Principia Medicinae Digitalis Sotoniensis

A History of Healthcare Computing and Advances in Clinical Information Productivity in Southampton, 1980 -2024

Essay 3: Evolution of the University Hospital Southampton Clinical Data Estate from 2000 to 2010

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Key Words

Healthcare computing, Electronic Patient Record, National Programme for IT (NPfIT), Hospital Integrated Clinical Support System (HICSS), eDocs; eQuest: Ordercomms systems

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Abstract

This is the third essay of a series which report the unique history of the Clinical Digital Estate (CDE) of University Hospital Southampton (UHS) from its origins in the 1980s to the current day. In this essay, I focus on developments between 2000 and 2010.

The knowledge of the early phases of the project largely survives in the recollections of those who built the system. I am therefore most grateful to key individuals whose recollections and substantial contributions to the programme date back to the 1990s.

Liz Horkin was the first Director of Information Management at UHS, generously provided a long written recollection of her leadership of the programme until 2002, when she was succeeded by Adrian Byrne.

Alan Hales was the technical architect of many of the key features in the modern UHS clinical data estate. David Cable has provided enduring support in his senior role in the Trust IT management team.

In the course of the conversations and within the documents, references were made to many legacy computer systems which were unfamiliar to me and will be little known to others. In order to make sense of the text, I have amplified these references with such additional description as I have been able to track down from public sources on the internet.

In the first essay, I considered the history of healthcare computing and early local experimentation with The Wessex Regional Health Authority computerisation plan. In the second essay, I reviewed the history of the first decade of development of the modern Southampton Clinical Data Estate and its key components, between 1990 and 2000.

In this essay, I continue the story through the period of 2001 to 2010, when the modern Electronic Patient Record (EPR) and its component systems took shape in Southampton.

Introduction

This is the third of a series of Essays on the history and principles of the unique Clinical Digital Estate of University Hospital Southampton from its origins in the 1980s to the current day. My particular interest lies in the way in which intelligent incremental design and implementation has progressively changed the efficiency with which information is collated and delivered to the health professional at the point of use, and the productivity and clinical safety gains which follow from this approach.

I have drawn on the contemporary documents and on the recollections of those who built the system wherever possible. I have sought to integrate them into a coherent narrative and reference volume for future system developers and managers at UHS and for the interest and education of a wider audience of digitally enabled health and computer professionals.

In this Essay, I cover history of developments through the first decade of the 21st Century, I am again indebted to Liz Horkin, Adrian Byrne, David Cable and Alan Hales for their contributions to the story. This project remains a work in progress and I will be pleased to engage with anyone who can contribute original insights, documents and images to amplify and enhance the existing content.

The first decade of the 21st century saw the maturation of many of the core digital systems which we now take for granted, including personal computers, mobile digital devices, emails and the Internet. The focus in healthcare computing now shifted from the implementation of basic systems such as Patient Administration Systems (PAS), Patient Master Indices (PMIs), basic Order Communications, Pathology, Radiology and Nursing systems towards the development of digital systems for the efficiency and productivity of all healthcare professionals, and the development of the practical Electronic Patient Record (EPR).

In the UK, it was the decade when hard and costly lessons were relearned about the limitations and costs of top down, bureaucratic direction of healthcare informatics and the limitations to the claims and promises of the large commercial IT companies. These culminated in the headline failure and costs of the attempt to build a unitary EPR NHS National Programme for IT (NPFIT) through the decade.

However, it was also the decade when the NHS was cabled up and cross-connected with a fibre-optic network, a national email system and national digital health data repositories. In Southampton, it was the decade when the key software systems which underpinned the evolving institutional Electronic Patient Record were developed and tested. The clinical workforce in Southampton became progressively more engaged with the local digital transformation programme, as independent applications and data sets were merged into the maturing core hospital-wide clinical IT systems.

Crucially, the Southampton IT team circumnavigated central NHS pressures to purchase one of the large, costly and evidently suboptimal commercial healthcare IT systems. They retained the freedom to select "best of breed" component systems where necessary, and to build our novel systems in house where suitable commercial systems were not available.

Liz Horkin, Adrian Byrne, David Cable and others played significant leadership roles this in this brave demonstration of the value of rigorous and independent thinking. Of particular importance in relation to this narrative, they worked in partnership with the software systems expertise of Alan Hales and his small team at Scorpio Systems.

Alan's early work on the Hospital Integrated Clinical Support System, HICSS, and his clear understanding of the UHS Clinical Data Environment, led to the implementation of a series of exemplar IT systems, including a free-standing and subsequently commercially successful endoscopy reporting system; the eDocs document generation and management system, and the eQuest Order Communications (OrderComms) system.

Critically, the collocation of the development teams and the professional healthcare workforce on the General Hospital site allowed rigorous user research and feedback, and hence the fast and iterative development of these complex and powerful systems.

The National Strategy Document "Information for Health": 1998 – 2005

Central direction from the Department of Health has always dictated the core strategies of healthcare computerisation and the flow of funds around the NHS in the UK. However, the large bureaucracy and the relative unfamiliarity of business processes in the fast moving global digital ecosystem left plenty of room for manoeuvre in individual health care units.

The 13th Report of The Parliamentary Committee of Public Accounts on the 1992 and the 1998 Information Management And Technology Strategies of the NHS Executive was published in April 2000. It is a useful place to start to understand the context in which the Southampton Clinical Data Estate evolved in the first decade of the 21st century,

The Committee noted the achievements of the six main projects and programmes examined within the 1992 NHS IM&T Strategy, which included:

- The New NHS Number which provided every NHS patient with a unique identifier.
- The creation of NHS Administrative Registers.
- A secure NHSnet, better telephone and mobile radio systems;
- GP-Health Authority Links for electronic transfer of administrative data.
- An Information Management and Training Strategy at local level.
- Community Information Systems for patient care and contracting.

The committee noted that in October 1998, the NHS had launched a package of new and existing IT projects and service aspirations ("The 1998 Strategy"). Key aims were the sharing information about patients between doctors and other health professionals in Primary Care Groups and GPs, NHS Trusts and Health Authorities, and providing information about healthcare to both health professionals and the public. The package aligned with the *Modernising Government* White Paper, which emphasised 'joined-up government' though the sharing of information between public services in order to improve them.

The Committee noted the problems with public sector IT projects during the 1990s, and made a series of recommendations to improve the management of healthcare IT projects. I

have described the subsequent failings of the National Programme for IT between 2003 and 2011 in the first essay in this series. I do not intend to return to this issue in detail this essay

The 1998 National Policy Directive set out a series of key targets for development, including:

- The Implementation of an Electronic Patient Record;
- The Use of NHS Net to provide services for GPs;
- The Implementation of the National Cancer Information Strategy;
- The Support for Clinical Governance, National Service Frameworks;
- Support for the Health Improvement Programme;
- Support for the National Performance Framework;
- The Development of collaborative working across the health economy, and
- The Provision of internet access to the National Electronic Library for Health.

The Local Implementation Strategy of March 2000 for the Southampton and South West Hampshire Health Economy therefore committed to supporting the development of systems which were aligned with the national vision for:

- Lifelong Electronic Health Records (EHRs) for every citizen;
- Continuous access to patient records and information about best practices;
- Seamless care through GPs, Hospitals and community services;
- Easy public access to information and care through on line services;
- The effective use of NHS Resources.

The Southampton University Hospital Trust's Digital Strategy of 2001

In January 2001, the Trust's Second Digital Information Strategy Document, "Making Information work: an e-Trust for the 21st Century: An Information and Technology Strategy for Southampton University Hospitals NHS Trust 2001 - 2007 was published. This was a comprehensive document of 160 pages, and I am grateful to Liz Horkin for an original copy. David Moss, then Chief Executive, stated in the introduction that: *"The Trust's previous of 1991 has successfully delivered a robust infrastructure on which we can now build....We must embrace information and technology and improve services for our patients."*
(SUHT Corporate Information Directorate, 2001; Byrne A. 2002)

Historically, digital information collection had emphasised general management functions around patient activity and waiting times. The 2001 SUHT Strategy Document gave extensive consideration to the information needs of Managers and Planners; and for the provision of Knowledge and Training. It anticipated a Business Intelligence Service for the Trust which would meet all management information needs, and which would identify and provide for patient and public information needs and feedback.

