Electronic Transmission of Prescriptions – Towards Realising the Dream

Darren Mundy

Centre for Internet Computing, Hull University, Scarborough Campus, Filey Road, Scarborough, YO11 3AZ, UK
Email: D.Mundy@hull.ac.uk

David W. Chadwick

Information Systems Institute, University of Salford, Salford, M5 4WT, UK
Email: D.W.Chadwick@salford.ac.uk

Abstract: The United Kingdom National Health Service (NHS) is about to commence upon major computerisation of its processes as part of a government plan of modernisation. One of these is the Electronic Transmission of Prescription (ETP). To achieve success it is important to know what benefits are expected from the new system and what barriers to adoption the systems will face. This paper reviews substantial ETP published material, and identifies seventeen issues that need to be addressed. These issues are categorised under 4 major headings of stakeholders, cost, technology, and current process and practice, and are then further classified as positive or negative influences on the project's success. Many of these influences will be common to most of the computerisation projects to be undertaken by the NHS, and therefore this paper has wider applicability than ETP.

1. Introduction

The United Kingdom (UK) government is supporting multiple technological modernisation projects within the UK National Health Service. Projects aimed at the introduction of electronic systems for appointment booking, transmission of laboratory results, patient records (EPR) and the transfer of prescriptions (ETP) have

been established. The government's aim is to modernise healthcare through re-building *"the NHS for the 21ˢᵗ Century, true to its priorities but radically reformed in their implementation"* [1]. In this paper we focus on the issues surrounding the reform of one of these health care processes – the prescription processing system.

The UK NHS came into being in 1948 and since then has provided fixed or zero cost medical services to all UK citizens. One of the fixed cost medical services is the UK drug prescription system controlled by a government organisation called the Prescription Pricing Authority (PPA). The NHS also provides free prescriptions to a large proportion of the population through exemptions for reasons such as age or severe illness. With the recent introduction of a National Plan of Reform for the NHS [1] came a goal to adopt a system for ETP by 2004 to replace the current paper based system which was introduced in 1948.

However, the fervour for ETP is not new. Over the past decade multiple academic and other publications [2-7, 9, 11-18, 20-30, 34] have been produced aimed at realising the dream of ETP integration into the health care system. In this paper we provide an analysis of the benefits and barriers towards the realisation of ETP integration into the UK NHS. We provide this analysis through research work we carried out into the UK prescription system and a critical appraisal of prior literature in the field.   We have categorised our findings under four major influencing factors, namely: the influence of stakeholders, the influence of technology, the influence of cost and the influence of current process and practice.

2. The Influence of Stakeholders

It is well recognised that organisational change is often resisted and stakeholder resistance to change is frequently stated as one of the major reasons for project failure. Furthermore, governments are not always the best organisations to manage large IT projects. We have found that stakeholders can influence the implementation of ETP in three areas described below:

?? Government Led

"Large (UK) *government IT projects seem to have a habit of going wrong. They are often late, over budget or both"* [2]. The UK government must ensure that ETP and other IT reform projects within the NHS do not follow this organisational trait of failure. However, the prescription process with all its foibles is thought to be an extremely large and complex IT project, providing difficulties for any ETP system developer [3][4]. We believe that because the NHS is both national and government run, that these factors in themselves may be significant impediments to the successful implementation of ETP. Furthermore, the authors believe the prescription processing system falls into the bracket of an 'irreversible' system as defined by O. Hanseth and E. Monteiro [8]. This is a system that consists of *"large, complex and highly entrenched actor-networks"* [8]. Hanseth and Monteiro believe that *"due to the interdependencies of the elements such networks are difficult to change"* [8]. Thus the omens for the introduction of ETP are not good.

