Principia Medicinae Digitalis Sotoniensis

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

Essay 2: Evolution of the University Hospital Southampton Clinical Data Estate from 1990 to 2001

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Abstract

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This knowledge of the early phases of the project largely survives in the recollections of those who built the system, as I have seen very little formal documentation from this era in terms of correspondence, emails or policy documents.

I am therefore most grateful to key individuals in the project whose recollections and substantial contributions to the programme date back to the 1990s. Liz Horkin, who was the first Director of Information Management at UHS, generously provided a long written recollection of her leadership of the early years of the programme. Alan Hales, Adrian Byrne and David Cable kindly gave their time in interviews, and Ian Brewer provided further written testimony.

Alan was the technical architect of many of the key features in the modern UHS clinical data estate. Adrian, David and Ian have had long and dedicated careers at senior level 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 impact of the ambitious and premature experiment in health systems computerisation in Winchester, which had collapsed in the late 1980s with considerable national political opprobrium and at huge expense before Southampton was drawn into it. In this essay, I have collated the story of the first decade of conceptualisation and development of the modern Southampton Clinical Data Estate and its key components between 1990 and 2001.

Introduction

This essay is the second 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. The knowledge of the early phases of the project largely survives in the recollections of those who built the system, as I have seen very little formal documentation from this era in terms of correspondence, emails or policy documents.

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Liz Horkin's Journey in Medical Informatics In Southampton

Liz recalls that her journey in medical informatics in Southampton started in managing paper records, and that even in the 1980s paper was still seen as the medium term future of clinical record keeping. She also recalls the lowly status of the clinical records libraries in the basement at Southampton General Hospital.

"The main records library was flooded by the sluice drains on D wing at one point. There was effluent everywhere. We had to use a record recovery company from Cambridge to rescue paediatric cardiac surgery records."

"I was working at SGH in or around 1987-1988 as a jointly appointed Nurse Tutor and Senior Nurse on the Surgical Directorate alongside Clinical Support Manager Douglas Pattinson. We were asked by then Chief Executive David Moss to go to Winchester Hospital to look at the Wessex Regional Information Systems/IBM Electronic Patient Record System. We had been tasked to roll it out at Southampton General and the Surgical Directorate was proposed for the pilot scheme". (see Denham J 1993 and the House of Commons report, referenced)

"We went up to Winchester to see The American Technicon Data Systems (TDS) deployment". *(Editor's note: This system is described in papers by H Melville (1990) by Sittig and Stead (1994) as a Level 3 Hospital Information System (HIS). Level One described a simple Patient Administration System (PAS). Level Two described Departmental Systems which shared a Patient Index. Level Three described informatics support for clinical activity. This included an Order Communication System which was integrated with a Patient Administration System (PAS), with departmental systems, and an e- prescribing module).*

"We planned that our new Level Three system would interface with Pathology and Pharmacy systems, and replace the Radiology system. The Pathology and Pharmacy systems were used regionally, so interface specifications would only need to be done once. The regional PAS was at end of life and it needed to be replaced. We were shown around Winchester Hospital and we were actually quite excited by the project. I had been keen on computerising Nursing Rotas when I was in Oxford and I thought that we could do a lot with computers".

"I liked the Order Communications and Clinical Noting elements, but I found the ward drug round module to be a bit laborious in the era before wireless networks. The Order Comms system would allow users to order Pathology, Radiology and other tests and to have an electronic report within the core patient record".

"We agreed that it appeared to be a fantastic opportunity for SUHT (Southampton University Hospitals Trust, the nominal predecessor of UHS), but we had no idea that it was shrouded in challenges and skulduggery! (*see the references to the Parliamentary Reports*)".

"It appeared to us that the Winchester system offered a whole site solution for Southampton that could be implemented in phases by clinical disciplines and not confined to a single specialty. David Moss was persuaded by the Regional Health Authority to work with the Royal South Hants Hospital as a unitary project." *(Editor's note: The 150 years of sovereignty of the RSH as an independently managed hospital ended in 1991 when it was absorbed into the Southampton General Hospital Management Unit).*

Liz notes that "I was appointed as the Full Time Clinical Co-Ordinator for the project, with Roger Buchanan, Consultant Radiotherapist, as the Medical Lead. We also had a Project Manager from Pathology (Chris Ward) and Roger Boydel was seconded from IBM. This pre-history is relevant to where we went next".

Early Discovery and System Development Concepts at Southampton General Hospital

"We appointed secondees from a range of clinical backgrounds to work as analysts, to create a map of services and transactions. These insights were then coded using Fortran (this was the language of choice in the aerospace industry) to create screens which end users would pass through by selecting items with a light pen. We all underwent training and started work on deploying the regionally led project".

"I learned a lot about how each part of the hospital and how individual clinical specialties worked. I uncovered a myriad of small, unlinked, clinician owned data bases, research systems and similar with no consistency of data structure. In order to move the clinicians onto the Technicon Data System, we were going to have to code data collection into TDS".

The Enter Once, Use Often Principle in System Design

Liz notes that "The Guiding Principle (the mantra) from here on was to collect a specific piece of data (for example name, date of birth) once rather than on multiple occasions. There was some clinical buy-in but as key major functions had first to be built it was some time before we would be replacing beloved local systems. Most stakeholders therefore were carried forward on the idea of an Order Communication System. Pathology was the first part of the intended Order Comms System (see Sittig et al 1994)".

The HL7 Interface Engine

"We planned to create a unitary **Patient Master Index (PMI)** across the PAS and key feeder systems. We worked with hospitals in Bath and Dorset who were also using Chart, which was the Regional PAS. The Regional Programme was using the Datagate (later E-gate) as the HL7 interface engine."

*Editor's note: **Health Level Seven (HL7)** refers to a set of international standards for transfer of clinical and administrative data between software applications used by various healthcare providers. These standards focus on the application layer, which is the conceptual "layer 7" in the globally recognised Open Systems Interconnection (OSI) model. The HL7 standards are produced by Health Level Seven International, which is recognised as an international standards organisation. An HL7 interface engine is therefore a central hub that receives, routes, and sends HL7 messages to the appropriate healthcare information systems. It simplifies integration in connecting healthcare computer systems.*

Liz recalled that "There were clearly problems with the way in which the TDS team had started with a relatively small hospital (The Royal Hampshire County Hospital in Winchester, which has since been subsumed into a partnership with Basingstoke Hospital)."

"For example, the numbers of Out Patient Department (OPD) slots that had been factored in within the core system were too few for a Teaching hospital or for the Royal United Hospital in Bath, which was a large District General Hospital. All sites shared ideas and we also worked closely with a team at Arrowe Park Hospital in The Wirral, who were also deploying

the system. We shared best practice in screen designs. For instance, Arrowe Park had good Physiotherapy departmental screens, while Southampton had good Prescribing screens".

