Principia Medicinae Digitalis Sotoniensis

Essays on the Evolution of the UHS Clinical Data Estate 1980 -2024

Section 1 Essay 3

The maturation of the Southampton Clinical Digital Systems 2001-2009

6th October 2024

Publication Plan

The Essays which comprise this series will be made available in the first instance on my professional website, https://www.wessexsurgical.co.uk/publications/essaycollections as downloadable PDF documents for review, comment and as a basis for further contributions. They will be amended, updated and supplementary as necessary and as any new material becomes available. All with knowledge and participation in the UHS digital programme are welcome to contribute, by communication with me through dr1@soton.ac.uk.

Once the project is as complete as is achievable with the available contributions, final copies of each of the essays will be submitted to the University of Southampton ePrint server for formal publication.

Section 1.

The History of the University Hospital Southampton Clinical Digital Estate 1980 to 2024

Essay 1:3 Contents

Essay 1:3 Introduction

This is the third of a series of Essays in Section 1 of the Collection which are intended to capture the history of the unique Clinical Digital Estate of University Hospital Southampton from its origins in the 1980s to the current day.

When complete, the Collection will form an e-book which will explain how the system came about, how it evolved, and how its addresses many challenges of clinical informatics through its component design and integration.

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

I am grateful to the University of Southampton for the facility to use the powerful ePrint Server as a vehicle for incremental publication of the interim Essays as they are completed.

In this Essay, I have sought to compile a history of developments through the first decade of the 21st Century, drawing on the recollections of key members of the digital team at SGH during that period, and upon contemporary documents.

I am again indebted to Liz Horkin, Adrian Byrne, David Cable and Alan Hales for their contributions to this Essay. 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.

Digital Healthcare through the first decade of the 21st Century

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 now shifted towards the development of digital systems for the convenience, efficiency and productivity of healthcare professionals, and the development of the practical Electronic Patient Record.

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 NHS National Programme for IT (NPFIT) towards the end of 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 the NHS ID number. 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 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 suboptimal commercial healthcare IT systems. They retained the freedom to select “best of breed” component systems where necessary, and to build our own systems in house where suitable commercial systems were not available.

Liz Horkin, Adrian Byrne, Ian Brewer, David Cable and others led this politically brave exercise, working 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 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 Southampton University Hospital Trust's Digital Strategy of 2001

In January 2001, David Moss, then Chief Executive of UHS, felt confident enough to state in the introduction to the Trust's Second Digital Information Strategy Document, *"Making Information work an 'e Trust for the 21st Century"* that: *"The Trust's previous information systems strategy of 1991 has successfully delivered a robust infrastructure on which we can now build....The Trust 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 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

At the turn of the century, the then current NHS Strategy Document "Information for Health: an information strategy for the modern NHS 1998 – 2005", and the Local Implementation Strategy of March 2000 from Southampton and South West Hampshire Health Economy recognised the paucity of systems to support clinical governance and performance management. The strategy therefore committed to developing systems within the national vision for:

- Lifelong Electronic Health Records (EHRs) for every citizen
- Continuous access to patient records and information about best practice for all clinicians

- Seamless care through GPs, Hospitals and community services
- Fast and convenient public access to information and care through on line services
- The effective use of NHS Resources.

National policy had also 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, the Health Improvement Programme and 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 Second Southampton University Hospital Strategic 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, with the following features:
- Incremental development and support for the direct delivery of patient care through a single user interface with the following features:
- Retention of the existing Patient Administration System (PAS), based on a single Patient Master Index (PMI);
- Development of the PAS to support partnership working, GP access, direct booking and enterprise scheduling;
- An Order Communications System to support electronic orders for clinical tests, including Pathology and Radiology, and ancillary services such as transport and catering;
- Results reporting;
- Electronic Prescribing;
- Support for Care Planning and integrated Care Pathways;
- The implementation of specialist clinical and departmental systems,
- The development of HICSS, 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. The second Trust Digital Strategy document was able to report that a series of new technologies, including web based, wireless and tele-digital technologies had been adopted.

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

The concept of the EPR was a logical evolution of the 1991 Hospital Information Support Systems 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 the Southampton EPR:

- should replace paper, film and other disparate records
- should have a single portal of entry
- should have an integrated and logical interface to all clinical information on any patient
- should reflect the structure of the familiar paper record

<u>The technical infrastructure would support these aims</u>

- 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 EMR, as for example in the integration with primary care data.

