Developing Online Dental Education in Scotland

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Contents

Executive Summary

This study was conducted during the first half of 2007 with the aim of scoping a possible framework for a collaborative or federated e-learning environment to support the many stakeholders involved with dental healthcare education in Scotland.

Part 1 considers the general context for dental education and e-learning in Scotland and the issues and concepts involved with collaborations and federations in general.

Part 2 considers the potential partners for any Scottish collaboration and federation and reviews their perspectives, current capacity and interests and options for development.

Part 3 presents a factorial review of the dimensions that need attention if any collaborative relationship were to be established along with a series of recommendations (which are reprised below).

A number of architectural options for a collaborative model have been considered ranging from a 'no change' option to a dominant (large) hub model which suggests a single provider of educational resources across the community common environment or collaboration, possibly following a form of federation across the various partner organizations, would seem the best way forward in the current climate. This option could start small and over time develop and grow.

The report recommends that:

- A 'Small Hub' architecture for a collaborative e-learning environment would offer the best balance of functionality and autonomy and should be a relatively low cost option to initiate a federation as it would build on work already carried out elsewhere, for instance JISC-funded middleware research.
- A draft NES report on e-learning has acknowledged the problem of plurality of logins. Although multiple system passwords and access are therefore going to be the norm for the short term, it is imperative that federated access using Shibboleth should be pursued.
- Steps be taken to acquire and/or develop high quality and educationally effective e-learning content. This should include simulations, virtual patients and reusable learning objects that would support of all forms and levels of dental education.
- Appropriate technology standards and specifications are adopted across the whole community in support of both current and future interoperability and that systems used, developed or procured should, as far as possible, be compliant with these standards and specifications.
- Sufficient attention is paid to the non-functional requirements as well as the functional requirements of any system or architecture.
- Attention and resource are dedicated to setting up appropriate structures for governance of any future collaboration or federation to ensure that the system is able to withstand political and regulatory challenges and change.
- Any collaborative arrangement should be able to afford participants options regarding the extent, timing and rate of participation and indeed the form of participation that best suits the organizations needs.
- Appropriate licensing and quality assurance frameworks are in place to ensure the rights and responsibilities of all participants.
- All plans are made within the context of well-formed business models that identify resource implications for all concerned and that match these to available sources of funding.

Part 1: Introduction

The professional, educational and regulatory contexts for a more collaborative learning environment for dentistry in Scotland will have a major influence on the kinds of solutions that are possible and those that are appropriate. Other factors include the nature of online teaching and learning and the nature of federated systems and technologies.

1.1: Aims and Objectives

1.1.1: Education Information Environments

An information environment consists of a number of information providers and consumers subscribing to a common set of rules and formats to enable open and meaningful exchange of information and services between them. These rules and formats are the bedrock around which such environments are able to function and are the critical success factor in determining the environment's efficiency and efficacy.

An education information environment is a particular instance of an information environment that has a focus on educational processes. Other special instances include healthcare and science. In these cases there is a duality between basic business processes such as who, what, where and when and domain specific processes; for education these include (but are not limited to) curriculum, assessment, portfolio, competence, assignments and educational content.

Although it should also include a consideration of the human parts of the overall system, a major part of an information environment specification needs to be based around its technical properties. In particular it needs to model those technical data formats required for exchange between systems in the environment. These will most likely be based around XML and web services and other semantically-rich, interoperable data exchange formats.

Notable projects in reference to this kind of undertaking are the e-Framework[1], the Common Information Environment project[2] and the COLIS Project[3]. The English NHS National Programme for IT now called Connecting for Health (NPfIT/CfH) also provides some useful reference points for this work.

Key projects and services already established within NES that will play a key role within the Scottish dental education include the NHS Education Scotland e-Library and e-Portfolio system.

1.2: Dental Education in Scotland

There are a number of key constituencies for a federated dental education environment:

1.2.1: Dentists

"Currently, 49% of Scottish adults and 66% of children are registered with an NHS dentist, with additional numbers of children and adults accessing primary care services through the Community Dental Service and some doing so under private arrangements.

Dental health services are delivered in a range of settings, with input from a wide range of potential dental team members: dentists, hygienists and therapists, dental nurses, receptionist/managers and dental technicians. Each has a key role to play in the delivery of patient care and there is agreement that maximising the potential of the dental team is of critical importance in tackling both oral health improvement and dental service improvements in Scotland.

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[1] See http://www.e-framework.org

[2] See http://www.common-info.org.uk

[3] See http://www.colis.mq.edu.au

Data from Information and Statistics Division (ISD), Scotland, indicate that, at September 2004, there were a total of 2,161 dentists working in General Dental Services in Scotland, including salaried and non-salaried principals, assistants and vocational trainees. A further 605 dentists provide care in the Community Dental Service and Hospital Services. The General Dental Service (GDS) provides the majority of dental services (accounting for approximately 75% of the costs of all NHS Dental Services in Scotland).

General Dental Practitioners (GDPs) are independent contractors who, while working under existing NHS arrangements, treat children and adults under a hybrid capitation and continuing care arrangement, supported by an item of service fee structure. While some practitioners undertake only private work, many GDPs undertake a mix of private and NHS treatment." (Scottish Executive 2005)

There are currently two universities graduating dentists in Scotland (of 16 in the UK as a whole) Dundee and Glasgow both of which run 5-year BDS programmes. Overall numbers of dentists in foundation training in Scotland have expanded to 220 in 2007 with a projected further expansion to 270 by 2010 (NHS Education Scotland 2006).

New or recent graduates from UK dental schools must complete one year's programme of vocational training in order to be eligible to work as associates or principals in NHS general dental practice. New graduates on training programmes are known as Vocational Dental Practitioners (VDPs). Graduate training is centred on approved training practices with a complementary educational support programme of 30 study days. There are 152 Vocational Training (VT) places in Scotland which are managed through regional educational centres across Scotland. Some dentists subsequently follow specialist paths such as oral surgery while the majority follow a General Dental Practitioner career path (GDP).

In addition, major new "Teach and Treat" centres are being built across Scotland. These centres will teach dental students as outreach, dental therapists and dental nurses.

Once qualified all dentists must complete 250 hours of CPD every five-years to remain on the UK Dentists Register. The General Dental Council monitors compliance by random sampling of dentists' CPD records. As a result access to CPD and related postgraduate activities is of growing importance to practicing professionals (Ireland, Palmer et al. 1999). Delivery of e-CPD could be part of a federated dental education environment's range of activities.

1.2.2: Dental Care Professionals (DCPs)

In addition to dentists there are a number of professions complementary to dentistry that clearly fall within the remit of a Scottish dental education federation.

"In recognition of the very valuable role that professionals complementary to dentistry can make to oral health and health services and the quality of those services, we have already taken significant steps to increase the number and scope of these professionals training in Scotland from the 18-22 hygienists completing training annually in Scotland in the late 1990s (Edinburgh and Dundee only produced one cohort every 2 years), to an annual output of 30 clinical PCDs per year by 2008, most of whom will be dually qualified hygienist/therapists. In addition we will further expand the numbers of the clinical PCDs beyond current plans, to an annual output of 45, a 50% increase by 2010. This will mainly be hygienists/therapists but also includes others such as clinical dental technicians." (Scottish Executive 2005)

The UK General Dental Council (GDC) identifies six DCP tracks with a minimum training period as follows (Smith, Birnie et al. 2004)[4]:

- Dental Nurses - 45 weeks
- Orthodontic Therapists - 45 weeks
- Dental Hygienists - 90 weeks
- Dental Therapists or Dental Hygienists/Therapists combined - 102 weeks
- Dental Technicians - 120 weeks

[4] See http://www.gdc-uk.org/NR/rdonlyres/3029D7DD-81AE-41C6-973A-F39FE7287BF8/15135/developing_dental_team2004.pdf

- Clinical Dental Technicians - 90 weeks

"Additional training places are being funded for dental therapists and a new course has been established for dental hygienists who want to train as dental therapists. Significant investment will also create an additional 200 student dental nurse places by 2007. in 2005 126 dental vocational training places were filled in Scotland, compared to 113 in 2004. The 2005 figure includes 30 graduates from outwith Scotland. Numbers are projected to rise further in future years to match the increased output of graduates from Scotland's dental schools." (NHS Education Scotland 2006)

"NES has put together the UK's first full time dental therapist vocational training scheme which will help improve access to NHS dentistry. Oral health therapists (OHTs) are a new dental staff group who combine the skills of dental hygienists and dental therapists. A qualified OHT will be able to treat both adults and children and undertake a broad range of clinical procedures including restorative and preventative dentistry. The first eight OHTs qualified from the Glasgow Dental Hospital in December 2005 and six are currently undergoing vocational training. NES intends to train at least 46 OHTs over the next four years. A significant proportion of training posts will be in remote and rural parts of Scotland and the appointment of therapists in these areas will provide a welcome boost to the NHS dental service." (NHS Education Scotland 2006).

In Scotland Dental Hygienist and Therapy courses are both moving into degree-level programmes while Dental Technician training is only carried out by Edinburgh's Telford College in Scotland.

New Professionals: Orthodontic Therapists

Orthodontic Therapists have been trained in the UK since 2006, one of the last developed countries not to recognise this auxiliary role. The regulations concerning the training of such individuals are contained in the General Dental Councils regulations 'Developing the dental team' which describes a training model that takes around10 months. In Scotland the previous Chief Dental Officer expressed a desire for the peripheral component of the OT's training to occur in both orthodontic departments of District General Hospitals and specialist practices.

It has been proposed that an e-learning system should be used to provide a medium for continued education, assessment and feedback during the 10 month second phase. Additionally the use of ' online ' tutorials and discussions would develop a sense of belonging in the core group and counter feelings of isolation.

An initial pilot programme for 4 students would be run to develop and test an appropriate on line model prior to rolling it out to the full programme for 10 candidates. Such a model could be reused with minor modification for other courses falling under the NES umbrella in postgraduate dental training.

1.2.3: Associated Professions

An additional associated community is those professions that support dentistry and dental education without being dentally qualified. These include: administrators, learning technologists, computing officers, educationalists and researchers.

1.3: Online Learning and Teaching

Within just a few years e-learning (a term that covers teaching, learning, assessment, administration and most other areas of the educational environment) has become an essential part of clinical education (Ward, Gordon et al. 2001). There is great variation as to

the extent of its uptake and the range of its use. For instance while some see e-learning as placing PowerPoint slides or lecture notes on a website others are delivering whole courses through online environments. The following topics outline issues relevant to the CLEO Project:

1.3.1: Content

Digital content is one of the most basic and yet most contested aspects of online teaching and learning. This is in part due to conflicting ideas as to what is meant by content. For some it is the syllabus or curriculum of a course, for others it is the collected materials used to deliver a curriculum and for many others it is any element of those collected materials such as text, image, video or sound files which may exist as static digital resources.

The importance of content depends on the kinds of teaching and learning activities being undertaken and the required learning outcomes. For instance if the objective is knowledge acquisition (particularly where it is fairly objective or scientific knowledge) then content may well have a particularly critical part to play whereas if the objective is around performative (competency-based), attitudinal, critical analysis or reflective learning outcomes then content is less important and tools to support more diverse educational processes are more important.

Media resource types:

- **Text** is perhaps the most ubiquitous and easily used content format that can range from just the words themselves (TXT) through to formats that include presentation markup (rich-text format (RTF) and Acrobat portable document format (PDF) through to formats that also include relational markup (hypertext markup language or HTML) or semantic markup (extensible markup language or XML). Text characters are based on one or another encoding specification where a numerical code represents each character. The most common character encoding format is ASCII for English text but there are many others for non latin scripts such as Cyrillic, Japanese, Chinese and Arabic. HTML markup allows for both presentation and interlinking of documents and document elements using hypertext. XML allows for user-defined markup that affords instructions about structure, meaning and relationships.
- **Binary Files** are files that need a specific type of application to interpret them. For instance Microsoft PowerPoint uses PPT, Microsoft Excel uses XLS, Microsoft Acces uses MDB, and Microsoft Word uses DOC. Most multimedia formats are also binary files such as images, animations, audio and video.
- **Binary Applications** are those files that can run themselves, typically called 'executables'. In that the executable part of the file needs to work with the host operating system most executables are platform-specific (for example Windows executables cannot be run on a Mac). Windows executables typically have an EXE extension while executables for Mac typically have the APP extension. There are some exceptions to the platform rule however and these are where a common runtime environment is available for multiple platforms such as Adobe's Flash technologies (SWF) or Sun's Java technologies (JAR). Examples of Windows executable files relevant to this report include the University of Birmingham's dental CALs[5] and the British Pharmacology Society's Pharma-CAL-ogy collection[6].
- **Images** come in two basic formats bitmap or vector. Bitmap images are made up of a grid of pixels each one of a particular colour, the resulting mosaic representing the picture. Bitmap images are defined by the size of the grid (number of pixels wide by the number of pixels high) and its resolution (the number of pixels per inch or centimetre). Online the resolution does not matter as (at 100% size) each pixel in the image will correspond to a pixel on the screen. Vector images are made up of mathematical expressions describing the size, position and geometry of all of the objects in the image and are resolution independent. In terms of web use of images

[5] see http://www.dentistry.bham.ac.uk/ecourse/cal/welcome.asp

[6] see Pharma-CAL-ogy at http://www.pharmacalogy.com/

these are most typically bitmaps as there is little or no native browser support for vector images (although scalable vector graphics or SVG is a growing format). Web image formats include JPEG, GIF and PNG while non-web viewable bitmap formats include PSD, TIFF and BMP.