Liz continues: "You can read in CRASH: Learning from the World's Worst Computer Disasters by Tony Collins and David Bicknell (Simon and Shuster 1998), how the Winchester project came to a grinding halt. In my view, the concept was viable –as was shown by its successful use in The Wirral until it was replaced by the Cerner system during the NPfIT programme".

"Unfortunately, IBM had over-promised and under-delivered and the region had underfunded the work. The timescales were overly ambitious and it emerged that there were issues with contracts and fraud, so the project was pulled. In 1990 the project was investigated by the National Public Accounts Committee".

"At that point, the project was still in the build stage at UHS. We had only deployed it on site to project offices and training rooms. A new communications network had been planned with an IBM Token Ring. This was a proprietary fast IBM network, linking workstations and servers. However, this network was superceded by Ethernet Local and Wide Area Network (LAN and WAN) technology and by its communications protocols".

At this point in Southampton, we had started to create interfacing designs between the PAS, PMI and Pathology systems as we were going to keep the Ferranti pathology system and develop an Order Comms interface (Ed: this was eQuest, which I describe in the next essay).

Developments in Southampton after 1990.

In Southampton, Liz recalls that "we were initially expecting to work on coding the new TDS system to capture clinical information for future NHS Diagnostic Related Groups (DRGs), which grouped International Classification of Disease ICD codes into similar resource groups.

Editor's note: The DRG model had been developed in the late 1960s at Yale University to classify hospital cases into groups with similar clinical characteristics and resource consumption. It was adopted in 1983 by the US Medicare system as a mechanism to control rising healthcare costs, and has since been widely adopted globally.

The UK National Resource Management (RM) project

Liz Horkin recalls that "When the Region cancelled the Wessex RHA Regional Information Systems Plan (RISP) project, the TDS project team was stood down. However, some work was ongoing as **the NHS Resource Management (RM) Project** had started to roll out".

Editor's notes: The UK National Resource Management (RM) project was nationally funded and it needed to be deployed locally with hospital management buy in. On Tuesday 20th February 1990, then Health Minister Roger Freeman had announced (Hansard 1990 Vol 167) that: *"The NHS Management Executive has been discussing the details of the (Resource Management programme for the coming financial year for which the Government have made available an additional £78 million.*

We are proceeding at a pace that the service can sustain in setting up project management teams and purchasing computer equipment. This is backed-up with guidance from the Management Executive on the best way to proceed".

JL Dixon and M Garside reported on the purpose and progress of the Resource management program in the NHS in England in Medinfo in 1995. They wrote that:
"The program began in 1986 with six pilot sites. In 1989, Ministers decided to establish a national Resource Management Programme covering all general acute Hospitals in England with more than 250 beds--some 250-260 sites.

The plan encompassed a range of elements, but was individual to each unit in setting out:
a) A vision of what was to be achieved by the project and the benefits being sought;
b) A focus on improving the quality of patient care in the unit;
c) Involving clinicians in the management process;
d) The availability of clinical information to support decision-making, including the hardware and software for Case-Mix Management and Nurse Management Systems, and for coding, classifying, and grouping systems.
e) A greater awareness of the financial implications of clinical decisions;
f) A project management approach to implementation;
g) An approach based on developing both the organization and its staff, with training.

The key to the implementation of the Resource Management program was cultural change at the unit level, and local ownership of the process was essential. The authors observed that over the initial eight years of the project, most units had adopted a Clinical Directorate structure, and many clinical staff were formally engaged in the operational and general management process. RM had focussed attention on clinical coding and grouping. Some RM sites were better able to negotiate with their purchaser organisations with have better quality data.

Resource Management exposed the need to develop or reassess Information Strategies at hospital unit level. RM had stimulated staff training and development and had been instrumental in improving the quality of training facilities and resources. RM had had a catalytic effect on NHS Reforms. The use of Casemix Management and Nurse Management Systems was also seen in some RM sites as improving the quality of patient care provided".

Dixon and Garside concluded that "good quality services require well-managed and competent provider organisations. The principles of RM should be taken forward in the broader context of provider development, with a focus on quality and financial control".

The National Casemix Office (NCO)

Liz Horkin recalls that "The National Casemix Office (NCO) was established in 1994 in Winchester, to improve the understanding of healthcare activities at local, regional, and national levels. (The NCO continues to prosper in 2026)."

Editor's Note: The NHS Website tells us that: "The term "casemix" has a number of meanings, including the literal 'mix of cases (patients)' seen by a consultant/hospital/region, and the way in which patient care and treatments are classified into groups. These groups provide a useful measure on which to make performance comparisons, to cost and fund healthcare. The principles of the casemix classification have been well-established internationally since the late 1960s.

A casemix classification (or Casemix Groups) needs to be clinically meaningful; relatively similar at the group level, in resource terms; based on mandated, standardised, and readily

available data; and manageable in number. Widely standardised Casemix Groups reduce the administrative and analytical burden of those who use them. They permit the comparison of clinical performance in different units".

Computerisation of Nursing Care in Southampton

Liz Horkin continues: "The CaseMix programme offered benefits in report generation, contracting and waiting list management. A new Nursing Information System was integral to the Resource Management programme and I was bought back into the project. I got on well with Paul Stafford and Paul Bates, who were working on RM, and a plan was made".

"We agreed that a mechanism was needed to get IT and computers to the wards. We could then look to a future of more complete clinical computing. We used the Nursing System requirements as the anchor, as this was nationally funded. We built on experience that we had had with a local IT initiative for nursing records that we named Florence".

"At the early stages of the Resource Management project, we had started to consider how we could get nurses more involved. A small local pilot project received funding and Ivan Foster developed a simple nursing rostering system which also focussed on ward based work, resource allocation and clinical noting. Ivan later helped us develop the technical standards for our IT strategy and departmental system in Cancer Care".

"The Florence nursing system was deployed in the Surgical Directorate as a pilot and it was helpful in understanding how nurses would take to using the ward based computer. The output from Florence could also be used to create management reports for the ward sister – and created a way of looking at resource intensity by patient group. The Florence computer system was useful but it was not going to secure national support or funding".

The Crescendo Nurse Management System

Liz recalls that "The National Resource Management Programme was extended to include a Nursing Information System, as Nurses were heavy users of the digital resource. The programme funded hospital wide nursing systems for RM sites. We procured Crescendo, which was one of a set of recommended national software solutions. Crescendo provided

care planning, rostering and work load modules for nurses". It interfaced with the PMI and it would eventually allow integration with some nationally sponsored knowledge data bases, including (for example) Wound Management guidelines".