Guiding Principles for the Southampton Electronic Patient Record

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; through improving accountability for clinical practice and providing support for clinical governance; and in supporting Research and Development.

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

- All clinical systems would be patient-focussed and would integrate with a single PMI
- All patient based operational systems must integrate through a single patient record for each episode of care and 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.

Furthermore:

- The EPR would provide an organised and integrated view of the patient's care, with appropriate decision support, context sensitive links and evidence based reference material;
- The view of the EPR would be sensitive to the needs and access controls of each user;
- The record would be captured in real time;
- The EPR would progressively absorb and supercede paper records;
- The EPR would integrate with digitally sourced content, including images, endoscopic content and digital data from monitoring equipment;
- The EPR would include administrative support functions, the PAS and word processing;
- The EPR would be as portable as possible as and more accessible than paper records, including integration with wireless networking.

The Components of the Southampton Electronic Patient Record

By 2001, the following components of the hospital clinical information system were in place. They included the following software systems:

- 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.

- The Patient Administration System had been replaced and modernised, as a necessary precursor to the nascent EPR.

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

- **Nursing and Cancer Information Systems** were in place, along with integrated office automation to permit transparency of new documents and records across the system.

- The **Corporate Information Services Directorate** had been further developed;

- **The Unitary Patient Master Index and there 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,** which is a software platform that enables communication and data exchange between different healthcare software systems, was in place, while Open Systems and IT standards added efficiency and reduced costs. (see Table 1).

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. Essay 1:3. 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 Hospital's 2001 strategy 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 the need for multiple passwords; inefficient support with multiple systems to manage with complicated interfaces; Inefficient training and transfer of learning; Complicated vendor management; and the Asynchrony of operating systems and versions.

High priorities for upgrades were therefore identified as A single user password; Graphical reports for senior management; General implementation of access to key systems; The distribution of standard Personal Computers and software for the network terminals; - Network upgrade to high bandwidth; and Enhanced data security and confidentiality.

The 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:

"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.

We therefore reset in our Second Strategy in 2001 "Making Information work for an 'e Trust for the 21st Century". 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, clinical-specific data and in some specialities (such as Renal and Ophthalmology) required specific algorithms, calculations and measurements.

We focussed on four specialties, including Vascular Diseases and Renal Failure. We developed a business case and proposal for the Hospital Board for which Alan Hales 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 system and we were not going out to the market.
To say that this approach was frowned upon in some places would be an understatement. 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.

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.

We continued to bid for any pot of funds we could, apply for grants and similar. For instance the need to get discharge letters out in 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, we proved that our overall concept for 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 would be funded all be 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 Impact of the NPfIT Programme upon the Southampton IT Programme

Liz continued: *"Clinicians and naysayers in the wider healthcare community were still sceptical of our efforts, 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 the plan. As NPfIT came along, it was assumed by many that our project would evaporate. Adrian was now the key to the day to day delivery while I was seconded to NPfIT.*

I was appointed to lead the South of England Procurement team. We procured a system 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. Richard 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 was created by Edith Korner CBE (1921-2000) (see Korner E 1984; Knox E 1986).

Editorial note: In 1967, Edith Korner 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 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".

Liz Horkin continues:
"We also had the concept of waiting lists in the UK, which were 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 front negotiator for the South, I knew that the IDX solution was unlikely to improve upon our locally developed Hospital Integrated Clinical Support System (HICSS), but I thought that that we could deploy it as the core engine for our PAS replacement programme. It would also provide 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 was efficient, cheaper, more effective in its use of scarce resources, and therefore correct.

The failure of NPfIT meant that our work on wider community records and patient access to their own records 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 up with the technology wherever society took us, and that NHS IT should be integral to the technology landscape."

The Management of Increasing Administrative Complexity in the UHS Clinical Data Estate

Liz continues: *"By the time we were five years into the programme, we recognised that we had to document both the data and the technology, and to maintain an overarching data and design map. This was a challenge as we did not have tools and technical authors and there was only so much that we could persuade the Trust to fund.*

I spent a lot of time writing business cases and specification for procurement. I also spent a lot of time on major IT infrastructure projects, including Pathology, a Picture Archiving and Communication System (PACS), other Radiology software, and Physiotherapy systems. There was a lot of boxing and coxing with resources, and we had to really push the message that as a clinically led organisation, Clinical Systems were as important as administrative systems.