Early planning for a Trust-wide Electronic Patient Record

The Plan of 2001-2007 recognised the need for suitable systems to support Finance, Commercial and Human Resources, Planning, Facilities, Estates, Telephone Services, Email and Office Automation. However, it also recognised the importance of developing and implementing a Trust-wide Electronic Patient Record (EPR), with the following features:

- An incremental development process:
- Development of the PAS to support GP access, direct booking and scheduling;
- Development of an Order Communications System with Results reporting;
- Development of Electronic Prescribing;
- Support for Care Planning and integrated Care Pathways;
- The implementation of specialist clinical and departmental systems,
- The development of the Hospital Integrated Clinical Support System, HICSS;
- Acquisition of a Picture Archive Communication System, PACS;
- Provision of Knowledge Resources to support clinical care.

These ambitions needed a detailed specification and procurement process, which was intended to proceed in partnership with Winchester and Eastleigh NHS Trust.

The Early Development of the Southampton Electronic Patient Record

By 2001, the Southampton IT directorate team had a well established framework and a clear view of future opportunities and challenges around the prevailing technical and knowledge base. A series of new technologies, including web based, wireless and tele-digital technologies, were already established, as described in the previous essay in this series.

Key national infrastructure projects had been implemented, including the NHS Number, the Clearing Service, Clinical Coding and Grouping systems, along with the NHS Net and the NHS digital spine communication system. These created a recurring annual cost to the organisation of around £1M and other modernisation costs of up to another £1M per annum.

The concept of the Electronic Patient Record (EPR) was a logical evolution of the 1991 Hospital Information Support Systems (HICSS) programme. This would lead to the delivery of all patient records within the single institution as a single electronic entity, all be it that the “look and feel” of the EPR was still under consideration. Over time, it was expected that the EPR would:

- Replace paper, film and other disparate records;
- Have a single portal of entry;
- Have an integrated and logical interface to all clinical information;
- Reflect the structure of the familiar paper record.

It was also planned that the technical infrastructure would support these aims would have the following characteristics;

- Solutions would be integrated rather than interfaced to core systems
- Technical standards would be established but upgradable
- The single patient number and NHS number would be rigorously adopted
- Key information, for example patient discharge letters, would be expedited

The Trust would adhere to NHS standards for data definitions, coding infrastructure and messaging standards to assist with the development of the wider Electronic Medical Record (EMR), as for example to facilitate the integration with primary care data.

The 2001 strategy document recognised that the core purpose of all Trust staff was to support the delivery of high quality clinical care. IT systems would achieve this through:

- Direct support of the care process;
- Improving accountability for clinical practice

- Providing support for clinical governance; and
- Support for Research and Development.

A set of guiding principles for technical implementation were therefore set out in the 2001 strategy document, as follows:

- All clinical systems would be patient-focussed through a unitary PMI
- All patient based systems must integrate through a single patient record
- Data must be captured once only
- Management information must be derived from operational systems
- Common standards for data interchange were obligated
- Purchased applications should have open standards to enhance integration
- Applications should be flexible to support changing requirements
- Systems should use common IT tools wherever possible.

In respect specifically of the design and implementation of the EPR, it would:

- Provide an organised view of the patient's care, with decision support;
- Be sensitive to the needs and access controls of each user;
- Be captured in real time;
- Progressively absorb and supercede paper records;
- Integrate digital content, including images and monitoring data;
- Include administrative support functions, the PAS and word processing;
- Be portable and easily accessible, as by wireless networking.

The Components of the Southampton Electronic Patient Record

By 2001, the following software components of the hospital clinical information system were in place. They included the following systems (see also Table 1).:

The Patient Master Index was established within the Patient Administration System. Following major efforts to cleanse data and to eliminate a high rate of duplicate records with different numbers, the quality and reliability of the patient identities was much improved. Nevertheless, "over 150 duplicate records were still created every week, and there were many hundreds of incomplete records on subsidiary systems". The NHS strategic tracing service was used to normalise NHS numbers wherever possible.

Contract	Supplier	Date of Contract	Change Controls	Novation Agreements	Modules
PAS – Contract for the Supply, Installation & Maintenance of a Patient Management System	IBA Healthcare (Europe) Ltd	7/7/95 Expires 2004	No 1 to 35	IBA to In Health In Health to Torex	All included in the change controls
Pathology – Contract for the Supply, Installation & Maintenance of a Pathology System	Bull Information Systems Ltd	16/7/96	None	Bull to Reel only	None
Network – Contract for the Development, Support and Maintenance of the Network	Satalcom (UK) Limited	4/1/99	None	None	None
PACS Pilot – Contract for the Provision of a Picture Archiving & Communication System & Maintenance Services	AGFA	18/1/02	None to date	None to date	None to date
IOS – Contract for the Supply, Installation & Maintenance of a Integrated Oncology System (IOS)	CliniSIS Ltd	7/6/00	None	None	None
HICSS	Scorpio Information Systems	14/08/02	Currently being produced	None	None
JAC Pharmacy	SLA with Portsmouth Hospitals	Unknown	None	None	None
HP Lease	Hewlett-Packard International Bank Limited	Feb 1999	None	None	None
Contract for the Supply, Installation & Maintenance of a Prolinks Keystone Messaging System	**Indigo 4 Systems Ltd**	1/3/02	None	None	None
Contract for the Supply, Installation & Maintenance of an Occ. Health System	**Warwick IC Systems**	16/1/01	None	None	None
Casemix Hardware					
Intelligence Warehouse					

Table 1. This list of Supplier Contracts for SUHT Core Systems from 1995 onwards summarises the key IT systems that were in place around the year 2000 (from Adrian Byrne)

The Patient Administration System had been replaced and modernised.

The hospital wide Local Area Network was in place with 5000+ endpoints, along with an email system and more than 2000 installed personal computer terminals.

The Nursing and Cancer Information Systems were in place.

The Corporate Information Services Directorate had been further developed;

The Patient Master Index and the single user ID were enabled. This permitted progress with the integration of Accident and Emergency and the Theatre data into the PAS

The Interface Engine was in place, with Open Systems for efficiency and reduced costs.

The 2001 strategy sensibly recognised that "a well organised and structured paper record would aid the development of the EPR. Bar coding of paper case notes and a Notes Tracking Module had been implemented with the acquisition of the new PAS, and the single off-site Medical Records Library allowed records in a large number of separate departmental libraries across the Trust to be consolidated in one unit.

There remained challenges in how best to integrate the clinician-specific range of proprietary databases into mainstream systems. Progress was also impeded by a range of technical issues, including:

- Multiple passwords for each user to electronic systems;
- Inefficient support with multiple systems to manage with complex interfaces;
- Inefficient training and transfer of learning;
- Complicated vendor management; and
- Asynchrony between operating systems and software versions.

The priorities for upgrades were therefore identified as being:

- A single user password;
- Graphical reports for senior management;
- General implementation of access to key systems;
- The provision of PCs with standard software for the network terminals;
- Network upgrade to high bandwidth; and
- Enhanced data security and confidentiality.

The Agile Implementation of the 2001 Strategic Plan for IT in Southampton

Liz Horkin, the Trust Lead for IT at the time, describes the challenges for the IT Management Team in implementing the plan. She recalled that:

"We were now faced with a large number of clinical systems which were duplicating functions, and which lacked data currency. Many clinicians wanted interfaces to Pathology records for results, but there was a massive problem with duplication of record numbers and patient ID numbers".

"We could not build multiple interfaces to individual systems, so a new approach was needed to create logical data structures, with future proofing and consistency with what was now being coined the Electronic Patient Record (EPR). We needed to use a single patient ID, with standard interfaces, and with standard outputs for everything from discharge letters to Case Mix and Clinical Audit data".

"The Trust had a small capital budget and some clinical audit funds. We now had a functioning Corporate Information Department and I was looking to solve the problem of yet more clinical systems (the investment was estimated at £12-15M over six years)."

"From the work we had done on the Technicon Data Systems (TDS) project (see Essay 2), I knew that in practice most information requirements were almost identical in all specialities. However, some specialities (such as Renal and Ophthalmology) required specific algorithms, calculations and measurements using particular clinical data."

"We had initially focussed on a few specialties, including Vascular Diseases and Renal Failure (see Essay 2 in this series). We had developed a business case and proposal for the Hospital Board for which Alan Hales had originally presented a costed proposal of under £50,000."

