Hospital Information Systems
Success, Failure, NPfIT
Complex Organisations

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HOSPITAL INFORMATION SYSTEMS: ARE FAILURES PROBLEMS OF THE PAST?

Governments across the world are launching ambitious and expensive initiatives related to health care information systems and information systems strategies that use IT as the basis for improving the health care of patients. Computer-based hospital information systems (HISs) are expensive, e.g. a typical HIS for a large hospital is estimated to cost some $50m, i.e. 140m PLN [21]. In contrast, the benefits that result from an information system - in health care or in other business sectors - have rarely been measured [9]. The National Health Service in the UK has embarked on a huge initiative, namely The National Programme for IT in the NHS (NPfIT), costing some £12.4 billion (70bn PLN) over 10 years to 2013-2014. Hospital information systems have evolved over the last three decades. Has this evolution allowed us to gain knowledge of, and understand, the problems and obstacles of HISs and their implementation? Have we a corresponding knowledge of how to achieve success and minimise failure in HIS implementations? In this context, this paper examines the NPfIT, the problems it has experienced and the successes it has achieved, in order to extract lessons from these experiences that might benefit future information and communication technology (ICT) implementations in health care.

1. INTRODUCTION

The current growth in health care information systems (ISs) in many countries in Europe and across the globe [8, 21] are large initiatives that contrast with the small-scale and slow adoptions of IT and IS solutions in the health care sector that have been the norm in health care in the past [18]. A typical example, and also one of the largest, is the plan of the National Health Service (NHS) to implement new ICT services in England at a cost of some £12.4 billion (70bn PLN) over 10 years to 2013-2014 – this constitutes the largest ever single ICT investment in the UK [4, 14]. This - the National Programme for IT in the NHS (NPfIT) – is a large e-health programme to improve health care provision [24] and includes (1) e-prescriptions, (2) e-appointments, referred to as 'choose-and-book', (3) e-patient medical record (EPR), and (4) a central spine infrastructure that will enable a patient's EPR to be accessed when the patient is remote from their home region.

Why is there such great interest in health care ICT at this time [30]? Is it that now (1) we can build large ICT systems with the minimum risk of failure, and (2) the culture and environment of healthcare is a climate in which ICT systems are not only needed but will flourish? In the UK, it has been said that the NPfIT is an attempt to "catch-up with around

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20 years of under investment in IT in the NHS" [14]. In the USA, President George Bush has called for EPRs for all American citizens within a decade [2]. In the following sections, recent health care initiatives will be considered in the context of three decades of health care ICT. First a brief overview is given of the meaning of success and failure in ICT projects.

2. RESEARCH METHOD

The paper is part of an on-going long-term research project related to success and failure in IT projects. This paper seeks to answer the overarching question 'Are we now able to build HISs without any significant risk of failure?' To develop an answer to this question, failure, success models and guidelines are considered. In addition, HIS case studies are presented and a literature review is explored of HISs in health care for the period 1965 to 2007. The guidelines and models presented in the sections 3.1 and 3.2 below, are used as a framework for evaluating events relating to the case studies, i.e. NPfIT and other HISs and ICT projects. The paper combines two research approaches, i.e. a case study approach and an argumentative approach [20].

3. SUCCESS AND FAILURE

Problems during IS developments are an inevitable consequence of the complexity of modern ICT systems. Developers encounter a variety of contrasting behaviours including (1) over-enthusiasm of users, (2) resistance of users, (3) devious political manoeuvres, and (4) managers whose support for ICT projects fluctuates, sometimes inexplicably. Therefore, a project at any given time can be seen as both a success and failure depending upon one's perspective. Technical books often portray IS developments as relatively straightforward, whereas it is accepted that a development scenario is rich in (1) social, (2) behavioural and (3) political aspects, where both success and failure are continuing facts of life.

In the UK it is estimated that IT projects cost some £22.6 billion per annum (120 bn PLN) and the public sector accounts for half of this expenditure. Therefore it is disconcerting that a significant number of complex ICT projects experience degrees of failure, e.g. they do not deliver to (1) cost targets, (2) time schedules or (3) end-user expectations. It is no consolation to know that these problems exist in many countries [25, 31]; nor that that there is little difference in the performance of the public and private sector concerning ICT project developments [29]. Public sector projects can have additional problems of (1) high visibility in the media, (2) politically driven timescales, and (3) enormous scale and complexity [27]. If scarce financial resources are to be used on ICT health care projects, it is essential that every effort is made to ensure that the possibilities of failure are minimised. There is a wealth of management guidelines which can be used by practitioners to minimise the effects of failure.