We secured a place on the Hospital Executive Board in our own right for a while which helped and other Directors joined – A new Transformation lead joined the Trust from the petrochemical industry. He understood what we were trying to do and fully supported us. We also had further help from Ivan Foster on setting out some of the technology. By now Ian Brewer had joined us, and we were also able to appoint Rob Storey as our first IT Manager. Rob was instrumental in deploying the network and setting out the bones of our IT infrastructure programme.

The Medical Records Strategy: Paper or Electronic?

Liz Horkin continues: *"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 library in less than 10 years – we had a 5 year lease with options to extend in 2 year chunks. In the meantime, 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 .

"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.

Ch 3 Figure 1. The empty New Medical Records Store in Nursling circa 2005

Ch 3 Figure 2. The full "Old" Medical Records Store in Nursling, c 2015.

The off-site records store was closed in 2017.

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 man hours 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."

Adrian Byrne takes up the story from 2002 onwards: Independence of SUHT from NPfIT

Adrian Byrne held the post of Chief Information Officer (CIO) to the Trust from Liz Horkin's departure until 2024, when he retired. He 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 Fujitsu, who had been allocated the NPfIT contract for our region, but their representatives did not appear to understand the issue that we raised.

Equest solved this problem. With additional functionality, it could also be made available to Clinical Teams, individual Consultants or Hospital Ward staff.

We therefore agreed to go last on the national implementation programme, noting that Peter Knight, then Chief Executive in Winchester, volunteered the Royal Hampshire County Hospital as an early CERNER adopter. UHS seconded Project Managers Tracey Silver to Region and John-Joe Campbell to Newbury. 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 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 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 was a troubled project. Similar problems were problems were met with the Accenture/iSoft Lorenzo platform and the Eclipsys EMR solution which had been purchased by Mororola from its eponymous founder company in 2002, and which 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."

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

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 Alan Hales. Alan had originally worked on day rate 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, including the eQuest Ordercomms module; the eDocs document management system; - Doctors Worklist, which organised the clinical work and handover schedules for hospital doctors; and the modular Hospital Integrated Clinical Support System, HICSS. eDocs and eQuest will be explored in greater detail in a later essay.

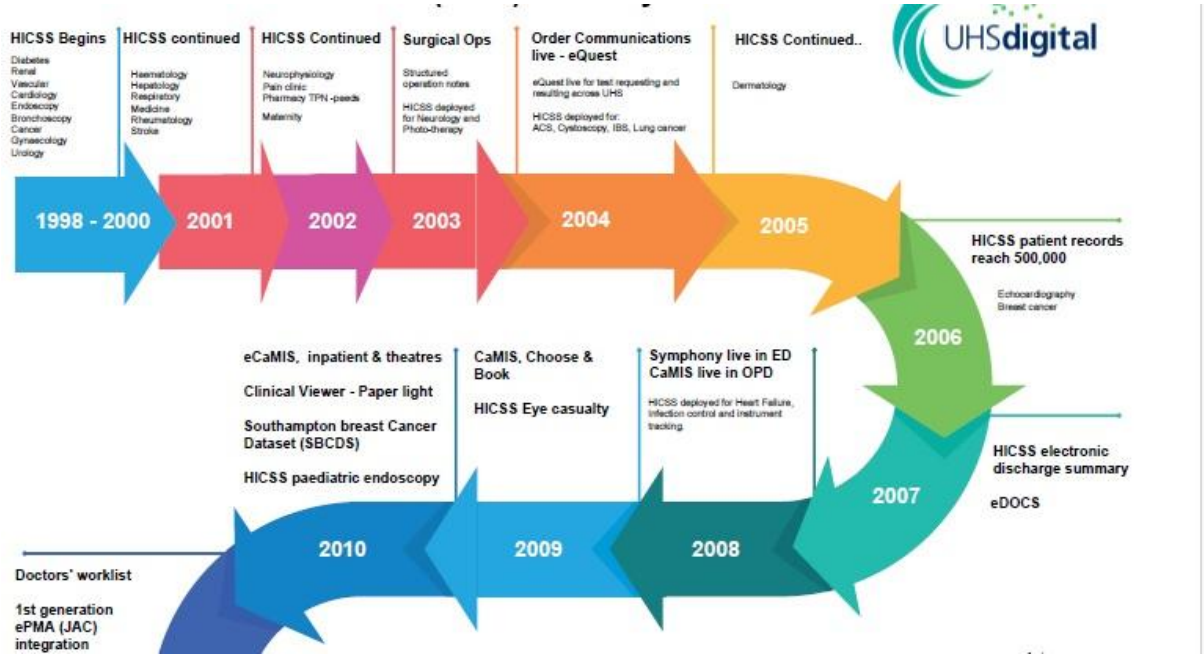

Figure 1 Essay 1.3 A flowchart of the sequence of development of the component systems of the UHS EPR from 1998 to 2021, courtesy of David Cable, credited to Ryan Beegan

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)

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 the work of Alan Hales on a vascular surgery module and on a renal failure module (see also Essay 1:2).