- **Animations** can come in a range of formats including:
    - GIF – a bitmap image format also supports animations
    - An animation may be saved as a video file (see video entry)
    - Adobe Flash is a commercial vector-based web animation authoring environment that exports to the .SWF (Shockwave Flash) format. Flash is the most common animation format found on the web and newer versions can include bitmap images, audio and video. Flash also has the ability to act as a web browser or XML parser for connecting to remote content or services.
    - Java is a fully featured and open object-oriented programming language. It can be used to create 'Applets' – compiled objects that can run inside web pages much in the same way as Flash. Java applets are more typically found in science, engineering and mathematics subject areas.
- **Audio** formats can be grouped into two types: streaming and non-streaming. Non-streaming files require the whole file to be downloaded before it can be played while streaming allows a subset of the whole datafile to be played before the whole file is fully downloaded. Other issues include the sampling frequency, whether there is compression applied and whether it is in stereo or mono. Common audio formats include WAV, AIF, MP3, ACC
- **Video** can also be separated in to streaming and non-streaming formats. Video visuals are made up of pixel grids (see section on bitmap images) and have the same issues of pixel width and height being a major determinant of their size. Note that both audio and video may be live streams (sometimes called webcasts) rather than pre-recorded files. Common video formats include AVI, MP4, MPEG, WMI, Apple's Quicktime and Real Audio
- Although the use of **3D** is relatively rare in dental education and there are relatively few standards in this area (such as VRML) there will be some instances of 3D models, 3D worlds and game-based worlds of interest to educators such as the 3D interactive tooth atlas[7].

A major concern regarding any form of content, and in particular content for education, is its provenance. Content always comes from somewhere: it has authors/originators, it has associated rights, permissions and copyrights, and it has perceived quality and value. All of these factors need to be considered in the context of federating and sharing content:

- Authoring content clearly gives the author particular influence and control over the artefacts they produce and to an extent what happens to them subsequently. This is complicated however by the context in which they act as an author. Many institutions consider all work done by their employees, that falls within their terms of employment, to belong to them while others differentiate between the open rights of academics and the closed rights of other staff. Furthermore, academics typically bring materials they developed in their previous employment to their new working contexts. This has different implications depending on whether that individual is leaving or joining an organisation. Any federated learning environment where these rights systems are mixed is likely to need clarification and flexibility around these areas.
- Licensing, permissions and consent are those terms under which content may or may not be used. Materials developed entirely within a local context (as long as they don't include any third-party content) offer few problems until they are moved to another context of use. In this situation the rights and responsibilities of the provider and the new user need to be set out clearly in order to avoid subsequent problems. Typically any kind of contract or licence falls into three areas

[7] 3D interactive tooth atlas - http://www.brownandherbranson.com/tutorial_atlas.shtml

- Rights – what the end user and provider can do. For instance a user may have the right to redistribute content to their student users or a provider may retain the right to be acknowledged as the author of the work in question. Two key aspect of rights are the intellectual property rights of the provider and the consumer rights of the user (particularly if money has changed hands).
- Responsibilities – what the end user and provider must not do. For instance a user may not resell the content or a provider may accept no liability for technical support.
- Consent – in the case of materials with clinical provenance, particularly ones where a patient is identifiable, a third issue of appropriate and informed consent is required. The University of Edinburgh JISC-funded CHERRI Project has explored this area in some depth[8].

Typically all of these aspects are combined in some form of license; a contract between the supplier and the end user. These may take the form of specific end user licence agreements (EULAs[9] - such as those presented when you install software) or standard contracts and licences like the increasingly popular Creative Commons[10] for any kind of original content or GNU Public Licence (GPL)[11] for software.

- Validation and quality assurance is also important: validation from an authoring perspective, quality assurance from the perspective of users of third-party content. While some collections have explored QA models based on peer-review such as MERLOT[12] the lack of academic recognition for such work (compared with research or publication for instance) has limited its effectiveness. A more common approach is some kind of user rating or popularity system such as the star ratings and formative reviews found on retailers' sites like Amazon.
- Stability and dependence are also areas for concern regarding content. If the content is not held in your own systems and it is connected to from somewhere else you are dependent on that source remaining stable and available, the content may be changed, it may change its location or it may disappear altogether.
- The other main consideration associated with the provenance of educational content is its value. If the content belongs to an individual then its value is reflected in the way it is looked after, updated, backed up and how user and technical support for it is provided. If content is located at a remote site then value may be reflected in a fee/subscription or the risk taken in using something over there is no control and which may be of less value to its owners or hosts than to the user.

The organisation and structure of content is also worth considering. While much content will be expressed as a single file it may also be made up of a number of different files and objects. A single web page may for instance be made up of separate text, image and other files such as stylesheets or scripts. HTML therefore is one model for aggregating and connecting content. Another is IMS Content Packaging – a specification that sets out how content can be packaged within a single zip file with accompanying XML files to describe how it should be organised. More complex models include IMS Simple Sequencing, which

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[8] see http://www.cherri.mem.ed.ac.uk

[9] EULA – see http://en.wikipedia.org/wiki/Eula

[10] "Creative Commons provides free tools that let authors, scientists, artists, and educators easily mark their creative work with the freedoms they want it to carry" – see http://creativecommons.org/

[11] see http://www.gnu.org/copyleft/gpl.html

[12] "MERLOT is a leading edge, user-centered, searchable collection of peer reviewed, higher education, online learning materials created by registered members, and a set of faculty development support services. MERLOT's strategic goal is to improve the effectiveness of teaching and learning by increasing the quantity and quality of peer reviewed online learning materials that can be easily incorporated into faculty designed courses." - see http://www.merlot.org/merlot/index.htm

describes how content is presented to the user based on their actions and choices and ADL/SCORM which build on both Content Packaging and Simple Sequencing.

An expanding and popular way of providing content is using syndication services, typically underpinned by the RSS[13] XML data format. Examples include syndicated news, weather and blog channels, podcasting (audio files) and vodcasting (video files) referenced within an RSS feed.

The promise of reusable educational content, most often cast as 'reusable learning objects' (or RLOs), has been the focus of substantial interest and investment over the past few years (Wiley 2000; Littlejohn 2003). However, reuse as a concept in education is clearly not a new one as RLOs in the form of library books have been in existence for millennia, indeed the very existence of text and image (or any other recording) implies distance between creation and application and therefore reuse. Although the argument for reuse focuses mostly around efficiency of production and investment, other considerations include reuse as a form of catalyst, sustainability, plurality, and increased autonomy.

The concept of the 'RLO economy' sees reuse as a matter of teachers spontaneously and easily going and getting their content from repositories and using it on need/demand. However, common repositories full of useful 'stuff' are still some way off, particularly in niche areas such as dentistry. Not only is the absence of easily accessible sources of RLOs an issue, there are also concerns regarding RLO granularity, provenance, quality, adaptability, rights, and challenges to the profession. Within a single institution there is little duplication of subject teaching, with the result that the utility of local RLOs is relatively limited. Campbell (2003) suggests the learning object economy should be based on materials being abstracted from their context of use. But context matters, particularly in resource discovery where trust, community, provenance and alignment are all important factors. Problems also remain in finding materials that match the needs of particular educational contexts - requirement for alignment (Biggs 1999) and message sensitivity (Snyder 1971).

Is reuse intrinsically a good thing? The University of Edinburgh ACETS Project was a 3-year study which followed and evaluated the work of 21 teachers tasked with reusing third party materials in their teaching in higher and further education (in healthcare-related subjects). The Project conclusions and recommendations include (Ellaway, Dewhurst et al. 2005):

- Reuse is not in itself a good or bad thing and it should not be encouraged or discouraged as a matter of dogma, rather it should be nurtured and supported where it can provide benefits but not where it will not.
- There is currently a mismatch between learning resource provision and need: most of the ACETS exemplifiers used materials from North American rather than UK sources.
- If reuse is to become mainstream then the needs of teachers must be addressed more directly. These needs of teachers are often highly specific, contextualized and related to their personal approaches to teaching.
- Reuse is not particularly dependent on technical support; local support is very important but it should be as focused on what could be done as on how it could be done, and learning technology support should address both the pedagogy and the technology and the skills repertoire of all of those concerned.
- Without motivation and clearly perceivable need teachers will be unlikely to overcome the difficulties associated with using existing third-party materials. In the absence of such a change reuse will remain a minority activity, championed by some but failing to gain widespread support

For content to be useful it needs to be available, accessible and/or discoverable. To that end it may reside on a local area network or LAN (such as EXE files) or it may be online – for either of these storage options all that is needed to access it is the appropriate path – a URL for web resources (assuming no security or authentication barriers have been set to restrict access). However, despite the power of search engines like Google this is not an efficient way to store and articulate content in any quantity. Specialised systems have been developed

[13] see http://en.wikipedia.org/wiki/RSS_(file_format)

to handle content and these are typically called content management systems, repositories or referatories. At their core all of these systems are databases that organise content around formal metadata and informal annotations.

- Content management systems (CMS) typically involve both publishing as well as storage of content and they are increasingly used to provide corporate and large organisational websites. Because of the focus on publishing they are less often used for managing educational or academic content.
- Repositories are systems that both store and catalogue resources – a library is a classic model of a repository. In the UK the JISC-funded national learning object repository is JORUM[14], a free online repository service for teaching and support staff in all UK Further and Higher Education Institutions. Access to JORUM requires an institutional subscription followed by individual access via ATHENS authentication.
- Referatories are very similar to repositories except that they don't store content but rather store metadata and links to wherever the content is (online or elsewhere). A good model of a referatory is a directory. The UK INTUTE (aggregate service) - http://www.intute.ac.uk/ and INTUTE Health and Life Sciences (previously OMNI) from http://www.intute.ac.uk/healthandlifesciences/medicine/ free online service providing you with access to the very best web resources for education and research, evaluated and selected by a network of subject specialists. No registration or login required as not access agent
- The fourth type of approach is a more loosely defined set of collaborative tools and systems which are part of the Web 2.0 revolution. These include the widespread use of feeds and 'casts for syndicating content, systems for sharing as well as storing specific kinds of content such as Flickr[15] (for photos) or YouTube[16] (for videos), systems for sharing links and tags to content (called social bookmarking) such as del.icio.us[17] and tools for creating collaborative content such as wikis and blogs.

Typical functions for these kinds of systems include cataloguing resources, searching, grouping, and external resource discovery where third-party systems can search the collection. When multiple sources are searched in one go this is called 'federated searching'. There are a number of common XML-based search and discovery protocols including z39.50[18], OAI harvesting[19] and SRW/U[20]. A number of repositories and services provide syndicated resource discovery using RSS protocol feeds (see section on organisation of content).

A JISC-funded project called 'CD-LOR'[21] is currently reviewing the provision of learning object repositories and in 2006 made the following recommendations regarding their design and use in higher education (Margaryan, Currier et al. 2006) (paraphrased):

- Repositories should shift from delivery of learning objects to supporting teaching and learning processes within communities in more explicit ways.
- Repositories should be more closely linked to institutional and national strategies for teaching and learning and be based on needs of the communities and potential users.

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[14] see http://www.jorum.ac.uk

[15] see http://www.flickr.com

[16] see http://www.youtube.com

[17] see http://del.icio.us

[18] see http://www.niso.org/standards/resources/Z3950_Resources.html

[19] see http://www.openarchives.org/OAI/openarchivesprotocol.html

[20] see http://www.loc.gov/standards/sru/

[21] see http://www.academy.gcal.ac.uk/cd-lor/

- User needs are best integrated through collaborative approaches to design and involve consultation with the representatives of the target group of users at all stages of the project.
- Recognition and rewards should be used to encourage the wider adoption of learning object repositories with rewards based on the user communities' needs.
- Mechanisms for quality assurance of resources must be developed/further improved, particularly those involving student-contributed resources.
- It must be ensured that personal resource management tools and institutional information environments, tools and systems work together to support learning within communities.
- User information literacy and development is an important factor in implementation of learning object repositories.