As indicated earlier, the guidelines, definitions and triangle of dependencies described in sections 3.1 and 3.2 are used as a framework for understanding and evaluating the case studies.

3.1. GUIDELINES FOR UNDERSTANDING FAILURES

Definitions of success and failure are both influenced by personal values, but in simple terms an ICT project failure can be defined as a project that is abandoned. A success is a project that continues to operate because if it continues to be used then it can be assumed to satisfy some organisational purpose. The guidelines given below can be used to examine real-world ICT projects. They can be used to analyse finished projects, and to plan new projects.

Critical Factors: The items listed in table 1 are critical factors which have been found to be associated with problems, if not failures, in ICT projects. One factor alone may not be critical, but the concatenated effect of a number, brings greater risk and possibly failure [6]. There are numerous management guidelines and checklists. The critical factors and a failure list prepared by the National Audit Office are shown below.

Table 1. Critical factors that contribute to failure

I Organisational Context		
CF1. Poor reporting structures	CF2. Abdicating responsibility	CF3. Bad news moderated
II Management of project		
CF4. Over commitment to success	CF5 Over commitment to completion	CF6. Unable to be impartial
CF7. Political external pressures	CF8. Targets set outside	
III Conceptual Stage		
CF9. Complexity underestimated	CF10. Technology over-emphasised	CF11. Lure of leading edge IT
IV Design Realisation		
CF12. Poor consultation (stakeholders)	CF13. IT fix for management problems	CF14. Design by committee
During building stage		
CF15. Competency	CF16. Staff turnover	CF17. Communication
V Implementation		
CF18. Poor testing of product	CF19. Poor training of users	CF20. Receding deadlines

The National Audit Office (NAO) Recommendations: This list was compiled by the NAO from its examination of public sector projects. Table 2 shows the eight most common causes of failure in public sector IT projects.. These factors are equally relevant in the private sector.

Table 2. Common causes that contribute to failure of ICT projects

1. Lack of a clear link between the project and the organisation's key strategic priorities, including agreed measures of success.
2. Lack of clear senior management and Ministerial ownership and leadership.
3. Lack of effective engagement with stakeholders.
4. Lack of skills and proven approach to project management and risk management.
5. Lack of understanding of and contact with the supply industry at senior levels in the organisation.
6. Evaluation of proposals driven by initial price rather than long term value for money (especially securing delivery of business benefits).
7. Too little attention to breaking development and implementation into manageable steps.
8. Inadequate resources and skills to deliver the total portfolio.

3.2. TRIANGLE OF DEPENDENCIES

This is a complex and integrated model of how computer-based projects are initiated and implemented. At its centre is the premise that innovation is linked to uncertainty. In IS projects, this uncertainty might even concern what the final product might be and who in the organisation it will serve. Analysis of innovation leads to a framework of (1) *a Project Organisation*, (2) *an Information System*, and (3) *Supporters*, that collectively form a 'Triangle of Dependencies' as shown in Fig 1. The *'Project Organisation'* is the formal and informal group of people involved in all stages of the project from conceptualisation through to maintenance. It is imperative that the *'Project Organisation'* not only has *'Supporters'* but that it manages and nurtures this support, otherwise the *'Supporters'* can disappear [28] and the project 'fails'.

The Royal Academy of Engineers suggest the importance of three appointments that relate to ideas found in the 'Triangle of Dependencies'. They recommend that three individuals, not committees, are publicly identified by name. They are (1) The overall executive sponsor or senior responsible owner, SRO, who will receive the glory for success or memorial for failure of the project; (2) The systems architect; and (3) The project manager. This extremely valuable idea of 'three key people' is found in some other guidelines, but not emphasised as it is here [27].