Alan has since been a key influence on the architecture and development of the Southampton Clinical Data Estate as a self-employed Computer Systems Consultant for more than 25 years. On the back of his interest and the success of his early consultancy work for the Trust in the late 1990s, Alan formed a small company, Scorpio Systems Ltd, to bring together a small team of developers and programmers to work almost exclusively on the UHS project.

The HICSS narrative begins in 1997, when Alan Hales applied for an advertised post within the IT Department, for which Alan was interviewed by Liz Horkin. He had wide previous experience of commercial software programming, having worked both within large corporations and later as a freelance IT consultant in logistics, for the French Postal System (La Poste); for Exxon Mobil and in implementing a corporate email system for Hays PLC.

The Origins of Speciality-Specific Clinical Systems on a Common Platform

Alan recalls attending a talk by Dr David Fine, then Consultant Gastroenterologist at UHS, who had expressed frustration at the lack of understanding or engagement from the IT team of clinical challenges around IT, and the prevalent focus on administrative processes such as "finished episodes care". He recalls that an audit had shown more than 200 individual software systems and databases that had been created by individual clinicians in various specialities prior to the millennium.

Alan therefore decided to try to meet the professional needs of clinicians with a better approach to clinical informatics. Drs Rod Dathan and Mary Rogerson had built a database of chronic renal failure cases, while Mr Cliff Shearman had ambitions for a database of vascular surgical cases.

These two clinical exemplars represented a spectrum of cases from a chronic condition which required long term monitoring, to acute events with consequences, such as carotid stenoses leading to cerebral ischaemia, and ruptured aortic aneurysms. This led to the development of a data model which had two key elements, vis:

- a review based paradigm for patients requiring continuous care
- an intervention-based paradigm which typically had some limited follow-up activity.

Subsequently, other clinical situations introduced somewhat unique use cases. For example, Maternity Care required a paradigm that is not disease or trauma driven and included both the mother and the products of conception, each requiring both separate and shared data elements.

This led to the creation of a Common Data Model (CDM) with key entities to support clinical activity and underpinned by a pragmatic approach which recognised that whilst some

things could be common throughout, not every clinical problem could be solved by the same approach. In many cases, significant historical data existed and clinicians wanted to retain this and build on top of it rather than start from zero.

Legacy data (such as had been collected in the renal system) was thus cleaned, validated and imported into the new CDM and integrated with core information from the existing patient administration system (PAS) and the laboratory information system (LIMS). This was initially done by designing and developing real time SQL interfaces with the underlying databases (PAS was Oracle, LIMS was Unidata).

The continued collection of clinical data for the renal and vascular surgery specialties was accomplished by developing the first stages of the web-based clinical application for which Liz Horkin and Alan Hales shared a vision of expansion to cover many areas of the hospital.

The Technical Origins of HICSS

In 1999, the use of web-based transactional applications (i.e. 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.

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

A strategic decision was made to use an Oracle database for these proof of concept applications. At the time SUHT had significant technical experience with Oracle and had the organisational resources to operate and support it professionally. It would have probably been easier to have used Microsoft SQL Server, but it would not have been accepted by the

SUHT IT organisation and would therefore have been problematic 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 SUHT's SGH location to run the IIS and ASP components of the HICSS solution. A second server was made available by scavenging a server purchased for another project that never got off the ground, and this was used as the development and test environment.

Alan was ably assisted by a young clever contract developer Angelo Colucci, who had a successful business developing internet browser productivity add-ons. Angelo had been hired by SUHT to work with a then young Kevin Hamer looking at novel clinical application developments. Angelo provided niche expertise in getting browsers to do things that weren't an inherent part of the product supplied by Microsoft/Netscape. Angelo struck me as an innovator who wasn't constrained by the user manual.