"We had to structure the funding application within the Standing Financial Instructions as we were taking an Agile and Iterative developmental approach. There was no formal specification (known as the Waterfall approach to digital systems development) for the intended system and we were not going out to the market."

“This unconventional approach was frowned upon in some places. However, my argument was that we had nothing to lose. We would have otherwise ended up with individual speciality systems which were expensive but which would not create an integrated system”.

Liz continued: “We judged that once we had two or three clinician-facing subsystems in place, other clinical specialities would fall in behind the project, and this is what happened. As things moved on, we were able to say to individuals with particular user cases: “yes you can go to market but you must be able to interface, meet X standard in terms of technology” and so on. In reality, applicants for bespoke systems could not find anything that fitted the bill, so gradually specialties with their own funding would start coming forward to join the integrating programme”.

“We continued to bid for any pot of funds we could identify, and apply for grants and similar. For instance, the need to get discharge letters out in a more timely way gave us an opportunity to develop the discharge letter function as we pulled in targeted funds. As time moved on it became clear that functionality built in one area could be replicated for another and so we adopted that as the mantra”.

“We also started working on Clinical Audit tools using the software system Business Objects which was subsequently acquired by German Company SAP AG. The clinical informatics teams started working on clinical measures and tools, under the direction of David Cable”.

“With Alan Hales help, we had proved that our concept for the Hospital’s Integrated Clinical Support System (HICSS) worked. The Hospital Board recognised that this was a project which would help clinicians and so it became a key plank in the overall Trust IT plan. We were able to agree under the 2001 strategy that HICSS would be an ongoing programme and that it would be funded incrementally”.

“We also knew that the products could stand alone and could be very attractive so we had a small tie back in our contract to return income to the Trust once we got to the second phase of work beyond the first four modules”. The Endoscopy module was subsequently marketed and continues to produce an income stream for the Trust.”

The Medical Records Strategy: Paper or Electronic?

Liz Horkin also addressed the issue of medical records in her recollections for this history. She recalls that by 2003: "We now had a plethora of IT systems and three different paper records systems, including The main record, Ophthalmology and Cardiology Records, which dated from the days of smaller specialist hospitals. We therefore had duplicates and multiple libraries in unsatisfactory conditions and locations. Older records were archived to micro fiche".

"We wanted to end up with a unitary and an integrated electronic record, so we developed a new Medical Records strategy in parallel with the IT strategy. We procured a leased site on the A271 at Nursling and we moved all records onto that site and eliminated duplicates, while moving to digitise the archives".

We wanted to move away from filing huge numbers of paper Pathology results, which was initially deemed heretical by many consultants. We sent all of the unfiled pathology reports to the new facility - boxes and boxes of them. This took 12 months and some 10 staff to file. We ran tours of the facility and showed attendees the piles of unfiled pathology reports. We had set the scene.

"My ambition was that we would close the records library in less than 10 years – we had a 5 year lease with options to extend in 2 year chunks. Meanwhile, we improved the availability of records using a new 24/7 service. It was an amazing achievement. We had recruited an ex Army officer with no medical records experience to run a massive logistics exercise".

"We had invaluable help from various people with whom we worked over the years. The commercial world seemed more impressed with what we did than the wider NHS when they came on site. Gartner Inc. (which is a technology research and consulting firm based in Stamford, Connecticut) helped by providing us with resources access to research and comparative information around new technologies".

Figure 1. The New Medical Records Store in Nursling circa 2005

Figure 2. The Full Medical Records Store in Nursling, c 2015. It was closed in 2017.

Liz Horkin concludes her time at SUHT

Liz was seconded by SUHT to lead the South of England Procurement team (The Southern Cluster") of the National Programme for IT (NPfIT) project in 2003. She remained in post at UHS for a year, before being appointed as Director of the Sussex Hospital Information System project in 2004. She reflects here on her time at SUHT on the digital development programme:

"We were able to develop new ideas such as Web portals etc at a very early stage, and we were empowered to look at the wider emerging technologies. Some very committed people in the Trust helped us build on the clinical solutions. Peter Lees as Medical Director pushed for clinical data analysis and we had a large resource of clinical data to draw upon using the Business Objects and Cognos software and other reporting tools. We developed clinical reporting suites and monitoring for clinical audit and clinical governance".

Liz concludes: "In summary, my role in the early days was all about selling the ideas, persuading people we could do it, making sure we delivered and had the resources. We had to set up systems to manage the workload and to estimate how much work we could take on and still deliver, we did not want to take on everything and then disappoint everyone".

"In other words we were not going to over promise and under deliver. We had to estimate the man hours of effort for all of our work and to balance resources across all the projects. I also spent much time getting the money, finding solutions and nagging for documentation. Looking at the 2001 strategy, I still wonder at how we got it all done and how we managed and we created the foundations for where we are today."

The expanding portfolio of clinical systems at UHS, 2001-2009

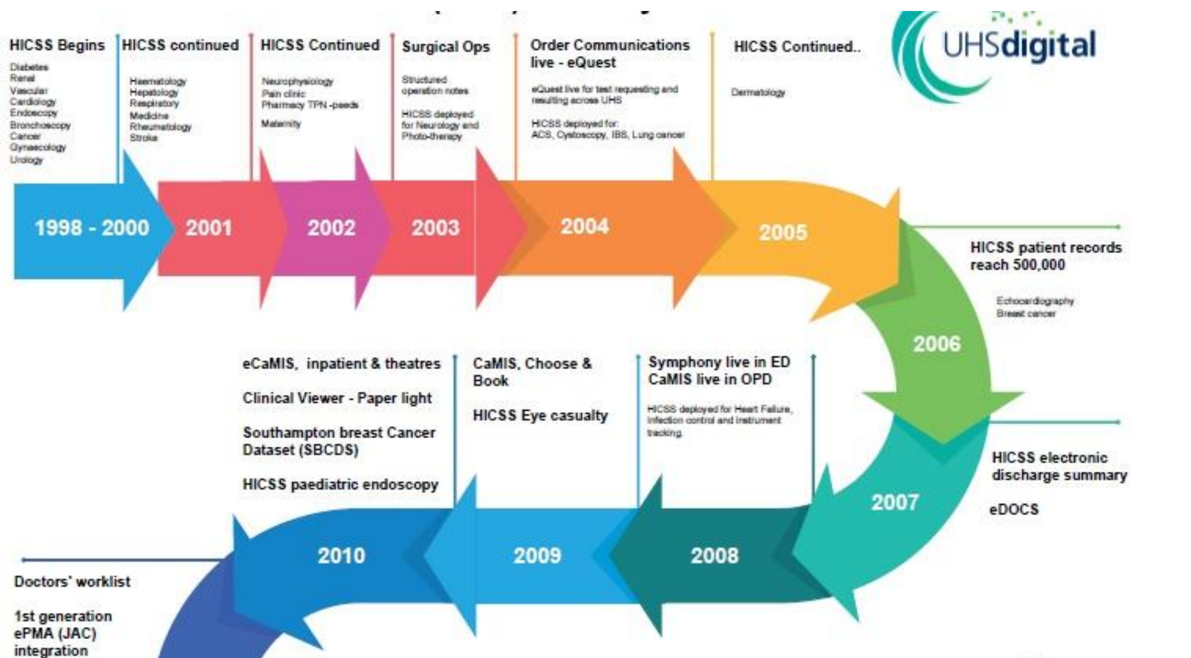

Figure 3. A flowchart of the sequence of development of the component systems of the UHS EPR from 1998 to 2021, courtesy of David Cable, credited to Ryan Beegan

Through the period 2001 to 2009, the portfolio of component systems of the UHS Clinical Data Estate continued to expand. They included the JAC Prescribing system, and a series of modules which were contracted with self-employed systems consultant Alan Hales. Alan worked on a consultancy basis with UHS. He formed Scorpio Information Systems (SIS) in 2002 to regularise this arrangement, and based the company locally in the New Forest.

Over the next five years, Alan and his team built a series of powerful modules for UHS. These included a large portfolio of clinical modules within his unique Hospital Integrated Clinical Support System, HICSS; the eQuest Ordercomms module; the eDocs document management system; Doctors Worklist, which organised the clinical work and handover schedules for hospital doctors; The Whiteboard bed allocation and ward management interface; and many other projects (Figure 3).