?? Senior Management and Clinician Resistance to Change

Stakeholder levels of commitment to the adoption of ETP are highlighted as a major potential barrier by many researchers [3][9][6]. We have also found this in previous research projects [10]. It is often easier for stakeholders to carry on working with systems and procedures which they have used all of their professional lives rather than undertake the task of adopting new ones. In a study carried out in public health care organisations in Hong Kong, investigating the factors affecting the adoption of telemedicine technology, it was found that the *"collective attitude of medical staff towards telemedicine and its enabled services was the most significant factor"* [9] in deciding whether to implement telemedicine applications or not. In research carried out be Kember Associates on behalf of Pharmed, physicians *"were ambivalent towards computer technology, saying that it was of limited importance in their work, preferring paper records"* [11]. This problem was also indicated as a key barrier to be overcome by a research team at Huddersfield University [12]. Whalley and Davies, in their study about implementing IT in NHS hospitals [13] noted *"Doctors used their power to limit the level of organisational changes that were being introduced in tandem with the technical developments [*of a Patient Management System*]"* Thus winning the hearts and minds of senior professionals in the NHS will be a critical successful factor in the UK Government's proposed roll out of ETP.

?? GPs and Pharmacists Concerns about its effect on Practice and Patient Care

There is concern amongst stakeholders about the effect ETP will have on operational practices and patient service (see later). GP's are worried that improvements made to the repeat prescription process may lead to loss of contact with patients [11]. Pharmacists are worried about directed prescriptions used within a number of the ETP pilot system designs and feel that this could increase competition between pharmacies [11]. In the socio-technical study carried out by Huddersfield University [12] it was found that clinicians and pharmacists are most concerned about the restrictions that may be placed on their present operations with the introduction of ETP into their practices, for example, the 'loaning' of patient medication and procedures for prescription modification.

Clearly the many concerns and fears that the professionals have will need to be allayed, and this should all be part of the change management process. There may also be patient issues with the new system that the professionals will need to deal with on a daily basis. In the results of previous research carried out by Kember Associates [48] only a minority of patients did not like the idea of electronic prescribing. However, these views were based on the understanding that the introduction of electronic prescriptions would lead to time and cost savings. Clearly if in reality the patients receive no benefits from the introduction of such a system then their views may change and their opposition to the system may grow.

3. The Influence of Technology

Technological availability is one of the major forces behind the government's radical reforms of the NHS. The introduction of ETP is not just a technical project as is shown above, although technology will have an influence on its successful integration into the health service. In this section we detail three technological factors that are significant in the introduction of ETP.

?? Better Communication Channels

ETP will require the installation of a resilient high bandwidth communications infrastructure to support the high demands of the prescription processing system. This infrastructure, when in place, should enable better communications between stakeholders [14][12][4]. H.Middleton [5] believes that *"the goal of seamless care between hospitals, GPs and community care would be a step nearer, if not a reality, with the electronic transmission of information"*. Stronger communication channels will not only support ETP but many of the reformed NHS services. This should be an enabling influence. However, it is not the availability of the technology that results in better communication channels. It is the stakeholders' acceptance and use of the technology that will result in benefits, for example, the transmission of over the counter (OTC) medication purchase information between pharmacy and GP.

?? Privacy and Security

There can be no doubt that ensuring the privacy and security of patient identifiable data within an ETP system is extremely important [7][15][16]. Research carried out with GP's [17], pharmacists [18] and patients [48] reveals that all user groups are worried about the potential threat of hackers and insecure ETP systems leaking personal medical information. There is not only the threat of patient privacy but also that of system abuse. In one of the previous implementations of ETP in the Wirral Hospital NHS Trust a serious security problem arose, that of *"a nurse using a doctors password to prescribe illegally"* [5]. The availability of high risk electronic services such as banking over the Internet, shows that privacy and security in an ETP system can be achieved. In our previous research we have shown that medical information can be made available across a public network without public disclosure of the transmitted information [10]. Never the less, *"the risks perceived or otherwise, of lax security may be a factor in discouraging trusts from actively driving forward the implementation of EPMA* (Electronic prescribing and medicines administration)" [3]. In [12] all users thought that system security and the potential for system abuse were relatively significant barriers to the success of an ETP system. Consequently, we believe the major issue may not be in implementing the actual technological security capability, but rather in convincing the stakeholders of the safety of an electronically secured ETP system.

