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THE SLOW ADOPTION OF MEDICAL INFORMATICS IN HOSPITALS

This paper examines the use of computing in hospitals and compares this with the use of computing in general practice. In the UK, virtually all GPs, i.e. doctors in primary care, use computers and computer-based records in their care of patients, whereas most doctors in hospitals do not [3, 25]. There are many reasons given for the lower use of computers in hospitals. It has been suggested that hospital medical activities are more complex than those in general practice and that there has been too little investment in hospital information and communication technology (ICT), two truisms. This paper examines and compares the different and contrasting theories that attempt to explain this phenomenum. The paper has relevance to (1) researchers wishing to migrate successful research from a 'research laboratory environment' such as in a medical school to a real-world setting in a hospital or a hospital clinic, (2) medical informatics researchers interested in investigating the problems of ICT implementations in hospitals, and (3) medical informatics practitioners involved in real-world hospital ICT developments.

1. INTRODUCTION – A BRIEF HISTORY OF THE ADOPTION OF ICT IN HOSPITALS

This paper reports on an on-going study and earlier research concerning the use of information and communication technologies (ICT) in healthcare in the National Health Service (NHS) in the UK. These earlier studies concern (i) the difficulties of migrating successful research from a 'research laboratory environment' in a medical school to a real-world setting in a hospital clinic [24], (ii) the causes of successes and failures in the implementation of ICT in healthcare [23], and (iii) the evidence that when new technologies, such as ICT, are implemented successfully (in a hospital) they are frequently not in a form envisaged by earlier researchers [26, 36] which is consistent with the hypothesis that the dominant use of new technologies comes as a surprise to both inventors and entrepreneurs [36] . This paper, based on these earlier investigations, considers the less successful take-up of ICT in hospitals compared with their common presence in general practice [3, 25].

Implementing hospital information systems (HIS) has a long and problematic history – it has never been easy. The first-ever HIS to support patient care indicated a difficult future for HIS. This pioneering entrepreneurial venture, implemented between 1971 and 1974, was the work of design staff of Lockheed Missiles and Space Company. They implemented a HIS at the El Camino Hospital in California. The HIS designers, with aerospace backgrounds, were highly experienced in

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computer-based systems where the solution and emphasis were focussed on solutions of technical problems. As a consequence of El Camino they were some of the first designers to face the other factors that control progress in health-care organisations, i.e. little-recognised and little understood non-technical, organisational and human factors. This implementation, although legendary for the difficulties encountered had a successful outcome [17], and resulted in the conclusions shown in Table 1. It is said that "Those that do not learn from history will be forced to re-live it". Since then, experiences over the past three decades, throughout the ICT industry and within healthcare computing, have indicated that the HIS community have, at the best, been poor learners, and consequently have re-lived many of the painful 'El Camino' experiences. A typical example is the IS plans of the Wessex Regional Health Authority – a disaster that after 8 years' work produced nothing but cost £43 millions [6]. Unfortunately, these problems exist in many countries throughout the world, and in the public and private sectors.

Tab.1: Lessons from the implementation of the El Camino information system.

IMPACT*:* The introduction of an MIS into a hospital has a profound impact on the *human* organisation to perhaps an unparalleled degree [17].
MANAGING CHANGE: The need for extraordinary attention to the management of change in a human organisation that is essential if an ICT-based project is to be successfully implemented.
BENEFITS: Users – not the ICT – save money.
MOTIVATION of DESIGNERS: The motivation of systems builders should be to provide both (i) an incentive to users to acquire and use an IS, and (ii) a return on investment to the builders of the software that will attract further resources for later developments of the IS.

These problems may also have a knock-on effect by causing some users to be 'risk-averse'. In the case of hospitals, have they deterred hospital personnel from experimenting with new ideas? In the UK, most GPs use computers and computer-based patient records, but most hospital doctors do not [3]. The hospital electronic patient record (EPR) is more complex than the GP patient record. Nevertheless, it is surprising that while it is recognised that the EPR is an essential technology for healthcare [19], it is only now that the EPR is starting to be used across Europe [22].

Tab.2: How General Practitioners use computers [36].

Registration	98%	Audit	77%
Repeat Prescribing	94%	Consultation	63%
Clinical Records	90%	Referral letters	51%
Call and Recall	84%	Clinical protocols	29%
Annual Reports	80%	Accounts	24%

The problems are, of course, wider than the EPR and these wider problems, e.g. of the sub-optimal use of computing in hospitals, exist in many countries. The problems were identified in the 1980s in a Council of Europe research study [8]. This said:

"Hospitals, over the past decades, while evolving into technical centres for patients needing acute care …. they [hospitals] have benefited less than other business sectors from the advances and dissemination of informatics and information sciences", and

"Hospitals are still isolated institutions where changes take place more slowly than outside hospitals i.e. the traditions are stronger and more difficult to change."

