems the origins of content are taken as a proxy for its authority.

The ClinTemplate.org web site adopted a different approach to this issue by allowing open access to commenting on templates, and a review feature was added. Anyone accessing the site could use these features and in this way, the groups provided a mechanism for a very open and accessible form of peer review.

Consultation with practitioners involved in the project confirmed that they found this approach attractive. The issue of whether controversial content was put on-line was answered by the view that it was better for people to find it, and find the reasons it was controversial, than not find it and look elsewhere.

The NHS Scotland e-Library Knowledge Management Service has offered to index the templates produced in the project, for example using MeSH, and integrate this index with the e-Library. This means that a search on a clinical topic in the e-Library will show relevant
clinical templates in the results, with links to the ClinTemplate.org web site. See Appendix E for more detail.

5.5 Examine the use of template-driven data entry for community nurses to identify models of integration with clinical practice

A survey of practice implications of standardised documentation could not be completed within the main project due to staffing problems. It is now underway and will be reported separately on completion.

5.6 Evaluate the implications of these models to produce implementation guidance

This could not be delivered even had the above survey been completed, because there is still no experience of implementing the templates produced in the project. In the absence of standards for supporting development and implementation there will not be the possibility of realising the goal of publishing templates so that they can be imported and used in information systems.

An intention to pilot this using the GCS toolset could not be realised due to problems of accessing the toolset and training within the timescale of the project.

There is an opportunity to pursue this in the GCS Community Nursing project which is just beginning as the Feasibility Study ends.

5.7 Project outcomes

The desired outcomes were to have:

**A clinically-owned reliable methodology for getting nationally standardised templates that support care delivery processes into electronic records and updating them**

The project has enjoyed the participation of a wide and diverse range of clinical practitioners. While the focus has been on community nursing, involvement has been much wider reflecting other care settings and disciplines. The approach has focussed on clinical topics rather than practitioner groupings, and this has worked well in getting involvement.

Levels of involvement have varied greatly, with some groups being largely inactive, while others have been very active, both on and off the web site.

Currently the content varies greatly between material that is from local systems and which looks useful, but with no evidence-base or other endorsement, and other content that has been validated through research studies. Rather than seeing this as a weakness, it should be seen as a necessary stage in the move towards development of high quality evidence-based clinical content. Until the tools, processes and collaborative space is available, this work will not progress beyond isolated projects in particular settings or clinical specialties.

**A sustainable mechanism, the national library, for maintaining the templates**

The ClinTemplate.org web site and the tools and processes it uses have been developed with modest resources, and most of the ongoing effort will be in the clinical groups themselves and ensuring that content is kept in step with developments in national data standards. Beyond that, the web site represents a way of propagating data standards as they develop.
The project has rejected the idea of one ‘National Library’ for two reasons:

1. Clinical standards are developed and owned by diverse groups which are not always consistent with national boundaries. So for example, professional bodies who see clinical standards development as an important area of their work are likely to publish templates. The RCN are discussing this in relation to their role in developing and disseminating clinical practice standards at a UK level, and NHS England is likely to develop this area.

2. The work on international standards (HL7, CEN, ISO, OpenEHR) is towards open repositories with the recognition that system developers will pull content from a variety of sources to meet their needs.

However, an approach based on diverse sources will only succeed if underpinned by common national data standards. Because the work on standards supporting clinical content models is now developing, whilst the one national library approach may not be a recommendation, it is sensible to put template development and management into as few places as possible, to help with this transition.

Existing projects such as SPICE and SCI-DC have fulfilled a similar role in developing standardised system content through collaborative effort, and will presumably move to adopt new standards as they develop. They might therefore move to be open template repositories at some point. This is analogous to the NHS Scotland e-Library: its existence does not preclude the existence of other specialist libraries, but anyone using the e-library would expect to be able to search and retrieve across all information sources.

The emerging picture would then be of a variety of communities of practice, supported by a diverse set of methods and tools, engaging in clinical system content development, underpinned by clinical practice standards, national data standards, and available throughout NHS Scotland for implementation in information systems.

Development of clinical templates as a national resource is likely to be successful, because:

- it can be done in a scalable, incremental fashion - unlike terminology, even a few good templates can be useful;
- with some further improvements, the processes and the results are already suitable for use by national projects;
- it can be usefully continued in parallel with developing information standards, supporting their development, using them, but not dependant on them if there are problems with the openEHR approach;
- similar, but proprietary, approaches are already being used by suppliers for their own development, suggesting they have confidence in this;
- NHS Scotland eHealth policy is to move towards national systems where appropriate, and these systems will both require and encourage national collaboration over content.