1.3.2: Designs for Learning (DfL)

"Common characteristics of professional and vocational education include relatively narrow post-qualification vectors (most graduates of a particular programme will go into a narrow range of similar professions, often with much better job prospects than non-professional and vocational education colleagues), a dependence on workplace learning and external regulation and accreditation, and a requirement for practitioner educators. Not only does this create technical obstacles for designs for learning (such as difficulties in reusing learning materials from outside the domain), but it also tends to obscure what kinds of designs for learning are required and their function and importance within different professional and vocational domains" (Ellaway 2007)

Dentistry shares some of its designs for learning with all areas of higher education, some just with healthcare subjects (like medicine and nursing) and some are specific to dentistry. Generic designs for learning include lectures, seminars and tutorials as well as project work and research. More bio/medical- and healthcare-specific designs for learning include scenario-based learning, problem based learning (PBL), and the use of simulators and practica such as manikins and virtual patients. Dentistry-specific designs for learning include chairside (as opposed for instance to bedside) teaching and learning.

From an online learning perspective the following are of particular relevance to dental education:

- Virtual patients: a virtual patient has been defined as *'an interactive computer simulation of real-life clinical scenarios for the purpose of medical training, education, or assessment'* (Ellaway, Candler et al. 2006). There are many ways in which virtual patients can be used as designs for learning including (Ellaway 2004):
    - The learner may take many different roles (role modes).
    - The learner may work within an existing virtual patient (player mode) or they may create one from scratch (author mode).
    - The learner may act independently, under the guidance of a tutor or instructor, or in a collaborative setting with their fellow students or other students from intersecting curricula (independent, tutor or peer modes).
    - The learning process may be naturalistic where uncertainties of real practice are key or formalized where the activity is more structured (naturalistic or formalized mode).
    - The learner may build up the virtual patient themselves (blank mode), or they may explore an existing patient or scenario (critique or rehearsal modes).
    - The virtual patient may be used to address particular topics (context mode), to explore personal/professional dimensions (reflective mode), or banks of patients or scenarios may be used to address broader issues such as public health (pattern mode).

- Whole-programme learning environments and curriculum mapping: not only is the amount of shared teaching minimal in professional programmes there are higher requirements for integrated and externally accountable curricula. As a result the ability to model and organise the learning environment as a whole is as important as supporting the courses and modules within a curriculum (Dewhurst and Ellaway 2005).
- Portfolios and professional development planning are also an important aspect of professional development and these kinds of activities are increasingly mediated online. NHS Education Scotland has for instance developed an online portfolio system that is being rolled out to postgraduate dental trainees as well as to other professional groups in Scotland and across the UK (see the next section on portfolios for more information).

Although all educational tools, systems and environments are designed to afford one or more design for learning the recent development of a technical specification for 'Learning Design' has led to tools and applications that address design for learning more explicitly. The most notable of these is the Learning Activity Management System (LAMS) developed at Macquarie University in Australia[22].

In comparison with systems, where some content may occasionally embody one or more instructional model, designs for learning are typically content independent.

1.3.3: Assessment

In addition to supporting teaching and learning educational technologies are also playing an increasing role in assessment. So-called e-assessment (also known variously as computer aided assessment (CAA) or computer based testing (CBT)) can be both formative and summative, and it can be used to test knowledge (e.g. using multiple choice or extended matching items), performance or competence (e.g. using OSCE stations or simulations such as virtual patient cases) or practice (e.g. using portfolios or 360˚ micro-assessments).

Formative self-assessment is an important tool in helping students to assess their knowledge and abilities and to diagnose any areas of weakness that need further work. Providing well-designed questions with high quality feedback can support effective learning. While in its more basic forms this may equate to banks of MCQs more advanced forms of formative e-assessment may involve virtual patients, skills simulations or using video to record and then review clinical performance.

There are many issues associated with e-assessment including:

- Choice of specific methods: there are a range of question types supported by different e-assessment systems. Some like multiple choice, extended matching or short/long written answers are close analogs of their paper based equivalents while others such as drag and drop, XY hotspot or matching are less so.
- Choice of overall methods: this includes whether all candidates are assessed in a single event, like a traditional sit down exam, or whether more open approaches such as continuous assessment and progress testing are employed.
- Authoring questions and whole tests or exams can be easier and more robust online but at the same time it will be limited to whatever the host system supports. Authors often have problems preparing resources such as digital images to incorporate into questions.
- For questions that have clear right or wrong answers automatic marking can significantly reduce the effort required.
- Analysis of the results from individual questions and whole exams can be a lot easier as computers excel at such mathematical processing.

[22] see http://www.lamsinternational.com/about/

- Security and identity are major concerns as a student should in many circumstances need to be prevented from accessing all of the computers facilities (such as access to the Internet) while sitting an assessment. From an invigilation perspective there are significant issues associated with the person on the other end of a computer terminal being the person they should be, whether they are working alone and whether they have access to any aids (such as books or the web).

The choice of which e-assessment tools and systems to use will be based on many issues. The major systems in use in UK Higher Education include: QuestionMark[23], Triads[24] and TOIA[25]

In addition many VLEs have built-in assessment tools, typically variations on multiple choice and text matching types.

From the point of view of this report there are two further issues of particular note:

- One of the more commonly used educational technology specifications is IMS Question and Test Interoperability (QTI)[26]. This sets out common XML schemas for encoding and sharing questions between systems that have implemented QTI (see later section on standards and specifications for more information on IMS).
- Question Banks are specialist kinds of repositories (see earlier section) which allow question items to be stored with appropriate metadata such as performance metrics and subject headings. A good example of a UK-wide repository in healthcare education is UMAP[27] a consortium of 14 organisations coming together around the development and use of a common question repository for undergraduate medical education.

1.3.4: Portfolios and PDPs

Portfolios for professional education often have a higher assessment profile than those found in non-professional subjects. Given the professional focus on the development of praxis the portfolio can act as both a developmental log and as a tracking mechanism to assure key outcomes such as fitness to practice. Portfolios in science or humanities subjects often sit 'outside' the teaching and learning context and are typically student owned, portfolios in professional education on the other hand are more often directly integrated into teaching and assessment and involve higher levels of tutor scrutiny.

Portfolios are increasingly being mediated and stored online, either as integrated parts of a virtual learning environment (VLE) or as a standalone system. The portfolio is also an increasingly key component in continuing professional development and accreditation, where an individual activity is rarely linked to a formal curriculum or context of study. In these situations evidence of activity, such as notes on papers written or read, presentations given, meetings attended or training activities completed, are often best stored (and signed of) using an online portfolio. This postgraduate focus tends to influence earlier stages in professional and vocational education and as a result there are varying pressures to integrate student and practitioner portfolios and their associated activities. This tends to reinforce particular subject perspectives on lifelong learning and their vertical alignment to the profession thereby weakening their horizontal alignment to portfolio designs for learning within their host institutions.

Portfolios may cover some or all of a wide range of functions and activities including (but not

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[23] see http://www.questionmark.com QuestionMark is a commercial software company whose main product is 'Perception', an online assessment management system that allows its users to author, schedule, deliver, and report on surveys, quizzes, tests and exams.

[24] see http://www.derby.ac.uk/ciad

[25] see http://www.toia.ac.uk

[26] see http://www.imsglobal.org/question/

[27] see http://www.umap.org.uk

limited to) logbooks and critical event analyses, personal and professional development planning (PDP), written case reports, progress tests, professional CVs, individual objectives and curriculum mapping as well as more personal and formative diary entries. Portfolios may also be expected to represent all aspects of the student (warts and all) or just their positive side (for instance in a CV). Some portfolio approaches concentrate on the accumulation of artifacts as evidence of activity or progress while others concentrate on processes like development planning and prioritizing.

Clearly the concept of portfolio can cover many different practices and systems, which creates problems regarding interoperability and equivalence between different systems. Although there are emerging interoperability specifications for portfolio systems they are as yet relatively underdeveloped and their support for some of the kinds of things found in professional education portfolios non-existent. Not only is there a question over how portfolios should interoperate there are even more basic questions whether they should in the first place. Longitudinal professional vectors and lifelong learning pose fundamental questions regarding what goes forward, who decides, how it retains its original context and how it is to be used in its new context.

It is worth noting that blogs are increasingly being used in a portfolio-like way as they support regular diary-like reflections with the ability to append files and other evidence and to have comments from other individuals (such as tutors or peers) attached.

1.3.5: Computer Communication

There are many different kinds of online support for collaboration and communication including:

- Discussion boards (also known as message boards, discussion groups, discussion forums, or bulletin boards) are probably the widest used online educational communication medium. Users interact by leaving messages in these boards either in chronological order or in threads (where individual topics of discussion follow their own paths) so that others may read their posts and continue the discussion[28]. The essence of this format is that it runs asynchronously i.e. users do not need to be online together but collectively build up the discussion over time. Because these messages are stored this kind of medium is relatively permanent and stable over time.
- Chat on the other hand is synchronous in that users need to be online at the same time to be able to communicate. As a result chat can have a high level of volatility; you need to be ‘there’ to partake in the interaction. Instant messaging is a particularly popular form of chat with the young. There are various different protocols (including AIM (AOL), MSN, Jabber, Yahoo!, .Mac, Bonjour and Google Talk) only some of which work with each other. Chat is intrinsically text based although many clients are now allowing file transfer and even VoIP (see next section) as part of the chat clients.
- While discussion and chat are intrinsically text-based, the use of audio is growing, partly due to improved bandwidth and connectivity and partly due to the development of robust and usually free voice over IP (VoIP) services like Skype. This so called IP telephony is replacing traditional ADSL telephony for many businesses and in broadband-connected homes. In addition to a computer and Internet connection users need to have soundcards and a microphone (typically integrated with headphones as a headset.
- While full video conferencing remains a relatively specialist activity it is growing in popularity not least because it represents a much greener alternative to international travel. Video conferencing breaks down into two forms. The first is dedicated video conferencing based on dedicated hardware and often specifically configured physical spaces (videoconferencing suites), protocols such as h323 and bridging technologies. All Scottish universities took part in a common video conferencing

[28] see http://en.wikipedia.org/wiki/Internet_forum

infrastructure project associated with the Metropolitan Area Networks (MANs) developed in the 1990s. The other popular form is desktop video conferencing with free clients such as Skype and iChat for basic use and commercial products such as Adobe Connect (formerly called Breeze) and e/Pop for more advanced kinds of use. In addition to a computer and audio capability video conferencing requires a suitable camera – increasingly these are being built in to the computer itself.

1.3.6: Environments

The traditional learning environment for healthcare education has always been the campus or workplace. Although much activity is now mediated online these have not disappeared – rather they are augmented by a variety of online systems and 'places'. General websites are still used by many courses, these typically are single-tier systems comprised of static web pages and associated content. However, more common, and typically more useful, are 'web applications' where the user interactions are structured against a programmed logic layer, which in turn interacts with its underlying databases. Web applications in use in education include:

- Virtual learning environments (VLEs) are course or programme specific instances of integrated tools and content. Typically these will include web page hosting, content management, discussion, scheduling (timetables or calendars) and student tracking. Some systems also include more advanced services such as assessment, portfolios, blogs and wikis. Popular commercial examples of VLEs include Blackboard and WebCT (which are currently merging) and open source examples include Moodle and Sakai. The term VLE is typically a European/UK concept while in North America the same systems are more typically called Learning Management Systems (LMSs). Virtual research environments (VREs) build on the tools and principles of VLEs but organise their support around research communities.
- Managed learning environments MLEs are whole-enterprise systems that can include one or more VLEs but also include student records and management as well as business systems components such as HR, finance and admissions. VLE providers such as Blackboard/WebCT and Sakai also provide full MLE applications support.
- Portals are web applications that present or 'surface' content and services from a number of different sources and are increasingly popular with larger institutions that have a diverse set of users to support. Each external website or web service is linked in to the portal via a channel or portlet so that the portal functions as a website of websites. Blackboard/WebCT and Sakai support portal technologies and a Sakai-related open source system called uPortal is currently particularly popular in UK HE. Portals are increasingly popular in healthcare with the Scottish NHS e-Library being a particularly notable example.
- Recent years have seen the rapid development and growth in popularity of so-called 'web 2.0' environments including YouTube, Flickr, Facebook, del.icio.us and Wikipedia. The underlying principle of these is user autonomy, usually in developing and sharing collaborations and content and openness, typically manifested in services being free to the end user and all content being open access, often to edit as well as view. The technologies associated with these systems are relatively simple and include wikis (web pages created and edited through the web itself), blogs (personal web diaries – blog is short for 'web log') and syndicated services such as news feeds, podcasting and vodcasting. The mass popularity of these tools (most students now set up and spend significant time in their own Facebook communities and use Wikipedia as a principle reference source) is leading many educational systems designers to include similar functionality in their own products.
- Game worlds are the most specific kind of educational environment. Based on computer games these are typically three-dimensional worlds in which the user can move freely and explore and interact with other users. The most popular of these systems is Second Life a free, massively multiple-user world with its own currency and economy. Although these spaces can be highly immersive they are expensive to set up and run and often need to be adapted for use in professional education.