Editor's note: Crescendo failed to secure national professional traction. In her 2003 paper, Melanie Wilson of the University of Manchester (Wilson M 2003) demonstrated the mismatch between the intentions of the technical developers and the experiences of the intended users on the wards of the unspecified UK "Royal Hospital" which she used for her case study. The findings are worth re-reporting, as they highlight ongoing challenges in the computerisation of ward work which are only now being resolved. Melanie observed that:

"There was hostility to the system from the outset because the Crescendo system took nurses away from care. The location of terminals in the nursing station or a rest room meant that the nurse would have to leave the bedside to enter the information into the computer. This limited time talking to the patient. Nurses had to prioritize record keeping over direct care, about which they nurses were very forthcoming about importance of the physical and emotional proximity to patients.

They also stated that using the system actually increased the administrative tasks. There were often queues for the one PC on the ward, resulting in plans frequently being written in retrospect. They were critical of the software and hardware since the terminals and network links were slow and access to the care libraries developed on other wards was limited. The way the system was set up lead to duplicated inputs, wasted time trawling through long-winded menus, and repeated logins due to the security set up and the sensitive nature of the patient information. The system was not sufficiently developed for workload planning.

Further, the care plans had too little detail; or they had too much detail; they reduced thinking and thus de-skilled nurses; and they took longer to produce. The shortage of time faced by nurses meant that the Crescendo system did not reflect how hard the nurses worked: if they were not busy, they had more time to type up the plan. If they were busy, they could not do a plan. This created a reverse picture of what had been happening on the wards in terms of intensity of activity."

The Southampton Hospitals Local Area Telecommunications Network

Liz Horkin noted that "We also procured and deployed a Local Area Telecommunications Network, which linked the Southampton General and The Royal South Hants Hospital across the upgraded Wide Area / Ethernet Network. These two hospitals would soon merge as a single Trust. This was our first major decision, to abandon the Token Ring and the Banyan Systems Virtual Integrated Network Service (VINES) UNIX systems infrastructure."

"We were an early NHS adopter of this type of network, and it laid the foundation for future developments with a resilient and future proofed solution. To deploy the Crescendo Nursing system fully, we needed at least two personal computers (PCs) per ward, and the network to run them on, which the Regional Health Authority agreed to fund."

"You can't collect clinical information anywhere but in clinical space"

"The telecoms installation became the basis of our future plans for a clinically relevant system, as we recognised that "You can't collect clinical information anywhere but in clinical space". For the next few years, we looked to use whatever the current management or national initiative demanded to create ways of extending clinical information systems."

"As the Resource Management Project Manager, I also had access to a lot of powerful training and development resources. These included the **PRINCE project management techniques** and **the Information Technology Infrastructure Library (ITIL)**."

Editor's note: *PRINCE is a structured Project Management method which is certificated and which follows a quality circle process. It moved projects away from closed technical situations and involved end users and champions in agreeing IT benefits and deliverables. The system continues to be available in the PRINCE2 format for online professional development (see https://www.prince2-online.co.uk).*

The Information Technology Infrastructure Library (ITIL).

Liz recalls that "ITIL was particularly enlightening for me. ITIL describes generic processes, procedures, tasks, and checklists which can be applied by an organisation toward strategy, delivering value, and maintaining competency. It is used to demonstrate compliance and to measure improvement. As an ex-ITU sister I expected IT to be structured and properly documented and I found that the local NHS infrastructure was not so well structured."

"The Ethernet network had a fibre-optic back bone and a dual ring design. This secured resilience. Dual-ring topology comprises two communications rings in a network. Each ring works independently. If one is disabled, the other ring ensures continuing data flow."

Editor's note: *"ITIL originated with the UK Government's Central Computer and Telecommunications Agency (CCTA) in the 1980s as a set of detailed practices for IT activities such as IT service management (ITSM) and IT asset management (ITAM) that align IT services to the needs of the business."*

The Southampton Hospital Information Systems (HIS) Strategy of 1991

Liz notes that "The original Information Systems strategy was written in 1991. It focussed on how we would now resolve the legacy systems problems that should have been resolved by the Wessex HIS project, in that:

- We had an ageing and unsupported PAS,
- We had a Pathology system which was supported by a man who was travelling around the world on a motor bike.
- It was running on hardware that was no longer available, so we had to purchase some second life Ferranti computer kit that had been acquired from oil rigs;
- We had a radiology system on its last legs."

"It seemed unlikely that we would ever again get the funding for a "big bang" project like the Wessex RISP project. We looked at technology adoption in other industries including finance and airlines. We concluded that we should incrementally build a "level 3", HIS or Electronic Patient Record (EPR) as it became known. We would do this by using industry

standard technologies rather than old NHS legacy data bases and we would create a single Patient Master Index (PMI) as the core: – one patient = one ID number with no duplicates."

We had selected an Oracle based Case Mix system (Rusnak JE 1987) for the RM project, as did the Wales Health Board. **The Clinical & Financial Information System (CFIS)** was a proprietary US based Case Mix solution which combined the ability to collate clinical information and financial costing information to create resource reporting. The original engine for this was the Diagnostic Related Group (DRG) model.

Within the UK Resource Management initiative, there was a programme to develop a UK version. We used **OPCS codes** for surgical procedures, whereas in the US they had an extended set of International Classification of Diseases (ICD) codes. This model was initially known as UK Case Mix and later became HRG's or Healthcare Resource Groups.

Editor's note: OPCS (Office of Population Censuses and Surveys) Classification of Interventions and Procedures codes are mandatory, standard, four-character alphanumeric codes which Aare used in the NHS for recording clinical procedures and interventions. They are essential for operational planning, research, and tracking patient care activities.

Liz continues: "The RM project should have been entirely clinical, but contracting created a demand for good management information around what we did so the Finance and Management tools were crucial to the Trust. Clinical Coding therefore became an essential tool, and over time we went from four clinical coders to a team of around 12 employees."

"The focus on contracting became both a blessing and a curse. Financial management lay at the centre of the future of the Trust. In the Finance Directorate, Alan Butler was responsible for delivering the wider IT strategy, although at that time individual systems were administered under their own Directorates. This created the necessary momentum".

Towards a Strategy of Clinical Computer System Integration

Liz recalled that "As a small team of 'contractors and seconded staff' we had gained a lot of knowledge through our procurement of the digital communications network and Case Mix and Crescendo software, both of which were 'Open Systems'. Our strategy was to focus on a cohesive technical platform that lent itself to more and more integration. Previously systems might have been bought that were rich in functionality but they were islands in technical terms".