A key factor in that strategy was the ability to pull together a talented team of visionary information technology managers and a small team of IT systems specialists and developers who were able to build the key elements of that vision.

The Hospital Integrated Clinical Support System (HCISS)

Alan recalls that "We aimed to extend the two proof of concept applications to meet the wider clinical computing needs of Southampton General Hospital and the connected healthcare community. This initiative was given the name "Hospital Integrated Clinical Support System" with the more familiar acronym "HICSS".

The HICSS system was identified as the intended vehicle for supporting specific clinical and departmental information needs from the late 1990s onwards. HICSS was a unique home-grown Southampton EPR solution whose origins lie in Alan's work on a vascular surgery module and on a renal failure module, which were introduced in Essay 2 of this series. They were followed by Endoscopy and Bronchoscopy modules.

Adrian Byrne recalls that a decision was made to regularize the arrangement with Alan Hales to deliver HICSS modules through a formal contracting arrangement which allowed business continuity. Adrian held the post of Chief Information Officer (CIO) to the Trust from 2002 until 2024, when he retired. This contract committed the Trust:

- To procuring modules and support activities between April 2002 and March 2003, and
- To procuring the same or greater for the second year of the agreement, plus maintenance costs for newly developed modules equivalent to 10% of the cost of developing the module.

The Technical Basis of HICSS

Alan continues: "In 1999, the use of web-based transactional applications (that is, applications that insert, update, and delete data) was in its infancy. The browsers available at that time, principally Internet Explorer v3 and Netscape Navigator were extremely limited compared to the browsers available in 2024 such as Google Chrome, MS-Edge and Firefox. There were few enterprise-scale development tools with which to build web-based applications".

Editor's note: The X/Twitter feed provides a very powerful animated visualisation of the changing influence of internet browsers over the period of 28 years to from 1994 to 2022 https://twitter.com/VisualCap/status/1650726331884158977 .

This work is attributed to @JamesEagle17 as "The rise and Fall of Popular Web Browsers since 1994" on the Visual Capitalist Blog. See also: https://www.visualcapitalist.com/cp/the-rise-and-fall-of-popular-web-browsers-since-1994/

Alan decided to use Microsoft's Active Server Pages (ASP) and Microsoft's Internet Information Server (IIS) of which he had experience from his time with Exxon Mobil and Hays PLC. Even so, he found that the database access via Oracle Open Database Connectivity (ODBC) drivers (a middleware product) and the Unidata ODBC drivers presented frequent challenges which required code to be carefully written to ensure application reliability and integrity.

He reports that "we made a strategic decision to use an Oracle database for these proof-of-concept applications. At that time, SUHT had significant technical experience with Oracle and had the organisational resources to operate and support it professionally. He felt that it might have been easier to have used Microsoft SQL Server, but this would not have been accepted by the SUHT IT organisation and it would therefore have been a problem to operate and support, especially outside of office working hours. A dedicated Windows NT server was purchased and installed in the Old Nurses Home at Southampton General Hospital to run the MS IIS and ASP components of the HICSS solution. An unused second server was repurposed to run the development and test environment".

"Following the delivery as promised of the proof-of-concept renal failure and vascular surgery applications within nine months, a plan was put in place to expand the scope of the HICSS project. This was enthusiastically supported by Liz Horkin but it met with some scepticism from other technical staff. A separate Oracle Instance Database was configured for HICSS on existing computer hardware, consisting of HP Unix servers at that time, to keep the project separate from other operational Oracle databases."

Alan notes that initially there was no opportunity to link HICSS to radiology data as the SUHT Detente system lacked an installed interfacing capability. Indeed, it was some years before healthcare system suppliers start to incorporate standard HL7 communication and message interfacing capability into their products.

The Timeline of the Subsystems of HICSS

Alan , recruited a former employee of his from Hays DX, Ken Cowin, to work with him at Scorpio Information Systems on the HICSS project. He recalls that "Ken was a computer science graduate from Portsmouth University. He had good relational database skills, high-level programming skills, and a passion for the subject of his academic studies. Ken did most of the early work with me on HICSS. I concentrated on the database and integration aspects, while Ken took main care of the User Interface (UI) development. We jointly developed the web-server code where most of the clinical logic lived**."**

Over the next three years, some 40 "HICSS modules" were developed, as follows:

1998-2000: early HICSS: Renal, Vascular, Cardiology, Endoscopy and Bronchoscopy
2000-01: Haematology, Hepatology, Respiratory, Medicine, Rheumatology and Stroke
2002: Neurophysiology, Pain Clinic, Pharmacy Total Parenteral Nutrition, Paediatrics; Maternity:
2003: Surgical Ops: Structured operation notes; Neurology and Photo-therapy:
2004: Cardiac Surgery, Cystoscopy, IBS, Lung cancer
2005: Dermatology
2006: Echocardiography, Breast cancer
2007: HICSS Electronic Discharge Summary,
2008: HICSS Heart Failure, Infection Control and Instrument Tracking.
2009: CaMIS, Choose & Book; HICSS Eye casualty

In parallel with HICSS, the important eDocs and eQuest applications were developed by Alan. In 2004, eQuest went live across UHS for test requests and results. In 2007, EDocs was launched. In 2008, The Symphony system went live in the Emergency Department and CaMIS went live in the OutPatient Department (OPD). A brief history and description of the HICCS modules is as follows:

The HICSS Endoscopy Module (2000): Alan recalls being approached by a diverse range of clinicians at UHS who had noted the success of the renal and vascular modules. Drs David

Fine and Praful Patel sought his help in developing the endoscopy data module, which encompassed diagnostic, interventional, test and therapeutic elements.

The work was also influenced by the work at national level of Dr *Roland Valori,* Consultant *Gastro-enterologist* at Gloucestershire Royal Hospital, in promoting training and audit standards for colonoscopy, in his role as National Clinical Director for Endoscopy from 2003 to 2013 and as the National Clinical Advisor to the English Bowel Cancer Screening Programme from 2006 to 2013.

Dr Valori's dedication to his role and strong presentation skills helped convince endoscopists across the UK of the need for a computer application to accurately record endoscopy procedures, along with the clinician training/experience records and evidence to highlight incidences of adverse events such as perforations, uncontrolled bleeds and so on. This effectively created an immediate demand for endoscopy applications for those hospitals who hadn't already purchased or developed such a system.

Alan recalls that he surveyed the market for endoscopy computer solutions and found only one dominant product, which in his opinion was technically much inferior to the HICSS Endoscopy Module as it had no proper integration with other core hospital systems.

Gastroenterologists had a strong desire for selected still images to be captured and stored as part of the endoscopic procedure record. Indeed, the protocols coming out of the National Endoscopy team called for photographic evidence of a complete endoscopy by taking an image of the terminal ileum or an image showing trans-illumination of the bowel.

Alan recalls that Scorpio spent considerable time developing their own endoscopic image capture hardware and software components that worked interchangeably with the main endoscopic device manufacturers, namely Olympus, Pentax and Fuji.

The Scorpio team were successful in achieving this goal and image capture is now an integral part of the HICSS endoscopy solution. There is now also a demand for video capture

of the endoscopic procedure and this will most likely be achieved in the future by interfacing the endoscope to a PACS system and not through the endoscopy application.

Alan realised that most hospitals would want to run a Microsoft SQL Server rather than an Oracle database. With this foresight, it was relatively easy to configure HICSS to run the Endoscopy module on either an Oracle or a Microsoft SQL Server because the underlying multi-platform development had been designed into HICSS from the outset.

He recalls that he spent a significant proportion of his time travelling extensively across the UK in promoting the sale of this system, talking to gastroenterologists and understanding their needs whilst extolling the benefits of having a properly integrated endoscopy application.

Over the years, Scorpio invested considerable resources into this flagship application, which has subsequently been sold on to some 27 other hospital trusts. It ran equally well on Oracle and SQL Servers and upgrades to the product have been released synchronously for both servers, though both required separate unit and user acceptance testing.

The HICSS Bronchoscopy Module (2000) persists to this day. David Cable recalls tracing its lung diagram from a textbook using a sheet of the infamously crispy and partially translucent Izal/Jeyes toilet paper.

The HICSS Diabetes Module (2001): This was one of the very early modules, whose development was driven by Dr Brian Leatherhead, Consultant Physician.