The proof of concept web applications interfaced to the Berkeley Computer Services Limited (BCS) Masterlab LIMS system which provided the data for all pathological departments at SUHT. BCS Masterlab used a somewhat limited Unidata ODBC (Open DataBase Connectivity) interface. The Microsoft Open Database Connectivity Architecture which underlies this approach remains fundamentally unchanged to this day, though it is nowadays embedded into assemblies (libraries) that are part of the application development toolset (e.g. Dot Net, PHP, React/Node JS) The ODBC drivers (software components) are written in C/C++to make it possible for applications to access data from a variety of database management systems (DBMS). ODBC embraces the 7-layer network model, referred to today as the OSI model with the key part being to rationalise the internal data-types of the variety of source systems into a unified ODBC data-type collection.

Alan emphases the importance of this local innovation, in integrating diagnostic test and clinical data in one combined data system. He also emphasises the design focus at that time in the renal module was upon a clinical application rather than upon audit and research applications for their own sake.

Delivery of the Renal Failure and Vascular Surgery Modules within HICSS

The proof-of-concept renal failure and vascular surgery applications were delivered as promised within nine months. A separate Oracle Instance (database) was configured for HICSS on existing hardware (HP Unix servers at the time), keeping it separate from other operational Oracle databases. HICSS was enthusiastically supported by Liz Horkin but the project was viewed with some scepticism by other technical staff.

Nevertheless, Alan recalls that the Renal Module was well received by clinicians, because it eliminated the need to re-key in demographic data on each patient and key in haematology, clinical chemistry and immunology pathology results each time a patient submitted a blood specimen. The application was further developed to include algorithmic calculations such as the Cockroft-Gault formula. This gave a predicted end stage renal failure date from biochemical measurements. The Cockcroft-Gault formula (CG) had been developed in 1973 using data from 249 men with creatinine clearances (CCr) from approximately 30 to 130 mL/m2. It was not adjusted for body surface area and is no longer used because it has not been expressed using standardized creatinine values.

The Origins of Virtual Clinics in the Renal Failure Module

The renal application set the foundations for the development of what were termed virtual clinics. These allowed the patient to have their bloods taken at their GP and visit the hospital less frequently because path results were now acted upon with significant computer aided diagnosis allowing patients to be properly monitored without the need to have to visit hospital potentially needing time off work and so on. Today, remote monitoring of chronic disease via virtual clinics or tools such as My Medical Record are saving significant clinician and patient time and delivering huge efficiency gains.

Alan contrasts the work with the renal module and the vascular surgery module, which focussed upon surgical performance audits and outputs. This was at a time when the national focus was increasingly being shaped by the consequences of the national enquiry into paediatric deaths at the Bristol Heart Unit. There was now a challenge of a fair representation of surgical performance, that was based upon the complexity of case mix and the referrals to individual surgeons.

Alan also highlights the work of Mr Gareth Morris, Consultant Vascular Surgeon and colleagues in the local development of an ultrasound based abdominal aortic aneurysm screening programme at this time.

In consequence of the success of these two projects, Alan formed Scorpio Ltd as a corporate limited liability company to continue with the development programme, with plans to extend the interfacing of clinical pathology systems to radiology (RIS) systems and other sources of medical diagnostic information.

Alan notes that initially there was no opportunity to link HICSS to radiology data as the SUHT Detente system had no installed interfacing capability. Only some years later did healthcare system suppliers start to incorporate HL7 messaging interfacing capability into their products.

The subsequent rapid expansion of the HICSS system after 2000

Adrian Byrne recalls that a decision was made to regularize the arrangement with Alan Hales to deliver modules through a formal contracting arrangement which allowed business continuity. This committed the Trust:

- To procuring modules and other support activities to a minimum of £181K i.e. one hundred and eighty one thousand pounds from April 1st 2002 - March 31st 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, unless the Trust has given notice as indicated in ... the main agreement.

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 Timeline of the Subsystems of HICSS

Alan created a limited company, Scorpio Information Systems, and recruited a former employee of his from Hays DX, Ken Cowin. The recalls that

"*Ken was a computer science graduate from Portsmouth University. He had developed 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, 40 or so "HICSS modules" were developed, including the following:

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, eDocs and eQuest were developed. In 2004, eQuest live across UHS for test requests and results. In 2007, EDocs was launched. In 2008, Symphony went live in the Emergency Department and CaMIS went live in the OutPatient Department (OPD).

The HICSS Endoscopy Module: 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, 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 surveyed the marketplace 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. In fact, 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. 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 a demand for video capture of the endoscopic procedure and this will most likely be achieved in the future by interfacing the endoscopic device to a PACS system and not through the endoscopy application.