?? Technical Problems and Development Process Complexity

As stated earlier, ETP is a large and complex IT project. It has many foibles and complex issues such as: the treatment of locums within the NHS who often work for many different practices [5], catering for GP mobility such as during home visits, the use of many different application systems in the NHS [6], and the varying state of organisational computerisation [7]. All this leads to complexity in both technical design and implementation. Technical problems have also been identified as potential issues to be overcome in the adoption of ETP in the NHS. Identified problems include: potential downtime [19], transmission reliability [7], extent of practice computerisation [12], maintenance of systems [5], message integrity [12] and legacy system integration.

It is believed the software development process is fraught with problems including local customisation, user friendliness, system changeover and clinical decision

support integration issues [3]. In our field work, we noticed the use of many different prescribing and dispensing systems in the sites we visited. Some of these were old MS-DOS based systems, others were newer Windows based systems. The dispensing performance at the pharmacies differed depending upon the dispensing application being used, suggesting some applications are quicker and easier to use than others. Clearly a large amount of work will be required in optimising the electronic systems when ETP is introduced, as the older MS-DOS based systems, which ironically seemed to be the most efficient, will be lost. Ultimately we believe that the technical issues in ETP system provision are solvable through good system design and implementation, but if a poorly designed system is first introduced to users, this can have a major negative influence.

4. The Influence of Cost

Cost is a major issue in the UK NHS. The NHS is publicly funded so is accountable to the citizens of the UK. It is often extremely difficult to define the Return on Investment (ROI) for technological implementations. The introduction of ETP is no different from a cost perspective. It has to be shown that the implementation of ETP can pay for itself without continually draining the NHS of funds. In this area we describe three factors that reflect the influence of cost.

?? Increased Efficiency and Decreased Costs

Multiple researchers expect all stakeholders to benefit from a reduction in the expense of the paper prescribing system [29][21][25][49]. In the Huddersfield University socio-technical study [12] stakeholders identified resource savings as one of the major benefits to be gained from an ETP system. An ETP system should also result in efficiency savings [4][20][21]. GP surgeries should benefit from improvements made to repeat prescribing (discussed separately) [22] and a reduction in telephone prescription queries from pharmacies [7]. Pharmacies should benefit from improved efficiency through the reduction in the number of drug queries with GP's, no transcription requirements [23] and savings in prescription collection services [24]. Pharmacists should also benefit from the overall increased efficiency of the system through faster payment cycles [22]. Savings made at pharmacies should hopefully translate into *"more time available to spend on patient management"* [22] and *"liberate pharmacy time for clinical duties"* [25]. Efficiency savings at the PPA should be the greatest, with the removal of the transcription of prescriptions and the provision of real time access to current prescribing trends. Looking at things from a patient's perspective they *"believe the new system will be more convenient for them, save them time travelling to a GP surgery and possibly having to travel then to a pharmacy to collect their drugs"* [12].

However, we believe that improvements in efficiency will be extremely difficult to achieve especially in the short term. Prescribing GP's, especially those who are already using electronic prescribing software, will notice no efficiency savings in ETP. Indeed it may take longer for them to input a password or PIN, for the digital signature to be created and the electronic prescription to be transferred, than it does today to currently handwrite their signature and give the prescription to the patient. (The GP's should gain efficiency benefits with repeat prescriptions, but this is addressed later.) Pharmaceutical operations at present are heavily time optimised. Time savings may only be measured in seconds through the removal of the

requirement for transcription within ETP. Technological system requirements may even increase the time taken, for example, the introduction of a bar coded prescription form may result in time increases because of bar code reading failure rates [26]. The only place where efficiency benefits should be realised quickly and definitely is at the PPA. However, during system rollout it is likely that the PPA will be required to run parallel systems. This requirement will, at least in the short term, have an affect on the efficiency savings that can be made by it.

?? Fraud Reduction

Fraud within the NHS prescription system has been targeted over the last five years and reduced significantly. Nevertheless, there is still a high level of fraudulent activity within the system and many researchers believe that an ETP system can help to further reduce this [12][19][27][14]. One of the ways that the PPA may do this is by reallocating the resources used in prescription transcribing to fraud reduction. However, we believe the best way to reduce fraud would be to introduce an electronic authorisation and exemption system such as our own [28]. This would help to focus fraud investigations onto a smaller subset of prescriptions.