The HICSS Hepatology Module (2001): This was driven by the local clinical and academic interest in Chronic Liver disease, including forms of cirrhosis due to various of the hepatitis viruses. Dr Nick Sheron also undertook some nationally recognised work on alcoholic lever disease, in developing algorithms to measure the Child Pugh score for liver cirrhosis.

The HICSS Respiratory Module (2001): This was another full process module that was written for the Respiratory Centre under the direction of Dr Peter Hockey, Consultant Physician. One objective was to help to minimise their stay in hospital of patients with severe respiratory diseases. David Cable recalls that efforts were also made to expand the uptake of this module. He recalls a trip with Peter to the Boehringer Ingelheim Headquarters in Bracknell to secure external funding, but to little avail. The module is no longer used.

The HICSS Rheumatology Module (2001): This was developed under the direction of Dr Brian Davidson, Dr Ray Armstrong and Professor Cyrus Cooper with a particular emphasis on the monitoring of Disease Modifying Anti-Rheumatic Drugs (DMARDS). It was also sold to Dr Brian Quilty for use in the Bournemouth Hospitals. It is still in use.

The HICSS Stroke Module (2001): This was developed under the direction of Dr Giles Durward to capture data on patients with strokes and transient ischaemic attacks.

The HICSS Neurophysiology Module (2002): This was primarily built as a repository for test results at the request of the clinical scientists. Test results had to be keyed in manually.

The HICSS Pain Clinic Module (2002) : This was built at the request of Dr Cathy Price

The HICSS Maternity Module (2002): Alan recalls that this was an important and very complex project, which was also what he characterised as the first full cycle application from the beginning to the end of a condition (pregnancy). The maternity process continues from the mother's antenatal presentation, including her past medical and obstetric history. It progresses through and beyond pregnancy.

David Cable recalls that this project was driven by Linda Campbell, the project Midwife, and it was built in stages. He particularly notes the important contribution of Cath Yates, who

was a strong and enthusiastic “ideas person”. Cath was the driving force behind the subsequent development of the HICSS Cancer System and the adaptation to the mandatory national cancer data reporting sets for each cancer.

The Maternity Adverse Events Sub-module

Alan Hales also designed and implemented a sub-module to address significant adverse antenatal events. This included a Logic Tree which may be regarded as an early form of Artificial Intelligence. It analysed various presentations, investigations and recordings, and suggested various courses of action, including a “Change Care Pathway” and Assignments of Conclusions.

The Assignment of an NHS Number to Newborn Babies in the Maternity Module.

Another key aspect of the maternity module was the first known linkage of a hospital maternity system to the National NHS Number for Babies initiative (NN4B).

Alan’s solution included an HTTPS (Secure Sockets) protocol and the use of standard HL7 computer messaging techniques. The national system was developed and hosted by BT Syntegra under a large NHS contract. Alan notes that the HL7 system was strong for administrative computing but was somewhat limited when used for clinical computing tasks. However, in the case of the NN4B registration, the HL7 solution worked well and in Alan’s opinion it was one of the more successful UK national IT initiatives that he has witnessed.

In the NN4B solution, the registration of the baby’s birth would include data such as birth weight, Apgar score (named after Dr.Virginia Apgar) and head circumference. Babies often do not have names at birth.

The Southampton HICSS Maternity data was transmitted directly to the National NN4B system, where a unique NHS Number and identifier would be automatically allocated to the baby. The data was returned directly to the HICSS Maternity module in Southampton, from where the information would be automatically forwarded to the Patient Administration System (PAS). The HICSS Maternity module was superceded by a national system, Badger.Net in 2022.

HICSS Surgical Ops (2003): This was developed incrementally with a range of functions:

- It recorded all operations at the Trust in a structured format with searchable functions

- it created a structured operation note for every procedure in a familiar surgical format;

It was progressively linked to the electronic discharge summary, to coding and to a range of audit systems which allowed individual surgeons to access their workload data. The module remains in use across UHS in this format in 2026.

The HICSS Cardiac Surgery and Interventional Cardiology Modules (2004): The national media coverage of the Bristol Paediatric Cardiac Surgery outcomes led to the creation of the national Central Cardiac Audit Database, CCAD, to monitor the performance of cardiac surgeons. Mr Bruce Keogh, Consultant Cardiac Surgeon was appointed to oversee this strategy. He was subsequently appointed as the Medical Director to the NHS and was awarded a knighthood for his work.

In order to bring clarity to cardiac surgical outputs and performance in Southampton, Alan was invited to develop a HICSS Module to record the Cardiac Surgery and Interventional Cardiology outputs locally. This data was in turn uploaded directly to the national CCAD system, and was another first of its kind system. Mr Steve Livesey, Consultant Cardiac Surgeon, was particularly involved with the HICSS Cardiac project.

This module included robust data outputs which could be visualised as graphical plots, specifically Variable Life Adjusted Data (VLAD) plots. It also proved to be very useful for recording pre-operative comorbidity data with multiple variables, which could be used to inform the Euroscore and Parsonnet systems.

Euroscore is a widely used risk stratification scoring system. It is funded by the Royal Papworth Hospital Charity and it is regularly updated (see https://www.euroscore.org/). Parsonnet was first developed in 1989 and has proved to be a popular cardiac risk stratification system (Kacila et al 2010), VLAD data led to binary analyses of outcomes, specifically survival or non-survival of patients.

The risk adjustment programme was calibrated to protect surgeons who were referred the most challenging cases from adverse inferences about their clinical performance. Again, the HICSS module offered integral predictive analytics and a timeline of score-related events. It helped to categorise the outcome measures for individual surgeons with trusted analyses, and it contributed to national audit modules for many other forms of surgery.

Overall, the HICSS Cardiac module meant that Southampton was the first Trust that was able to submit timely data and in an efficient manner to the national CCAD reporting system. Alan was in regular contact with the central CCAD development team, and he was very pleased to be able to report the feedback that Southampton was highly regarded centrally for its work.

The HICSS Cancer Module (2004)

The HICSS Cancer Module was another important element of the HICSS programme, and development started in 2004-2005. Alan recalls that a key contributor was Kath Yates, who subsequently moved to Taunton and became a major contributor to the development of the widely used Somerset Cancer Registry system.

The specific driver to the HICSS Cancer Module was the national Cancer Waiting Times initiative. This administrative ruling mandated a delay of no more than 14 days to referral, 31 days to clinical decision making and 62 days to definitive treatment. At that time, Southampton had no Trust-wide cancer database with which to understand the processes. The data demands were initially focussed entirely upon logging administrative data such as the date on which the patient was referred, the date seen and so on.

Data collection was very labour intensive and was undertaken with limited resources. The initial programme was not comprehensive for all cancers, but only for those which were nationally specified for attention.

The development of the HICSS Cancer Module was informed by work done on the Colorectal Cancer module, to which work Miss Karen Nugent, Mr Nick Beck and Mr Paul Nichols, Consultant Colorectal Surgeons and Mr James Byrne, consultant upper GI surgeon, had

contributed. Their module included both benign and malignant caseload. There was an ambition to incorporate this module into the evolving HICSS Cancer Module to increase its clinical utility.

Components of the Cancer Module included Diagnostic and Treatment information, which in turn included Surgery, Radiotherapy and Chemotherapy. Alan had to address further complexity in integrating the Surgical Ops Module into a clinically useful system.

Regrettably, it proved increasingly difficult to maintain the HICSS Cancer System with limited human, financial and programming resources, as national level bureaucracy kept demanding new data fields, many of which were of dubious information value. The project was badly managed. There were no common terminologies, and the requirements expanded well beyond the practical utility of the data requested.

A decision was eventually made to retire the HICSS Cancer Module in 2013 in favour of a purchase of the nationally underwritten Somerset Cancer Registry from Taunton in 2014. However, all data within the HICSS Cancer Module was conserved and much was ultimately ported into the SCR system, to which I will return in a later essay.

Concurrently with local database developments such as the HICSS Cancer Module, a number of the Royal Colleges were collecting data around their own specialities.

The Cancer Outcomes and Services Data set (COSD)

The Cancer Outcomes and Services Data set (COSD) is now the national standard for collecting cancer data in the NHS.   The website (accessed In May 2024) tells us that

"COSD s a compiled data set which provides the standard for secondary uses information required to support national cancer registration and associated analysis at local, regional, national, and international level, as well as by other national cancer audit programmes.