The ClinTemplate.org web site will be maintained as a national resource, and further development is planned on completion of this Feasibility Study.
The next phase of development will use a hybrid approach to template development, continuing template development using W3C XML Schema (using ISD standards where available), and moving to openEHR standards as the tools become available, and in collaboration with NCDDP work.

A number of projects within NMAHP eHealth have expressed an interest in using the web site and the process:

- The GCS Community Information System collaboration;
- The Perinatal Telehealth Project;
- Nursing Quality Indicators project; and
- various other groups already engaged in the Clintemplate.org web site have expressed an interest in continuing their work.

It may make sense to have just one resource for NMAHP templates in Scotland, but it is essential that this be seen as part of a bigger picture of clinical standards and information standards development. The approach used should therefore be discipline-neutral, to integrate with and support NHS Scotland information standards, content developed with other disciplines, and across national boundaries.

NHS Scotland should take a lead and develop such a resource to: support NHS staff; develop content that is consistent across NHS systems; and promote national objectives that are dependent on consistent information.

In conclusion, the project has identified a number of likely benefits to a variety of stakeholders in NHS Scotland from the development of clinical templates as a national resource.
6 Recommendations

1. Further development should focus on agreement and use of standardised ‘building blocks’ which can be combined and re-used in templates. This should be based on the preferred data standards under development by ISD (eg archetypes, or compound clinical concepts).

2. Further work is required to ensure effective management of large collections of templates.

3. Agreeing models for the clinical record suitable for NMAHP practice would help guide template development. These should reflect the differing requirements between differing levels of practice, and use by patients and carers.

4. Content in use in existing systems is an un-tapped resource and should be used as the basis for new template development.

5. Existing clinical groups and communities of practice should be the starting point for further clinical template development.

6. Clinical template development should be one source of content for ISD data standards development.

7. Templates developed by the project should be migrated to standards as agreed with NHS Scotland Data Standards.

8. Further development should use similar methods to the project web site, based on openness and transparency, and promoting peer review. It should be discipline and application-neutral (ie, capable of use in any system or on paper).

9. Clinical templates developed by the project should be indexed and integrated with the NHS Scotland e-Library.

10. National projects involving content development for NMAHP eHealth or clinical standards should be required to make that content available using archetypes or templates that are compatible with national resources.

11. It is essential that continuing work on clinical templates develop best practice in linking supporting guidance on use of templates, and in particular, any logic associated with decision-making.
Appendix A.  Continence Group case study

Members of this group have been involved in the SIGN Guideline [27], the NES Best Practice Statement [28], and the NCDDP Continence Dataset. [29]

The group volunteered because they felt that there was still a need for useful and usable tools that could be used in record systems, and they wanted a tool to encourage better assessment and identification of continence problems in non-specialist practitioners.

They developed the ‘Continence trigger questions’ template which guides a user to a correct diagnosis of the type of continence problem.

Their first template was developed without reference to the Continence dataset, however they reviewed it for the second draft, and revised some items where they were in the dataset. Most of the template items were not in the dataset, which should make this work useful for validation and revision of the dataset at a later date.

The group used the web site to go through a complete cycle of analysis, identification of focus, development, review and revision. Initial discussion and review were done with participation from the wider group membership, while the Core Developers made the final decisions on revisions.

Examples of other sample content relating to continence were shown to the group, and they were very positive about taking on the ownership of these fragments. As an example, the child health group had a ‘Child assessment, 8 weeks to 15 months’ with a short item on bowel elimination. Once this was made into a sub-template and put in the Continence Group they proposed revising it to use the Bristol Stool Chart as a more consistent assessment measure.

They considered the benefits of this process to be better for:

- clinical use, as the assessment tool was widely used and more reliable;
- secondary use, as this would make coding of assessment data consistent across sites and systems that used this template; and
- decision support, for example by consistently coding *continence assessment*, their ‘*Trigger Questions*’ template could be offered to a user to help assess the type of problem, and link to guidance material.
Appendix B. Web site

The front page shows news.

