Walter Sisulu University

PROFESSORIAL INAUGURAL LECTURE

25 JULY 2012
15H00
MTHATHA HEALTH RESOURCE CENTRE

Topic: Developing Health Informatics as a New Scientific Dicipline

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Auditorium, Mthatha Health Resource Centre, Mthatha, Eastern Cape

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WALTER SISULU UNIVERSITY
RESEARCH CHAMPION
PROFESSOR IN THE FACULTY OF MEDICINE
FACULTY OF HEALTH SCIENCES

TOPIC

DEVELOPING HEALTH INFORMATICS AS A NEW SCIENTIFIC DICIPLINE

BY
G WRIGHT

DATE: 25 JULY 2012

VENUE: MTHATHA HEALTH RESOURCE CENTRE AUDITORIUM

This lecture is predominately about the development of Health Informatics as a discipline and the author's involvement in this emerging academic subject over the last three decades.

What is Informatics?
The Oxford English Dictionary online states that information originates from:

"late Middle English (also in the sense 'formation of the mind, teaching'), via Old French from Latin *informatio(n-)*, from the verb *informare"*

As a teacher, I resonate with the notion of "formation of the mind". I could spend the whole of this lecture examining the meaning of the word "information" in different disciplines. However for the purpose of understanding its usage in this lecture information is defined as:

1. a sequence of symbols that can be interpreted as a message
2. data that has been processed and is understood by the recipient. (Wright and McKendrick, 1985c).

The Concise Oxford English Dictionary © 2008 Oxford University Press has defined "Informatics" as:
"informatics /□□nfə□mat□ks/
plural noun [treated as *sing.]*
Computing the science of processing data for storage and retrieval".

Bill Hersh states that his definition of informatics is

> "the discipline focused on the acquisition, storage, and use of information in a specific setting or domain".
>
> (Hersh, 2009)

David B. Shires from Canada, IMIA President 1980-1983, described health informatics as early as 1974 as being:

> "The study of the nature and principles of information and its applications within all aspects of health care delivery".
>
> (Shires, 1974)

Information has been part and parcel of medical behaviour for many years in the forms of textbooks but to illustrate information in research I will explore three interesting historical developments.

1. Epidemiology

John Snow in his 1855 publication "On The Mode of Communication of Cholera" presented data on the outbreak of Cholera collected in the residential area surrounding the Broad Street pump (Snow, 1855). He located the main drinking water supply to local residents as the source of the infection. Many recognize this work as the start of the science of Epidemiology.

2. Coding of Disease

The annual London Bills of Mortality listed only the numbers of burials as an early warning system against the onset of bubonic plague. The earliest London epidemic of the disease recorded in the "Bills" occurred in 1563 and killed between 20 and 25 percent of the population. Other facts were added over the next century.

John Graunt tabulated and studied the thirty-two years of data from the annual Bills from 1629 through 1660, and in 1662 he published *Natural and Political Observations Made upon the Bills of Mortality.* The volume used the Mortality Bills' list of eighty-one causes of death, and is considered the forerunner of today's international mortality classifications (Graunt, 1939). In 1837 the General Register Office of England and Wales was opened and William Farr was appointed as its first statistician.

In 1900, the first International Conference for the Revision of the *International Classification of Causes of Death* occurred with the participation of twenty-six countries. The list that was adopted had 179 groups of causes of death and an abridged classification of thirty-five groups and was called the "*International Classification of Diseases"* (ICD). In 1948 the World Health Organization took over the development of Health Statistics and ICD's have grown to 60,000 categories in *International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)* (WHO, 1992). This is a coding of diseases and signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases.

Chapter	Blocks	Title
I	A00–B99	Certain infectious and parasitic diseases
II	C00–D48	Neoplasms
III	D50–D89	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
IV	E00–E90	Endocrine, nutritional and metabolic diseases
V	F00–F99	Mental and behavioural disorders
VI	G00–G99	Diseases of the nervous system
VII	H00–H59	Diseases of the eye and adnexa
VIII	H60–H95	Diseases of the ear and mastoid process
IX	I00–I99	Diseases of the circulatory system
X	J00–J99	Diseases of the respiratory system
XI	K00–K93	Diseases of the digestive system
XII	L00–L99	Diseases of the skin and subcutaneous tissue

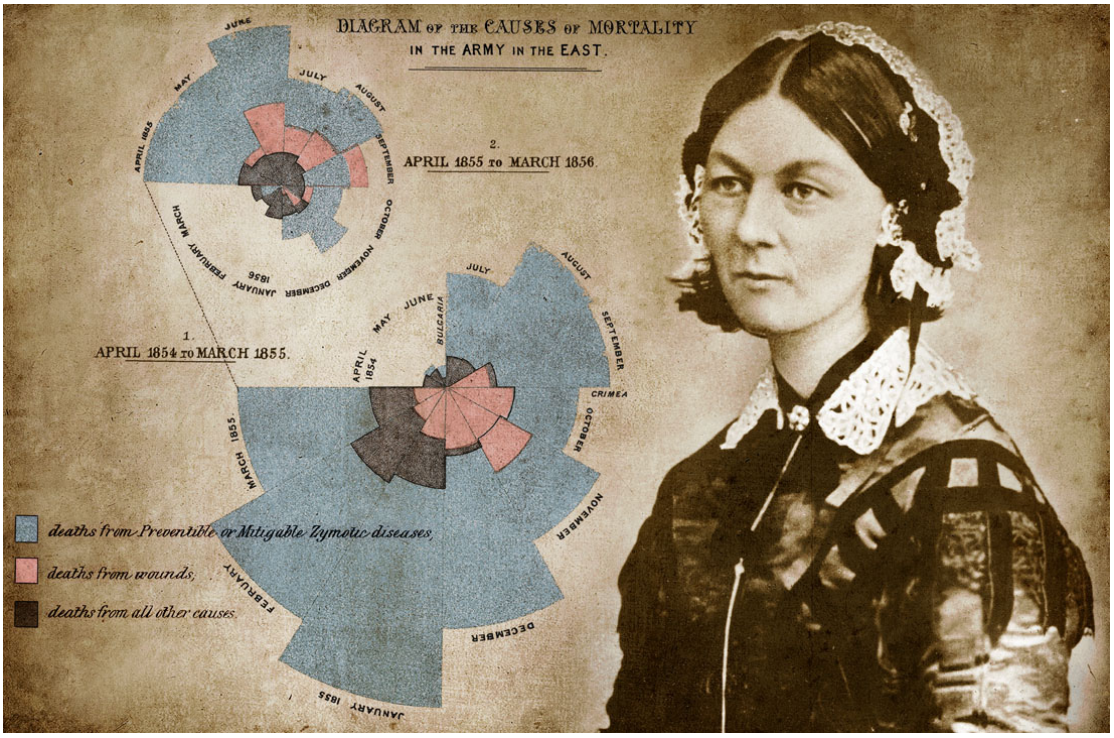
XIII	M00–M99	Diseases of the musculoskeletal system and connective tissue
XIV	N00–N99	Diseases of the genitourinary system
XV	O00–O99	Pregnancy, childbirth and the puerperium
XVI	P00–P96	Certain conditions originating in the perinatal period
XVII	Q00–Q99	Congenital malformations, deformations and chromosomal abnormalities
XVIII	R00–R99	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
XIX	S00–T98	Injury, poisoning and certain other consequences of external causes
XX	V01–Y98	External causes of morbidity and mortality
XXI	Z00–Z99	Factors influencing health status and contact with health services
XXII	U00–U99	Codes for special purposes

Table 1: Showing the Chapters in ICD 10

3. Mortality Rates and Hospital Data

In 1854 the British went to war in the Crimea and the Minister at War asked Florence Nightingale to lead a party of women to Scutari to help with the wounded (Betts and Wright, 2003). Cook (1913) suggests that her return signaled not the "summit of her attainment or the fulfillment of her life. Rather it was a starting point".