This standard consists of a set of individual data items, with their definitions, and their assembly into discrete data sets, along with the means of linking the data items and of compiling the data into a unified and verified data set.

All patients who are diagnosed with or receive cancer treatment in or funded by the NHS in England are now covered by the standard. This includes adult and paediatric cancer patients. Providers of cancer services have been required to provide a monthly return on all cancer patients diagnosed from 1 January 2013 using this data set. Data are collated via the National Disease Registration Service (NDRS) local offices, and are sent to the NDRS.

The COSD data set is regularly updated to match the ambitions of the Cancer Reform Strategy of 2007 and of the "Achieving World-Class Cancer Outcomes, A Strategy for England 2015 to 2020 (Taskforce Report)". Data can be submitted from a range of systems such as Cancer Management Information System software, PAS (Patient Administration Systems) and Pathology Laboratory Information Management Systems (LIMS).

They include site-specific items to help record and analyse services and outcomes. They are also used locally for patient management and clinical care... Data from all sources are linked by the NDRS at patient and tumour level using NHS Number to complete the full data set. See https://digital.nhs.uk/ndrs/data/data-sets/cosd

The HICSS Gastrointestinal diseases module (2004): This focussed particularly on inflammatory Bowel Disease under the direction of Dr Mark Wright.

HICSS remains a foundation stone in the UHS EPR in 2024, more than 25 years after it was first conceived, given its utility in linking individual records to a range of useful functions within the EPR, including patient demographics and key identifiers to reports and results through a common coding platform.

Order Communication Systems and the Southampton eQuest System

Tests and investigations are a key element of clinical care. Traditionally, reports and test results were printed on paper and filed in medical records folders, where they had to be retrieved by searching through the documentation. A busy hospital processes many thousands of test requests every day.

Blood test requests are processed through automated sample analyses on sophisticated machinery and on an industrial scale. Samples must be accurately tracked from the source patient to the final report, and the entire process demands a very high standard of technical proficiency across the entire system.

Well into the 1990s, test results in Southampton were printed out on paper, for manual filing in paper records. This was costly in time and effort to retrieve file and store the information and it created significant clinical risk of key results could not be obtained or retrieved in a timely fashion.

Moreover, outdated test results accumulated as a dead weight of paper in increasingly voluminous filing systems, and in "lost" files as paper notes were shunted around hospital departments. An entire empire of notes tracing teams developed to track medical case records and their contents around hospitals and to unite them with printed reports. Liz Horkin highlighted this particular challenge in her recollections of the medical records store in this essay.

The processes of filing, storage and retrieval of test results were therefore were a critical target for early computerisation. All test results must be filed in an intelligible and retrievable way against the individual patient record, either as data (blood tests) or as written or as dictated reports with specialist interpretation from subject matter experts, including radiologists or pathologists.

More importantly, test results must be communicated in a timely manner to ensure that they are acted upon and not missed, overlooked or ignored.

An automated test request and review system must therefore offer:

- The ability to request a wide range of investigations in a safe and reliable manner;
- Comprehensive and rapid retrieval from a range of automatic sample analysers, specialist reporting systems and formats;
- Capacity for long term storage;
- Ease of accessibility and search for the user;
- Ease of integration and linkage to other elements of the electronic patient record; and
- Minimisation of paper across the system.

The computer systems which subserve any or all of these functions are known as Order Comms Systems (OCS). The Wikipedia entry on Laboratory Information Management Systems (LIMS) records that up until the late 1970s, the management of laboratory samples and the associated analysis and reporting were time-consuming manual processes. They were often riddled with transcription errors. Custom in-house solutions were developed by a few laboratories, and commercial reporting solutions emerged in the form of special instrument-based systems.

In 1982, the first generation of LIMS systems were introduced using a centralised minicomputer, with automated reporting tools. By 1988, second-generation commercial offerings were using relational databases to expand LIMS into more applications. A third generation of LIMS which used personal computers emerged in the early 1990s. These new LIMS used client/server architecture to improve data processing and exchanges.

By 1995 the client/server tools allowed the processing of data anywhere on the clinical data network. Web-enabled LIMS were introduced in 1996. From 1996 to 2002 additional functionality was included, from wireless networking and geo-referencing of samples, to the adoption of XML standards and Internet purchasing.

An Ordercomms system fulfils a range of important functions.

It allows the health professional to order (on line) a wide range of tests, including:

Haematology & Blood Transfusion: The structural components of blood and their characterisation: red cells, white cells, platelets; their blood grouping or antigenicity and physical environment (eg Acidity/ pH and concentration)

Clinical Biochemistry: Circulating chemical elements in blood, which include salts and ions (Na, K, Ca, Cl, ions) proteins and their products (albumin, urea), proteins and enzymes, such as are associated with liver diseases

Immunology, Virology and Serology: Antibodies, which are associated with a range of specific diseases, along with Toxins, drugs and foreign substances;

Imaging tests, including Ultrasound, Xray, cross sectional CT or MRI scans, and nuclear medicine (radioisotope scans).

Microbiology and Bacteriology: (infectious) diseases tests in urine, pus, blood and other body tissues and fluid.

Tests of heart and circulatory function, including Electrocardiograms (ECGs) and angiograms,

Newborn Screening Tests

Mortuary reports

Tissue Typing

Tissue and cellular samples: cytology and histopathology

Invasive investigations, including endoscopic tests (for example gastroscopy, colonoscopy, cystoscopy, hysteroscopy).

Access to specialist services can also be added to an Ordercomms system.

The Origins of the Southampton eQuest Order Communications System

David Cable recalls the origins of the eQuest Ordercomms system in 2003:

"We initially wished to purchase an Ordercomms system, but no satisfactory product was available. We therefore commissioned an Ordercomms system from Alan, in the expectation that this would be a temporary solution (a "throwaway" system). I was asked to write the specifications for the system, so I worked closely with Keith Burrill (Pathology Manager) and John Wood on this project. There were a number of principles which guided our design philosophy, in that:

- We wished to "close the loop" in linking every request to every order;

- We stipulated that no request should be impacted by changes in service, such that if a particular doctor or secretary was away or had moved on, the result of the test would still be directly available to anyone who was involved with the care of that patient;
- The result of every test had to be formally acknowledged by someone.

“Initially, test results had to be chased back to their requesters, and the supervisory responsibility fell to Mr David Weeden, Consultant Thoracic Surgeon. Subsequently, on the initiative of Derek Waller (Consultant Physician), a formal electronic acknowledgement and sign off process was introduced for every test to mitigate the clinical and operational risk of critical test results going un-noticed and un-actioned”.

“We intended that the solution would be a collaborative project, given that users included partner hospitals and general practitioners in the Southampton area. We had considered various commercial systems, principal among which was the predecessor of the Clinisys ICE (Integrated Clinical Environment) system, which had evolved from the Labcentre branded product. However, Clinisys ICE was expensive and would have required a lot of configuration to work with our existing subsystems.”

Alan therefore proposed and was commissioned to produce a suitable system for the requesting, processing and electronic distribution of test results within the emerging Southampton EPR. His system proved to be so good that it continues to this day. We never commercialised it because our bespoke solution is not easily exported, and we did not have the necessary programming resources or funding. However, eQuest was aligned in 2023 with the Clinisys WinPath Enterprise Laboratory Information Management System (LIMS), which is a collaborative purchase of the Dorset NHS consortium”.

Alan Hales recalls that “At the turn of the new millenium, Liz Horkin and the SUHT Trust management of the time took the brave and far-sighted decision to support the building of a “home grown” Order Communications and Clinical Documentation applications that were to become eQuest/Results-Server and eDocs.”

"eQuest emerged from the Southampton OrderComms project to deliver a practical automated test requesting and reporting system. From the user perspective, test requesting and accessing test results are two separate operational activities which are separated by the time and activities needed to conduct the test and process the findings. However, behind the screen, the entire process from beginning to end is conducted as a single data management system."

eQuest was launched in 2004 within the Southampton clinical data and web browser environment. It has endured and flourished over 20 years through a series of adaptations, and it is now wholly integrated into the CHARTS EPR environment.