The Oracle Relational Data Base Management System (RDBMS)

"We aimed to use industry standard technology and to standardise as far as possible on one of two emerging 'industrial' standard Databases. We therefore acquired two relational data bases, including Oracle (from the Oracle Corporation) and SQLserver as a secondary relational database, with Microsoft Structured Query Language (SQL) server applications. These acquisitions brought coherence to a plethora of NHS systems, antiquated operating systems and a lack of standards for coding and of mapping data".

Editor's note: The Oracle Relational Data Base Management System (RDBMS) was first released by Larry Ellison's Software Development Laboratories in 1977, and it has continued to thrive through serial updates and evolutions over since. By 1998, it contained Native Internet Protocols, and it could be run as a virtual private database.

Oracle was also functionally linked to the Java object orientated programming language (OOPL) (Sun Microsystems), which was finally acquired by the Oracle Corporation in 2010. Object Orientated Programming organises software design around data (objects) rather than around functions and logic.

Liz recalls that "we also introduced an email system in 1993/94, initially using the Microsoft Windows 'Pegasus' system. We moved to the 'Groupwise' system, which was rolled out across the Trust, eventually to be succeeded by Microsoft `Outlook'.

The Strategy of Incremental Implementation of the Southampton EPR

Liz notes that "Our thinking was that as each component of our new solution came into being the project would be functional, even if further projects were not funded or took longer than anticipated. We did not want to invest large amounts of money, time, effort and enthusiasm to see everything crash again. The watch word was **incremental.** There was a lot of debate across the wider NHS as to optimal IT solutions. Many hospitals were looking to the evolving commercial market for Order Comms and a combined PAS system".

"The issue of how we moved forward in terms of providing HIS / EPR was a hot topic across the NHS Informatics world. I was invited to take part in a public platform debate with my peers from Kensington Chelsea and Westminster Hospital on the topic of "Big bang, versus single solution v incremental". I argued that we had been bitten locally by a Big Bang approach (as of course we would be again when NPfIT failed for almost the same reasons as the Wessex Regional Informatics Project) and hence we had opted for incrementalism."

"This approach had some great wins and was going in the right direction but it was not immediately a great success. It proved to be 'bleeding edge' rather than "leading edge". The technology took time to catch up with our thinking. as did our understanding of what we were trying to do".

Liz Horkin's Reflections on Updating our IT strategy in Southampton: The First Decade

"Our first strategy in 1990/91 had been mainly words and vision, with little of the necessary technology to carry it forwards. We had set out with two accountants, a Nurse and some key clinicians to flesh it out. We used trusted third parties including Ivan Foster and individuals within other consultancies including Admiral and Gartner who were working with us elsewhere or through contacts at Region".

"The first 10 years of our programme was mainly spent on procurement of key essential infrastructure, and building the case mix system, and contracting for resources. The network procurement, the Case Mix and the Nursing system projects were followed by a major project to replace the PAS".

Replacement of the Patient Administration System

Liz recalls that "The NHS had a large number of legacy PAS which offered no advantages over our existing NCR (National Cash Register) Corporation Chart PAS. Newer commercial solutions used legacy technologies so we looked further afield and acquired an Australian system, developed by IBA Health Group Ltd. This system was ported to Oracle. It had potential to bring elements of a level 2 Hospital Information System (HIS) with a simple Order Communications, moving us towards our preferred level 3 HIS status".

"The purchase of the IBA PAS was also interesting in so far as we were breaking the mould in going outside of the authorised NHS family of such systems. The Region was concerned but the company managed to acquire an Australian-backed financial guarantee which got us over the line. The IBA Health Group later established a UK base in the Midlands and became a supplier within the UK market".

" Replacing a PAS was a major undertaking, but it did not help the Clinicians who were by now under pressure to undertake more Clinical Audit and to participate in more specialty research. Many clinicians were keen to transform their working environment and to create their own local speciality records using commercial systems. Some of these were promoted by the Royal Colleges, and some clinicians were also under pressure from a plethora of small system suppliers to buy specialty specific solutions".

The Origins of the Hospital Integrated Clinical Support System, HICSS

Liz recalls that "At this point in early 1997, by fortunate coincidence, I met Alan Hales, who proposed the idea of HICSS. Alan was an independent computer systems consultant who has since made a huge contribution to the development of IT systems in Southampton".

"Alan had come in to look at a clinical system for a clinician as a contractor and he had come to us to discuss it. We were soon on the same wavelength. He was from an engineering background and was completely in tune with what we were trying to do. Importantly, he also understood the clinical process and "design and build" methodologies using current technologies. We came up with the notion of doing something which was unthinkable in the NHS IT management climate at the time. We elected to build a local software solution

rather than go to market, and we named it the Hospital Integrated Clinical Support System, HICSS".

"The HICSS system was intended to supporting specific clinical and departmental information needs from the late 1990s onwards. HICSS would be a unique home-grown Southampton. We would aim to build a modular clinical solution which could be speciality based. Core components such as the PMI interface, and the Pathology interface would be developed locally".

"Services such as discharge letters and reporting tools would also run across all modules, but the local clinical data capture would be bespoke for each specialty. We had replaced pathology at this point with a system called Masterlab from Berkeley Ltd, which was founded on the Unix based IBM Unidata database system".

Alan Hales' Recollections of the 1990s Development Programme

Alan takes up the HICSS story from Liz Horkin:

"My first interaction with Southampton was in 1997. Southampton had completed an assessment and found they had over 200 disparate, disjointed clinical systems which had been written in various programming languages and styles. Many of these were considered likely to be problematic on New Year's Eve 2000 for a variety of reasons, including the widely publicised issue of "**The Millenium Bug**" of two digit codes which had been used in time-interval calculations, and was anticipated to cause extensive software crashes".

"Many of these systems had been written by doctors and students with little or no documentation and no source code. We realised that these applications were going to fail at some point because upgrades in the leading computer operating systems would mean that those programs would stop working without tortuous workarounds. Moreover, there was little or no consistency in the applications. The validity of the encapsulated logic was unclear and we were not sure whether they correctly reflected contemporary coding protocols, or what clinical risks they posed".

The First Proof of Concept of an Integrated Clinical Support System

Alan recalled that "I had designed and developed a wide range of applications in scientific, commercial and financial organisations and had practical skills and experience of web-based applications. I also had an established background in relational databases including Oracle, Sybase and DB2, and Object Oriented programming techniques. I had 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 an email system for Hays PLC".