Nightingale was distressed by her experiences in Scutari and so analyzed the death rates and causes of death. She realised that the vast majority of soldiers need not have died (Cook, 1913).



Picture 1: Florence Nightingale with the Polar Diagram

The most famous of her statistical diagrams is the coxcomb designed to illustrate the causes of mortality in the Army in the East. It showed that most of the British soldiers died of sickness rather than of wounds or other causes. It also showed that the death rate was higher in the first year of the war, before the Sanitary Commission arrived to improve the hygiene in the camps and hospitals in March 1855 (Betts and Wright, 2003). In the hospital where Nightingale worked five thousand men died in the winter of 1854/5. Wounds and other causes of death were secondary (Betts and Wright, 2009).

In 1860 Nightingale wrote a paper on Hospital Statistics for the fourth International Statistical Congress in London. She maintained that standardised, accurate statistics would lead to improvements in medical and surgical practice (Cohen, 1984). The primary objective of her proposal was to acquire a standardised record of facts from which to calculate statistical results (Bishop and Goldie, 1962). Nightingale also urged the adoption of William Farr's classification of diseases for the tabulation of hospital morbidity in her paper, *Proposals for a Uniform Plan of Hospital Statistics* (Nightingale, 1860). Until that time only causes of death were reported but Farr recognized that it was desirable "to extend the same system of nomenclature to diseases which, though not fatal, cause disability in the population, and now figure in the tables of the diseases of armies, navies, hospitals, prisons, lunatic asylums, public institutions of every kind " (Farr, 1856).

Miss Nightingale developed the idea that social occurrences could be measured and mathematically analysed. Her statistical work earned great respect, which was recognised in 1858 with her election as a Fellow of the Royal Statistical Society and in 1874 an honorary member of the American Statistical Association (Betts and Wright, 2006).

Computers

Some of the modern technologies that we take for granted in our everyday lives have not been in common usage for all that long. The personal computer, or microcomputer, for example was first sold in large numbers in 1981. Prior to that mini and mainframe computers took up a whole room, which had to have air conditioning, and were extremely noisy.

In 1976 USA Presidential candidate Jimmy Carter and running mate Walter Mondale used email to plan campaign events and Queen Elizabeth II sent her first email at an army base, making her the first state leader to do so. The armed forces and academics mostly used the Internet although it was not called the "internet" until 1982.

Between 1978 and 1981 whilst working as a Nurse Tutor the author learnt how to program a computer and how to design basic systems. It was an exciting time with new developments seeming to occur weekly. It was during this time that he met and

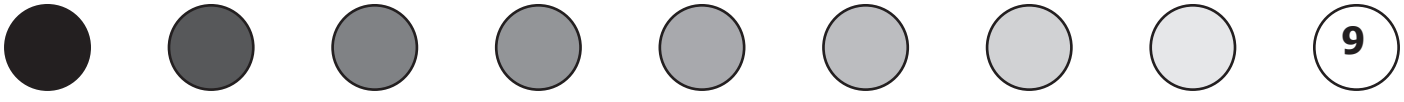
teamed up with David McKendrick, a nurse and fellow enthusiast. The author had seen a gathering momentum in the authorship of Computer Based Training material and thought that there needed to be a publishing company who would be willing to be author focused and also distribute the growing "Public Domain" collection of programs. Together they started the Open Software Library (OSL) (Wright, 1984, Wright, 1986) as part of the Warrington Hospital Computer Club in 1982. It was incorporated as a limited company in 1984 (Wright, 1986 Article first published online: 28 FEB 2003) and operated for 28 years mainly due to the efforts of David who became its full time Director. The author fulfilled the role of Technical Director spending many hours debugging programs and preparing them for publication and days copying the programs, which were written on a multitude of PC's, onto magnetic tape drives or 5.25 inch floppy disks for distribution.

A major issue at this time was the lack of portability of programs from one computer to another as they all had different operating systems, The author had some 20+ computers as each had to be used to make copies for the unique operating systems of the different computers. OSL looked for programs that would allow authoring of programs on one computer to be moved to another but only managed simple transfer with a version of BASIC programing language and Microtext, an authoring language, which was developed for the BBC computer and then adapted for various PC's and other microcomputers.

The Public Domain programs were distributed at many of the computer conferences during the early 1980's in particular the Healthcare Computing conferences run by the British Computer Society Health Informatics Committee and the British Journal of Healthcare Computing & Information Management, which attracted over 2,000 delegates and 4,000 visitors to the exhibitions and is still run by BCS Health.

By the mid 1980's the author had become recognised as an active computer expert following the publication of a commissioned series of articles by the Journal of Nursing. (Wright and McKendrick, 1985b, Wright and McKendrick, 1985f, Wright and McKendrick, 1985c, Wright and McKendrick, 1985a, Wright and McKendrick, 1985d, Wright and McKendrick, 1985e) and was invited to join a number of influential bodies which included an honorary fellowship with the Health Service Management Unit, at the University of Manchester. In 1986 the author gave his first International Paper at the European Federation for Medical Informatics Conference in Helsinki entitled "The rationalization of educational software resources in the UK" (Wright, 1985).

In 1986 and 1988 OSL ran two major conferences in conjunction with the National Health Service Training Authority at Keele University (WRIGHT et al., 1986, WRIGHT et al., 1988), The proceedings of "The Second National Conference on the Use of Computers in Health Care Education and Training", are widely accepted as being the first which were completely edited, published and printed electronically.



The conference papers included many on email and teletext systems with a paper outlining the current state of "Online services for communication and training in the UK" (McKendrick and Wright, 1988), which discussed a number of Online systems including the 300,000 page PRESTEL system and the OSL Health Services Bulletin Board System (BBS). The OSL BBS was set up in 1987 and ran until 2009; its main functions were exchanging e-mails and enabling discussion groups among the users of over 30,000 bulletin board services around the world.

To put this in context the growth of PC 's was in its infancy and it would be another six years before the birth of the World Wide Web (WWW). This then was the leading edge in UK computing and it was ahead of most of the world.

Joshua Quittner, a journalist writing in The Times Magazine in March 29, 1999 said of Tim Berners-Lee:

> "He wove the World Wide Web and created a mass medium for the 21st century. The World Wide Web is Berners-Lee's alone. He designed it. He loosed it on the world. And he more than anyone else has fought to keep it open, nonproprietary and free. ."
>
> (Quittner, 1999)

What Sir Time Berners-Lee FBCS did was to develop: -

- a system of resources on the Web Uniform Resource Locator (URL) and Uniform Resource Identifier (URI);
- the publishing language HyperText Markup Language (HTML);
- the HyperText Transfer Protocol (HTTP).

These three elements enable us to have web pages.

The first web page went live on August 6, 1991. It was dedicated to information on the World Wide Web project and was made by Tim Berners-Lee. It ran on a NeXT computer at the European Organization for Nuclear Research, CERN.

Picture 2: The world's first web server 1991

The first web page address was
http://info.cern.ch/hypertext/WWW/TheProject.html.

And this is what it looked like: -

World Wide Web

The WorldWideWeb (W3) is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an executive summary of the project, Mailing lists , Policy , November's W3 news , Frequently Asked Questions .

What's out there?
Pointers to the world's online information, subjects , W3 servers, etc.
Help
on the browser you are using
Software Products
A list of W3 project components and their current state. (e.g. Line Mode ,X11 Viola , NeXTStep , Servers , Tools , Mail robot , Library)
Technical
Details of protocols, formats, program internals etc
Bibliography
Paper documentation on W3 and references.
People
A list of some people involved in the project.
History
A summary of the history of the project.
How can I help ?
If you would like to support the web..
Getting code
Getting the code by anonymous FTP , etc.