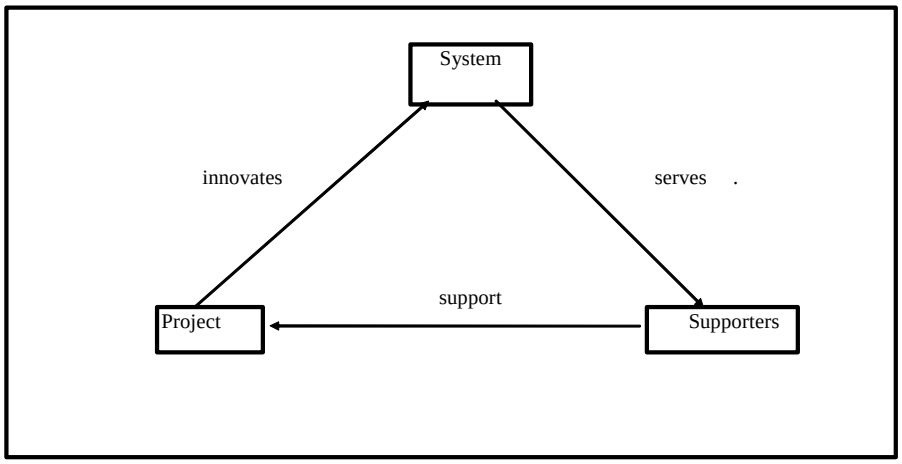

Fig.1. The triangle of dependencies

4. HOSPITAL INFORMATION SYSTEMS – THE EARLY YEARS

The Technicon medical IS is one of the first examples of a HIS. It was designed for use in one hospital or a group of hospitals, including outpatients. The designers' aim was to provide a measurable financial benefit from use of the HIS that was sufficiently large that (1) the hospital could pay for the HIS and (2) the designers would have a surplus after profits to fund improvements to the HIS [11].

The HIS was built by the biggest USA space company, Lockheed Missiles & Space Corp. It was built at the El Camino Hospital, California between 1968-1971. In May 1971 a contract was agreed between El Camino and Technicon (the new owners of the HIS). It was

an unusual agreement. *Technicon asked for no payment except the savings made by the hospital through use of the HIS.*

The HIS (1) provided an online patient record, (2) used terminals and a light pen (an advanced and unusual feature in 1970), and (3) allowed physicians on entering the hospital to use a terminal to view all their patients' records, check their progress and then plan their work accordingly. The HIS came into official operation in May 1971. During the next 2 years, the future of the HIS hung on a slender thread and for the project manager this was an extremely unhappy period. [12]. Fortunately it had a happy ending.

El Camino was a 440 bed, short stay, specialist focussed hospital. The project manager had wide industrial knowledge and understood the advantages that can accrue from comments and even criticisms concerning his work. He was nevertheless unprepared for the onslaught in the public press (and later on radio and TV) to which he was subjected, because of his work at the hospital. Typical press comments are shown in table 3. From July 1971, it was virtually all bad news and this continued with attacks increasing over the next year. On one occasion, 50 hospital doctors had a special meeting with the five doctors from the Hospital Board of Managers. They complained of wasted time, potentially dangerous errors and tensions, all rising from the HIS project. The five doctors, led by the Chairman of the HIS Doctors' Committee, responded by stating "The HIS can do the job we want". The chairman changed doctors' attitudes [12]. Fortunately, an independent audit of the HIS was funded and carried out with staff from the hospital. In July 1973, it was declared that the HIS was successful, and saved the hospital money.

Table 3. Criticisms in the public press

o Physicians deeply split over "dream computer".	o Doctors look with ill-favor at new computer.
o Work-saving computer enslaves hospital staff – doctor claims.	o Computer doesn't help doctors or patients – independent study
o The HIS system has caused deterioration of our ability to care for patients.	

There are numerous lessons to be seen in this real-world implementation, but two extremely important lessons are: (1) the introduction of a HIS into a hospital profoundly impacts a human organisation – if the need to manage the change process is ignored, resistance is certain and rebellion is possible [22], and (2) leadership and example within the medical staff are crucial [11].

5. LATER YEARS – THE E-PATIENT OR E-MEDICAL RECORD

At the centre of all health care lies the e-patient (EPR) or e-medical record (EMR). After the hard earned success at El Camino, it might have been assumed that health computing would have successfully evolved to advanced-HIS combined with a comprehensive EPR. This has not been the case and hence we have President George Bush's recent call for EPRs for all USA citizens within a decade [2]. In the 1980s and 1990s, it was thought opportune to implement EPRs. In the UK in the late 1980s, the NHS's Hospital Information Support Systems (HISS) project was an attempt to integrate fragmented hospital ISs. In 1996, after seven years, HISS had cost some £100m (600m

PLN) with relatively small savings of £3m (Collins'97). This work was criticised for not involving clinicians. Another ambitious project of the late 1980s was attempted in Wessex Regional Health Authority. The vision was a regional information system plan (RISP) requiring the development of five core computer systems covering (1) hospital information, (2) human resources, (3) estates, (4) community care and (5) accountancy, all to operate to common standards. The basic design was completed between 1985 and 1987, but then there were national reorganisations in which administrative functions were moved from Regions into Districts and from Districts into Hospitals. This radically affected all the analysis. A mainframe computer costing £3m (18m PLN) remained unused. The project was abandoned in April 1990 with Wessex RHA suggesting losses of some £20m (120m PLN) [3, 13].