1.4: Infrastructure

The environment for any federated activities between dental education systems needs to be taken into consideration as it can have both an enabling and disabling effect on what can be done. The environmental dimensions can be grouped into health sector, education sector and public sector infrastructures:

1.4.1: Scottish Health Sector Infrastructure

Most NHS organizations have one or more Local Area Networks (or LANs) which connect the computing systems within the single organisation. In addition the NHS has been connected internally using a virtual private network (VPN) and to the Internet in general for a number of years through a UK-wide service called NHSnet. A replacement service called N3 was announced in 2004 as part of the National Programme for IT (NPfIT). Although initially an English programme there is now an N3 contract for Scotland with an installation of more than 1,800 connections on a network that will eventually extend to about 3,000 sites[29]. NHSnet was scheduled to have closed in March 2007. There have been some concerns expressed over the speed of the network and some organisations have made separate arrangements.

One of the principle organisations involved with online services and service delivery is the NHS Scotland Information and Statistics Division (ISD[30]):

> *"ISD Scotland is an essential support service to NHS Scotland and the Scottish Executive Health Department; proactive in determining and advising how best to use information and Information Technology to ensure efficient, effective delivery of patient care. ISD Scotland is a business operating unit of NHS National Services Scotland [formerly known as the Common Services Agency]. It has been in existence for 40 years, originally as the Research and Intelligence Unit of the Scottish Home and Health Department."*[31]

Scotland's Health on the Web (or SHOW[32]) is part of ISD and provides the bulk of its web publishing presence and underlying services and systems.

Although there is little available evidence to substantiate it, there is a general reported malaise among NHS staff regarding their access to functional, networked and Internet-enabled computers in the clinical workplace. Due to an organisational culture of (often well-founded) paranoia, risk avoidance and distrust of its staff the NHS severely limits what can be done on its computers, in particular what can be done online. As a result there is no guarantee that online resources for staff in the NHS are accessible by them in the workplace; typically access to online educational materials is in specially set up facilities such as training centres or in their own time, usually at home. This is more of an issue for tertiary staff than for primary as the latter have more autonomy on the setup and availability of systems within their own practices. There is little adoption of wireless networking in the NHS except where academic units are collocated within a clinical space and even then care is required to ensure it does not interact badly with clinical equipment such as monitors.

1.4.2: Tertiary Education Sector Infrastructure

All publicly funded institutions of further and higher education in the UK are connected by a single high-speed network backbone called JANET (Joint Academic NETwork):

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[29] see http://www.n3.nhs.uk/n3scotland/

[30] see http://www.isdscotland.org/isd/CCC_FirstPage.jsp

[31] see http://www.isdscotland.org/isd/3352.html

[32] see http://www.show.scot.nhs.uk

"the JANET network connects UK universities, FE Colleges, Research Councils, Specialist Colleges and Adult and Community Learning providers. Over 18 million end-users are currently served by the JANET network" [33]

In Scotland tertiary education institutions are connected to a number of Metropolitan Area Networks (MANs) which are in turn connected to SuperJANET (the latest high speed version of JANET)[34]:

- AbMAN (Aberdeen Metropolitan Area Network)
- ClydeNET (connecting sites in the Glasgow area)
- EaSTMAN (Edinburgh and Stirling Metropolitan Area Network)
- FaTMAN (Fife and Tayside Metropolitan Area Network)
- UHIMI (connecting sites in the Highlands and Islands of Scotland)

Tertiary academic local area networks (LANs) are typically high speed and provide little barriers in terms of what, how much or when Internet services are accessed although firewalls, spam filters and other protections are typically well-established to block malicious or unwanted access or attack.

Increasingly academic networks are wireless-enabled to enable more fluid access to and working with networked services. Staff and student access to computers is generally good and is not seen as a barrier to working. Note that the NES Dental Teach and Treat Centres typically fall outside the academic network context and are therefore connected using domestic telephone network broadband connections.

1.4.3: Public Infrastructure

Because many staff and students will choose to connect from home or in transit some consideration of public infrastructure is important. There are many devices the mobile learner may use including desktop and laptop computers, PDAs, smart phones and Internet-enabled TV. Access may be via dialup, broadband, private or public wireless or via a third party cable connection such as in a hotel.

1.5: Federations

The present scoping study was initially commissioned as an essential first step towards building a collaborative learning network for dental healthcare education in Scotland – a project called CLEO. A defining aspect of the original CLEO proposal was that it was about federating existing systems rather than creating new ones from scratch. In this respect there are a number of issues associated with federated systems that should be explored.

1.5.1: Topology

Options/types:

- Point to point connected: in this configuration there is no centre and therefore federation has no extant independent identity but is rather a distributed phenomenon amongst those that elect to be identified as part of such a network. In terms of supporting federated connectivity this arrangement offers no more than is already available as this has already been achieved via the partners' connections to the Internet.

[33] see http://www.ja.net/about/index.html

[34] see http://www.ukerna.ac.uk/about/topology/SJ5-topology-map.pdf

- Peer-peer model: in this setup individual organisations connect and share in paired channels independent of any other following the approach taken by peer-to-peer (P2P) file sharing networks such as Napster, Gnutella (inc LimeWire) and BitTorrent. In this situation federation is largely invisible and self-organising and has relatively little discipline or control, which in turn raises risks such as users pirating content.
- Big hub model: the hub is a separate environment in its own right, with content, activities, gateways etc all held centrally. Connected systems place things in the hub and take things from the hub. Advantages include load placed at the hub and coupling/dependency is only at the hub, control and authority embedded in system processes, uniformity. Disadvantages include cost of setting up and sustaining another service (ownership and control), barriers to connecting partners directly.
- Small hub model: still a star model but with the centre made up of middleware and other agent services. In this case the hub acts as a brokering layer connecting federation members with each other and acts to connect and translate between local system content and services. Advantages include relatively light touch development since no content is stored centrally and very few services are run centrally. Disadvantages include a requirement for subscribing systems to be able to provide a full range of Service Oriented Architecture (SOA) connectors through the hub, partiality and potential problems of translational layers.
- Portal model: discussed earlier in the section on environments, portals act as a 'website of websites' in that they surface channels of content and services from external sources in the one place. A portal depends on the existence of these other services and their being available in the correct technical format (typically XHTML). A portal's users are usually afforded some control over the choice of channels displayed and their relative layout although this varies between systems. The advantages of a portal model are that the portal itself can be quite 'thin' in that it need contain very few of its own services (typically authentication and presentation). The downside then is that portals are dependent on there being external content and services for it to consume which are properly formatted and stable over time. In addition the ability for users to configure a portal can be very attractive to them but can make it hard to maintain a common assured experience.

1.5.2: Identity and Trust

A key aspect of any kind of online system is the ability to authenticate the identity of any individuals using it. This may be to ensure only selected individuals get access or it may be to support the personalisation of the system to a particular individual.

The issue of authentication takes on a whole new level of complexity when it is considered across a number of different systems, particularly when they are located in different organisations and cultures.

An individual's identity may be the same or different between systems, furthermore it may be held in one system, held centrally or replicated across the systems. Clearly there is a concept of trust (or the lack of it) between systems. For instance, federated authentication models (such as employed by Shibboleth) depend on a robust local authentication mechanism that is trusted by other systems so that the credentials of the individual are sent to the subscribing systems and accepted in lieu of a local authentication or login.

Although there are technical solutions to these problems more fundamental is the preparedness and ability of the organisations that own these systems to allow them to be connected to others such that authorisation is shared.

1.5.2.1: Authentication

Assuring the identity of the incoming user against a known profile (minimally consisting of a user name and associated password) is an essential aspect of any secure information system. There are three broad approaches to authentication:

- System-level: this is where authentication takes place on a per system basis. Although users may reset their passwords to be the same across multiple systems each system's authentication is independent of that of any other.
- Single or reduced sign on: this is where authentication takes place within a wider organisational context with systems sharing an authentication mechanism. Within a single organisation this can be in the form of a directory service where user credentials are matched on each challenge against a single shared database (examples include LDAP and Active Directory), or in the form of a single-sign on where users move from one system to another cross checking with a central server that both credentials are valid (examples include Kerberos and SAML). For situations where some systems require further authentication (for instance for particularly sensitive or mission-critical services) this is called reduced sign-on.
- Federated authentication: this is where independent systems with an established local single sign-on system are connected by extending trust to the other partner's authentication step. *"Federated identity allows for information about users in one security domain to be provided to other organizations in a common federation. This allows for cross-domain single sign-on and removes the need for content providers to maintain usernames and passwords. Identity providers (IdPs) supply user information, while service providers (SPs) consume this information and gate access to secure content*."[35] A key example is Shibboleth which is the basis of the JISC's "UK Access Management Federation for Education and Research"[36].

Some systems allow users to self-register or submit to an authority for registration while others are closed other than to specific people such as members of staff or registered students.

Shibboleth

"Shibboleth is an Internet2 Middleware Initiative project that has created an architecture and open-source implementation for federated identity-based authentication and authorization infrastructure based on SAML. Federated identity allows for information about users in one security domain to be provided to other organizations in a common federation. This allows for cross-domain single sign-on and removes the need for content providers to maintain usernames and passwords. Identity providers (IdPs) supply user information, while service providers (SPs) consume this information and gate access to secure content." [37]

"The JISC Core Middleware initiative aims to improve the way in which users access resources throughout the UK educational sector. Specifically, the goal is to allow users to access internal and external resources seamlessly using a single, institutionally controlled identity. This will reduce substantially (if not eliminate altogether) current problems in which users are required to maintain multiple passwords for multiple resources in multiple domains. For the last two years JISC has devoted a significant part of its development funding to access management issues. Many different solutions and scenarios have been investigated and tested, alongside research into supporting factors such as cultural change. The outcome is to base the strategy on Shibboleth technology, a new standards-based approach in this area." [38]

JISC's roadmap for joining the UK Access management Federation (see http://www.jisc.ac.uk/uploaded_documents/FAM%20leaflet%20FINAL.pdf) outlines three options for institutions wishing to move to Shibboleth: do the whole thing in-house, pay someone to manage the technical aspect of Shibboleth, pay someone to manage the whole service.

[35] see http://en.wikipedia.org/wiki/Shibboleth_%28Internet2%29

[36] see http://ukfederation.org.uk

[37] from http://en.wikipedia.org/wiki/Shibboleth_%28Internet2%29

[38] from http://www.jisc.ac.uk/publications/publications/pub_shibboleth.aspx

1.5.2.2: Authorisation and access

Authorisation follows authentication in that once the identity of a user is assured it can then be matched against a record of what aspects, areas or views of the system they are allowed to see or interact with. This may be based on direct mappings between user profiles and functions or it may be managed via an intermediate role layer where users have one or more roles, which in turn are mapped to the functions available to those given that role. The latter is more scalable and flexible and is typically found in larger information systems.

1.5.2.3: Personalisation

The last part of the identity and trust process is the personalisation of the environment to the particular user's profile. This may include addressing the user by name, setting presentation properties such as colour or text size, setting bookmarks and annotations or changing the information itself to match their role(s) or profile within the system.

1.5.3: Politics of Federations

All information systems have human dimensions. They order, control and shape the way their users work and interact with each other and as such they also have significant political dimensions. These issues are multiplied in a federated environment where the ties between partners are relatively weak and usually asymmetrical. As in any civil society members of a federation need to be able to trust each other which means addressing and formalising issues such as:

- Governance: every successful federation will need to have methods for formulating and advancing policy and strategy, resolving disputes and maximising positive common outcomes while minimising bad ones. Arrangements are usually democratic and based on representative government (typically by committee or steering group) although if one partner is particularly dominant in terms of power, resources or capacity then governance may be more autocratic. For practical purposes operational control is often given over to a director or project manager that report to the strategic governing authority.
- Equity: partners in a federation will not all be at the same stage, have the same resources and capabilities, or have the same levels of engagement and enthusiasm. As a result most federations are asymmetrical and this can in turn cause problems if not managed properly. Issues such as lack of engagement or contribution, dominance or absence, and disparities between contributions and withdrawals all need to be considered both in terms of the practical effect on the federation and on the ways participants perceive themselves and each other.
- Autonomy and dissent: not all partners or the members of partner organisations will wish to comply with the majority view or strategy. Federations are typically quite loosely coupled so that partners retain significant autonomy, for instance regarding what they do in their local organisational context. Despite this, the extent of autonomy and the minimum compliance requirements should be clearly articulated and managed across the federation as a whole.

The implementation of these political frameworks (and any other) required to manage the federation over time had both human and technical dimensions. Due process and appointments to positions of responsibility need to be matched with reified workflows and documentation to ensure the stability and sustainability of the federated enterprise.

1.6: Standards and Specifications

Almost all computing technologies are transient in that they are the current but not ultimate solution to a problem or need. There has been a great deal of churn and change over the past several decades as one system or technology is replaced with another. Along the way investment in content within these systems has often been lost along with the technology

itself. In order to address this problem common standards and specifications have been developed so that content and/or services can be moved from one system to another. These include hardware standards such as for CDs or cables, file and format standards such as for images or text and protocol standards such as TCP/IP (which underpins the whole Internet) or RGB video (that allows computers to connect to monitors and data projectors). The state where two or more systems can work together using standards and specifications is usually called 'interoperability' [39].