The CERN site: - The website of the world's first-ever web server is available on http://info.cern.ch/ and it gives the following facts:-

> During 1991 servers appeared in other institutions in Europe and in December 1991, the first server outside the continent was installed in the US at SLAC (Stanford Linear Accelerator Center). By November 1992, there were 26 servers in the world, and by October 1993 the figure had increased to over 200 known web servers. In February 1993, the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign released the first version of Mosaic, which was to make the Web available to people using PCs and Apple Macintoshes.
>
> (CERN, 2011)

On April 30, 1993, CERN announced that the World Wide Web would be free to anyone, with no fees due.[

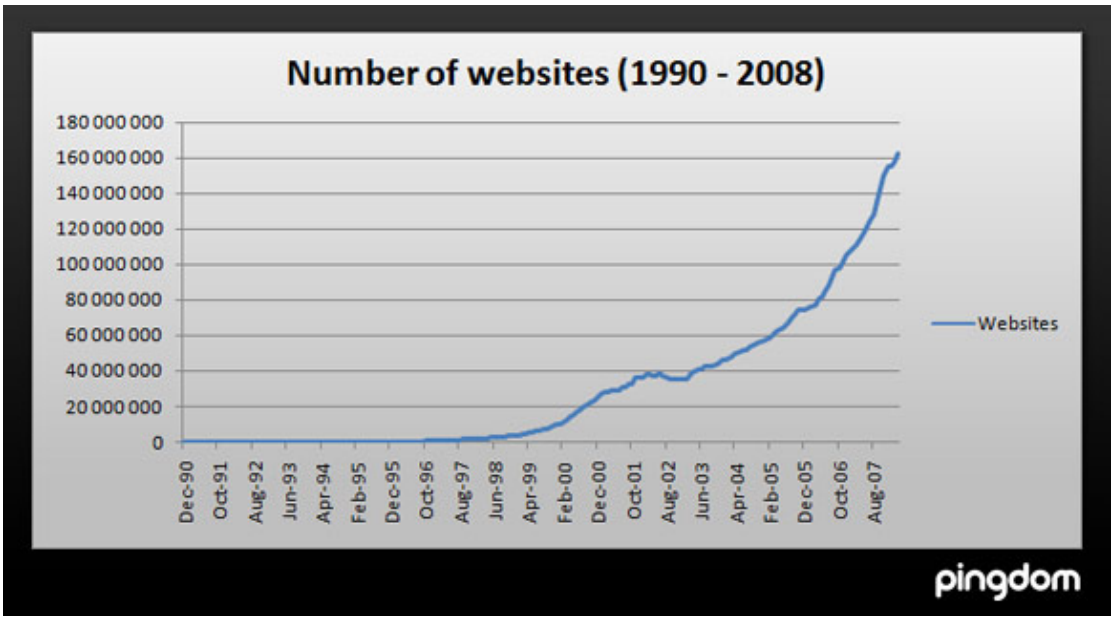


Chart 1: showing growth of WWW.
(PINGDOM, Posted in Main on April 4th, 2008 by Pingdom)

Sir Tim Berners-Lee founded the World Wide Web Consortium (W3C) after he left the European Organization for Nuclear Research (CERN). 1 October 1994 is the birthday of the W3C. It is now only 17 years old so not old enough to vote.

But he also had to travel the normal road of an unknown researcher; his paper for the Hypertext '91 Conference in San Antonio, Texas (USA) was only accepted as poster session.

Picture 3: the 1991 poster showing the World Wide Web for the first time.

The reader may be forgiven for thinking that the author would now start to use the Internet for publishing online materials and programmes. Fate was to intervene and take the author's attention into other directions.

System Failures

In 1988 the author was invited to become an Honorary Fellow at the Health Service Management Unit, Manchester University at the newly opened Centre for Health Informatics under the leadership of Victor Peel.

Greenhalgh Consultancy Limited (GCL) and the Centre for Health Informatics were commissioned to run a think tank for the Department of Health that was co-ordinated by the author. The group consisted of senior Health Professionals including the Dean of Liverpool Medical School, the Director of Primary Care for the NHS, leading GP's and Social Work Directors and was facilitated by Victor Peel and Christine Greenhalgh for monthly 24-hour sessions between 1990 and 1992. The group visited Sweden for a week to explore the Stockholm model of primary care and produced models that would support integrated purchasing of public services. The work of the group was summarised in a discussion paper for the Conservative Government (Greenhalgh et al., 1992) which at the time was facing an increasingly popular Labour party. Much of the paper was used in the Labour Party Health manifesto including the commissioning of services, which still survives along with the National Institute of Clinical Excellence (NICE).

However, one of the big questions at that time concerned the failure of health computer systems. The national view of computers at the time was of a very practical knowledge base about how to use a computer in the medical field and that if you could program a process then that is all that needed to happen.

Nevertheless at Manchester University there were teams with Management, Finance and Clinical backgrounds who were involved in a number of national evaluation studies mostly commissioned by the government because of lack of progress. They brought a new set of paradigms and started to show the linkages between IT, organizational structures, management, finance and patient care particularly following some major evaluation studies such as 'Project Glan Clwyd - Five years on: Clinicians in Management, Information Systems and Benefits' (Peel et al., 1995).

In November 1986 the NHS Management Board announced the piloting, at six acute hospitals, of the Resource Management Initiative. It was a new approach to resource management whose focus was on achieving, and demonstrating, measurable improvements in patient care through better use of all a hospital's resources. The full involvement of doctors and nurses in the hospitals was fundamental to the new approach to determining the cost of clinical care. In 1989, Ministers decided to establish a national Resource Management Programme covering all general acute Hospitals in England with more than 250 beds, around 250-260 sites in all. The evaluation of the Resource Management Initiative, undertaken by the Health Services Management Unit of the University of Manchester on behalf of the NHS Management Executive in March 1996, concluded that the objective of engaging clinicians in management was a success.

Conversely, it also concluded, that the IT component, or casemix, failed. In total, over three years, nearly £300 million was invested in the Resource Management Initiative ± more than £1 million per hospital involved in the programme.

There were a number of reasons identified in the evaluation that could explain why the IT element failed. Integrating the feeder systems to the casemix was problematic and very few sites managed complete integration. This meant that, in order to feed the casemix box with the data that it needed, hospitals began to employ low-paid data entry staff whose job was to painstakingly type the data in often, ironically, copying data from computer printouts generated by one computer into another that resisted successful integration. The technology was expensive and bulky. Casemix was retrospective and was considered a data collection exercise with little real benefit to the clinicians that were expected to `feed the beast'. They were parasitic systems, feeding on the data collected by any number of real operational systems, or typed in by reluctant operators. The data collection was retrospective. It was not real-time, up-to-the-minute data. And this meant that the data analysis was also retrospective and not real-time. It made the casemix box a data store that would only ever be useful in generating data extracts for managers.

A key component of the RMI programme, for example, was the necessary introduction into hospitals of new nurse care planning systems. These nursing systems were intended to provide additional data to the casemix about nursing interventions, essential if managers were to get an accurate understanding of resource usage. But the implementation of these systems did not deliver any real-time clinical benefit for the busy nurses who had to use them. Nurses considered them a data collection exercise that they could ill afford to do. Updating the database became a low priority, and the casemix system began to suffer from a shortage of data.

It was of no value to managers unless all the data was there, but this was an almost unattainable goal, and of no use to clinicians in the delivery of clinical care, if the system was not used in real time.

In a House of Lords debate in 1993 The Parliamentary Under-Secretary of State, Department of Health (Baroness Cumberlege) said:

> The noble Lord, Lord Cocks of Hartcliffe, is right to point out that it is the human element which is most important, especially in health care, and that nurses must not become slaves to data-hungry machines. It is fair to say that in the past many NHS computers have been used solely to produce statistics and their clinical application has been of limited value.