Now that we are at the beginning of the millennium, has the position changed since the 1980s? Perhaps not. In the UK, a recent review for the Government commented on the poor record in health services of the use of ICT. The report, consequently, called for an immediate and huge increase in the expenditure on ICT in the NHS. The review proposed that the expenditure on ICT should be doubled from the current £1.1bn to £2.2bn in 2003-2004 and increasing to £2.7bn in 2007-2008. This is within a context of the total NHS budget increasing from £65.4bn in 2002-2003 to £105.6bn in 2007-2008 [37].

The slow uptake of ICT in hospitals appears to be similar in the USA. This is illustrated by the statement related to ICT usage in American hospitals from the Institute of Medicine saying "IT must play a central role for improvement in quality … IT has barely touched patient care" [19].

2. USING COMPUTERS IN GENERAL PRACTICES – THE LESSONS LEARNED

It has been found that 98% of UK GPs are computerised and use an EPR system. These practices use computers for a wide range of tasks, as shown in Table 2. The general practices are advanced in terms of computer use, and are fast moving towards the goal of being paperless – they are a great deal closer to this than their equivalents in the USA. This has been made possible through GP investment in ICT, heavily subsidised by the British government [5].

Based on this experience of GP computing over two decades, it is possible to identify some benefits and issues related to physician use of computerisation and the EPR in the patient-doctor encounter [3, 29, 35]. These are shown in Table 3.

Tab.3: Benefits and issues in the patient-doctor encounter when using computer-based tools.

Benefits	Detrimental effects on the consultation
1. Quality of care	1. Increased time for the consultation
2. More appropriate use of drugs	2. No measurable patient satisfaction
3. Better management of chronic physical .illnesses	3. Increase in doctor content - reduction of patient initiative and social content
	4. Can prevent doctor from developing empathy with patient
	5. Confidentiality concerns increased

In addition it is recognised that current informational retrieval systems are too slow for busy clinicians to address the myriad questions that arise in clinical practice. Over the past two decades hospital physicians and GPs have had available similar computing technologies. GPs have accepted computer-based systems, far from perfect, and used these with considerable success. Why is there this wider acceptance in primary care? A simplistic answer is that the benefits to patient care and patient management, despite the inherent risks, outweigh the problems. GPs have accepted computerisation, perhaps welcomed it, because it not only provides an EPR but also gives wider benefits, such as patient management and information on drug interactions. Because of this success in general practice, it might be concluded that hospitals have not used the available ICT to make the progress in using computing that they should have achieved.

3. ICT IN HOSPITALS – SHOULD THERE HAVE BEEN WIDER ADOPTION AND GREATER PROGRESS?

In 2002, in the UK 76% of hospital clinicians use the NHS Net for e-mail and browsing, but few hospital clinicians use EPR systems [32]. This is in marked contrast with GPs, as illustrated in Table 2. However this picture - of large differences between GPs who are major users of computing and hospital clinicians that are minor users – is one that is common in countries where the GP acts as the 'gatekeeper' and controller of access to secondary healthcare through 'referrals' [11]. This occurs throughout northern Europe. This low utilisation in hospitals would not be expected in an ideal world because there is a vast range of potential applications in a hospital as shown in Table 4.

Tab.4: The range of applications that a HIS could provide.

1. Patient care	4. Accountability and audit	8. MIS for comparison of performance and other needs - for example with local, national, regional and international performances.
2. Preventive care, i.e. call, recall and follow-up.	5. Management and financial control.	
3. Decision clinical support	6. Legal evidence.	
	7. Research and trials.	

The applications shown in Table 4 are not always available in hospitals because there are greater difficulties in hospitals than in the GP operation. These difficulties include:-

- The complex workflow, job specialisation and division of tasks and sub-tasks combine to create complex patterns of information usage within a hospital. Even the mode of use can be different in different departments, e.g. in accident and emergency, out-patients and intensive care unit.
- In a hospital there are a huge number of different clinical specialties.
- The hospital EPR has greater and wider use.
- Hospital coding and medical classification of clinical terminology needs to be complex to provide the multiple hierarchies and the ability to classify concepts from different perspectives. Agreement on terminology and classifications has caused difficulties in the past [23, 30]
- There are likely to be many different computer systems in a hospital – connection is not easy.
- Confidentiality, which is less of a problem in GP computing, becomes significant in a hospital because of computing availability in a hospital being 7 days per week for 24 hours per day by 100s of users [4, 25, 33].
- Another problem seldom mentioned in the literature is that staff turnover is greater in hospitals than in general practice. Therefore, staff are less willing to learn about computer systems that will not play a permanent role in their professional work. The hospital, too, does not have the same commitment to training migrant staff.