This is a group page, showing resources, templates and discussion.
This is the form view of a template, showing how comments can be placed in situ, beside a particular item.
Appendix C.  List of groups
At 20 August 2007, 98 subscribed users in 13 groups:

- Alcohol
- Child Health
- Continence
- Delirium
- Diabetes
- Falls Assessment
- Health and Wellbeing
- Hypertension
- Miscellaneous
- Perinatal Telehealth Project
- Smoking
- Stroke
- Tissue Viability

Appendix D.  List of templates
At 20 August 2007, 27 clinical templates:

- The Abbreviated Mental Test
- Accident prevention summary
- ASSGN Cardiovascular Risk score
- Bowel elimination summary
- Cause for concern (family health)
- Child assessment, 8 weeks to 15 months
- Child development summary
- The Confusion Assessment Method (CAM)
- Continence trigger questions
- Delirium Observation Screening (DOS) Scale
- Fast Alcohol Screening Tool (FAST)
- Alcohol screening tool (health and wellbeing)
- Health and wellbeing screening tool
- Immunisation administration summary
- Infant congenital conditions
- Infant illness symptoms (summary)
- Infant skin problems
- Intravenous cannulation
- Maddox scale
- Maternity call record
- NEECHAM Confusion Scale
- Nutrition assessment (MUST steps 1-4)
- Severity of Alcohol Dependence Questionaire (SADQ-C)
- Test template
- Waterlow pressure sore prevention score
- The WHO Alcohol Use Disorders Identification Test (AUDIT): Self-Report Version
- Wound assessment
Appendix E. NHS Scotland e-Library Metadata Management Services

This information is excerpted from the NHS Scotland e-Library document: 'Metadata Management and Shared Space – Outline of services available to third party services' accessed March 7 2007.

What is the Metadata Management System (MMS)?

The MMS is an internet-based end-user tool enabling the application of metadata for resource description. A “resource” in e-Library terms is any publication available for searching or browsing on the e-Library. This might be an electronic book or journal, a clinical practice guideline, an e-Learning resource or any other publication which supports practice, education or personal development. The MMS allows a description to be created for a resource; this description is then stored within a database which is then available for searching in a structured format.

Elements of the Metadata Management System (MMS)

Descriptive metadata can be entered for an e-Library resource via MMS forms. Currently there are different forms within the system corresponding to different types of resource, e.g. Book, Journal, and Database. Each form is available in “short” format, containing a core set of metadata elements for the resource under description, however this links to a “Full edit” form within which you can add more metadata if desired. It is not compulsory to apply data for every metadata element available in the system, however a subset of metadata elements are mandatory to ensure that at least a core amount of metadata is available for searching or browsing via the NHS Scotland e-Library, and adherence to a minimal level of interoperability.

The combination of the short form and the full edit form results in a complete set of metadata fields or elements adapted from the e-GMS. Each field may also contain a number of refinements. Examples of descriptive metadata fields include:

- Title
- Description
- Creator
- Subject
- Resource type

Certain metadata fields, e.g. Title and Description, allow the entry of free-text. Other fields can only be populated from a controlled list of values, e.g. Subject, Resource Type.

Controlled vocabularies have been imported into the system for standards-based description of the Subject field. Currently the e-Library has adopted the e-GMS (e-Government Metadata Standard), MeSH (Medical Subject Headings) and CareData.
Appendix F. Ontology and OWL

Within the pilot project, we explored the use of ontologies to support the management of a template repository. The Web Ontology Language (OWL), a recommendation of the World Wide Web Consortium, is emerging as the de facto standard ontology representation language.

An ontology describes the entities in a domain and the relationships between those entities. Within an OWL ontology, **OWL classes** are interpreted as sets that contain individuals (i.e. OWL classes contain objects that exist within a specific domain). OWL classes are organised into a superclass-subclass hierarchy (i.e. a taxonomy). **OWL properties** are binary relations on individuals (i.e. OWL properties link two individuals together).

A simplified graphical representation of the 'hasEnumeratedValue' property and the relationship that holds between individuals in the classes 'Observable' e.g. 'typeOfWound' and 'DomainThing e.g. 'diabeticUlcer' is given below.