"I recognised the need to establish a core foundation upon which specialist clinical applications could be developed, operated and supported. I also recognised a commonplace problem with the deployment of software to Personal Computers (PCs) in the era of client-server computing that had emerged since the mid 1980s. I proposed that we should move to new web-based architectures".

"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. He recalls that "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".

He recalled that "A strategic decision was made 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. 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 therefore 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 from another project that never got off the ground, and this was used as the development and test environment".

The Reasoning Behind the Southampton Web-Based Architecture

Alan explains the reasoning behind the early move to a web-based architecture for the Southampton clinical data system:

"There are inherent strengths in web-based architecture. The client-server model required organisations to invest progressively in more powerful PCs, more memory, faster processors and other upgrades, because client applications were often inefficient and every PC had to run the applications".

"With web-applications, the PC has only to run a browser, although some web-developers do far too much client-side processing and again create a need for high-end PCs and workstations. This tendency should be controlled by good IT developer management, but this is not always the case".

"Client-server solutions also often required the purchase of licenses for all manner of drivers and other client-side application components, which could amount to a lot of money for larger organisations, such as UHS".

"Client applications were also tied to the operating system of the client PC in the days prior to the **Java Virtual Machine**, which itself created operational challenges. Such choices created real dilemmas at a time when organisations were being prompted to choose between Unix/Linux solutions and Windows. This is less of an issue now as most organisations have settled on Windows".

"Very early on, I saw the potential of web-based applications. I committed to the methodology several years before it became mainstream, having previously been somewhat of a client-server guru. My strategy was therefore to develop a web-based architecture

which was integrated with the secure, stable Oracle database environment which was already established at Southampton and for which there was technical know-how".

"The new environment would be integrated with the new core hospital systems, including the PAS (Patient Administration & Patient Master Index), and Radiology (another departmental system operating in an isolated software bubble) The Suppliers were:
Interfaces - DataGate E*Gate (DataGate Inc, Jacksonville, Fl)
PAS – IBA (IBA Group, now in Prague, Czech Republic)
Radiology – Detente, under a prime agreement with IBA
Pathology – Berkeley (Berkeley Softworks Inc, Berkeley CA, later Geoworks Corporation)".

"UHS pathology reports were written and stored in a Ferranti Computer System from January 1990 to mid-1997. These were transferred to the Clinisys (previously Masterlab) Labcentre system when the SUHT Laboratory Information System (LIMS) went live in 1997".

The Origins of Speciality-Specific Clinical Systems on a Common Platform:
The HICSS Vascular Surgery and Renal Failure Test Modules (1998-1999)

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".

"I 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, Consultant Vascular Surgeon, had ambitions for an audit and outcomes database of vascular surgical cases.

"Liz Horkin and I agreed that I would develop two applications within a common framework as a proof of concept. These modules were a Vascular Surgery module and a Renal Failure module/application. There was also consideration of an endoscopy module and a diabetic module".

“I had sufficient understanding of human biology and medicine to appreciate that the processes and data for surgical and non-surgical healthcare are significantly different, although they share a substantial core of common elements, the patient being the most obvious. I therefore devised the first clinical data-model concepts which still underpin the current CHARTS applications today (to which we will return in later Essays in this series). These concepts of interventional and review-based events, which are supplemented by many other core entities, together define the electronic health record to a considerable degree”.

“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 Common Data Model (CDM) with key entities to support clinical activity”.

“It was 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. The CDM therefore had two particular elements, in the form of:
- a review based paradigm for patients requiring continuous care
- an intervention-based paradigm which typically had some limited follow-up activity”.

“Legacy data such as had been collected in the renal system was 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)”.

“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”.

“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 I shared a vision of expansion to cover many areas of the hospital”.

“The Vascular and Renal prototype applications were delivered in 6-9 months and they evidenced the various aspects of the strategy that Liz Horkin and he had formulated. The applications shared core system data, but they required complex and one-off interfacing techniques because generalised messaging such as HL7 had not really evolved beyond basic patient data at this time”.

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

Alan recalls that “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 contrasted the real time clinical role of the renal module with the vascular surgery module, which was 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, which was based upon the complexity of case mix and the referrals to individual surgeons.

He also highlighted 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.

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.

In consequence of the success of these two projects, Alan formed a limited liability company, Scorpio Information Systems (SIS) Ltd, 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. He assembled a small team of developers and programmers to work almost exclusively on the UHS project.

Alan Hales' Perspectives on Adapting IT Skills to Clinical User Needs

Alan notes that there remains a significant gap between the skills and necessary linear logic of computer and programming professionals, and the necessary probabilistic and uncertainty principles f clinical practice. This gap in perceptions, understanding and communication continues to undermine excellence in the development of healthcare systems. The gap has been bridged to a very considerable degree in Southampton by the effective co-location of programming teams and the clinical user base, and Alan has played a significant role in bridging that gap.

He notes that “IT/Computing from 1970 onwards was very much a mathematical and logically based discipline. Few user experience (UX) analysts, database designers and programmers had the scientific background in chemistry, biochemistry and life sciences which provide the foundation of clinical theory”.

“The systems, Information Technology and Applications developments across the NHS until 1997 were predominantly non-clinical. IT professionals were comfortable with handling patient demographics, numbers of outpatient clinics attended, number of procedures performed and broad-brush coding as for the ICD and OPCS clinical classifications standards”.

Editor’s note: *The International Statistical Classification of Diseases –ICD- was first mandated for use in the UK in 1995. It is now in its 10th Revision (ICD-10). It is produced and maintained by the World Health Organisation, the WHO).*

Alan continues: “However, IT professionals generally struggled with anything that required insight into clinical diagnostics, diagnoses, treatments anything more than labels or categorisations, the definitions of which, they often did not know or understand”.

“In consequence, progress with clinical computing was slow and haphazard. Most clinically oriented applications were developed by medical staff who did not have a professional computing education. Consequently, they created systems that were technologically diverse, non-scalable, lacking in good data-modelling and so on”.

“I was very ably assisted in the early stages by Angelo Colucci and by Kevin Hamer, who would go on to become the team leader/manager of the UHS My Medical Record programme. Angelo had had a successful early business career in developing internet browser add-ons to improve productivity. He had been hired by SUHT to work with Kevin in looking at novel clinical application developments. He provided niche expertise in getting browsers to do things that weren’t an inherent part of the product as supplied by Microsoft or Netscape. He struck me as an innovator who wasn’t constrained by the user manual”.

“Our proof of concept web applications solution interfaced to the Berkeley Computer Services Limited (BCS) Masterlab LIMS system. This 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 the 2020s, 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) were 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 emphasised the importance of the local innovation, in integrating diagnostic test and clinical data into one combined data system. He also emphasised that the design focus at that time in the class exemplar renal module was upon a clinical application rather than upon audit and research applications for their own sake.