Eight endeavours in the USA , of varying degrees of success, are outlined in [7]. One development at the University of Virginia Medical Centre started in the early 1980s and evolved over 10 years. Its development costs rose threefold and resulted in changes to working relationships in the hospital. A confrontation between medical and administrative staff contributed to a less than successful conclusion. In other hospitals, the recurring difficulty of finding a balance between security and easy access for users, caused problems [16]. Recently, Kaiser Hospitals – renowned for its computer-based ISs – has experienced difficulties with a new e-health records management system [26].

In the early 2000s, many countries in Europe and across the world have returned to the need for and the importance of EPRs. To this end and for wider visions, Australia, Canada and New Zealand have implemented new health care strategies [8]. Many researchers have indicated concern that these costly initiatives follow a rather long list of less than successful ICT ventures. The New Zealand plan is to (1) integrate ICT in the health sector and (2) facilitate the adoption of EPRs. New Zealand has an extremely complex health care ICT architecture and integration will be difficult according to Gauld [8].

5.1. SUCCESSFUL ICT PROJECTS IN HEALTH CARE

While EPR and HIS developments have in part been problematic, it must be remembered that huge areas of health care computing have been successful [18]. NHS Direct, an e-health application, is a highly successful implementation (see table 4). NHS Direct also illustrates a now common feature in which a new business has at its centre an ICT platform. UK e-University (UK e-U) is a similar project of the same period, with an e-learning platform at its centre. The latter shows that successful ICT does not guarantee business success. While UK e-U developed an excellent e-learning platform, through concentrating on this one business area, it forgot that for a university to be successful recruitment of students is fundamental [19]. UK e-U failed in its first year of operation. At roughly the same time, NHS Direct was being successfully created through a balanced management of business issues covering ICT, nursing staff and patient needs. NHS Direct is an example of implementation excellence [27, 20].

Table 4. A successful ICT project – NHS Direct

o **NHS DIRECT is a 24 hours per day nurse-led telephone call centre/help line that operates every day of the year.** o **NHS Direct is accessible via a single national telephone number. Nurses assess callers' needs with the help of decision support software. A caller is advised (1) to seek help urgently at a hospital, (2) to visit their GP or (3) to self-help. The advice errs on the side of caution.**	o **The service includes an on-line information service.** o **The concept and plan for NHS Direct was made public in December 1997.** o **The national telephone service was achieved in November 2000. The companion online service was scheduled for Autumn 1999, but was operational in December 1999.**
A National Audit Office value-for-money review of the creation and implementation of NHS Direct reported to the UK House of Commons that given the innovative nature and scale of the NHS Direct project it was a significant achievement that all targets were met. NHS Direct is an excellent example of e-health and of tele-medicine; and of project management and implementation [27, 18]	

NHS Direct is but one of many examples of good use of ICT in health care. Across the world, there are huge numbers of doctors, nurses, administrative staff and scientists successfully using health care computing applications every day, and without ICT their work would be more difficult.

6. A LARGE NATIONAL ICT HEALTH CARE PROJECT

In 2002 the UK Government received a report [32] that called for (1) a large increase in national spending on health combined with (2) investment in health care ICT to improve health care services. The Government agreed and as part of this response (1) large sums were allocated for ICT developments and reserved for this purpose to ensure that these funds were not diverted into other activities, and (2) it was decided to appoint key senior staff to give strong central leadership to this huge project and to coordinate these large investments in ICT. Prior to 2002, ICT developments had been in and for individual organisations. The results, in general, had been unfavourable and created hundreds of different systems and configurations, making it difficult for effective communication between health care professionals in their efforts to care for patients.