As educational technologies have matured and their capabilities expanded and normalised there has been a push for standards and specifications in this domain as well. There are a number of notable groups whose work in this area has worldwide uptake:

- IMS Global (http://www.imsglobal.org) are perhaps the largest and best known educational technology specifications organisation in the education world and has over 50 contributing partners and affiliates including members from industry (Microsoft, Apple, IBM, Blackboard, Moodle), education (Open University, JISC, Cambridge University) and the publishing world (Elsevier, McGraw Hill, Pearson). IMS have produced specifications in the following main areas: Accessibility, Competency Definitions, Content Packaging, Digital Repositories, Enterprise Services, ePortfolio, Learner Information, Learning Design, Meta-data, Question and Test Interoperability, Resource List Interoperability, Shareable State Persistence, Simple Sequencing, Tools Interoperability, and Vocabulary Definition Exchange.
- Best known for the development of the Sharable Content Object Reference Model (or SCORM) the Advanced Distributed Learning (ADL) Initiative is a part of the US Department of Defence. "*SCORM is a collection of standards and specifications for web-based e-learning. It defines communications between client side content and a host system called the run-time environment (commonly a function of a learning management system). SCORM also defines how content may be packaged into a transferable ZIP file"*[40].
- The Institute of Electrical and Electronics Engineers (more commonly just called IEEE) publish technical standards for, amongst other areas, computing technologies. The most well known educational standard (and the only commonly used 'true' educational technology standard) is the IEEE Learning Object Metadata model (or LOM).
- MedBiquitous (http://www.medbiq.org) is a non-profit, international group of professional medical and healthcare associations, universities, commercial, and governmental organizations dedicated to advancing healthcare education through technology standards that promote professional competence, collaboration, and better patient care. MedBiquitous is accredited by the American National Standards Institute (ANSI) to develop information technology standards for healthcare education and competence assessment and is the only healthcare education-specific standards organisation in the world.

Note that *"A standard is a recognized (nationally or internationally) technology, format or method, documented in detail, ratified by a respected authority such as ISO, BSI, CEN or IEEE … a specification is an industry-produced "draft standard" that has not been ratified by such an official body but may be useful for achieving de facto standardisation in the interim between identifying an industry need, and standards being ratified by ISO, IEEE etc. Currently, IMS produce specifications, not standards. SCORM is also a specification, not a standard."* [41]

[39] for more information see http://zope.cetis.ac.uk/static/standards.html

[40] http://en.wikipedia.org/wiki/SCORM

[41] source CETIS http://zope.cetis.ac.uk/encyclopedia/entries/20020307141133/view

Part 2: Partners

There are a number of partner organizations associated with this project including …

2.1: University of Dundee

(http://www.dundee.ac.uk/dentalschool)

2.1.1: Dundee background

The Dental School at the University of Dundee is housed within the main university campus and is co-located with the NHS Dundee Dental Hospital. The School has 34 academic staff and 18 support staff (technical, administrative etc). The School runs two undergraduate programmes of study:

- Bachelor of Dental Surgery (BDS) a 5 year programme recruiting 68 students per year (65 home + 3 overseas). Currently there is one exceptional year (in terms of student numbers) moving through the BDS of 90 students. The curriculum model is highly integrated – ICRA (Integrated Clinically Related Activity) – very early exposure to clinical work, final year 15 weeks in outreach, recently semesterised; this has changed things, academic teaching year is now much longer than before. Dundee's approach overall is integrated rather than modular – it is hard for students to transfer in to the programme because of the specificity of the whole programme.
- Bachelor of Science in Oral Health Sciences, a 3 year degree taking10 students per year and funded by the Scottish Executive

The school offers a range of taught PG courses although there are relatively low numbers of students at present. Dundee is looking to expand this area as a revenue generating exercise. Current numbers are around 12 taught postgraduates, as well as 10 NHS Senior House Officers and 7 NHS Specialist Registrars.

Dundee's main problems are currently focused around lack of space and staff capacity. The School's physical space was originally built for 35 students a year, whereas now student numbers are nearly double this number. The School is compensating for this via its outreach (OR) centres (in partnership with NHS Education Scotland and NHS Boards). Dundee's OR centres are at Aberdeen, Kirkcaldy, Arbroath, Springfield, Perth and Inverness.

As noted earlier the School shares its building with the NHS Dental Hospital. In addition to the School's on-site resources there is also a PG Dental Education Centre run by NES with its own IT suite. There are major issues associated with there being three separate IT networks within the School (separate cabling, routers and ports): the University; NES and NHS. Online connections between and sharing with the NHS is therefore virtually non-existent although a few staff use the NHS e-Library. The School's library services are provided by the main University library with an allocated librarian responsible for dental resources.

The Dundee Dental Education Centre[42] (DDEC) is *"adjacent to the existing Dundee Dental Hospital and School. The state of the art facilities provide a centre of excellence for postgraduate dental education, encompassing every member of the dental team, including clinical skills training for all dental professionals, supporting pre-registration training for Dental Nurses, Return to Work courses for all dental team members and Introduction to NHS courses for overseas dentists."*

2.1.2: Online environment and capability

Blackboard: The University of Dundee uses the Blackboard[43] MLE as its core e-learning environment, this includes the public facing website 'My Dundee'. The Dental School is

[42] see http://www.nes.scot.nhs.uk/offices/dundeedental

[43] Blackboard (http://www.blackboard.com) is a commercial software company whose main product is the Blackboard Academic Suite – an enterprise managed learning environment (MLE). Components

currently using Blackboard mostly for providing lecture notes and making announcements to students. The School is very pleased with the e-learning support it receives from the University, which has invested a lot of time and money in setting things up and training staff in the School. Currently there is much more potential than actual use of Blackboard – mostly staff post their lecture slides and send messages to students, so far mostly only for early years students.

Blackboard is set up to run year-based modules for the School rather than modules within a year despite a University-wide modular programme. Archives of previous years of Blackboard are available. The University uses the Blackboard content management system (CMS) which allows for central object referencing and update with per object access permissions. This allows digital content to be managed and reused across Blackboard instances.

The School's largest problem with Blackboard is getting staff to use it. This difficulty is inseparable from related issues such as who owns the copyright of material (individual or institution – Dundee is taking a softly-softly approach in this area). There is a very big associated issue of photographing patients, particularly as this is linked to the Ninewells[44], NHS photography service.

The School has moved to converting PPT to PDF files to reduce options for students copying images – however there are no systematic checks on IP and consent compliance in material posted in Blackboard although some random checks are made by the central e-learning team.

As regards collaborations and federations, Blackboard provides an extensible 'building blocks' architecture that allows for the development of channels and services that can be incorporated into Blackboard. Current Building Blocks channels include a commercial journal tool and another for integrating QuestionMark Perception, and some internally developed ones. Dundee's Law School is currently using Building Blocks quite extensively for third-party content integration. The Blackboard CMS also allows for external services to be attached which means that a federated search facility (as was proposed in CLEO) should be relatively easy to attach to this system – the main requirement being that available content should have been tagged to enable effective searching.

QuestionMark Perception: One individual, Andrew Mason, was consistently identified as an e-learning innovator creating digital illustrations and doing a few exams using QuestionMark Perception. First year BDS teaching is shared with the University's College of Life Sciences and staff from there are doing quite a lot in e-learning, especially in assessment – both formative and summative. However, a shared repository of questions is not on the radar at the moment.

Portfolios: The School currently uses a paper portfolio in the BDS programme. Although Blackboard's portfolio system is available it is not being used, although the School is looking at it. The strongly stated preference was for a longitudinal approach to personal portfolios that integrates with the NES portfolio project's system.

Video Conferencing: Video conferencing between Dundee and outreach centres (OCs) is increasingly important. The School has tried to use 'proper' bridged videoconferencing but the OCs are not on SuperJANET and as such there are problems of network speed and capacity. The current solution has been to use e/Pop an IP-based desktop solution[45].

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include the Learning System VLE, a content management system (CMS) and a portfolio. Blackboard took over its main rival WebCT in 2006 with the result that the WebCT product range is currently being merged with the Blackboard Learning System. Blackboard has been more notable in the last year for its patent on VLEs and its legal action against other VLE developers. In 2007 Blackboard vowed to refrain from asserting its patent rights against open-source developers, except where deemed necessary. The Blackboard platform is extensible using 'Building Blocks' APIs allowing for the development and implementation of external services and content within Blackboard.

[44] Ninewells is the main regional NHS hospital for Perthshire, Fife and Tayside and is situated on the western outskirts of Dundee.

[45] See http://www.wiredred.com/video-conferencing/

2.1.3: Authentication

Dundee University runs a Novell[46] network which uses a LDAP directory service. Dundee are also in the early stages of a Shibboleth implementation project including an ATHENS gateway. Another part of the project will include an investigation of Single Sign On mechanisms such as Yale CAS and Pubcookie which have been shown to integrate well with Shibboleth. In addition the usual problems of NHS authentication/access to and from University networks and the systems and content on them were also common.

2.1.4: Use of third party resources

The School does not currently use third party resources or services to any great extent although Birmingham was noted as an example of an institution which does provide dental education resources. A lot of the commercial teaching materials were considered to be very sophisticated, for instance using NASA technology for 3D fly-throughs, and therefore hard to reuse within the School. Within the School Andrew Mason was also noted as a regular author of still artwork and diagrams.

2.1.5: Collaborative Working

Dundee sees itself as strong in some areas and relatively weak in others and as such is keen to collaborate with suitable partners for mutual benefits. In particular there are strong existing relationships with the school in Glasgow with a "terrific will for cooperation". The Dundee and Glasgow Deans meet regularly and have developed a very positive and effective collaborative relationship.

2.1.6: Federation Issues

- The School would need someone to coordinate and pursue people for content, as well as having technical developer skills, educational skills, and editorial skills, to develop and maintain the federation connection in Dundee. Development of existing services such as RSS feeds or the use of CMS etc. would not require much central University time. However, Building Block development in Blackboard would be classed by the University as a software development project, and thus would require more time and resource, for example development of single-sign on, integration of other services etc. It should be noted that Blackboard services and connectors are relatively ready to go as a result of its underlying architecture, SSO less so.
- Dundee has major issues as to who owns copyright/ownership of teaching materials; institution, individuals, NHS and has not acted to substantially resolve the problem. There are also likely to be relatively hidden consent issues. There is also a very big issue surrounding photographing patients; the School needs to use the Ninewells medical photography service around which there appear to be ongoing issues. There is a clear need for a common IPR and consent model for any such federation to support the exchange of materials - this could draw upon the work of the CHERRI Project[47].
- Video conferencing is used for connecting students in the School's outreach centres. This is not just a Dundee issue as other schools and centres also use or are interested in using video-based connectivity. A Scottish dental education federation may be well placed to provide common or at least interoperable video conferencing services for the Scottish dental education community.
- The federation project was clearly seen as following and supporting the transition from undergraduate to postgraduate and on to professional practice within dentistry.

[46] Novell (http://www.novell.com) is a commercial provider of enterprise network solutions

[47] See the CHERRI Project Report at http://www.cherri.mvm.ed.ac.uk/cherri.pdf

The will to use the NES Portfolio, to engage in CPD as well as UG/PG courses and the will to collaborate with other Scottish institutions in this area are all indicative of the need and will to pursue collaborative activities aligned to the broader dental education communities needs. It should also be noted however that this would not be at the expense of core School business.

New Locations: Teach and Treat Centres

"A network of dental "teach and treat" centres (also known as Outreach centres) is being established across Scotland that integrate patient care with education and training. One of the most significant developments is the £17.5 million Centre for Health Science (Ionad Eolas Slainte) being built in Inverness. Phase II, which will include the dental facility, will open in Autumn 2007. The Centre is a partnership between NES, NHS Highland, the University of Stirling, UHI Millennium Institute and Highlands and Islands Enterprise. It will provide a multi-professional approach to training dental teams to serve the north of Scotland and island NHS Boards. Similar developments are taking place in Aberdeen, Dundee, Dumfries and other parts of Scotland."

(NHS Education Scotland 2006)

2.2: University of Glasgow

(http://www.gla.ac.uk/schools/dental/)

2.2.1: Glasgow Background

Glasgow Dental School is co-located with the city's NHS Dental Hospital in Sauchiehall Street. There are around 400 undergraduate students in the School along with a smaller number of postgraduates (expanding to around 50 in the next 3 years). The School has around 45 academic staff along with another 60 staff involved in teaching (either in a University support role or as NHS staff involved with teaching).