He noted that “The pathology and radiology systems had been designed with no thought about data sharing with other systems, so we had to work with whatever existed. Southampton was nevertheless provided a rare and enabling working environment place where we could develop these ideas through a small group of open-minded IT staff who had already started to think about broader data models”.

“A key example of this far-sightedness was the "Clinical/Financial Information Systems (CFIS) and Casemix" application, which was originally an Oracle supplied application. It was later to be redesigned and developed in-house in Southampton by Ian Brewer and Richard Brooker.”

“The "Casemix" system did not extend to true clinical computing, but it did support clinical coding and upward reporting of cases. It thus had a solid foundation that could sit under an evolving clinical computing environment**.** The data-modelling of the administrative data had been done well and supported the core computing functions of the organisation well.”

“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”.

Adrian Byrne’s Recollections of developments in the late 1990s

During the late 1990s, Adrian was working as an IT Manager at UHS, initially on informatics projects around pathology services, from where he became increasingly involved in the strategic planning of the Hospital’s IT programme. He was promoted to be the IT lead for the Trust in 2004.

During a wide ranging conversation in December 2023, Adrian reflected on the impact on the UHS digital strategy of a range of centrally made decisions and plans at Government and Department of Health level back to 1992, when a series of Resource Management Projects were established with a focus on Patient Administration Systems, Nursing Systems and Casemix.

He noted that Casemix is a national system which is run by the National Casemix Office. It supports payments to healthcare providers, and it informs the National Tariff Payment System. The data which it collects also informs epidemiological studies and service planning, benchmarking and performance management. It is underpinned by the Healthcare Resource Group (HRG) classification system for hospital care, episodes and spells, and specifically for Admitted Patient Care, Non-Admitted Consultations, Emergency Medicine, Adult Critical Care, Paediatric Critical Care, Neonatal Critical Care and Renal care.

HRGs match patient events that are judged to consume a similar level of resource and allocate a five figure alpha-numeric code to each group. HRG coding is underwritten by the

Grouper national software system, which is updated annually. The coding was in turn informed by the ICD-9 (International Classification of Diseases, 9th Edition) system of disease codes until 1999, when ICD-10 was introduced to include mortality codes; and by the OPCS classification of interventions and surgical procedures.

The Importance of Accurate Information Feeds into Casemix

Adrian noted that "at the operational level in individual hospitals, income is therefore clearly and wholly dependent on the accuracy, efficiency and completeness of the administration of Casemix and HRG data. However, these processes also provide scope for optimising income in complex service provision".

Adrian recalls that "in the matters of Casemix and HRG coding, an investigation of the payments for cardiac services at UHS in the late 1990s highlighted serious underpayments for complex service provision. This highlighted the need to optimise the data management and reporting systems feeding from UHS into the national information systems".

"I also remember that on one occasion the Grouper changed and all of a sudden income for a knee operation dropped through the floor until we added back in a code for an individual piece of equipment or procedure that was used.

"We were very aware that you had to be agile and have full clarity in the way things were coded and passed through to the national systems, the Secondary Use Service (SUS). Data from this is passed also to Health Episode Statistics (HES) and ultimately comes back in terms of your outcome performance in the Good Hospital Guide - the HSMR and SHMI data".

"Ian Brewer therefore took on the roles of owner of the substantive data model, and Oracle Head Analyst, Tak Tang made major contributions to adapting the Oracle system for HICSS, the Hospital Integrated Clinical Support System. However, the key to this program was the work done by Alan Hales in building an innovative unifying prototype of HICSS as a consolidated data platform."

DLL Hell and the Origins of Web-Based Architecture

Adrian also explained the problem of PC based data processing on the many different clinical databases to which Alan Haleshad alluded in formulating the concept of HICSS. Adrian recalls that:

"The prevailing tendency was to rely on the PC to do the processing for the local user ("client side"). It led to a lot of applications running on a machine, where software libraries would be updated at different intervals. This became known as DLL Hell".

"DLL Hell described the complications that arose in working with dynamic-link libraries (DLLs) used with Microsoft Windows operating systems particularly legacy 16-bit editions, which were all running in a single memory space. It was such a widely recognised challenge that it has acquired its own (extensive) Wikipedia page."

"From this point, there were two possible approaches. One way was to let the work be done back on the remote server as in old "green screen" monochrome monitor days. The other way was to run the software on the PCs, using a virtual machine approach".

"This was the Citrix solution (Citrix Inc, Ford Lauderdale, Florida), which effectively gave each application/user a separate virtual machine. However, it was very expensive in licensing; difficult to manage in terms of things such as printing; and it didn't take us forward in technology terms".

" Later techniques of data processing are more tiered. Typically, they have a standard user client in the web browser, some middle logic in web servers, and a separate database server environment. This is much more scalable and manageable".

The implementation of HyperText Markup Language (HTML) protocols and Oracle

Adrian recalls that the key choices for the direction of travel in the late 1990s were driven by the collective determination to build the future Data Estate around internet and HyperText Markup Language (HTML) protocols. At that time the internet was evolving from "Web 1", the display of pages, to "Web 2", which permitted ease of interaction with web content, and hence the ability to conduct transactions across the Web.

He noted that: “There were two key players in the rapidly evolving Internet Browser market in the mid 1990s: Netscape and Microsoft Internet Explorer. Microsoft was more heavily invested in the development of the enabling technologies of the public internet. In general terms, systems were proprietary, and the purchase of any particular system locked the purchasers into that technology”.

He recalls that decisions were therefore made to acquire:

1. The Microsoft proprietary web enabling systems, including

- Internet Explorer as the browser;
- The Microsoft Visual Studio environment as a software development tool;
- Microsoft Active Server Pages (ASP) which was the first language in (1996) that was specifically designed for programming with dynamic web pages; and
- Microsoft Active X Controls, which allowed the development of small applications (for example Calendar display) in web systems.

2. The Oracle Data System and the associated Structured Query Language (SQL) for searching relational databases.

These systems also offered controls to security which were are a critical enabler of all modern computer systems. Adrian recalls initial challenges with achieving connectivity with the many “private” databases which were held by individual clinicians and units across the Hospital. There was necessarily a drive to integrate these locally developed legacy clinical databases into a logical framework which facilitated shared ways of working and consistency to store all clinical data against the core patient record.

Adrian also notes that: “The connectivity issues as I recall were using ODBC to connect Microsoft to Oracle. It all seemed quite proprietary or primitive. You had to use very specific versions as they were not "open". We did not really try to connect to databases that were there other than the large stuff mentioned. Our plan was to replace them with new modules”.