?? Cost of Transformation

Transforming the legacy paper processing system to an ETP system will not be an inexpensive process [30][19][18]. Transformation costs identified include: the software development [3], hardware and infrastructure purchases, and the initial decreases in productivity as clinicians get used to using ETP instead of paper [19]. Frank Quinlan, National Co-ordinator of the General Practice Group in Canberra, Australia in a 2000 paper on the integration of electronic prescribing into general practice in Australia noted that *"Computerisation is generally costly, whether measured in terms of capital outlay, training, maintenance, length of consultation or organisational change"* [30]. However, the UK government realises the vast costs of informational reform and has a significant budget available, which is far in advance of previous NHS IT expenditure levels [31].

5. The Influence of Current Process and Practice

Prior to the integration of ETP it is useful to gain an appreciation of what revised practices ETP may lead to and what new support processes need to be in place to help the integration process. Overall the changes made to process and practice will have a major influence on system acceptance and ultimately on project success. We have identified eight factors of influence within this section.

?? Medication and Transcription Errors

One of the major benefits in the introduction of ETP will come in the form of a reduction in medication errors [32][19] and transcription errors [23][18]. Medication errors in the present system *"often occur because of illegible handwriting, confusing drug names and dosage mistakes"* [7]. Transcription errors can occur at the PPA and pharmacy when the paper prescription is input into the computer system. It is believed that *"receiving prescriptions direct will reduce transcription errors"* [14]. At present these problems can result in incorrect dispensation, litigation when medication error may result in patient complications [5], administrative errors,

payment errors and inaccurate prescribing statistical information. From previous research [10] the authors have seen that the transcription processes can lead to poor data integrity within a system therefore affecting stakeholders' attitudes.

?? Repeat Prescribing Benefits

One of the main areas where ETP is expected to benefit GPs and pharmacies directly is in the transformation of repeat prescribing [22][11]. Repeat prescriptions count for an estimated 70% of prescriptions issued in the UK [33], so any gain here will have a significant impact. ETP should *"eliminate the need to collect scripts from surgery"*[14]. Indeed it is estimated that *"electronic transmission of prescriptions could save pharmacists up to 51.8 working days per year with reference to script collection service"* [17]. The patient should also benefit from not having to make multiple trips to their GP to order to collect repeat prescriptions. GP's may also benefit through reduced administration time requirements. However, care must be taken to ensure that patients are getting the treatment they require and that ETP does not increase the error potential in repeat administration. For example, some patients in receipt of repeat prescriptions, especially the lone or elderly, actually want to visit their GP regularly, for the social contact that it affords them. The potential for errors in repeat administration may increase with ETP because of poorly designed systems that remove the GP's opportunity to reflect upon or recall erroneous prescriptions before they are dispensed (e.g. the prescription could be transferred immediately to the pharmacy after electronic signature).

?? Improved Quality

Prescription quality is an issue in the present paper prescribing system [34][20]. In this context, quality refers to conformance to prescription standards, with regards to both the drugs that are prescribed and the other data that is included on the prescription form, for example, signatures, drug quantities and drug guidance information. Drug unavailability, missing signatures, ambiguous drug quantities and wrong/ambiguous instructions for drugs are all identified as the most significantly occurring prescription errors [12]. Poor quality prescriptions may lead to delays [4], illegalities [5] and errors in the dispensation process [35]. ETP has the potential to ensure that transmitted prescriptions conform to prescription standards. For example, on an electronic prescription there will always be an electronic signature, or the ETP system should refuse to accept it.

The potential for improved prescription quality is highlighted in the results of two prior research projects. Research undertaken in the Derbyshire Royal Infirmary (a UK NHS hospital) between 1998-9, found that the quality of prescriptions constructed electronically was far superior to that of present paper based prescriptions [34]. A study has also been carried out into whether computerised prescribing improves the accuracy of drug administration [35]. In the study it was found that computer based prescribing produced a lower error rate (5.5%) than manual prescribing (5.7%) even after excluding mistimed administration. Far fewer instances of timing errors (wrong timing of drug administration) occurred with computerised prescribing.