The School's main degree programme is the five-year BDS following which graduating students go onto vocational training (VT) or general professional training (GPT) with NHS Education Scotland (NES). This will be changing to two foundation years as part of the dental equivalent of the Modernising Medical Careers (MMC) programme. The Dental School redesigned and relaunched its BDS curriculum in 2004. The new curriculum includes an increased role for e-learning and e-teaching. Postgraduate programmes planned to commence in 2008 include an MSc in Primary Dental Care, an MPhil in Oral & Maxillofacial Surgery, and a number of other doctorate and research degrees.

2.2.2: Online Environment and Capability

The School has recently increased the extent of its online teaching and learning activities, largely centred on the use of Moodle[48] (Glasgow University's preferred virtual learning

[48] "Moodle is a free software/open source e-learning platform (also known as a Course Management System (CMS), or Learning Management Systems (LMS), or Virtual Learning Environment (VLE)). Its open source license and modular design means that many people can develop additional functionality, and development is undertaken by a globally diffuse network of commercial and non-commercial users" from http://en.wikipedia.org/wiki/Moodle (8 February 2007). Moodle is programmed using the popular and open source PHP scripting language and it uses MySQL or PostGreSQL for its database (although a wider range of databases can be used from version 1.7 onwards). See http://moodle.org/

environment). The School has its own instance of Moodle (and was one of the first to do this in the University), which means that any changes to their VLE will not directly affect other instances of the system. The School's Moodle is hosted and managed centrally within the University and as such any changes and customisation would need to be undertaken by the central University support team. The contact in this case is Steven Gallacher who runs the Moodle management team. Potential other contacts may be made with the University e-Learning Team who both train on and promote Moodle (and other system) use within the institution. There is only a very limited programming/development capacity within the School itself although there is School-based administration of Moodle.

Some staff use e-learning a lot but many don't and as such the School is a fairly typical example with the majority using it as a means to publish their PowerPoint slides. However, the new "2004 Curriculum" is seen as providing more scope to use e-learning. For instance, in years 1 and 2 the students are set "Moodle assignments" where each student completes an essay on a particular topic, then their tutor puts out a specimen answer and a commentary, and finally the student writes a reflective entry on how well they did. Other aspects of Moodle being used are asynchronous discussion fora, synchronous chat rooms, quizzes etc.

All students have a paper-based portfolio. There is a general intention to move it online but currently without any particular plans for doing so. Students also complete checklist logs on their practical skills. There is a good awareness of and interest in exploring how student portfolios spanning the undergraduate and postgraduate phases – the ball is currently with NES as to how and why this might be taken forward.

So called 'Web 2.0' tools such as wikis, blogs and news feeds were discussed but the School is not at present using any of them. Issues of quality and resource discovery were seen as significant barriers to their adoption.

The School is also experimenting with moving its lecture content online and some trials using Microsoft Producer are already under way. Others are trialling podcasts combined with PowerPoint slides to reproduce lectures at the students' on demand.

In addition to Moodle the School also has a public website (shortly going over to a content management system - CMS) and an intranet largely for administrative processes such as timetabling, groups, forms and so on.

The School is also likely to adopt VALE[49] to support its educational administration, although integration issues with Moodle have yet to be explored.

2.2.3: Authentication

Glasgow has a central LDAP service and is investigating, but has not yet implemented, a Shibboleth service. ATHENS[50] issues are covered by Helen Marlborough the subject librarian for dental education

2.2.4: Use of Third Party Resources

RM is a member of the Higher Education Academy (HEA) and often seeks to make use of MEDEV[51] educational and development opportunities. Generally there is little use of third party teaching and learning materials, largely due to problems of finding and securing materials of suitable subject matter and educationally quality and reliability.

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[49] VALE is a course administration system developed for undergraduate medicine at the University of Glasgow by Dr Barry Clark. This is an in-house application using active server pages (ASP), Microsoft SQL Server and some Delphi desktop application components.

[50] Eduserv Athens offers a range of solutions for enterprise-wide single sign-on and Identity Access Management capability – see http://www.athensams.net

[51] The Higher Education Academy Subject Centre for Medicine, Dentistry & Veterinary Medicine is part of a UK-wide initiative supported by the four Higher Education Funding Councils in order to enhance the student learning experience - see http://www.medev.ac.uk

2.2.5: Collaborative Working

The Glasgow and Dundee dental schools already work closely in a range of areas and have good general relations - Alec Crighton, a particular pioneer and early adopter in e-learning in the School, is for instance already looking at producing common materials with Dundee. There are also good relations with NES with both School and associated NHS staff involved in CPD teaching.

2.2.6: Federation Issues

The following are issues and opportunities discussed with respect to the proposed dental education federation:

- A repeated concern was regarding the generation of materials that could be shared across Scotland. The School has little content of significant use or quality for innovative e-learning (the majority of their online content are PowerPoint presentations that have little value out of context). It was anticipated that part of any collaboration's role would be a focus on supporting the authoring of quality dental education content that could be shared across Scotland. In terms of such resources we discussed both the provision of new technical and editorial support as well as buying out academic time to free practitioners to be involved in authoring. The School has previously had problems with the recruiting for backfill posts and was more interested in exploring the former. The support required would encompass identifying, encouraging and to an extent cajoling academics to provide raw materials, working with them to create materials and acting to some extent in an editorial role clarifying and improving the raw academic input. The subject matter, academic level, educational design and technical format of any such materials were not discussed. Interestingly preliminary discussions have already taken place regarding collaborative development with Dundee where one school would cover some subjects while the other would cover other complementary ones. There is no current capacity to undertake this work without external investment.
- Educational evaluation and research, such as evaluating the impact of learning technology interventions, was discussed. This is of interest but of relatively low priority. It was also considered staying in touch with alumni was a relatively low priority. CPD was of more interest but the School is not currently active in the area (although many teachers are working with NES on Section 63 courses) – opportunities to develop capacity in this area would be of interest.
- Another issue that has particular ramifications for the School's students is that they want to work within just the one system. Any collaboration or federation should, as far as they are concerned appear as part of their local learning environment rather than as yet another system 'elsewhere'. This strongly points towards a web-serviced approach for any federated hub.
- In addition to funds to support collaborative developments in the School support may also need to go to central university services to support technical developments, such as programmatic changes to Moodle and setting up appropriate single-sign-on services.
- Many of the School's teachers are NHS clinical staff or GDPs. This raises issues of accountability and identity regarding the use of electronic systems, in particular their presence or otherwise in a single-sign-on system.

Recommendations: in order to progress the following are required in the first instance:

- Develop Shibboleth-based single-sign-on capability
- Fund and explore common and collaborative content development with Dundee and Glasgow
- Explore the development or reuse of PHP-based web service clients for Moodle
- Explore issues of identity with respect to university and NHS staff

2.3: NHS Education Scotland (NES)

(http://www.nes.scot.nhs.uk/)

"NES helps to provide better patient care by designing, commissioning, quality assuring and, where appropriate, providing education, training and lifelong learning for the NHS workforce in Scotland."

NES provides professional and postgraduate dental education and training in the areas of:

- Vocational Training & Dental Foundation for graduating dentists.
- Hospital Dental Service: including Oral Medicine, Dental and Maxillofacial Radiology, Oral Microbiology, Oral Pathology, Orthodontics, Paediatric Dentistry, Dental Public Health, Restorative Dentistry, Endodontics, Periodontics, Prosthodontics, Oral Surgery, and Surgical Dentistry
- Dental Care Professionals: from pre-registration training for dental nurses, vocational training for technicians and hygienist/therapists, to a comprehensive continuing professional development programme for all DCP.
- General Dental Service: NES runs a national programme containing courses for all members of the dental team in the GDS and the CDS.
- MFDS - Membership of the Faculty of Dental Surgery is offered in collaboration with the Royal College of Surgeons of Edinburgh
- Dental Technician Vocational Training Schemes
- Postgraduate Dental Education Rural Training Fellowships

The NES Dental Portal is at http://www.dentistryportal.scot.nhs.uk

In addition to its direct educational activities NES provides a range of educational support services including the e-Library and the e-Portfolio services.

2.4: NES e-Library

(http://www.elib.scot.nhs.uk)

2.4.1: e-Library background

NHS e-Library is a part of NHS Education Scotland and it provides library and information services for the whole of the NHS in Scotland, and its higher education and voluntary sector partners, and it is developing services to meet many patients' needs as well. Principally accessed online the e-library presents a wide number of Managed Knowledge Networks, which are effectively portals, based around particular specialties, disease groups or communities of practice. Each of these portals has a discrete web address plus a range of tailored services relevant to the subject or topic in hand. The Dentistry e-Library portal was launched in March 2007.

There is a huge diversity of content and services available through these portals so to support discovery and selection across the resource base there is a powerful search service at the heart of the e-Library system. The search facility is used more often than any other aspect of the e-Library.

Postgraduate and CPD activities are a rapidly growing area, including access to information on courses and events, and a small but growing collection of e-learning materials. A Virtual Learning Centre is to be built on top of the e-Library to support the NHS Knowledge and Skills Framework (KSF) initiative. The e-Library has particular staff development focus on information literacy and evidence-based practice.

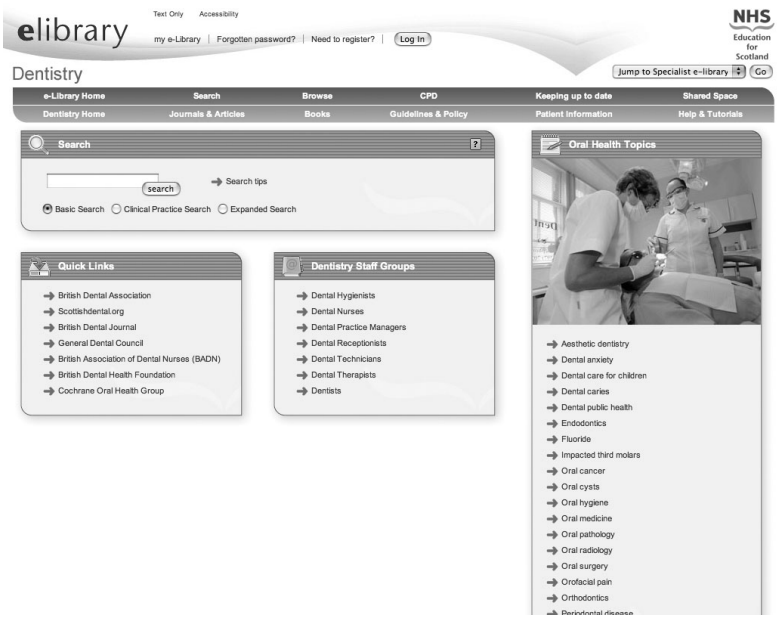

Figure x: the NHS e-Library Dental portal

2.4.2: Online environment and capability

Despite its many portals the NHS e-Library has a single system architecture. There are many locally held records augmented by remote cross searching of many third party remote databases (using z39.50 and other webservice protocols). The e-Library runs on three core servers: one each for delivery, database and webservices, all of which are located at Livingston (note the e-Library does not use the SHOW hosting service for a range of practical and business reasons). Each could run the whole service if the others fail. Most contemporary information service features are supported including RSS feeds and alerting services.

As a library system metadata is a key aspect of how the e-Library functions. Its core format is Dublin Core[52] with IEEE LOM and eGMS[53] qualifiers.

Bandwidth and connectivity in to NHS is good and the e-Library works to high-level accessibility conformance standards. Despite this there is an acknowledgement of the problems of staff access to Internet services from within the NHS and the core service is designed to gracefully degrade and work down to very restricted systems (although much of the content may not follow). The e-Library has also engaged in extensive performance testing (especially search) involving concurrency, load, stress testing etc.

There are many partnerships with other NHS organisations and with external services such as Ovid. There is some connectivity with electronic patient record systems (such as GPASS – for medical general practitioners) and with the Scottish Care Information (SCI) gateway[54].

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[52] Dublin Core is a set of 15 metadata elements for cross-domain resource descriptions – it is maintained and developed by the Dublin Core Metadata Initiative (DCMI) see http://dublincore.org

[53] The UK's e-Government Metadata Standard (e-GMS) lays down the elements, refinements and encoding schemes to be used by government officers when creating metadata for their information resources or when designing search systems for information systems.- see http://www.govtalk.gov.uk/schemasstandards/metadata.asp

[54] the Scottish Care Information (SCI) Gateway is a national system that integrates primary and secondary care systems using familiar yet highly secure Internet technology. see http://www.sci.scot.nhs.uk/index.htm

2.4.3: Authentication

Most authentication is conducted via EDUSERV's ATHENS services[55], which allows a degree of federated authentication (including access from tertiary educational organisations). The e-Library plans to implement Shibboleth by 2008 (as part of ATHENS migration to using Shibboleth) although they may end up tendering for a 3rd-party Shibboleth-compliant authentication system instead of instantiating one in house. Shibboleth only manages authentication and it provides no discriminating authorisation information. To overcome these problems the e-Library is planning to use SWISS[56] as their staff list and thereby master permissions list.