In response Tom Keighly, the regional nursing officer for Yorkshire RHA, has said that in Yorkshire over 1,000 copies of the learning programme "Using Information in Managing the Nursing Resource" are in use. Nurses are benefiting considerably from this programme run in several districts in conjunction with colleagues of higher education. (HANSARD, 1993).

The BCS history book UK Health Computing: Recollections and Reflections (Hayes and Barnett, 2008) on page 435 states that :-

> Probably the most well-known product to emerge was the Rainbow 1 Pack Using Information in Managing the Nursing Resource (Wright et al., 1994a) of whom Graham Wright, Christine Greenhalgh and Helen Jackson were instrumental in its development.
>
> Rainbow was accredited in a number of ways. In Scotland it was part of the National Board's Charge Nurse Diploma and was the basis for a Diploma in Using Information in Nursing at Manchester University and from there franchised by the University of Wales.

A report from the NHS in England identified it as "an excellent development programme for nurses, which was relevant in the NHS agenda, providing a flexible approach to learning" (NHSTD, 1993) The following year an evaluation of Rainbow in Scotland found that over a half of Colleges used the material and that there was demonstrable changes as a result of this training (Strachan et al., 1994).

Rainbow 1 sold 35,000 copies in the UK at a price of 70 GB pounds for a set. You can buy it on-line now for 29 GP pounds for each of the 7 booklets.

Problem Based Learning and Action Learning are two well-known approaches, which informed the development of the Learning material. Each of the Five Regional Health Authorities involved in the development had a facilitator from GCL who ran a Focus Group to generate the content outline. This reflected the skills and competencies required by the nurses, and midwives (Betts et al., 1994), to undertake specific roles and tasks related to Workload, Quality Management, Skill-Mix Management, Finance and Human Resource Management. The author was the facilitator for the Quality Management and the Workload Focus Groups. The core team then used the Focus Group outputs to produce drafts, which were based on their experience in Research and Development (R&D) and the prevailing literature (Wright and Kelly, 1995). The latter was somewhat scarce and there were no online search systems. GCL had been involved in a large number of R&D projects for the UK Departments of Health.

In 1991 the author had designed a workload analysis system using time and motion study software on a "Techtime board".

Picture 4: A Techtime data capture board

The observers captured some 2,500 events per 24 hours each. This included which healthcare worker undertook which task for a particular patient. The data was analysed in a spreadsheet using a framework devised by the author based on the Activities of Daily Living to enable results to be presented in terms of workload and skill-mix.

This methodology was used in a number of large-scale studies in the UK

- Skill-mix and workload analysis at University Hospital, Nottingham. (Baxter et al., 1993) This study included 15 wards and produced 140,847 recorded data items
- Partners in Care: the Interface Between Junior Doctors and Nurses; a Research Study for the Department of Health (GCL, 1994) which highlighted the number of hours junior doctors spent on tasks which could be undertaken by nurses and assistants (in South Africa they are now called Clinical Associates).

Thus the team at Greenhalgh had much experience in defining the needs of this emerging discipline and it was then natural for the company to look at Informatics Training in Europe.

IT EDUCTRA was part of the Fourth Framework Telematics Application Programme (Health sector). It was a 1million + Ecu R&D project to develop and disseminate the academic subject of Health Informatics. The author was originally one of the management team and led the research design and educational framework that attempted to answer the question: - "What do healthcare professionals need know about health informatics?"

In IT-EDUCTRA a number of worksets were defined covering the subjects that were deemed important by healthcare professionals in those countries who were interviewed during the Eductra programme.

Authors were contacted to write contributions in the following defined subjects:

1. Health care records in all their forms
2. Diagnostic methods
3. Health information systems
4. Management of the care of individual patients
5. The use of reference sources
6. Information for citizens
7. Administrative support to the direct patient care functions
8. Communication within health care
9. Informatics for strategic planning and modeling.
10. Database management as applied to health.

The learning material is available on CD-ROM (in the WSU Health Informatics collection in the Medical Library).

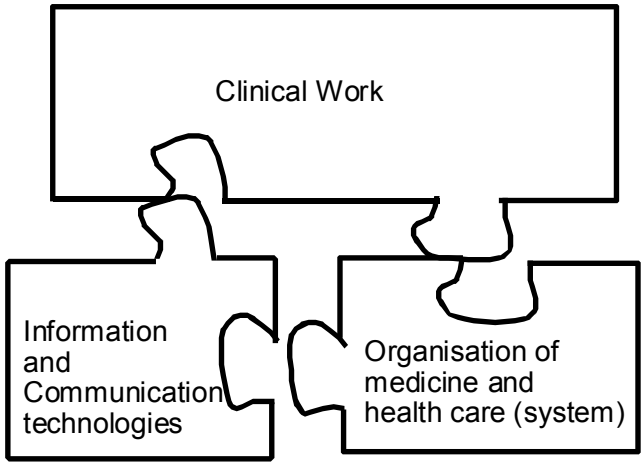
A Review of IM&T in the Nursing Curriculum (Higher Education provision)
Following the release of the NHS IM&T strategy in 1992 a study to review the Information Management and Technology (IM&T) provision within pre and post-registration nurse education was undertaken in September 1993 (Wright et al., 1994b). The review was sponsored by the NHS Executive and was the first national survey in England to assess the readiness of nurse education to provide programmes that addressed the emerging IM&T issues. The results indicated that 41 percent of respondents included computer skills in the curriculum. The NHS IMG adopted a number of the recommendations. The BSC NSG under the author's chairmanship then produced two Benefits Realization Monographs on Nursing and Midwifery systems for the NHS Executive Information Management Group (Eaves, 1995, Betts, 1996).

Review of IM&T in Higher Education
A second survey was undertaken in April 1999, based on the original questionnaire from 1993 (Betts et al., 2000) that showed little progress over the five years. The questions were updated and the focus was on pre-registration nursing and midwifery education only whilst the remit covered the whole of the UK. The report was submitted to the Council of Deans for UK University's Departments of Nursing.

So far the author has attempted to paint a picture of the state of Information Technology and Health Informatics in the UK during the 1980s and 1990s to illustrate the birth of a new environment and knowledge development. Many IT failures were being evaluated by the teams that the author worked with in Manchester University and long discussions were held at seminars and conferences resulting in two major papers involving the author.

A change from IT being seen as the major problem was highlighted in the ground-breaking work on organisational issues, Aarts, Peel and Wright showed how three different domains interact (Aarts et al., 1998). In health care provision fundamental changes were taking place in the practice of clinical work and in health care systems. Increased accountability, the demand for consistently high quality services, continuous improvements in health outcomes, cost containment and cost effectiveness were the main drivers for change. Information and communication technology was considered essential to enable the changes that would support high quality clinical work and enhance the cost effectiveness of the health care system.

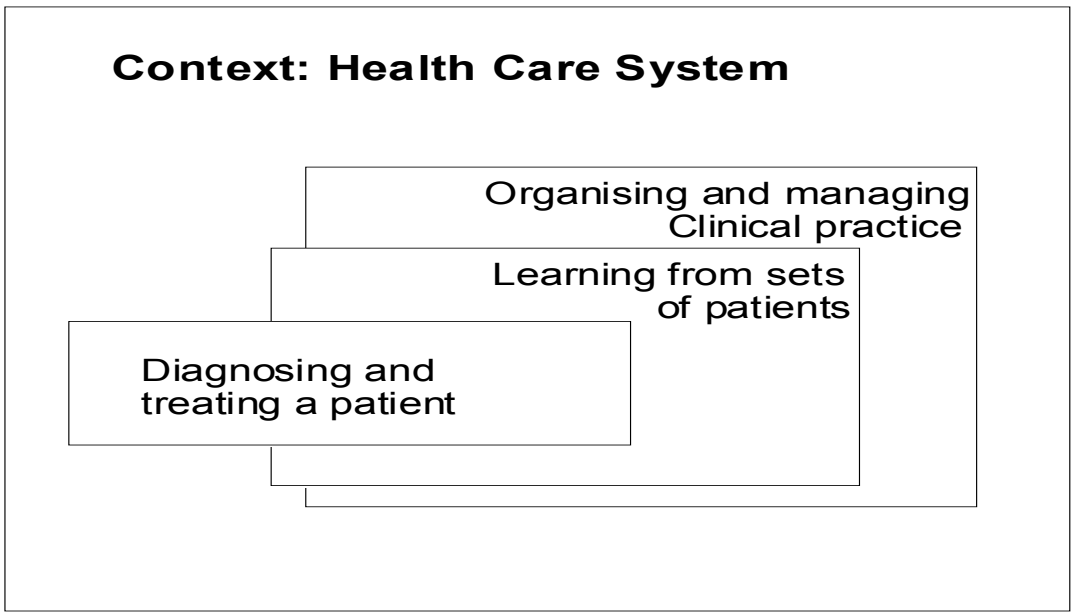
Health care needed leaders who were able both to anticipate and manage strategic organisational change incorporating appropriate information and communication technologies. They must be able to establish an effective 'fit' between the needs of clinical work, the health care system and information and communication technologies.