He recalls the early contributions to information integration of consultant clinicians Brian Leatherdale (Diabetes); Mary Rogerson (Renal); Chris Canning (Ophthalmology), Praful Patel (Gastrointestinal Endoscopy) and Iain Simpson (Cardiology).

David Cable's Recollections of the Early Years of the UHS IT service

David Cable is another long serving member of the IT team at SUHT/UHS. As a senior manager in the service, he has played a major enabling role in many of the original projects and systems described in this book.

I interviewed David on 5th January 2024. He recalls that he graduated in 1992 with a degree in Geography and English, with which he went to work for the London Ambulance Service (LAS) as an Information Department Assistant with responsibilities for data input on ambulance response times. This was the era of punch card data entry into mainframe computers, and desktop computers with 286/386 processors.

An automated despatch process for ambulances was implemented on 26th October 1992. Within a week it had locked up completely, forcing a reversion to manual systems. A detailed account of this episode, its history and aftermath was recorded by Darren Dalcher of the Forensic Systems Research Group at South Bank University in a paper titled Disaster in London: The LAS Case Study, published in April 1999 (Dalcher D 1999), to which I have previously referred in the first Essay in this series.

David left the LAS in March 1994 for a role at SUHT, with the PRINCE (PRojects IN Controlled Environments) programme. PRINCE was derived from an earlier project management methodology, PROMPT (Project Resource Organisation Management Planning Techniques). In 1989 the UK Government's Central Computer and Telecommunications Agency (CCTA) had adopted a version of PROMPT as a national standard for information systems (IT) project management, including hardware, security and professional development and knowledge of IT systems among central government staff. The CCTA was subsumed into the Office of Government Commerce in 2000, but PRINCE2 survives as a structured project management and certification system in various national and international programmes.

The specific requirement in Southampton was for an information officer to use a project management system to implement the PAS, Maternity and Radiology IT systems. Between 1994 and 1996, the PAS was purchased from IBA Health Ltd, An Australian Company, and a Radiology system was purchased from DETENTE Systems Pty Ltd, also an Australian company, which was taken over in 2004 by the Quadramed Corporation. It was not possible to source a suitable Maternity system at that time.

David's role evolved into the Radiology Project Manager, but he recalls the frustrated attempts to source a single supplier for the IT programme. This started the thought processes around building integrated systems in house.

Through 1999 and 2000, David had a further role in delivering classroom based IT training a largely IT-naive workforce at SUHT, passing on generic skills such as the use of a computer mouse, and the correct way to label specimen tubes to minimise data input errors. He reflects that the challenge of the optimum delivery and measurement of IT skills training and uptake has never been satisfactorily resolved, whether through printed manuals, on line interactive teaching, video presentations or all day induction courses for new staff.

Ian Brewer's Recollections of the Development of UHS IT Systems

Ian Brewer has spent much of his career at UHS in key roles within the IT Directorate. He recalls that:

"I started my career in 1984 working as a computer technician (and classroom assistant) at of high schools on the Isle of Wight, before moving to the IOW College of Art and Technology to develop and manage their student records systems... In 1991 I spotted a job at the SGH as a Casemix system manager and saw that they were looking for Oracle database administration, and Unix system management experience.

I had honed such skills in my last job and to my pleasant surprise I was offered the job. I figured I could cope with the 2 hour+ commute from Shanklin Old Village on the far side of the Island each day for a few months until something permanent came up on the Island. Little did I know that Southampton would show me that my hobby could actually become a proper career.

In 1990/91, the Resource Management project was established within the Hospital Finance directorate to implement a Casemix RM system, and a nursing information system to support electronic care-planning under Liz Horkin's direction as the project manager.

Within a year I was running a small technical team as the IT function grew out of the Resource Management project team that was established to implement Casemix and the Crescendo Nursing Information System.

In 1992, the Corporate Information Services department formed within what then became the Finance and Information directorate. Liz H became overall manager, and later Director of Computer Information Services and then Director of Informatics when the Informatics Directorate was formed as a separate entity to Finance.

Within CIS were two sections; Information Services under Ruth Gardiner (nee Grant), and Information Technology, with Rob Storey being brought in as IT Manager.

Also in 1992, the Oracle Casemix system went live with Clinical Studies and Contract Monitoring. The originally planned Costing system (PLICS as it would now be known) was abandoned in favour of contract monitoring. The Crescendo nursing system also went live.

In 1994, Nigel Armstrong took over as the IT Manager. Plans to implement an integrated Patient Management System, including replacement of the NCR Chart PAS, a Radiology management system, and a maternity system continued into 1995.

In 1995, we implemented the IBA Healthcare Unicare PAS and Quadramed (Detente Omnisys) Radiology system. Indeed, IBA Healthcare were prime contractor for the whole Patient Master System, which went live in March 1996 and which replaced the NCR Chart PAS. All data from Quadramed was migrated to the EQuest Results Server in 2010. The implementation of a maternity system was abandoned as no suitable solutions were found."

The Introduction of the first Trust Integration Engine (TIE) into the Data Estate

Ian notes that this period also saw the introduction of our first Integration Engine, Software Technologies Corporation (STC) Datagate. An Integration Engine works like a telephone exchange within the data management system (Figure 1). The TIE is designed to receive and distribute internal or external messages. Healthcare Integration Engines manage text, images, XML documents and other secure file types.The most recent iteration of the Integration Engine in the UHS system is the Ensemble product from Intersystems Healthcare (Cambridge Mass).