2.4.4: Use of third party resources

The e-Library already provides federated access to content from more than 5,000 full text journals, 5,000 e-books, many clinical guidelines (including a guidelines finder database), supplementary clinical 'grey literature' and copious amounts of patient information. The e-Library has incorporated NHS 24's patient information resources, and catalogue and they have indexed the resources and content of a number of large healthcare-related charities.

2.4.5: Collaborative Working

In addition to its information services the e-Library also supports a growing number of virtual collaborative working spaces that allow particular users to share resources, and engage in online dialogues and networking (these services use ATHENS + local authentication).

2.4.6: Federation Issues

The e-Library is already a well-established and well-resourced learning support system that employs federated authentication along with a relatively large hub model. In terms of working with more federated architectures and services, and in particular with the dental education federation focus of this report some of the ways forward include:

- Using the e-Library as the gateway service for the NHS to any federation as it is the only common access point with a remit and coverage of the whole NHS. Its support of federated authentication, in the form of ATHENS and Shibboleth, make this a particularly strong argument.
- However, the e-Library is not itself a member of the core dental education constituency and as such it would need to identify a partner NHS user group with which to work on developing a pilot implementation. Provisional discussions have identified Tayside for this purpose but this would need to be explored further before committing to any partnership.
- The e-Library will also need to consider and prepare a proposal on its participation profile within any emerging federation. There are many relevant services already being provided including search, collaborative workspaces, and local and remote content

2.5: NES e-Portfolio

(http://www.nes.scot.nhs.uk/medicine/contactus/eportfolio/default.asp)

[55] see http://www.athensams.net/

[56] The Scottish Workforce Information Standard System (SWISS) is an NHS Scotland service to support common workforce information across Scotland – see http://www.eyou.scot.nhs.uk/index(orig).htm

2.5.1: NES e-Portfolio background

The NES e-Portfolio Project originated from a need to provide the new medical Foundation Years with a system to track and record their progress, assessment and evaluation in the South East Scotland Deanery. At the time (and indeed subsequently) the team were unable to source a system that met their needs so it was built from the ground up entirely in-house. The Project has been a great success with it subsequently being picked up to support all core Foundation Year medical training across the UK as well as a number of professional training contexts. In particular it is now being used to support training and professional development for nursing, mentor training, pharmacists (integrated with an online course), allied health professionals and medical chaplains. For each of these different uses some variations in the architecture and approach are required and as such each system variant is cloned from the original and modifications added on top. Typically the system support and messaging remains common to all variant subsystems but pretty much everything else is adapted from the original medical foundation model.

The medium and long term planning for the NES portfolio is still emerging and the business case options are still being developed as to what should be kept in house and what outsourced, although it is likely to be based on outsourcing the technology aspects and keeping the management and educational development in house.

2.5.2: NES e-Portfolio and Dentists

At the time of writing the NES e-Portfolio is currently undergoing trials with a group of ~30 Vocational Trainees across all regions with the intention that it will be expanded from August 2007 to include all Scottish Foundation dentists and Vocational Trainees.

For dentists the e-portfolio is based around the assessment process replicating what was done by the dental assessment units: LEPs, knowledge assessment tests, reports to students and to the Deanery, some logging of attendance at study days etc. The e-Portfolio team is currently adding significant event analysis for this community.

2.5.3: Online environment and capability

Pinnacle is the common NES HR database for all trainees. The NES e-Portfolio will link with Pinnacle to make sure all trainee information remains in sync (from May 2007).

The e-Portfolio is developing web services with related systems like the Radiology - Integrated Training Initiative (R-ITI); if a trainee completes a R-ITI activity it can be recorded in e-Portfolio automatically. Targets and partners are still being identified.

The e-Portfolio is commercially hosted (Open Hosting in Bolton - £~7.5k per annum for ~11,000 users) as they didn't want to be dependent on unreliable local NES servers. The team has 1 permanent developer + 1 on annual contract + 4 on-contract programmers as well as 1.5 FTE managers.

2.5.3: Authentication

Authentication is at the system level only. Federated authentication models are currently outwith the e-Portfolio team's development plans.

2.5.4: Use of third party resources

None.

2.5.5: Collaborative Working

The e-Portfolio is about individual learners.

2.5.6: Federation Issues

Significant technical work would be required to bring the e-Portfolio into a common online dental federation. More importantly different user group needs are accommodated using rebuilds of the core system. If needs differed across a Scottish dental education federation then either multiple variants of the e-Portfolio would be needed or a rebuild to accommodate these differences within a single build.

2.6: NES Dental Education Centres

There are five regional dental education centres:

- Aberdeen Dental Education Centre
- Dundee Dental Education Centre
- Edinburgh Postgraduate Dental Institute
- North of Scotland Institute of PG Dental Education
- West of Scotland Centre for PG Dental Education

2.7: UHI Millennium Institute

The UHI Millenium Institute is currently developing a new dental therapist course in partnership with NES but is otherwise inactive in dental education.

2.8: Edinburgh Postgraduate Dental Institute (University of Edinburgh)

(http://www.epdi.org.uk/)

Although the Edinburgh undergraduate dental programme graduated its last students in 1994 it has retained and extended a Postgraduate Dental Institute for a number of years. Currently the Institute has just over 20 postgraduate students, around 50 GPT/VT posts and around 80 PCD training posts. The Institute is small with just 2 full-time academic staff and access to 13 (FTE) dental consultants from the adjacent Dental Hospital. The EDI creates all of its own educational materials.

The EDI has not so far engaged in e-learning beyond the use of email and the web for literature searching. It has a growing range of MSc programmes, including a particularly successful Primary Care programme, that are being recast for distance e-learning. As it already shares some of its teaching with Glasgow and Dundee the ability to co-develop and run MSc modules across the three Schools is of particular interest, as is developing working relationships with the Royal College of Surgeons in Edinburgh.

2.9: FE Colleges

Although much PCD training has in the past occurred in the further education sector, with the change in profile and substance of PCD curricula this is increasingly moving to degree level and is being accommodated in the higher education sector instead. There remain some dental courses – such as the S/NVQ in Dental Nursing – in the FE sector though.

2.10: Other related organisations

The General Dental Council

(http://www.gdc-uk.org) is the organisation that regulates dental professionals in the United Kingdom. All dentists, dental hygienists, dental therapists, clinical dental technicians and orthodontic therapists must be registered with the GDC to work in the UK. From 31 July 2008

all dental nurses and dental technicians will also need to be GDC registered to work in the UK.

See appendix 2 for a fuller list of other related organisations …

Part 3: Developing Online Dental Education in Scotland

There are a number of factors and associated recommendations that need to be considered regarding the options for supporting online dental education in Scotland on a more substantive basis.

3.1: SWOT Analysis

3.1.1: Strengths

- Scottish dental education is a small community with relatively tight operating parameters and well-defined edges
- There is a strong will to collaborate across the community
- There is little or no competition or conflict within the community
- There is at present significant investment coming into dental education in Scotland from NHS Education and SEHD
- There is little in the way of legacy materials or practices to accommodate giving a fairly blank slate to develop on

3.1.2: Weaknesses

- Although there is a certain amount of e-learning activity going on, on the whole there seems to be a relatively low state of e-learning readiness and experience across the community and an absence of proactive leadership at a community level.
- As a small community Scottish dental education is always going to have relatively poor economies of scale in comparison with other subjects (like medicine or nursing) or larger regions (such as England). The NHS Radiology (R-ITI) project has been successful in part because it was targeted at a sufficiently large and therefore sustainable community.
- There is a real lack of sharable educational content – 'e' or otherwise – within the community.
- There is an apparent lack of engagement with learning technology mainstream as well as an apparent lack of engagement with healthcare education in general. As a result the stakeholder communities are not realising the potential to draw on the support and resources from these sources.
- Although Scotland is pursuing an increasingly distributed model of dental education (regional centres, embedded trainees etc) there does not seem to be a sufficiently capable and robust IT network model in place to support it. For instance the 'teach and treat' centres are not on SuperJANET and have to rely on domestic broadband connectivity instead, which in turn creates problems for services such as videoconferencing.

3.1.3: Opportunities

- Dental education is in flux – there are new roles, curricula, locations, training patterns – allowing it to be ambitious and innovative
- In addition, as there is little in the way of legacy systems or arrangements to accommodate, it is almost a blank canvas
- There is (currently) substantial external and internal investment and political commitment to developing dental education and dental services as a whole in Scotland

- There is a very low competition threshold to overcome in developing this area. Community members recognise the strengths of others and the opportunities for sharing and demonstrate little or no behaviours towards competition or 'not invented here' that often compromise these kinds of efforts.
- There is a clear need for collaboration and a will to engage in collaborative work that is relatively rare even in other healthcare disciplines.

3.1.4: Threats

- Although resource is available at present this is likely to be temporary and any kind of collaborative or federated setup needs to be resourced and sustainable for the medium to long term.
- Sustainability is a problem in a small and relatively closed community as economies of scale are hard to establish.
- There is a lack of experience and leadership in developing collaborative and federated ways of working across Scottish dental education.
- There is a predominance of institutional rather than subject focus in sectoral funding and support arrangements (funding councils, JISC etc).
- There are dangers of complacency as the problems raised with respect to sustainable are not currently seen as critical or needing to be addressed as a matter of priority at a sufficiently high or broad level.

3.2: Development Issues

There is no common platform, technical approach or set of methods that unite the potential members of a Scottish dental e-learning federation at the moment. That does not in itself constitute a barrier to federation as local autonomy and diversity are to be expected and even encouraged within such a federation. Nevertheless the following issues and accompanying recommendations should be considered carefully as part of any planning exercise in developing future partnerships and ways of working:

3.2.1: Architecture

The architecture of any dental education federation poses a fundamental set of challenges as it will in many ways determine much of what can be done within it and how it is done. There would appear to be a number of stages along a continuum between there being no central hub and there being almost nothing but a central hub:

- No change – that collaboration proceeds on a low-level and ad-hoc basis as before.
- No hub: a setup where partner systems would interact directly with each other directly with no central coordinating hub or point of contact. Despite the absence of a common point of entry such peer-to-peer networks still require some kind of common protocols by which they can interact and share information and resources.
- Small hub: this where the hub acts as a broker between different systems facilitating communication and exchange and providing connectivity services not found in any particular subscribing system. The hub runs core enabling services such as authentication or search which are provided using a middleware layer; the subscribing learning environments remain pretty much as they were before other than to have a set of client services built in with which to interact with the hub services.
- Large hub: as the core services grow in number, complexity and criticality the small hub will inevitably start locating more and more services in the hub itself. In addition to the connectivity services found in the small hub model the large hub may also

include content services such as a repository, portfolio, discussion, blog, wiki, or news feeds.

- All hub: as the contributing systems federate out more and more of their services and support to the hub there will come a point where the hub supplies most if not all of the environment's needs with subscribing systems running a 'thin client' system against it which provides a local window onto the central array of services and content. Note that this is the same kind of model as the web or any other client-server architecture. Although this model provides a high degree of uniformity across the federation as a whole (which makes it much easier to construct and sustain) it does reduce the amount of sustainable diversity in the system as a whole.

Note that this continuum of federation options needs to be considered in the wider context that the partners work in. Each partner is a part of a larger organisation, each of which will have its own peculiarities and needs, only some of which may align with those of the federation. Indeed there may be a number of non-contiguous federations involved with any partner at any one time. The amount of development capacity and system-level flexibility within any given organisation is both a technical and political issue and one that will find different solutions and issues in each situation it occurs.

RECOMMENDATION: the small hub model would seem to offer the best balance of functionality and autonomy and should be a relatively low cost option to initiate a federation, as it would build on work already carried out elsewhere, for instance JISC-funded middleware research.

3.2.2: Identity and Trust

Authentication: none of the potential partners have a local single sign on implemented at present although all of the universities contacted are moving towards this as part of the JISC-supported UK Access Management Federation which is in turn based on the Shibboleth federated authentication model. On the other hand the NHS in Scotland does not seem to be exploring Shibboleth at this time so there may be more work involved on their side of any federation that gets developed. Until there is a reliable and substantial Shibboleth service in place a small hub model (see previous section) is perhaps the best option.

Authorisation: this is based on the roles that users are assigned and could have many shades and forms of expression. In the initial stages it may be sufficient to distinguish between students and staff although over time what kind of student users (undergraduate or postgraduate, dentist or other professional, early/late years in programme etc) and staff users (teaching or support, clinical or non-clinical etc) may be required.

Personalisation: although this can help improve and focus the user experience the small hub model should be relatively transparent to users

RECOMMENDATION: the NES e-learning strategy (draft) has acknowledged the problem but has decide not to tackle it head on. Although multiple system passwords and access are therefore going to be the norm for the short term, urgent attention to federated access using Shibboleth should be pursued.

3.2.3: Content and Services

Although services such as portfolios may become part of a more federated approach over time, the main focus and need is around the development and provision of high quality and educationally effective e-learning content.