Three Domains Needing an "Effective Fit"

Clinical work by its very nature is information dependent. However, the richness and complexity of clinical information has been difficult to capture in computer-based information systems. The multiple 'connectivity' of thought processes involved in clinical decision-making and the practical skills of clinical practice are non-algorithmic. It is an iterative and largely intuitive, cognitive, emotive and manual process with highly personal and professional beliefs, values and attitudes, which are impossible to describe in a linear fashion.

Often the care process involves numbers of clinicians (Doctors, Nurses, and other health therapists) working in various organisational settings. Therefore, the impact of information technology on clinical work has not been as beneficial as was expected by the developers, suppliers and purchasers of these technologies. Similarly, the expectation of benefits for the wider health care systems that is at local, regional or national levels, of improved quality of care, cost effectiveness and cost containment through information technology have generally not been met.



The three levels of clinical activity which should be the focus of information technology in a health care system

The nature of independent and often idiosyncratic clinical work has meant that integrating clinical practice and information technologies whilst accommodating the managerial needs of the wider health care system has too often been inadequately considered. The subsequent implementation is also often poorly managed. Too often informatics staff have experience and insight at only one of these three levels.

"We argue that identifying information requirements, choosing, procuring and implementing such rapidly developing technologies have a social as well as a technical dimension. It is only relatively recently that the extent of this social and individual dimension has been recognised as critical to the successful implementation of health and medical systems and the realisation of their benefits. In order to successfully specify, select and implement information and communication technologies it is necessary to understand why previous projects have failed as well as succeeded." (Aarts et al., 1997)

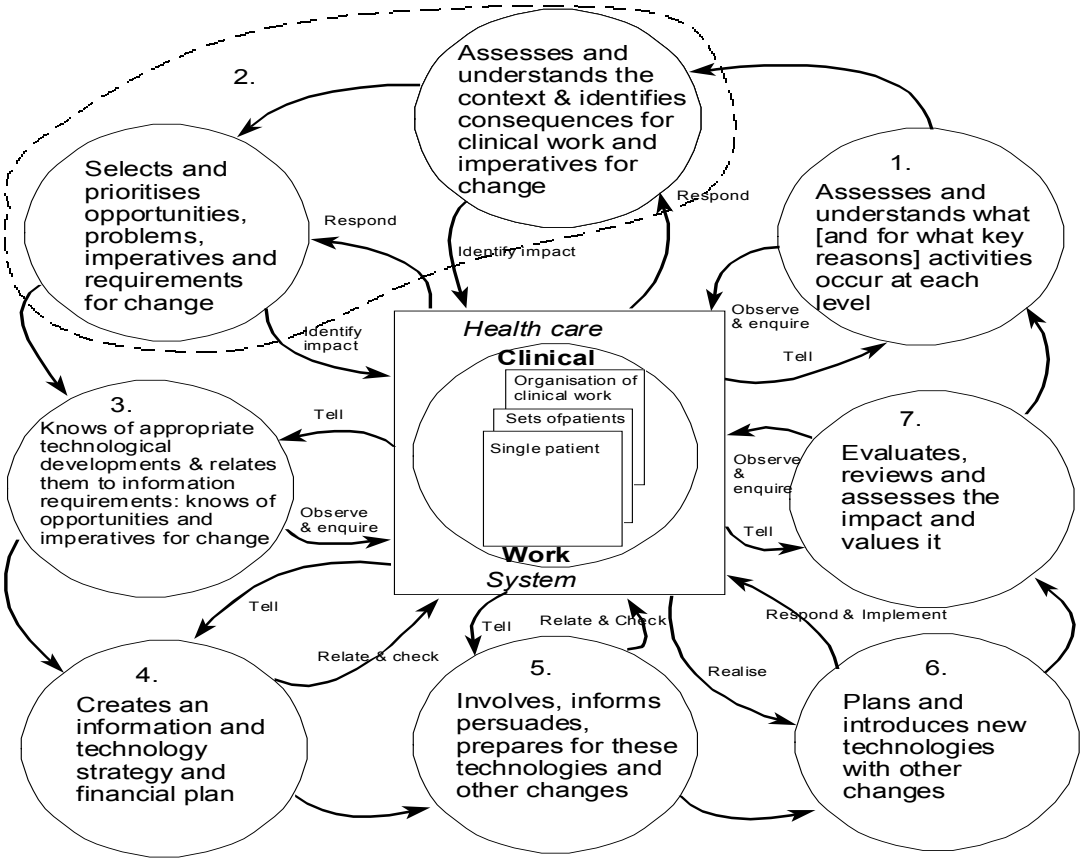


Diagram 1: Showing the Aarts, Peel and Wright model (Aarts et al., 1998)

The Paradox of Medical – Health Informatics

Yuval Shahar at an International Medical Informatics Association (IMIA) Invited Satellite Working Conference 'Challenges in Medical Informatics – successes and failures', Madrid March 2001 said: -

> "Health Informatics is having a mid-life crisis, it is a 45 year old profession wandering around the desert to find itself.
> (Roberts, 2002)

Shahar at the same workshop questioned whether medical informatics is a scientific or an engineering discipline. At the same workshop KC Lun considered that Health Informatics was a tool for the health and medical sciences rather than a science in its own right?" Van der Lei went on to suggest that "medicine identifies the area of research. Informatics identifies the methodology used" (Roberts, 2002).

This later statement prompted the author to consider in depth the question "if Health Informatics is a profession and discipline what is its unique knowledge base?" The research to "map the discipline" would help answer this question.

There are many titles for the discipline that are often used interchangeably: -

- Health Informatics
- Medical Informatics
- Clinical Informatics
- Nursing Informatics
- Bioinformatics
- E-health
- M-health
- Dental Informatics

A search using Google and Google Scholar reveals some interesting facts, particularly the massive growth of information on Bioinformatics that is predominately concerned with genomics.

Title	Results on Google
Health Informatics	3,190,000
Medical Informatics	3,920,000
Bioinformatics	33,700,000

Table 1: showing results of search conducted on the 14th April 2012

Title	Results on Scholar
Health Informatics	about **34,500**
Medical Informatics	about **243,000**
Bioinformatics	about **1,170,000**.

Table 2: showing results of search conducted on the 14th April 2012

Public domain, FLOSS and standards

In the 1980's it seemed obvious that there was a need for interoperability between systems and this has remained a main issue as computerised health systems have grown. An interoperable system can facilitate the sharing of information and knowledge between human users as well as participating software systems.

The growth of standard operating procedures and the adoption of international standard such as CEN and IEEE, the development of taxonomies, terms and coding systems has attempted to solve the interoperability problems through standardisation. The movement known as Free, Libre and Open Source Software, **(**FLOSS.)