6.1. BALANCING LOCAL AND NATIONAL NEEDS

To avoid these historical problems, the new project was based on a dual policy (1) to procure, on a national and large scale, the big and small systems required at both a national and local level and (2) to implement through local service providers (see table 5). A central procurement has the advantage of helping to create an integrated national system. Local service implementation permits local systems to be tailored to match local characteristics. The NPfIT includes (1) a broadband network, (2) E-prescriptions, (3) E-appointments (for the initial patient appointment with a hospital consultant) and (4) E-patient-record (EPR).

Other features include general practitioner (GP) services, e-mail, a national directory and a picture archiving communications system (PACS).

Table 5. Local services are delivered through five large clusters (over 10 years) [24]

AREA	**NW ENGLAND**		**NE ENGLAND**	
Local Service Provider	Computer Sciences Corporation (CSC)		Accenture (†)	
Cost and Population	£973 m	12.3 m	£1,099 m	7.5 m
AREA	**LONDON**		**E ENGLAND & E MIDLANDS**	
Local Service Provider	British Telecom		Accenture (†)	
Cost and Population	£996 m	7.2 m	£934 m	9.5 m
AREA	**SOUTHERN**		(†) Accenture has recently withdrawn from the majority of this work and the work has been transferred to CSC. *The Local Service Provider has full responsibility for delivering services within that area.*	
Local Service Provider	Fujitsu			
Cost and Population	£996 m	13 m		

The EPR is a muli-media integrated health care record in two parts: (1) a local detailed clinical record – for local use where health care is delivered and where it can be used by the GP, community clinicians and within hospitals, and (2) a national summary. There is often patient and doctor concern related to the EPR and confidentiality. This was addressed in part by a guarantee as described in table 6.

Outsourcing and payments: To ensure quality services both locally and nationally, payments were only made after 'deliverables' had been implemented and tested to demonstrate that they operate correctly. A delivery without successful testing receives no payment.

Table 6. The care record (EPR) guarantee

1. Only those involved directly in a patient's care have access to identifiable individual patients
2. Only authorised parties have access to records.
3. A record is maintained of all who look at records.
4. Patients can check their own records and ask for corrections.
5. Clinicians can withhold some information only for other clinicians.
6. Patients can not opt out completely.
7. Patients can opt out of having their information shared

6.2. PROBLEMS, SUCCESSES AND THE FUTURE

Surveys of staff have shown that there is huge support for ICT modernisation in the NHS. At the mid-point of this 10 year project, the enthusiasm is reducing, as might be expected. The sheer size of the project makes it slow. Recent reviews by government agencies and researchers have indicated project areas that require attention as the project

moves to its final 5 years [24]. These include (1) better communication with all NHS staff and trusts, especially with clinicians, (2) clarification of local responsibility and accountability related to local implementations, perhaps with greater responsibility at this level, (3) leadership changes, (4) concerns relating to the shortage of healthcare ICT capacity within suppliers – there are 3 local service providers dependent upon 2 software suppliers, and (5) more robust schedules [24].

NPfIT has received praise for (1) its extremely quick procurement process, (2) establishing some system features quickly and even ahead of schedule, e.g. the broadband network and 'choose-and-book' software, (3) intrusive management of the supply chain, (4) a dedicated Website showing project progress, (5) continuity of leadership at project management level, and (6) the principle of payment for 'real' results – i.e. 'working' systems [24].

The NPfIT approach allows some flexibility, such that there are opportunities to learn from experience and so to make some changes in direction and for amendments to modus operandi. For example (1) elements of local ownership are to be enhanced including timing of deployments and choice of products and (2) there is a supplier catalogue of accepted products.

7. ANALYSIS

If the guidelines and management checklists presented in section 3 are used to analyse the events of the NPfIT case study, there are no significant omissions or differences. As one would expect, a high profile government funded project such as NPfIT follows the principles formulated in the guidelines. A more interesting comparison is that between events in NPfIT with those that occurred in the El Camino implementation.

The El Camino case study stressed the importance of key people [27]. Therefore it is unfortunate that NPfIT did not have one Senior Responsible Owner (SRO) appointed to nurture this project; the review [14] identified six different SROs in three years. The El Camino project demonstrated how the SRO could influence other clinicians, and even change their attitudes. The absence of one ever-present SRO weakened influence on, and communications with, clinicians. If this had been in place, combined with the excellence of the project manager, NPfIT might have been closer to a 100% success story. The question remains as to whether the Department of Health understands the importance of continuity in the role of SRO in the continual engagement with clinicians.