These points do not imply that hospital computing has not had its successes, but it does outline the size of the obstacles that must be overcome before a successful HIS can become operational. Successes have been achieved in smaller implementations such as in individual departments of a hospital, where the scope of application is less global, more manageable and better understood [32].

However, over the past two decades while the introduction of PCs into general practice has brought great benefits to GPs [3], hospitals have been unable to produce similar successes. During this period, few hospitals have been able to fund or to install the number of computer workstations that would be necessary for providing clinicians and other users access at anytime and anywhere

within the hospital. Therefore, it is not surprising that independent reviews have (i) identified a shortfall in hospital computing facilities and (ii) indicated the need for a huge increase in ICT investment in UK hospitals [16].

4. AN INCREASE IN ICT INVESTMENT – IS IT SENSIBLE?

There is support for the NHS ICT initiative and recognition that things must change [2]. As might be expected there have been some that have expressed concern because of past ICT failures [9, 23]. Nevertheless, many believe that this is a 'revolution' long overdue. For example one hospital clinician has said:-

> "The initiatives are to be applauded. A good IT system could free doctors' time much more than any other proposed re-structuring."

A GP added a note of caution:-

> "It is a good idea in principle but reputations will crash if it is not implemented in a way that meets the needs of patients and clinicians." [10] (It should be noted that the initiative has the personal interest and backing of Tony Blair, the UK Prime Minister.)

The financial size of the initiative is unprecedented in NHS ICT history. The plan is to embark on a massive nationwide investment in ICT to improve healthcare provision costing £13 billions over six years. It will support new projects including e-prescriptions, EPR and e-appointments using new technologies many of which have been successfully used in e-business [9, 16, 26]. Outcomes will include:

- By 2005, GPs will be able to help patients by making on-line appointments with hospital consultants.
- To support the on-line appointments, and for other purposes, there will be a broadband connection between hospitals and GPs; and primary care trusts – i.e. groupings of GPs – will have a minimum speed connection of 2 Mbps.

This will increase the ICT expenditure of the NHS by a large amount and bring the NHS ICT budget more in line with similar organisations, e.g. the Kaiser Permanente, a successful Californian health maintenance organisation, proposes to spend 2% of total budget on ICT over the next 5 years. Kaiser has demonstrated that greater efficiency can be achieved through greater investment in ICT [13].

The planners in the NHS are aware that these huge projects - e.g. e-prescriptions, EPR and e-appointments - carry the potential of many problems if not failures. Therefore, safeguards have been taken to reduce risk, such as:

- Allowing only major companies to tender for projects that will cost £1 billion over 5 years.
- Demanding that all components will be tested in a simulation of a live NHS environment especially for compatibility.

It must be remembered that these projects are infinitely more difficult than simply upgrading software or loading new software [6, 10, 23]. These projects require this scale of management control.

5. WHAT IS REQUIRED TO ACHIEVE SUCCESS?

In this section, different guidelines and recommendations that have been formulated to assist healthcare computing users to achieve success, are presented and examined to establish whether or not the present circumstances in the NHS are favourable for the NHS ICT initiative.

5.1. SATISFACTION OF USERS – DOCTORS, NURSES AND PARA-MEDICAL STAFF

If users expectations are met then there is every possibility that an ICT development will have a satisfactory outcome. In this context, one hospital clinician has outlined what he would expect from a HIS. He indicated that he would enthusiastically support and use a comprehensive facility, as outlined in Table 5 [28].

Tab.5: The features that would tempt hospital clinicians to compute [28]

1. Readily available.	4. Accessed quickly.
2. With all patient details and complete medical history.	5. Security, effective and sensible.
3. Pathology results.	6. Use of e-mail internally and from home, plus Internet access.

A second hospital clinician said “Medicine is critically dependent on accurate comprehensive data for good clinical management, audit, research, teaching, administration, financial control, general management and statutory and legal needs. Computer technology offers solutions to the huge accumulation of data in specialty and hospital, *yet it has not yet been fully exploited*.” However, more importantly this same doctor said “The proper foundation for healthcare computing should be a clinical IS based on the individual patient”, that is the EPR [32]. The clinical IS that this doctor envisages covered (i) clinical management, (ii) clinical administration, (iii) clinical services and (iv) general management.

The NHS ICT development programme outlined above in Section 3, has aims that clearly aspire to satisfy the requirements of both doctors. One therefore might assume that the new ICT initiative is appropriate for end users. The question that remains to be examined relates to whether the design and implementation of these new ICT developments will be realised successfully.