Whilst working in Brussels for the European Commission as a member of the IT panel of Experts, Peter Murray, Jan Vejvalka and the author decided that standards for Open Source needed to be addressed and that a major platform was required to engage the international communities. That year a proposal was developed to start a working group under the auspices of the International Medical Informatics Association and the European Federation for Medical Informatics.

The *Open Steps* thinktank of February 2004, was facilitated by members of the Centre for Health Informatics Research and Development (CHIRAD) research team, led by the author and Dr Peter Murray. It was to be the first in a series of meetings planned by the Open Source Working Group of the International Medical Informatics Association (IMIA OSWG) and held in conjunction with the British Computer Society Health Informatics Committee, CHIRAD and other groups. Most participants were from the UK, although others were from The Netherlands, Czech Republic, Belgium and North America.

The main purpose of this 24 hour think tank was to identify key issues, opportunities, obstacles, areas of work and research that may be needed, and other relevant aspects, around the potential for using open source software, solutions and approaches within health care, and in particular within health informatics, in the UK and Europe. (Murray et al., 2005)

The research techniques used at this consensus meeting included small group work that developed and explored a number of possible scenarios for the status of FLOSS within health services, and the NHS in particular. The groups reported back to the main group and participants voted using an electronic voting system "Interactive Presenter" which was linked into a PowerPoint presentation. This provided instant visualization of the opinions of the participants. The Interactive Presenter system was also used to poll participants views on the issues and questions being discussed, and to reach consensus views.

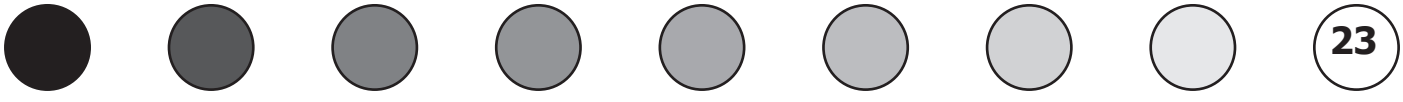
Findings from the Marwell meeting

Three quarters of attendees described their ideal vision for the future use of software in healthcare as containing at least a significant percentage of FLOSS; nearly one third wanted to see it entirely open source (Murray and Wright, 2004).

Following discussion and further voting, participants felt that the strongest drivers were:

- adoption and use of the right standards (the strongest driver);
- development of a FLOSS killer application (the next strongest);
- a political mandate towards the use of FLOSS;
- producing positive case studies comparing financial benefits of FLOSS budget reductions;
- sharing of learning and knowledge about FLOSS; and promoting FLOSS best practice case studies.

Participants rated the most important issues why people do and might use FLOSS within the health domain as quality, stability and robustness of software and data, as well as long-term availability of important health data through not being locked up in proprietary systems that do not allow interoperability and data migration.



The outputs of the Marwell meeting were used to inform a well-attended international discussion, held as part of the activities of the IMIA OSWG at medinfo2004 in San Francisco, USA in September 2004 (Murray and Wright, 2004). They also informed much of the International debate in the following years and were revisited in 2008 at the EFMI Special Topic Conference, which was organized by the same group of people from CHIRAD and the BCS. Graham Wright, Helen Betts and Peter Murray. (MURRAY et al., 2009) The MSc students from Walter Sisulu University, Mthatha attended the conference as part of a 10-day study tour. Many Governments including the South African, now have policies to encourage the use of the use of FLOSS.

Mapping the discipline of Health Informatics

The *Education Steps* think-tank meeting of 2005 in Otley, North Yorkshire was the first stage of this project initiated by the Health Informatics Forum (HIF) of the British Computer Society (BCS) and conducted by the Centre for Health Informatics Research and Development (CHIRAD).

The Otley meeting was an intensive 24-hour workshop involving small group and plenary discussions, with participants and the team in residence overnight. There were 24 participants, who came from a number of health informatics groups, including BCS Health Informatics Forum, BCS Health Informatics Specialist Groups, ASSIST (The Association of ICT Professionals in Health and Social Care) and IMIA (International Medical Informatics Association), the world body for health/medical informatics. Most of the participants were from the UK (and covered all four home countries), whilst others came from Europe, Australia, South Africa and the USA.

It was recognised, by the research team and by BCS HIF that there existed, from developments over the previous 5-10 years, and primarily funded through the NHS Information Authority (NHSIA), much good work relating to skills and competency frameworks for health informatics.

The CHIRAD research team set out to build a mapping of the discipline of Health Informatics as a cognitive mapping exercise. The author had worked though the research design and had spent three weekends explaining the method to the team who decided that an analogy was required to simplify the complexity of the model. Dr Betts came up with the notion of have ponds and ducks landing on various ponds.

As the members of the team had a strong background within the academic world, and had many years of experience in delivering education, designing curricula, and associated academic and scientific activities, including research and publication, they felt that the project should be situated within an appropriate academic context. It was therefore felt that a theoretical framework would be useful within which to locate the work of the project. Bloom's taxonomy was selected, as it is well known from health, medical and nursing curricula, and provides a hierarchical framework for categorising

levels of abstraction for objectives within educational settings, and maps well against other academic levels, e.g. progression from undergraduate to postgraduate levels.

Using the cognitive domain of Bloom's taxonomy, it was intended that participants in the Otley meeting would be able to collate the conceptual basis of health informatics to elucidate the elements that can subsequently be categorised as knowledge, comprehension, application, analysis, synthesis and evaluation. Participants were asked to familiarize themselves with documents such as the IMIA Scientific Content map, and any other relevant documents to which they had access. In addition, in preparation for the workshop, participants were asked to bring with them either:

- the module descriptions from any health informatics programme that they were involved with, which should include the aims and objectives or learning outcomes, and indicative content; or
- a list of the models, theories and laws, constructs and concepts that framed their understanding of the discipline of health informatics.

The team also emphasised to potential participants that the focus would be on education rather than training, and that we were going to explore the cognitive rather than psychomotor aspects of the health informatics discipline.

The ducks and ponds metaphor

The workshop aimed to capture all the elements of the discipline of health informatics, and also the broad themes or subject areas into which these elements can be grouped. It was at this point that the analogy of ducks (for the individual elements) and ponds (for the broad themes of the framework) was felt to be an appropriate way of helping participants visualize the tasks they would be undertaking.

1. Within small groups, participants identified the main subject areas (ponds) from their own lists, curricula or knowledge and experience.
2. Participants identified elements (ducks) of subject areas also within small groups
3. Participants assigned each duck to a subject area and where possible a level from Bloom's cognitive domain as a whole group activity.

Picture 5: putting ducks on the ponds

The first set of ducks and ponds

Using the metaphor of 'ducks' and 'ponds' to represent respectively the finer elements of the discipline and the broad themes within which those elements could be clustered, the discussions resulted in a first set comprising 221 ducks in total, grouped into 13 ponds.

1. Health and social care – care processes;
2. Health (care) records;
3. Health informatics standards;
4. Computer Science for Health Informatics (ICT for Health);
5. Health and Social care Industry;
6. Knowledge Domains & Knowledge Discovery;
7. Legal & Ethical;
8. People in organisations;
9. Politics and policy;
10. Terminology, classification and grouping;
11. Toolkit (systems);
12. Uses of clinical information; and
13. Uses of informatics to support clinical healthcare governance

Validating and Disseminating the Otley Outputs

This first listing resulted from a time-limited discussion among a relatively small group, albeit of nationally and internationally recognised experts. All participants recognise the provisional nature of this first list and the need for further reflection, and refinement of the list. They were invited to comment on the list, and to propose amendments, through a mixture of individual commentary and online group discussions.