Another key person is the project manager [27]. This was successfully achieved in the NPfIT project by the Director General of IT [14, 24]. Alongside this, the El Camino emphasises the importance of managing change – as yet there is no rebellion, and perhaps no resistance, but the national review suggested the need for better communications which could result in better support. During NPfIT there were many similarities between the press responses and those of the press some 30 years ago.

There have been calls for greater clinician involvement. These will be acted upon, but clinicians' questions require not only answers from the project manager, a non-clinician, but also from the SRO – doctors' criticisms and questions must be answered by a senior clinician. When questioned about the need for more communication with clinicians, the Acting Chief Executive of the NHS indicated that in 37 years he had never known so much

effort put into this activity [14]. While this response was correct, it was to be expected, because NPfIT was the largest ever IT project in which he had been involved.

On a more detailed level of the project, there have been requests to move more responsibility to, and clarify, local implementation and accountability. Now that adequate levels of national standardisation have been established, it is possible to allow greater choice at the local level including choice of products and timing of deployments. The 'choose-and-book', e-appointments facility, has been criticised because the software is suspect and 'choose-and-book' is not liked by doctors [10]. However, the voices of those critical of choose-and-book have been louder than a great many GPs who have quietly accepted the software. There seem to be big geographical differences in choose-and-book implementation and this may be related to the flexibility of local arrangements and the ease with which the work can be delegated from GPs to administrative staff. In these circumstances 'choose-and-book' is a feature that patients appreciate and find extremely useful. Nevertheless, 'choose-and-book' has been slow to grow. The number of new out-patient appointments is 9.4 million each year. After two years of operation 'choose-and-book' is used for only 15% of these appointments [20].

8. CONCLUSIONS

Are we now able to build HISs without significant risk of failure? NPfIT demonstrates that although (1) we can *build* large ambitious e-health projects, (2) there are still issues concerning completion to time and cost, and problems related to the management of change.

The guidelines for achieving success or minimising failure, presented in section 3, are clear and helpful. However, if they are useful and well understood, why is it claimed that ICT projects experience problems and even failure [27]? Why is it that a group of designers can be successful on one project but when they move to another project they fail [25]? It is evident that the guidelines are simply counsels of perfection which do not recognise (1) the complexity of organisations and of projects and (2) the frailty of human beings, i.e. people's behaviour is not constant, not predictable and sometimes not rational.

In this paper the guidelines have been used to evaluate the NPfIT project. It is evident that the NPfIT project has been relatively successful, if for no other reason that it continues to operate and its 'triangle of dependencies' remains unbroken. It is too early to measure the degree of success [5] of this massive e-health initiative. However, good and bad signs have appeared, i.e. it can be viewed as both a success and a failure. In its favour, NPfIT is an essential part of bringing e-based health services in line with those in other business sectors [1] and in catching up on "20 years of under-investment in health care IT" [14]. NPfIT has raised awareness of the potential (and the cost) of health care ICT. In addition, it has demonstrated the merit of stringent results-oriented contracts and shown that they can be used to advantage in the public sector. This is successful project management. The Health Informatics Committee of the British Computer Society warned in 2002 that success of the NPfIT might be prejudiced because of the lack of experienced ICT project managers. The NHS overcame any such difficulty by searching for a top-class project manager, within both public and private sectors. The Director General of IT has been one of the success stories of the NPfIT project [1]. A less favourable impression of the NPfIT project can be seen in the slippage on features such as the EPR [14, 24].

It was inevitable that NPfIT because of it size would cause controversy, but few foresaw the disagreements it would generate. To some it is a waste of an inordinate amount of money and perhaps the worst example of disastrous government computing; while to others it is a model of tight contracting and project management combined with being an absolute necessity to allow health care to move into the 21st century. At this point in time it displays success and failure. There are those who support and those who question; but as Hodge [11] warns this must not turn into support versus rebellion because "conflicts among users are significant factors contributing to project failure" [33]. Hysteria might be a self-fulfilling prophecy which leads to less commitment and hence less success for NPfIT [1].

NPfIT will soon have a new project manager. Then the senior responsible owner, the new project manager and their teams must dispel the problems and differences in order to lead the NPfIT project to a 'successful' outcome – whatever that might be. The UK Government will welcome this because of the huge funds it has invested in this ICT health care project; ICT health care professionals will be rewarded for their contribution to ICT health care evolution [30]; and patients deserve it in order that they can benefit from the highest quality health care available in the 21st century.

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