RECOMMENDATION: that steps be taken to acquire and/or develop high quality and educationally effective e-learning content such as simulators, virtual patients and reusable learning objects in support of all forms and levels of dental education.

3.2.4: Standards and Specifications

There are currently no common technical standards and specifications in place for Scottish dental education. Some of the systems used, such as Dundee's Blackboard and Glasgow's Moodle, do support some specifications, notably IMS Content Packaging and ADL/SCORM. Areas requiring normalisation within a collaborative and/or federated environment include:

- Digital rights management, for which The Open Digital Rights Language (ODRL)[57] Initiative is best placed to support the needs of Scottish dental education, except for issues of consent which need to take into consideration the recommendations of the CHERRI Project[58]
- Digital content should be exchanged using IMS Content Packaging, ideally using the SCORM application profile.
- Learning object metadata should be expressed using the MedBiquitous Healthcare LOM profile[59]

RECOMMENDATION: that appropriate technology standards and specifications be adopted across the whole community in support of both current and future interoperability and that systems used, developed or procured should as far as possible be compliant with these standards and specifications.

3.2.5: System Requirements

The functional requirements of any system or federation will emerge from the strategy and policy adopted to take them forward. As such it would be premature to second-guess them other than to acknowledge some of the non-functional system requirements associated with designing and implementing information systems in general.

Accessibility is clearly an important issue, both in terms of any individual gaining access and of those with different abilities gaining access (such as those with visual or physical disabilities). Often associated with accessibility is the concept of usability – how easy (or not) a system is to use. As change is inevitable then factors such as Adaptability, agility, extensibility, flexibility, scalability, configurability and customizability all need to be accommodated. Any system will need to be managed by the community it serves which means that factors like administrability, auditability, maintainability, and accountability are important as are more economic factors such as affordability and sustainability. Higher-level issues such as dependability, reliability, durability, predictability, Interoperability and reusability will also need to be accommodated.

RECOMMENDATION: that sufficient attention is paid to the non-functional requirements as well as the functional requirements of any system or architecture developed.

3.2.6: Organisational Issues

Any kind of collaborative or federated architecture for Scottish dental education needs arrangements set in place for its governance. In particular attention needs to paid to:

- Strategy and policy need to be coordinated to ensure that all activities are carried out with reference to the general directions the community is taking and methods adopted to achieve them.
- The Dependence and coupling between subscribing systems also needs careful consideration. What happens to system A if it depends on a service from system B that fails to work as expected?

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[57] see http://odrl.net/

[58] see http://www.cherri.mvm.ed.ac.uk/cherri.pdf

[59] see http://www.medbiq.org/working_groups/learning_objects/HealthcareLOMSpecification.pdf

- Although the Scottish dental education is quite small and well defined it is distributed across a number of different cultures and organizational contexts: higher and further education, NES, dental hospitals, general dental practitioner surgeries and so on. Differences such as funding coming from different sources with differing priorities and variations in local priorities and expectations can create real tensions within any collaborative or federated relationship. Issues such as ownership and control and the extent of autonomy afforded participants and conformance required need careful negotiation and management.

RECOMMENDATION: that attention and resource be put in to setting up appropriate mechanisms and structures for governance of any future collaboration or federation to ensure that it is able to weather political and regulatory challenges and change.

3.2.7: Different models and rates of adoption

There is a great deal of asymmetry in e-learning capacity across Scottish dental education. Furthermore, its distributed nature means that partners have differing trajectories of interest and development. It is unlikely therefore that all participants in a collaboration or federation will wish to proceed at the same rate, in the same way or at the same time.

RECOMMENDATION: that any collaborative arrangement should be able to afford participants options regarding the extent, timing and rate of participation and indeed the form of participation that best suits the organizations needs.

3.2.8: Licensing

Warranties and liabilities are important for any organization working with or for other organizations. For instance what liability or warranty is associated with learning materials from one organization being used in another; what happens if the content is inaccurate or technically flawed? Who is responsible and in what way?

Related to warranty and liability are issues of quality assurance, review and audit are all important to ensure the accuracy, reliability, validity and other aspects of any content or service that is shared between partner organizations. In addition all other rights such as intellectual property, consent, data protection and freedom of information also need to be accommodated in any system

RECOMMENDATION: that appropriate licensing and quality assurance frameworks are set in place to ensure the rights and responsibilities of all participants.

3.2.9: Business Models

Last but by no means least are issues of economics and sustainability for any collaborative arrangements across Scottish Dental Education. Issues such as all the differing kinds of cost associated with any large scale collaboration or federation (including money, time, effort, churn, displacement etc), who pays, and who benefits all need to be carefully considered.

Finance for dental education (as for any domain within healthcare education) follows traditional models of disconnected institutional responsibility with little connection between the educational and practice contexts or between different professional strands within dental education. A collaboration or federation by definition cuts across this model and as such financing and sustaining it will be an uphill struggle without review and realignment of the funding and organizational model for dental education.

RECOMMENDATION: that all plans are made within the context of well-formed business models that identify resource implications for all those concerned and that match these to available sources of funding.

Appendices

Appendix 1: Current Provision of Dental Services in Scotland

The following is taken from “MODERNISING NHS DENTAL SERVICES IN SCOTLAND” at http://www.scotland.gov.uk/Publications/2003/11/18542/29108 accessed 7 February 2007

2.3.1 General Dental Services (GDS)

The majority of the approximately 1900 General Dental Practitioners (GDPs) in Scotland are independent contractors who treat children and adults under a hybrid system: a partial capitation and continuing care arrangement is supported by an item of service fee structure. This means that the dentist is paid for each patient that they have on their list to treat under NHS arrangements, and is also paid per item of NHS treatment that they carry out. In addition there are payments for 'occasional' and emergency treatment and a number of specific allowances (e.g. for continuing professional development). GDS constitute the main provision for family dental services for people in Scotland, delivered from some 900 locations. The nature of the service has changed over the years from extractions to restorations and, more recently, to aspects of prevention, but is still seen largely as 'care and repair'.

An estimated 10-20 practitioners undertake only private work whilst the majority undertake a mixture of private and NHS treatment. There has been an increasing move towards private provision during recent years.

2.3.2 Salaried General Dental Practitioners

Scottish Ministers have the power to authorise Boards/Trusts to appoint salaried dental practitioners in areas of unmet need or where there is difficulty accessing NHS dental services. Over 50 salaried dentists are currently working in Scotland. These dentists provide the full range of NHS dental services and work from premises owned, supported and staffed by NHSScotland.

2.3.3 Community Dental Services (CDS)

There are approximately 300 Community Dental Service staff in Scotland who are employees of NHS Boards/Primary Care Trusts. Their main target populations are disadvantaged groups and those with special needs (including children, people with learning difficulties and the elderly in residential care). In addition they provide a 'safety net' for those who are unable to access GDS. Salaried GDPs and the CDS play a significant part in service delivery in remote areas. Their services are provided at some 300 locations across Scotland, in fixed or mobile clinics.

2.3.4 Specialist Dental Services

Hospital dental services (HDS) accept patient referrals from both dental and medical practitioners and from other hospital services. The main specialist areas are oral and maxillofacial surgery, oral medicine, orthodontics, restorative dentistry and paediatric dentistry.

2.3.5 Professionals Complementary to Dentistry (PCDs)

Professions Complementary to Dentistry are dental nurses, dental hygienists, dental therapists and dental technicians. The range of work that suitably trained dental therapists and hygienists are permitted to carry out was extended on 1 July 2002. This was intended to allow hygienists and therapists to take on more of the dentist's routine work and allow dentists to take responsibility for more patients as a result.

2.3.6 Expenditure

Current (2002/03) expenditure on GDS is around 194m, including 53m of income from patient charges. Capitation and continuing care fees account for around 20% of expenditure. Some areas of activity have increased more than others over recent years e.g. the cost of orthodontic treatment has gone up from 4.4m in 1995 to 7.25m in 2002.

Appendix 2: Related Organisations and Resources

Scottish Dental www.scottishdental.org

NHS-HE Forum www.nhs-he.org.uk

British Dental Association http://www.bda.org

British Dental Health Foundation http://www.dentalhealth.org.uk

British Orthodontic Society http://www.bos.org.uk

British Society of Paediatric Dentistry http://www.bspd.co.uk

The Faculty of General Dental Practice (UK) http://www.fgdp.org

Orthodontic Technicians Association http://www.orthota.co.uk

British Dental Hygienists' Association! http://www.bdha.org.uk

Orthodontic Technicians Association UK http://www.orthota.co.uk

BNF http://www.bnf.org/bnf/

PubMed http://www.ncbi.nlm.nih.gov/PubMed

MEDLINE http://medlineplus.gov

BDJ http://www.nature.com/bdj/index.html

JADA http://www.ada.org/prof/resources/pubs/jada/index.asp

Dental Practioners Association http://www.uk-dentistry.org

U. Iowa Oral Pathology Image Library http://www.uiowa.edu/~oprm/AtlasHome.html

Appendix 3: N3

Adapted from
http://www.connectingforhealth.nhs.uk/publications/toolkitaugust05/factsheet_n3.doc

N3 is the new National Network for the NHS. It provides reliable, supporting IT infrastructure, world class networking services and sufficient, secure connectivity and broadband capacity to meet current and future NHS IT needs.

N3 is replacing NHSnet, the current private NHS communications network in England. It will link all NHS organisations in England, providing a reliable service at every site where NHS services are delivered or managed.

N3 offers:

- a fast and reliable network for NHS organisations, ensuring that current and new systems and services run smoothly and quickly
- networking solutions tailored to the needs of individual NHS organisations, with the flexibility to cater for future as well as current needs
- sufficient bandwidth to implement new approaches to healthcare; for example, the fast transmission of digital images via Picture Archiving and Communication Systems (PACS)
- an opportunity for the NHS to take early advantage of updates and improvements in networking technology.

The framework contracts to provide NHSnet, the current network for the NHS, came to an end in 2004.

The standard connections to NHSnet that were allocated to all trusts have meant some organisations have had to manage with services that do not exactly fit their needs.

Network provision for the NHS needs to be sourced at competitive rates.

The NHS needs flexible provision of bandwidth to cope with future demand, as well as satisfying the current needs.

N3 underpins and enables the delivery of new IT systems and services for the NHS. Those applications will all require bandwidth in excess of that provided by NHSnet.

The N3 network provides the essential technical infrastructure through which the benefits to patients and staff from the new systems and services will be fully realised and sustained in the future.

N3 will speed up the delivery of images - a chest x-ray originally had to be delivered by taxi, taking hours; using a standard telephone line it took half an hour to transmit; using NHSnet it took approximately four minutes; via a typical N3 link to a GP surgery, it should take less than one minute and a user at a main trust location should receive the image in around 15 seconds.

N3 can save the NHS an estimated £900m over seven years, relative to current NHSnet contracts.

There are general savings for the NHS in using N3 because it is a nationally driven initiative that achieves value for money because of the size of local contracts.

As part of the N3 contract, a free of charge voice consultancy service is available to all NHS organisations to help identify areas where savings can be made on telephony and other telecommunications related costs.

Working with a number of major telephony suppliers, the N3 voice consultancy service has agreed and developed a number of reduced call charge and line rental tariffs, which primary care trusts, trusts, health authorities and GP practices can all take advantage of.

N3 is being delivered by NHS Connecting for Health, the organisation responsible for NHS IT systems and services. An N3 Service Provider (N3SP) was appointed by NHS Connecting for Health to take responsibility for integrating and managing the service.

The N3 service has been procured from a number of subcontractors. The N3SP is bringing together the separate elements into a complete and seamless end-to-end network, whilst ensuring flexibility and best value for the NHS.

The N3SP also manages the network, dealing with, for example, fault reporting and customer relationship management.

Implementation of N3 began in April 2004. The migration of current NHSnet connections and the addition of new connections will take three years.

Sites are prioritised for migration according to a variety of factors. These include the potential for making cost savings on network provision and the need to support the roll-out of NHS Connecting for Health initiatives.

Priority for migration in the first phase of implementation has been given to:

- sites whose existing NHSnet contract will expire before 2006
- data centres for National Application Service Providers (NASPs) and Local Service Providers (LSPs)
- major sites where it will be possible to implement converged voice and data networks by early migration to N3 (these are likely to be nominated by LSPs)
- sites that will either be targeted for early implementation by LSPs or that will save money by migrating (these sites will be nominated by clusters).

By prioritising sites in this way, NHS Connecting for Health is ensuring that maximum cost savings are obtained as quickly as possible during the period of migration and that the service requirements of each customer are met.

By August 2005 over 10,000 sites had received their N3 connections, including more than 75 per cent of GP practices.

N3 timeline:

- 31 March 2005 More than 6,000 sites connected in the first year of implementation
- 31 March 2006 12,000 sites to be connected
- 31 March 2007 All 18,000 sites in the NHS to be connected

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