The participants were excited by the possible uses of the outcomes that they listed as including:

- trying to answer the question 'is there such a thing as health informatics as a subject?;
- producing a position statement about the levels of elements;
- assisting in the maturing of the identity of the health informatics profession;
- providing the basis for a transferable credit rating system;
- bringing together education and training elements of health informatics;
- contributing to the academic rigor of the UKCHIP (www.ukchip.org) framework;

The initial outputs have been used in a number of ways including to help formulate an undergraduate biomedical informatics degree programme (Pritchard-Copley et al., 2006) and as a framework to classify scientific papers for the European Federation for Medical Informatics (EFMI) conferences.

Workshops to verify international interpretation

Workshops were conducted in 2005 at two major Health Informatics conferences, the European Federation for Medical Informatics MIE2005 in Geneva and the American Medical Informatics Association AMIA 2005 in Washington DC. They were short workshops and hence explored the overall concept and the clinical informatics theme only. Participants commented that there were no major issues with either the methodology used in phase 1 or the initial outcomes that should modify the direction of the project.

Another workshop to validate the outputs was held in Belfast in 2007 after a January 2007 workshop in London highlighted the size of the "Toolkit". This meeting focused on refining the technical and computing themes previously developed in phase 1 and successfully affirmed the two technical themes "Computer Science for Health Informatics (ICT for Health) and Computer Systems Applications in Health (Toolkit)". Thus the large toolkit theme was logically separated and participants from computer science who had expressed concern that the single large theme didn't reflect the computer science heading system were the main re-shapers of the two new themes. The final themes are shown in table 1.

Computer Science for Health Informatics (ICT for Health)
Health & Social Care processes
Health (care) records
Health and Social care Industry
Health informatics standards
Knowledge Domains and Knowledge Discovery
Legal and Ethical
People in organizations
Politics and policy
Technologies for health
Terminology, classification and grouping
Uses of clinical information
Using informatics to support clinical healthcare governance
Computer Systems applications in Health (Toolkit)

Table 3: The final 14 themes

The International Medical Informatics Association and the British Computer Society agreed to fund the next stage of this research, which would produce the IMIA Knowledge Base.

Extraction of keywords from the available published index papers on Health Informatics using computer software packages and techniques.

Scopus is the largest abstract and citation database of research literature and quality web sources with smart tools to track, analyse and visualize research. A search of Scopus was undertaken using a set of keywords that are descriptors of Informatics. The project's International Advisory Board agreed the key words:

- Health Informatics
- Medical Informatics
- Clinical Informatics
- Nursing Informatics
- Pharmacy Informatics
- Dental Informatics

The keywords within each article of the Reference Manager 11 database were exported as a series of files and then imported one at a time into an excel spreadsheet as in the raw data format the total number of keywords extracted exceeded the number of rows available in an excel worksheet. After processing the data to count the number

of occurrences of each keyword a master list of some 10,000 different keywords were identified, many of which were just English terms rather than Health Informatics specific, for example the authors' place of abode and conference venue or country of study. The use of keywords in many publications depends on author choice and often reflects the wish to have the article seen as being in a particular theme or subject area. This is particularly so with conferences that identify themes for the submission of papers. This activity produced a new set of data and so triangulated with phase 1 of the project in Otley that also produced raw data. In itself it was preparatory work for the next two phases of the project.

Workshop to examine and exclude keywords

The next phase of the project refined and reduced the raw data by removing keywords not directly associated with Health Informatics. The lists of keywords were given to information specialists, grouped into teams of three, at a workshop in London, UK in January 2007. The groups considered each word and excluded any that was not thought to be a Health Informatics term. Each word was tagged with the number of occurrences it had in the search. At the same time, keywords were assessed to see if they would fit into the existing cognitive map from the Phase 1 workshop (Table 2).

Theme	USES OF CLINICAL INFORMATION	
Element	Data analysis & statistical presentation	
	Automatic Data Processing	78
	Analysis	635

Table 4: Illustrating how keywords fit into the Theme and Element Framework and the number of occurrences of each keyword in the literature.

The participants in the workshop reduced the list of 10,000 words to 444. The number of occurrences found in the literature search ranked each keyword on the spreadsheet and small focus groups excluded words unconnected with health informatics. The remaining 444 words appeared to be connected with areas of Health Informatics as opposed to being just English words and phrases used to describe the content of the articles.

Voting in of keywords by international volunteers using a voting system based in an Excel spreadsheet

An Excel spreadsheet was constructed with a list of the keywords from which participants were invited to chose (vote in) those that were associated with Health Informatics. The complete spreadsheet together with instructions and examples of how to vote was emailed to the International Advisory Board, the IMIA working groups, the BCS specialist groups, and the European Federation for Medical Informatics (EFMI) working

groups. The voting was conducted with all of the keywords listed on the spreadsheet and a choice box next to each. The 444 keywords were divided into groups and each group was given a range of letters, A to G, H to M, N to R, S to Z. Participants were asked to complete the group that contained the Initial letter of their Surname. Thus Heather Carter voted on the columns A to G and Peter Ross voted on columns N to R.

Participants voted for about 100 words in their group. They were asked to vote for the keywords they thought were Health Informatics terms and classify them according to which Phase 1 theme they thought the keyword belonged by putting the number of the theme next to the word on the spreadsheet. Keywords that were consistently chosen were added to the original Phase 1 cognitive map. These final two phases used methodological triangulation to refine the data and match it with the output of the first two phases: the Phase 1 workshop and the international interpretation workshops.

The final spreadsheet, which forms the basis of the IMIA Knowledge Base, was hence constructed from the outcomes of the original Otley CHIRAD workshop to produce a Cognitive Map of Health Informatics, the subsequent phase to check international interpretation, a review and content analysis of the literature, and a two phase refinement following the extraction of keywords from the entire electronic published papers on Health Informatics.

The phases of the project in all took:

- data from different sources (people and electronic papers) – data triangulation
- using different research methodologies (workshops, electronic searches, electronic analysis, electronic voting) - methodological triangulation
- by different investigators (one primary investigator, with five secondary investigators) - investigator triangulation
- from different theoretical positions (grounded theory, educational theory) – theoretical triangulation.

Through using mixed modes of research within and between the different phases of the project the investigators and subsequently the International Medical Informatics Association (IMIA) Board and General Assembly were confident in the confirmation and completeness of the data through cross confirmation and validation from more than one data source. Triangulation strengthened the project and ensured the validity and reliability of the project outcomes. Nancy Lorenzi, Past President, reviewed the final draft version. She approved the work and thanked the team. The endorsement of the 'IMIA Knowledge Base' took place at the IMIA Board and General Assembly meetings of IMIA in July 2010. The final report and spreadsheet are available on the IMIA website in the section on IMIA Endorsed Documents (Wright, 2009).

Although the team therefore considers this project 'complete', it does not see what has been developed as a static entity. The nature of the discipline of health and biomedical informatics is continually changing, as is its interrelationship with other emerging disciplines. It is incumbent on IMIA to take account of these changes, and so the team view the IMIA Knowledge Base as an evolving entity, and hope that IMIA and others will explore ways of revising it so that it remains up to date and reflects the ever-changing nature of the discipline in which we work.

In South Africa we have use the IMIA Knowledge Base to help design a new Post Graduate Diploma in Health Informatics that will be provided at Walter Sisulu University.

I would like to conclude with a brief mention of social networks, such as Facebook, LinkedIn and Twitter which have spearheaded such an unexpected set of phenomena including the Arab spring uprising, the change in the way popular music is published and the leaking of corruption and maladministration by Governments on Wiki-leaks. The social changes are as surprising as the impact of IT in the banking system. Who could have forecast the advent of ATM's, digital money or 24 hour online banking from your own home?

The author started the Health Informatics Professional (HIP) member group on Linkedin shortly after starting work at WSU. This is the stated aim of the group:

> The aim of this voluntary register is to allow Health Informatics Professionals to take the first step and declare that they wish to be a registered Health Informatics Professional and abide by the code of ethical practice published by the International Medical Informatics Association (IMIA).

It now has nearly 1,000 members most of whom are recognised experts in Health Informatics from around the world.