5.2. HAMMOND’S CRITERIA FOR SUCCESS

Hammond [14] makes a case for certain factors being present for successful implementation of ICT projects. These include (1) healthcare providers with a shared vision of the electronic medical record, (2) agreement regarding which objects will be collected under given circumstances in order to create comprehensive datasets, (3) a trusted technological infrastructure, (4) a finely grained comprehensive medical vocabulary, and (5) guarantees for the protection of confidentiality of patient data. These criteria are easier to satisfy in primary than in secondary care. Primary care is a contained environment with small groups and populations, which provides a natural setting in which a consensus vision can be nurtured and agreement reached on datasets. The hospital scenario is considerably more complex. The personal computer alone, or perhaps networked, provides the trusted technological infrastructure for the general practitioner, whereas that required for a hospital

is more costly and extremely more difficult to engineer. As for a medical vocabulary, the history of the Read Codes [23, 30] shows that a vocabulary, Read Version 2, could be established for primary care painlessly – the equivalent for secondary care, Read Version 3, has been problematic [23].

In the past, the problems alone of a medical vocabulary would have been an insurmountable problem. However, perhaps the problems of medical vocabulary [23, 30] have been overcome with (i) time and (ii) through a combination of Read Version 3 and the SNOMED clinical terms. In 2003 in the NHS, are the problems of the medical vocabulary solved? If so, then the NHS ICT initiative appears to be able to satisfy all of Hammond's criteria for success.

5.3. INCENTIVES

A second view regarding the factors that create success, highlights 'incentives' i.e. incentives to (i) doctors and (ii) their organisations in this case hospitals. This hypothesis is based on the observation and assumption that UK GPs absorbed ICT into their practices over some 20 years because of government incentives to computerise and to remove barriers [3]. In addition to government incentives, the researcher recognises the need for professional leadership. Other factors were the incentives of (i) free PCs and (ii) possibly increased remuneration. Will the presence or absence of incentives be critical in this new ICT initiative for hospitals?

While recognising the effect that incentives and remuneration can have on staff, perhaps it is important to remember that there is a great deal more to successful implementation than remuneration. The relationship between money and motivation is complex. In fact, 'incentives' are best considered as 'motivators'. The work of Herzberg and McClelland [15], the celebrated management researchers, point to the important motivators of achievement, power and affiliation. In the context of the success or failure of the current NHS ICT initiative, will the impact of remuneration and incentives [3] be critical? Or will the McClelland motivators be more important? With respect to the organisations, the hospitals, as opposed to the individual hospital doctors, the huge funding of ICT that comes with the new plans should be sufficient organisational incentive.

5.4. SCALABILITY

Another perspective on success relates to the scale and size of hospitals. In particular, technology that works for a GP will not scale-up successfully for hospital use [4]. For illustration, (i) the EPR has a more diverse range of uses in a hospital than those used by the GP; (ii) in hospitals there is the need to link together many different computer systems, again a problem not present in general practice; (iii) security and confidentiality are relatively simple for the GP but are major problems in hospitals; and (iv) the number of doctors, nurses and other users in a hospital setting make critical demands on technology and support staff, a problem not present in the GP setting.

The above factors might, in the past, have held back hospital ICT development, but in 2003 the position is more promising. The SNOMED clinical terms [30] and Internet technology are two of many factors that form the basis for optimism regarding the hospital ICT new initiative.

5.5. GUIDELINES FROM NON-MEDICAL BUSINESS AREAS

The first-ever HIS - discussed in Section 1 above – highlighted the need for meticulous care of the management of change. Nowadays, this dimension is widely recognised – if not always practised – throughout the ICT industry. IBM in their advice to companies proposing to build 'E-business on demand' say that *"embedded in the concept of every ICT project is the notion of change"* [18]. In industry in general, it has been observed that as increasingly more powerful ISs are designed and implemented, they affect larger and more heterogeneous groups of people and more organisational areas [27]. Trials in hospitals of the EPR have shown that if the introduction is to be successful then there is need for changes in staffing, organisational structures, pay scales, and working practices [7, 10]. Consequently, the challenges to implementation success are less technical and more behavioural. To successfully introduce ICT systems into healthcare organisations requires an effective balance of (i) technical skills and (ii) organisational and human skills [7, 23, 25].

6. CONCLUSIONS

All the factors discussed in Section 4 above have relevance to the successful outcome of (i) any medical informatics implementation in a hospital in general and (ii) the NHS ICT initiative in particular. These factors include Hammond's criteria for success [14], the importance of incentives [3] and their limitations, motivation factors, scalability [4], and the management of change [7, 23, 26]. Success will not be achieved through any one of these guiding principles, nor by the use of the whole set of ideas [6, 23]. However, failure can be minimised through a sensible and balanced use of all these separate principles.

It is important to repeat that a key part of this huge NHS ICT initiative is *change,* e.g. changes including those to structures of organisations and the working practices of influential and powerful professional groups [7]. The tasks will not be easy but if successful these projects will bring major benefits to patients.

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