![Simplified OWL representation of 'EnumeratedObservable']

**Figure 4: Simplified OWL representation of 'EnumeratedObservable'**

The class structure would correspond to the entity 'EnumeratedObservable'. The RDF/XML code for the class 'EnumeratedObservable' is given below.

```xml
<owl:Class rdf:ID="EnumeratedObservable">
  <owl:equivalentClass>
    <owl:Class>
      <owl:intersectionOf rdf:parseType="Collection">
        <owl:Class rdf:about="#Observable"/>
        <owl:Restriction>
          <owl:onProperty rdf:resource="#hasEnumeratedValue"/>
          <owl:someValuesFrom rdf:resource="#DomainThing"/>
        </owl:Restriction>
      </owl:intersectionOf>
    </owl:Class>
    <owl:disjointWith rdf:resource="#MeasurableObservable"/>
  </owl:Class>
</owl:equivalentClass>
</owl:Class>
```

**Figure 5: RDF/XML code for the class 'EnumeratedObservable'**
It would be extremely difficult to construct manually even a simple OWL ontology due to the complexity of OWL syntax. However, software tools such as the open source Protégé ontology modelling environment are available to support ontology development. The Protégé graphical user interface allows developers to focus on conceptual modelling, without being exposed to the awkward syntax of OWL.

![Screenshot of the Protégé graphical user interface](image)

**Figure 6: Screenshot of the Protégé graphical user interface**

In addition, Protégé can interface with reasoners such as FaCT++ and Racer (also called classifiers) to facilitate automated description logic reasoning. Reasoners can interpret ontologies in order to check:

- consistency
- subsumption relationships among classes
- equivalence between classes.

The use of OWL might help to ensure consistency between templates, while promoting reuse of template elements. So for the example given previously, ‘EnumeratedObservable’ would serve to constrain the values of an actual template item such as ‘type of wound’ to a list of relevant wound types e.g. ‘diabetic ulcer’, ‘surgical wound’; while the item ‘surgical
wound’ might appear in many such lists e.g. for ‘source of infection’, ‘cause of scarring’, etc.

As part of the pilot project, a prototype template ontology has been developed to support such functions, with encouraging results. In common with standards for document architectures, the template ontology is made up of a ‘Container’ class (e.g. woundAssessmentTemplate) which contains either other containers, or ‘Observable’ classes.

‘Observable’ classes include:

- ‘DateTimeObservable’ e.g. dateAndTimeOfWoundAssessment which take the value ‘DateTimeDatatype’
- ‘EnumeratedObservable’ e.g. courseOfWound which takes any enumerated value from the overarching class ‘DomainThing’ e.g. the ‘Qualifier’ tracking
- ‘NumberObservable’ which takes the value ‘NumberDatatype’
- ‘MeasurableObservable’ e.g. depthOfWound which takes the value ‘NumberDatatype’ and the unit ‘MeasurableUnit’
- ‘TextObservable’ e.g. locationOfWound which takes the value ‘TextDatatype’.

All sibling classes are made mutually disjoint, in line with good ontology development practice. FaCT++ was used to check consistency (reasoning revealed no inferred hierarchy and no equivalent classes). The complete RDF/XML code is given in an appendix.

A graphical representation of an example template (represented as the individual ‘woundAssessmentTemplate’ within the ontology) is given below. Note that this is only a partial representation of the complete prototype wound assessment template.

### Wound assessment template

<table>
<thead>
<tr>
<th>Date/time of assessment</th>
<th>A DATE/TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic of wound</td>
<td></td>
</tr>
<tr>
<td>Course of wound</td>
<td>Tracking</td>
</tr>
<tr>
<td></td>
<td>Undermining</td>
</tr>
<tr>
<td>Location of wound</td>
<td>TEXT</td>
</tr>
<tr>
<td>Dimension of wound</td>
<td></td>
</tr>
<tr>
<td>Width of wound</td>
<td>A NUMBER cm</td>
</tr>
<tr>
<td>Depth of wound</td>
<td>A NUMBER cm</td>
</tr>
</tbody>
</table>

Figure 7: A graphical representation of a small part of the prototype wound assessment template

Further work is needed to determine the extent to which the use of OWL facilitates indexing and retrieval of templates. An example of this work might involve template metadata i.e. rather than representing the content of templates in OWL as described here, metadata
might be represented in OWL to reveal possible relationships (overlap, equivalence, specialization, etc.) between templates.