The Southampton eQuest system permits printing out of bespoke request forms with bar code labels for samples, both at the point of generation of the request and for the relevant recipient, who may be a phlebotomist, laboratory technician or any other service provider. It then tracks the sample or request through the system, to the point of generation and receipt of the test result and its distribution to the relevant recipient. The module has been progressively automated and integrated across the hospital's clinical data estate to increase the speed, accuracy and efficiency.

The Southampton eQuest Order Communications System in Use

In the case of urgent blood tests, the processing and issuing of results may take minutes, while specialist investigations may take weeks or even months to conduct and report upon. Furthermore, tests and reports are conducted and generated in a range of different specialist systems, as for example imaging reports. The eQuest Reports system delivered an effective solution, in that:

- it collated results from a range of technical systems.
- it ensured real time reporting as test results are generated and as reports are authorised
- it provides as simple, convenient and adaptable requesting methodology from within the evolving EPR
- It replaces a large collection of separate paper request forms
- It provides comprehensive coverage of test results, where-ever generated
- It offers ease of access to the system at all times and is designed around a clean interface.

eDocs: The Southampton Word Processing and Document Management System

By the 1990s, the value of word processing software had been universally recognised. A variety of popular proprietary systems had achieved widespread use, including the WordPerfect and Microsoft Word series of version releases. These were variously adopted by admin teams and individual users across the health system.

However, it became apparent at SUHT that a centralised clinical document creation system was essential. Clinical Documents include clinic letters, discharge summaries, and documents for a range of other purposes. A central word processing module:

- would link every document directly to the PAS, thus populating the document with the standardised and contemporary information for that patient
- would add metadata which linked the document to the individual patient, and which would therefore automatically identify the date, time, speciality and by whom it was generated.
- would have a powerful search tool to retrieve a document by content or theme. For example, a trial search on the name "Darth Vader" yields a trove of documents in which a young patient speaks in a particular syndromic way.
- would sufficiently resemble the functionality and familiarity of other word processors, and particularly Microsoft Word, that minimal training would be needed in its use.

David Cable recalls the evolution of the eDocs project:

"The eDocs system grew out of the typing up of discharge summaries on manual typewriters with carbon copies. This led to the K:Patient electronic document filing system, whereby all documents relating to any one patient would be filed and stored centrally on the K Drive of the hospital servers.

Nilesh Patel played a major role in designing the system, to which Alan Hales also made major conceptual contributions in the design stage and in building it from scratch".

eDocs was not a modified pre-existing word processing package, but it shared the the familiar features and capabilities of all common word processing programmes.

Figure 4. Screenshot of the Southampton eDocs interface to the record of a fake test patient within the UHS CHARTS EPR wrapper. The yellow rectangle highlights the subject taxonomy of content. All documents are automatically allocated to the correct subject according to the speciality of the document author.

On clicking on the subject field title, the tab opens to a list of all documents under that tab in date order. The metadata descriptors to each document are displayed, as highlighted in the red rectangle. Clicking on the document number (blue hyperlink) opens it. I thumbnail preview can also be displayed. Additional function options are highlighted in the green rectangle at the top of the screen.

eDocs has a range of important practical functions, in that:

- it allows for the formatting and filing of every document with standard metadata (date-time stamp, originating clinician and subject field);
- it holds a library of standard templates;
- it provides standard rendering of document formats;
- It permits functions such as word search;

- it creates draft views, and permits editing, delegated sign off, auto-send and auto-finalisation functions;
- it creates logical work-streams for secretaries and clinicians;
- it permits onward integration with other components of the UHS Clinical Data Estate;
- The experience of typing an eDocs document is no different to typing into MS Word.

Local ownership and familiarity with the source code permits rolling iteration and upgrades by the resident IT team, for example in the recent integration with the reliable and accurate Nuance voice recognition and dictation system for clinicians in clinics.

Alan Hales adds: “I believe that we did a very good job with eDocs, and it has stood the test of time. eDocs is a very functional web-based document authoring tool. It still stands up well against commercial web document authoring software that will have had orders of magnitude more development effort and funding than we were afforded in the local build”.

“We also had a lot of work to do to change the mindset of our intended users, who were unfamiliar with what we were seeking to achieve. I recall that one of Nilesh Patel's biggest challenges with eDocs was to manage the fierce resistance to change from using MS-Word from medical secretaries and support staff who would try every trick in the book to avoid it”.

“For example, I well remember a long-running battle over the use of tab stops (line returns) while authoring documents. Tab stops were of course a fundamental part of traditional typing both with mechanical typewriters and the early word-processing software packages like WordPerfect and early versions of MS-Word”.

Documents are now formatted entirely differently in modern systems, whereby we largely type first and then format after as opposed to having to type the words and format in one process. It's rather akin to original recording of music with a single-track record versus modern multi-track recording, punch-ins, post-recording mixing and overdubs”.

The Scorpio Portfolio and the Circle of Life

The announcement of the UK National NPfIT programme in 2002 offered to derail the Southampton IT programme. Alan recalls that "the then national director of NPfIT, Richard Grainger, had told small clinical computing companies like Scorpio to find other outlets for their business as there would be no place for them in the NHS going forward".

Alan sold Scorpio (SIS Ltd) to Ascribe Software in 2007, along with the intellectual property to a portfolio of products, on which he initially continued to work on these projects as a consultant to Ascribe. However, this arrangement ended in 2009, and Alan returned to support UHS as a self-employed IT systems consultant. His former Scorpio colleague Ian Ferguson also continues to work remotely for UHS from Glasgow.

This arrangement has proved hugely beneficial to UHS, as Alan continued to produce a series of innovative systems for the Trust and innovative intellectual leadership to the programming team and the digitally engaged clinicians at UHS for a further 15 years, and I am personally hugely appreciative to him for his collaborative work on a series of projects which I will describe in greater depth in further essays in this series.

Ascribe sold out to EMIS Health in 2013, and it subsequently became apparent that EMIS was not interested in developing Alan's UHS related hospital software systems, because it was focussed upon other strategies and markets. UHS funded an EMIS development team at Chilworth Science Park to maintain these systems, in a profitable arrangement for EMIS.

Eventually, EMIS agreed to sell the "orphan" systems back to UHS in mid 2019, so ownership of the eDocs and eQuest product suite and the expanded development team went full circle. UHS continues to use the CAMIS Patient Administration System from EMIS.

The Symphony Emergency Department System

The Symphony Emergency Care system for the A and E Department was originally developed locally by the Forman-Walker company in Ringwood in Dorset. Symphony was purchased and marketed by Emis Health Ltd. It was acquired by UHS in 2008 as a specialised clinical data system for urgent and emergency care, with patient management, tracking and clinical workflow functions.

The Acquisition of Medical Imaging Reporting Systems in Southampton in the 2000s

Medical Imaging systems were not developed in house at UHS. However, they provide an interesting parallel history of software evolution and of the decisions behind their acquisition.

“Medical Imaging” is a broad category which includes “traditional” XRays and a wide range of other technologies and applications across many disciplines, including cardiology, endoscopy, nuclear medicine, tissue pathology and clinical photography. The transition from analogue storage to digital formats progressed in earnest during the 2000’s.

In the 1990s, medical imaging was still largely analogue. X-ray images were created on silver coated files which were filed in large folders on image library shelves. The core functions of information systems at that time were the archiving of images and the distribution of specialist (radiology) reports. JP Agrawal and colleagues have documented the development of imaging systems from 1990 to 2015 (Agrawal et al 2016).

The early 21st century saw a rapid transition to digital imaging systems, which added digital image storage and transmission to reporting and archiving functions. This introduced Digital Imaging and Communications in Medicine, (DICOM)* and Picture Archiving and Communication System, (PACS) ** to the professional lexicon.

*DICOM, is a standard for storing and communicating medical images and data.

** PACS is a system that uses the DICOM standard to store and manage medical images. The term Radiology Information System (RIS) also addresses these functions.

The UHS Picture Archiving and Communications System (PACS)

Adrian Byrne recounts the story of the acquisition of a PACS system for UHS, as the exemplar of the challenges of acquiring nationally mandated systems. He recalls that:

“The narrative starts in 1998 in the National Strategy for Information for Health. Paul Warner was appointed as the Local Implementation Lead, a post he held from 1998 to 2001. National funds were notionally allocated to purchase IT systems, but the NHS was financially stressed”.

Adrian reports that at this time he learned the meaning of the word “hypothecated” in financial terms. This means that although funds may be notionally allocated to you, they are in fact up for grabs (not ring fenced) and you are not assured of receiving them.