Alan realised that most hospitals would not want to run an Oracle database, and having had this foresight at the outset, it was relatively easy to configure HICSS to run on either Oracle or 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 were released synchronously, though both required separate unit and user acceptance testing.

The HICSS Maternity Module: 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. He also recalls that the Maternity Module was another success. 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.

Alan also designed and implemented a submodule to address significant 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.

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). 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.
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 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 was one of the most successful national IT initiatives he has witnessed in the UK.

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 given by parents at birth.

The 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, and the data was returned to the HICSS Maternity module in Southampton, from where the information would be automatically forwarded to the local Patient Administration System.

The HICSS Maternity module was replaced by a nationally authorised system, Badger.Net in 2022.

The HICSS Cardiac Surgery and Interventional Cardiology Modules: The National Bristol Cardiac Surgery saga led to the creation of a national data base, the Central Cardiac Audit Database, CCAD, to monitor the performance of cardiac surgeons. Mr Bruce Keogh, Consultant Cardiac Sureon 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 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 sought to protect the good 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 registered Southampton as 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

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 of 14 days to referral, 31 days to clinical decision making and 62 days to definitive treatment. At that time, the Trust had no Trust-wide cancer database with which to understand the processes. The data demands were initially focussed entirely upon logging administrative data (date referred, 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.

It proved increasingly difficult to maintain the HICSS Cancer System with limited human, financial and programming resources, as central 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 we will return in a future chapter.

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 the 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 is regularly updated to match the ambitions of the Cancer Reform Strategy of 2007 and 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, whether direct Provider submissions from other national collections or derived from other 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

HICSS Surgical Ops: This was developed from 2003 onwards with a range of functions:

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

- it permitted the creation of a structured operation note for every procedure in a format which was familiar to all surgeons.

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. It remains in use in a little changed format in 2024.

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

The HICSS Hepatology Module: 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. He developed algorithms to measure the Child Pugh score for liver cirrhosis, for example.

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

The HICSS Respiratory Module: 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. The module is no longer used.

David Cable recalls that efforts were also made. He recalls a trip with Peter to the Boehringer Ingelheim Headquarters in Bracknell to secure external funding, but to little avail. **The HICSS Bronchoscopy** system persists to this day, avid recalls tracing its lung diagram from a textbook using a sheet of the infamously crispy Izal/Jeyes toilet paper.

The HICSS Rheumatology Module: 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: 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: 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: This was built at the request of Dr Cathy Price

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.

The Symphony Emergency Department System

Symphony was developed and marketed by Emis Health Ltd 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. It has evolved significantly since then with Electronic appointment booking functionality and bespoke tracking grids.

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

Medical Imaging includes “traditional” XRays and a wide range of other technologies and applications across a wide range of 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. Xray 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, transmitting, 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): A short case study

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.

The narrative starts with the 1998 UK Government's ambitious 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 founds 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.

Essay Summary

In this Essay, I have recorded the history of the development of the UHS Clinical Data Estate over the 2000s, the first decade of the 21st Century, from the perspective and recollections of those who 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 NHS National Programme for IT,

In the next essay, I intend to look more specifically at two key component systems of the Southampton Electronic Patient Record. There were the locally grown eDocs document management system and the eQuest Requesting and Reporting (Ordercomms) system, both of which Alan Hales built through that decade, and both of which have survived and prospered as key elements of that system into the mid 2020s.

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Appendix 1 to Essay 1:3.

UHS Corporate Information Services Directorate: Second Strategy Document 2001-2007: Making Information Work: an e-Trust for the 21st Century: A Green Paper:, pp 160; 2001

This is a digital version of a key reference document, the original paper copy of which was kindly provided to me by Liz Horkin during the preparation of this essay, and digitised by Mrs Paula Sands and her team at the University of Southampton Library.

I am unaware of any other publicly accessible copies of this document, which I therefore post as a valuable adjunct to the UHS Digital History for further reference.

Appendix 2 to Essay 1:3

Byrne A (2002) UHS Corporate Information Services Directorate: Second Strategy Document 2001-2007: Making Information Work: an e-Trust for the 21st Century: A Green Paper: Technical Standards, pp 27

This is a digital version of a the Technical Standards' Supplement to the SUHT Second Strategy Document 2001-2007, the original paper copy of which was kindly provided to me by Liz Horkin during the preparation of this essay, and digitised by Mrs Paula Sands and her team at the University of Southampton Library.