RDF/XML code for the template OWL ontology with prototype wound assessment template

```xml
<?xml version="1.0"?>
<!DOCTYPE rdf:RDF [
  <!ENTITY owl "http://www.w3.org/2002/07/owl#" >
  <!ENTITY xsd "http://www.w3.org/2001/XMLSchema#" >
  <!ENTITY rdfs "http://www.w3.org/2000/01/rdf-schema#" >
  <!ENTITY rdf "http://www.w3.org/1999/02/22-rdf-syntax-ns#" >
]>  
<rdf:RDF xmlns="http://www.owl-ontologies.com/unnamed.owl#"  
  xml:base="http://www.owl-ontologies.com/unnamed.owl"  
  xmlns:xsd="http://www.w3.org/2001/XMLSchema#"  
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"  
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"  
  xmlns:owl="http://www.w3.org/2002/07/owl#">
  <owl:Ontology rdf:about=""/>
  <DateTimeDatatype rdf:ID="aDateTime"/>
  <Process rdf:ID="allergy"/>
  <Process rdf:ID="anaemia"/>
  <NumberDatatype rdf:ID="aNumber"/>
  <TextDatatype rdf:ID="aText"/>
  <Container rdf:ID="characteristicOfWound">
    <contains rdf:resource="#courseOfWound"/>
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## Appendix G. Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
</table>
| **AHP** | Allied Health Professionals, eg physiotherapists, dieticians. A parallel project has also been developing Care Programmes as part of eCHIP.  
See http://www.show.scot.nhs.uk/sehd/ahpechip |
| **CEN** | The European Standards Body, covering all aspects of life, and including healthcare.  
See http://www.centc251.org |
| **CHI** | The NHS Scotland Community Health Index- a unique identifier for people receiving health care in Scotland. |
| **CHD** | Coronary Heart Disease |
| **CNNet** | The Community Nursing Network for Scotland.  
See http://www.cnnet.org.uk |
| **eCHIP** | "The electronic Community Health Information Project (eCHIP), endorsed by SEHD Management Board, in March 2002, aimed to develop an alternative robust and reliable approach to collection and analysis of community health services information that better meets the needs of both practitioners and policy makers."  
See http://www.show.scot.nhs.uk/sehd/echip/ |
| **EPPIC** | "Effective Purchasing and Providing in the Community". An NHS Scotland project which started in 1994, developing community information standards. |
| **EPR** | Electronic Patient Record |
| **Health and Social Care Data Dictionary** | The central repository for management and publication of NHS Scotland’s national data standards.  
See http://www.datadictionary.scot.nhs.uk |
| **ISD** | ISD provides Information and Statistics services to NHSScotland. This includes information standards, national dataset development, and national statistics.  
ISD is part of NHS National Services Scotland [formerly known as the Common Services Agency]. See http://www.isdscotland.org |
| **ISO** | International Standards Organisation.  
| **MESH** | Medical Subject Headings, used for indexing. See http://www.nlm.nih.gov/mesh/ |
| **NCDDP** | National Clinical Dataset Development Programme  
See http://www.clinicaldatasets.scot.nhs.uk |
| **SCI-DC** | See http://www.diabetesinscotland.org |
| **Secondary uses of information** | If the primary purpose of clinical information is for hands-on care, secondary uses would be for management, research, audit etc. It generally implies aggregation of data- adding each patient’s data to that of others to |
look at services, groups or populations.

<table>
<thead>
<tr>
<th><strong>SEHD</strong></th>
<th>Scottish Executive Health Department</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SNOMED-CT</strong></td>
<td>&quot;SNOMED-Clinical Terms (SNOMED-CT) is a computerised clinical language designed by clinicians to provide a single unified terminology for use in acute and primary care. It will be an underpinning feature of the development of Electronic Patient Records and Electronic Health Records in Scotland by facilitating integration of computerised clinical information.&quot; See <a href="http://www.show.scot.nhs.uk/isdonline/isd_services/NHSiS_services/National_data_standards/snomed.htm">http://www.show.scot.nhs.uk/isdonline/isd_services/NHSiS_services/National_data_standards/snomed.htm</a></td>
</tr>
<tr>
<td><strong>SPICE</strong></td>
<td>Scottish Programme For Improving Clinical Effectiveness in Primary Care See <a href="http://www.ceppc.org/spice">http://www.ceppc.org/spice</a></td>
</tr>
<tr>
<td><strong>SSA</strong></td>
<td>Single Shared Assessment (SSA) covering health and social services.</td>
</tr>
</tbody>
</table>

**Appendix H. References**


[13] Scottish Diabetes Survey