“The funds in fact moved towards the designated commercial providers of the NPfIT programme, including BT, Computer Sciences Corporation (CSC), Accenture and Fujitsu. The premature termination of the NPfIT programme left large quantities of hypothecated funds (“a glut of money”) available for alternative uses, and the national PACS programme was the beneficiary of those funds”.

“The GE PACS system was designated for Hospitals in the South of the UK, and it was acquired by UHS. However, it was delivered in a hurry and it did not share images as planned. A crucial problem was that it mandated the use of the NHS Number for all images”.

“This may seem logical, but many Xrays are taken in emergency situations, including of unconscious or unknown patients, for whom it is essential to allocate an alternative identifier until the patient’s NHS number is found. Overall, the nationally mandated PACS failed because of very poor contracts, wastage in the rules of procurement, and costly maintenance agreements.”

“Gordon Robinson, who was the local PACS lead at the time, was strapped for cash to buy the preferred alternative system, SECTRA PACS, not least because of the VAT costs on the equipment. He therefore led a campaign to have VAT removed from the purchase price of

this essential hospital system. His campaign report went to Parliament as an amendment was required to Treasury Legislation, but the campaign succeeded and UHS received its preferred system. SECTRA PACS was acquired by UHS in 2012 and it remains in use".

The Shadow of the NHS NPfIT Programme over Southampton

The NPfIT project was the drumbeat in the background to the development work in Southampton during the post-millennial decade. Liz Horkin recalls that in the early years of the decade, "Clinicians and naysayers in the wider healthcare community were still sceptical of our efforts to do our own thing in Southampton, as they didn't understand our plan. Adrian Byrne and David Cable did a brilliant job of promoting the message more widely at conferences, but I recall that people locally just did not see the significance of our plan".

"As NPfIT came along, it was assumed by many that the Southampton project would fail. Adrian was now the key to the day to day delivery while I was seconded by SUHT in 2003 to lead the South of England Procurement team ("The Southern Cluster") of the NPfIT project".

Liz recalls that "it was meant to be a part time secondment, but then it was Full Time for three months, which was further extended. Consequently Adrian Byrne was in day to day control although I was still the Director. I returned to the Trust in 2024 for a few months before going to Sussex. Before my departure, I was responsible for the Medical Records library move. After I left SUHT, I kept in touch regularly to ensure that SUHT was up to speed with the Cerberus implementation, and to seek advice on my work in Sussex".

We procured a computer system for The Southern Cluster of NPfIT from US Company IDX Systems Corporation, which was subsequently amalgamated into GE Healthcare in 2006. Our plan was torpedoed by Richard Grainger. He was a management consultant who was seconded to the Dept of Health as Director General for the National Programme for IT. Grainger pressurised IDX Systems to deploy their latest version of the US based software in the UK. The problem was that the UK data structure within the hospital setting was very different, in that data was collected from the PAS using a model which had been created by Edith Korner".

Editorial note: In 1967, Edith Korner CBE (1921-2000) had studied the use of computers in the health service for the South Western Regional Hospital Board. She became the Chair of the South-West Regional Health Authority in 1976 and in 1980 she chaired a national review of the way information was generated and handled in the NHS. The Körner Committee produced a series of recommendations to standardise the collection of clinical administrative data, all of which were adopted by the UK government. This paved the way for a full-scale computerisation of the health service; and the statistical information used to monitor the work of the NHS became known as "Körner Data". (see Korner 1984; Knox 1986).

Liz continues: "The UK concept of waiting lists was unheard of in the United States. All NHS reporting systems and structures relied on this fundamental data structure. Fujitsu bid an anglicised version of the IDX product but on deployment there were delays and problems. Eventually IDX was dropped and the Cerner product that had been bought by NHS London was adopted. However, the Cerner solution specification was also not in line with NHS needs. This all ended up in court and the programme faltered. The problems arose originally in expecting a supplier to redevelop a system and to deliver it in an impossible timescale."

"Having originally been the principal negotiator for The Southern Cluster, I knew that the IDX solution was unlikely to improve upon our locally developed Hospital Integrated Clinical Support System (HICSS) in Southampton, but I thought that that we could deploy the IDX solution as the core engine for our PAS replacement programme and as a replacement for Nursing and for smaller departmental systems over time. However, this was not to be."

"I was convinced that our initial agile, modular and incremental strategy of software development in Southampton was more efficient, cheaper and more effective in its use of scarce resources, and therefore the correct option for healthcare software. The failure of NPfIT meant that our work on wider community records and patient access to their own records in Southampton could continue. Other global technologies emerged that we could never have envisaged when we started (for example smart phone Apps) but we knew that we wanted to be at the forefront of technology in Southampton."

Adrian Byrne takes up the NPfIT story from 2002 onwards

Adrian recalls that "We followed the evolution of the NPfIT programme very closely, but we decided that we would rather be at the back of the queue for national harmonisation, as the proposed systems in NPfIT did not appear to offer any improvements over our existing systems. Nevertheless, we seconded Viv Durrant to the programme for the Data Collection Worksheet project".

"Our thinking at that time was profoundly influenced by two tragic deaths of young people at the hospital in 1997 and 2003, where clinical data quality issues in emergency situations were highlighted as critical elements in the adverse sequence of events. This led to the development of our own Ordercomms system, eQuest."

"We looked carefully at the proposed Cerner Millennium Project National System for hospitals which initially ran from 2004 to 2007, but we could not see how it addressed the lessons of our hard won experience. In particular, we valued the functionality of eQuest to provide access to results from partner health care units in the South West Hants area, including Primary Care Centres".

"There was a particular problem in Cerner with "unsolicited results", that is urgent test results before the sick patient had been allocated a unique hospital identifier. We also discussed the problem with the Fujitsu team who had been allocated the NPfIT contract for our region, but they did not appear to understand the issue that we raised. Fortunately, our own eQuest system solved this problem".

"We therefore agreed to go last on the national implementation programme, noting that Peter Knight, then Chief Executive at the Royal Hampshire County Hospital in Winchester, volunteered the Hospital as an early CERNER adopter. UHS seconded Project Managers Tracey Silver to Region and John-Joe Campbell to Newbury, where the Southern Cluster project was headquartered".

"The Cerner Millennium EPR was deployed by Fujitsu and BT, and later by BT alone, to some 20 acute trusts in the South of England and London. The Winchester Millenium system was

eventually switched off following the merger with Basingstoke Hospital into Hampshire Hospitals NHS Foundation Trust in 2012. The attempt at a common national IT build proved unworkable, as the needs and legacy systems and experiences of different hospitals differed considerably".

"We nevertheless looked at the IDX LastWord first generation Electronic Medical Record. We sent David Quo to the Chelsea and Westminster Hospital to examine their system. It ran on the NonStop fault tolerant Server System from Tandem Computers, which was subsequently taken over by Hewlett Packard. This system was based on mainframe computing. It was marketed as Resilient and Reliable, but it was expensive and proprietary, which did not meet with our ambitions for an open source system."

"LastWord evolved into CareCast. It went live in Sidcup in Kent, but it was a troubled project and the product has since been phased out. Similar problems were met with the Accenture/iSoft Lorenzo platform and with the Eclipsys EMR solution which had been purchased by Mororola from its eponymous founder company in 2002. , Eclipsys was subsequently merged with Allscripts, which became Veradigm Inc in 2023".

"BT delivered Cerner to some hospitals, including the Homerton Hospital in London, but the national imposition plan for Cerner collapsed in 2007 and Sarah Elmendorf, Chief Information Officer from Basingstoke Hospital succeeded John Wilshire as the national lead."

Summary

In this Essay, I have recorded the history of the development of the UHS Clinical Data Estate over the first decade of the 21st Century, from the perspective and recollections of those who senior members of the team were most closely involved in it.

This work proceeded against the background of rapid technological change in software, hardware, operating systems and network technologies, and in the context of the parallel and disruptive NHS National Programme for IT, whose outcomes I addressed in greater detail in the first essay in this series.

By the end of the decade, the principal components of a high functioning Electronic Patient Record system were in place in the Southampton University Hospitals Trust Clinical Data Estate for further major advances in user optimised and productivity enhancing components within the EPR and within the wider operational environment of a large UK teaching hospital.

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