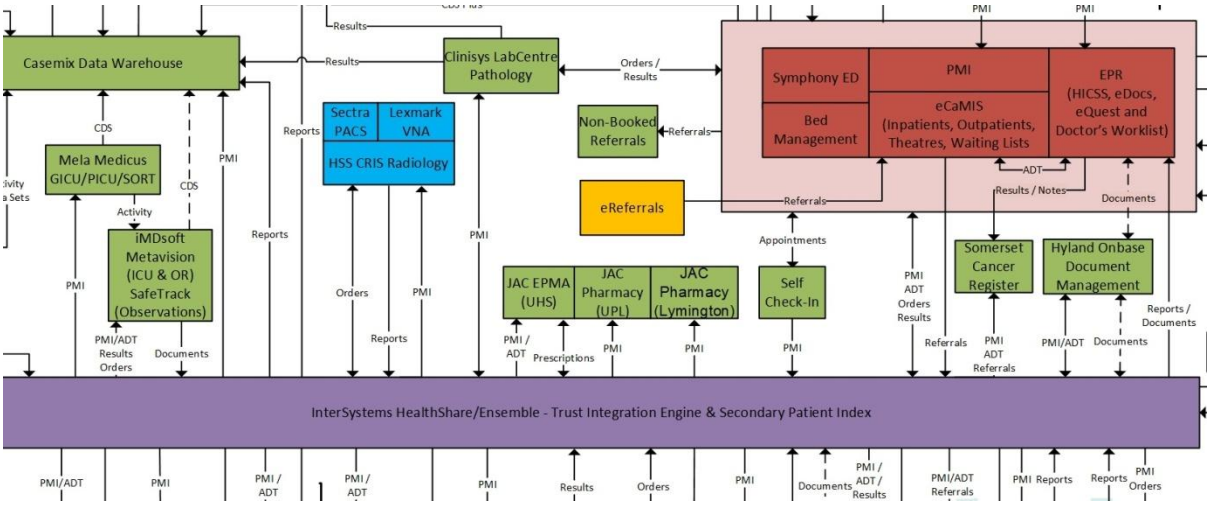

Figure 1. Ian Brewer created this system diagram in 2016 to illustrate the complexity of the UHS Clinical Data Estate. This image only displays the central elements of a much larger map. The Integration Engine is highlighted in purple. The pink/brown system cluster contains the principal user-facing EPR component systems.

Alan Hales comments on the strategy pursued by SUHT/UHS with the TIE:

“Most Trusts employ TIEs, but Ian was well ahead of the game and probably instrumental in UHS now having a TIE that is more extensive and far reaching than most other Trusts. The pros of using a TIE are significant in providing a universal "message broker" between disparate systems using libraries for common protocols (e.g. HL7v2, HL7v3, FHIR, DICOM etc) that don't need to be maintained in-house. It doesn't come cheaply, but neither would doing the same thing in-house, so cost is probably neither or a pro or a con”.

“The cons of the TIE approach need to be understood by those developing future strategies. These include the use of uncommon tools from the TIE product suppliers, with proprietary technologies and the rather esoteric InterSystems Caché database environment. This requires significant re-training of core computing personnel.”

“Ian is well placed to advise on this aspect of the project because he will have written numerous business cases for the TIE over the years, with the switch from E-Gate to Ensemble and the clustering (duplicate processors) of the hardware”.

Ian continues:
“In 1996 we also initiated a project to replace the Ferranti Argus based Pathology system. Adrian Byrne and Mike Ives joined the trust as the Pathology Project Manager and as the IT Operations manager respectively”.

“In 1997 I formed the IT Development team from a combination of IT and Information specialists. The primary aim was to demonstrate to the Trust (and to the Dept of Finance in particular) how much effort was needed to do an in-house development of Casemix, and contract monitoring in particular”.

“Also in 1997, Nigel Armstrong left and was not replaced. Mike Ives ran IT Ops, Adrian Byrne ran the Pathology system replacement for the Ferranti system and Masterlab (latterly renamed to LabCentre) was implemented. Mike Lawrence ran Networking”.

“ Liz Horkin made me the unofficial “Professional head of IT” when she needed a figurehead of IT to be rolled out. "Corporate Information Services" had grown significantly by 1997. My personal circumstances had also changed and the long commute from the IOW had turned into a local commute when I moved to the mainland and 10 miles down the M27”.

“ I was asked to establish a small development team to focus on developing solutions in-house for IT problems the Trust was facing. That function grew slowly, alongside the operational IT infrastructure team who looked after the core hardware, software and networking under the leadership of Mike Ives”.

“We started the integration of more of the Trust's systems, along with early iterations of our business intelligence capabilities, based around the Casemix system that I had run. In 1998, Liz reinstated the IT Manager role, to which Adrian Byrne was appointed. Work began in earnest in assessing the potential impact of the infamous Y2k Millennium Bug, whereby there were widespread legacy date coding would crash many software systems at midnight on 00/00/(20)00”.

“Our deep dive into the resilience of the Trust systems revealed some 270 “small” systems, many of which were running whole clinical services, whose “owners” had not wanted central functions such as IT to have involvement in them”.

“As soon as The Millennium Bug became an issue, they were rushing forward to raise their corporate importance. It became evident that we would not be able to support the necessary development and/or replacement of every system. We therefore developed a plan to create a solution in-house. This was to build around an integrated Patient Master Index (part of the UniCare PAS implemented in 1996) with access to pathology results via the integration with the new Masterlab solution...”

“In the end, The Millennium Bug amounted to very little, although it leaves me with a memory of seeing in the new Millennium standing on the back stairs of the Old Nurses Home with my late wife, watching the distant fireworks in Mayflower park while waiting for the panic phone calls from all over the hospital. They never came! A planning job well done, or possibly just a stroke of luck!“

“ Mike Ives and I continued to work closely together until his retirement in 2019, at which point his Infrastructure Department and my Development Department were brought together to form a single IT department, and my current role came into being.”

“My role continued to evolve, and I suppose that is a large part of why that temporary role I took back in 1991 became a three decade career. I've had a few comments from new starters who have joined since the start of the Covid pandemic, who have come from the

private sector (typically as Covid furloughed staff) about how they realised that they might have been working for big corporations on decent salaries, but had come to question whether their job was really giving them satisfaction and a sense of giving something back".

"We might not be the front-line staff who so rightly get the praise in the media for battling through often horrendous situations to do their very best for patients, but there is something deeply satisfying in being one of the "back-room-boys"."

"In summary, we have so far shown how forward planning and effective leadership from the early 1990s in Southampton created the context for meaningful progress towards an effective local form of the hospital EPR during the 2000s".

"We have also survived the grand attempts at designing a national computerised health environment which under-achieved through the same decade, as embodied in the experience of the UK NPfIT programme."

"We kept our systems running, and developed and delivered new solutions that hopefully make the working lives of front-line staff's just a little bit easier. And so here I was, 32 years later with a rebadged title of Associate Director of IT and recognition of the role of Chief Technology Officer for the organisation".

Summary

The contributors to this Essay have generously reconstructed from personal memories an oral history of the first decade in the evolution of the University Hospital Southampton clinical data estate, with all of its complexities and challenges, for which contemporary documentation is otherwise scarce.

This was a period of rapid technological evolution and diversification, when intelligent foresight and brave decisions which challenged collective wisdom in public and commercial healthcare computing set the condition for the sequential development of a powerful series of software tools which collectively contributed to the framework for an enduring and advanced Electronic Patient Record.

In the next Essay in this series, I will explore the development of the Southampton Clinical Data Estate over the decade of the first decade of the 21st century, 2000 to 2009. During which the Internet and its assistive technologies became globally embedded; the concept and possibilities of the Electronic Patient Record matured; and through which key enabling software systems were introduced and inter-connected at UHS.

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