In this lecture I have attempted to acknowledge the contribution others have made to my academic development in particular Dr Helen Betts (my wife), Dr Peter Murray, Dr Jean Roberts, Dr Jos Aarts, Victor Peel, Professor Denis Protti, Professor Sir Duncan Nichol, Christine Greenhalgh and the late David McKendrick.

In the year 2000 my wife nursed me through a serious illness that resulted in spinal surgery and my being absent from work for 6 months. I returned slowly to health over the next two years and moved from Surrey University to the University of Winchester as a visiting professor. I started the MSc in Health Informatics and returned to being active in the British Computer Society and the International Medical Informatics Association.

Our friends from South Africa Dr Sedick and Dee Isaacs invited us to visit Cape Town for a holiday in January 2004 and asked that I run a workshop for the Medical Research Council regarding the Clinical Information System that I had installed into a General Practice in England.

The MRC asked me to meet Prof Khaya Mfenyana to discuss the possibility of running the University of Winchester MSc for staff from the Eastern Cape at Walter Sisulu University in Mthatha. As you know he is a very determined man who inevitably achieves his wish, and so we came to Mthatha a dozen times over the next three years and took ten staff through the programme. Three years ago I was delighted to be appointed as a Research Champion in the Faculty of Health Sciences facilitating research and mentoring staff across the Faculty. We now have a group who are undertaking research in Health Informatics and a Post Graduate Diploma going through the approval systems. I am grateful to all of those WSU staff for giving me the opportunity to share my work with them over the last eight years.

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Citation
Professor Graham Wright is a chartered information systems practitioner with a clinical and managerial background.

He trained as a Mental Health Nurse (RMN) and then a State Registered Nurse (SRN) ending up as a Charge Nurse in an Intensive Care Unit, which was associated with Liverpool University, 1974 to 1979. He did his first research project in 1974 looking at the management of 'flail segments', which had killed all 13 patients admitted into the Unit that year.

In 1978 he was sent to Liverpool Polytechnic to undertake a Clinical Teachers course.

He was a Nurse Tutor, a Senior Tutor and then Acting Director of Nurse Education at Warrington District Hospitals School of Nursing from 1979 to 1990. It was during his Nurse Tutors course that leads to a Certificate in Education, that he learned to program a computer.

Diploma in Nursing	London University	1980
Certificate in Education	Leeds University	1981
Master of Philosophy	Council for National Academic Awards	1989
Master of Business Administration	University of Central Lancashire	1999

His MPhil thesis was about Assessment and Objective testing whilst his MBA thesis focused on the Benefits Realization of the NHS IT strategy. All of his master's work was completed whilst in full time employment.

He was awarded a Fellowship by Manchester University in 1998 and became an Honorary Fellow at the Centre for Health Informatics, Health Service Management Unit (HSMU), University of Manchester, 1988 to 1998

In 1990 he was invited to attend a three-day general management assessment centre and was found to have skills in consultancy. Just a week later he was head hunted by Christine Greenhalgh to be a Senior Managing Consultant with Greenhalgh and Company Limited, Macclesfield, 1900 to 1996. He ran the Education and Training division and 50% of his time was sold to Manchester University, where he ran executive programs and undertook research with Victor Peel's team at the HSMU.

In 1996 he successfully applied for the post of Director of Education and Profession Training for the European Institute of Health and Medical Sciences (EIHMS) at the University of Surrey, (employed as professor), 1996 to 2000. He was responsible for the amalgamation of seven colleges of Nursing, into Surrey University to integrate

with a University Department of Nursing, Three International Robens Research Groups and the General Practice Deanery from London University into the European Institute of Health and Medical Sciences. Other additions included another technical college (NESCOT) with 20 Nursing Programs and a Research group from Imperial University and a Master program in Chiropractic. EIHMS was about three times the size of WSU Faculty of Health Sciences and he was responsible for all education and training programs, finance, manpower planning, appointments and personnel issues amongst the 300 staff. He also led one of the five academic subject groups in the Institute, Management Science Subject Group, which included Health Informatics as well as Ethics.

In 2000 he moved to run an MSc Health Informatics as Programme Director and visiting Professor at the University of Winchester, 2000 to 2009. (Part-time) He delivered a program at Winchester and also at WSU in Mthatha, South Africa from 2005 to 2009.

He functioned as the Director of the Centre for Health Informatics Research and Development (CHIRAD), 2000 to 2009, responsible for all research and development activities. (Part-time)

He was appointed the General Manager, Hawthorn Medical Practice, 2004 to 2008, responsible for the strategic and general management of the Practice. (Part-time)

He was asked to become a GP Tutor, The Deanery at Swindon, Kennett and NW Wiltshire PCT, formerly at University of Bath, 2006 to 2009. (Part-time) Responsible for quality assurance and coordinating training practice approval visits and he was also responsible for post registration Continuous Professional Development for General Practitioners within North West Wiltshire.

Societies and Organisations.
He has held the offices of:

- Member of Council of Deans and Heads of UK Universities for Nursing, Midwifery and Health Visiting.
- Treasurer and Chair for the British Computer Society (BCS) Health Informatics Forum. 2001 to 2009
- Chair of BCS Nursing Specialist Group, 1993 to 1997, and NI-IMIA UK representative
- BCS UK representative to the International Medical Informatics Association (IMIA).
- CHIRAD representative to IMIA
- The chair and deputy chair of the IMIA Working Group on Open Source.
- The President of ProRec UK which is part of the EuroRec research project.
- Member of International Standards Group, Comeite Europeen de Normalisation

(CEN) Technical Committee CT251 and the British Standard Institute BSI technical committee during the late 1990's.

World Health Organisation (WHO) temporary advisor to the Department of Health, Israel 1993, where he helped to write the National IT Strategy and its associated Education and Research strategies. He did this by running a workshop in Hebrew.
He was The Technical Director of the Open Software Library Ltd (OSL) from 1982 to 2008

Honors
He was awarded a Fellowship of the British Computer Society and Charted IT Professional status in 2000.

He was admitted to the Royal Society of Medicine as a Fellow in 2008.

He was elected as a Fellow in the Royal Academy of Medicine in Ireland in 2008.

He was granted International membership to the Sigma Theta Tau Chapter of the Research Honors society at Capitol University, Ohio, USA in 1998.

Visiting Fellow at the EIHMS, University of Surrey 2001 to 2009.

He was invited on behalf of the University of Athens to be a Member of the Advisory Committee of the Department of Nursing at the Cyprus University of Technology in 2008.

He was a member of the European Commission Expert Panel for the 5th Framework program.

He was the editor of Information Technology in Nursing in 1998 and an Assistant Editor for the following decade.

He has been a member of the International Journal of Care Pathways Editorial Board for a decade and a regular reviewer for the International Journal of Medical Informatics.

Prof Wright's interest areas in research are Health Informatics, Management, Clinical Audit, Health Systems, Social issues and Care Pathways, and Medical Education. He has 16 invited keynote addresses; 25 peer reviewed papers; 3 research published reports; 10 chapters in books; 2 editorships of books; 37 published presentations; and numerous consultancy reports and unpublished presentations.

In 2012 he was rated by the National Research Foundation (NRF) as C3 which is seen as
"Established researchers with a sustained recent record of productivity in the field

who are recognised by their peers as having:

- produced a body of quality work, the core of which has coherence and attests to ongoing engagement with the field and
- demonstrated the ability to conceptualise problems and apply research methods to investigating them.

The reviewers assessed the national relevance and potential impact of Prof Wright's contributions most favourably; the development of Health Informatics as a discipline is a critically important area as there is a world-wide shortage of skilled Health Informatics resources, more so in developing countries. This is especially important in the current South African context, where there is a need to deal with the implications of the national e-health strategy and new National Health Insurance Fund. Reviewers commended Prof Wright's past, current and planned activities in the development of Health Informatics education, capacity building and research at Walter Sisulu University."

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