?? Improved Practice

The introduction of an ETP system should result in improvements in practice at the GP surgery, the pharmacy and the PPA [30][21]. For the GP multiple improvements are envisaged from the introduction of ETP with researchers stating *"greater evaluation and assessment of the practice"* [30], *"reduced litigation"* [5] and improved practice through *"greater implementation of evidence based treatments and guidelines"* [30]. At the pharmacy ETP could lead to administrative improvements, greater use of automation (e.g. automatic label printing on receipt of an electronic prescription and/or automated dispensation). At the PPA real time access to prescribing and dispensing patterns can help target health resources and provide an early warning system for the community [30]. Real time prescribing statistics could also lead to improved public health planning at a governmental level [30]. Note however that stakeholders will need to have the time, resources and will to implement these improvements - ETP is only an enabler of them.

?? Legalities

In prior research this has been identified as a barrier to the successful adoption of ETP [23][5]. Recent legislation [36][37][38][39] has been adopted allowing electronic signatures on prescriptions within the three UK ETP pilot studies [40][41][42]. However, there may still be a problem with the legislation in future, for instance in the areas of control drugs and repeat prescriptions where ETP could require significant changes to legal practice. Thus there is still the potential for *"inappropriately worded legislation and official guidance"* [3]. For example, the present legislation does not seem to take account of new practices that only become possible once an electronic system is established, such as attaching digital signatures to multiple prescriptions in a bulk authorisation mode by simply entering a password once. Whether this should be allowed legally or ethically requires careful consideration, research and legislation.

?? Multiple Drug Codes

In May 2000, Dr Michael Daly, Chief Pharmacist with the Royal Wolverhampton Hospitals NHS Trust stated that *"A fundamental difficulty is the problem of multiple drug codes used by individual trusts, hardware vendors and software developers."* Dr Daly went on to say *"Any single therapeutic entity should have a unique identifying drug code, and the development of this unified drug code is an essential prerequisite for the rapid and safe development of integrated prescribing systems."*[6]. After this, the NHS set up a project to develop a single code for each drug, called the NHS Primary Care Drug Dictionary [43]. In December 2002 the outcome of this project was presented to the primary care community and now practices are beginning to adopt this standard set of drug codes. Migration to this standard set should remove this barrier to ETP. But we don't know how long it will take.

?? Education and Implementation

The education and implementation process may also prove a barrier to the successful implementation of any ETP system [5][6][29]. *"The time and effort needed to change from a paper based system – to an electronic system...is considerable and should not be underestimated"* [34]. The authors believe that the implementation of ETP should

be treated by the NHS as a change management project, with the consequent stages of unfreezing, moving and re-freezing of stakeholder positions and should not be rushed. Without adequate stakeholder education and persuasion, the forces that oppose change are likely to overwhelm those that want to migrate to ETP.

?? Improved Public Health

Through reform, the UK government's main aims seem to be improved public health through greater and more timely access to services, and cost reductions through decreased wastage and greater efficiency, leading to further investment in health care. Giversen's case study in Denmark [47] shows that the use of IT can lead to improved public health. Improvements in the prescription processing system could lead to improved patient care and overall improved public health [20][48]. However, improved public health will only come as a direct result of benefits gained and obstacles avoided. Fewer medication and transcription errors will result in fewer medical complications as a result of prescription error. Money saved from the consequent reduced litigation and fraud reduction should be used towards the provision of better patient care in the NHS. Indeed, Keith Farrar and Ann Slee have recently provided significant evidence for this in their literature review of published evidence for using electronic prescribing and medicines administration in hospitals [44]. The availability of new information and statistics could lead to improved patient care. For example, in research carried out by Kember Associates on behalf of Pharmed [45] 12% of patients stated they had failed to collect their medication with 66% of these stating they had simply forgot. In the more sophisticated ETP applications reminder notices could be sent to patients if they have failed to collect their prescriptions in a certain period.

Time saved by the pharmacist may lead to improved patient education. In the UK Audit Commission's national report on medicines management in UK Hospitals, Exhibit 18 clearly demonstrates the benefits of ETP to pharmacists *"pharmacists are able to devote more time to direct patient care"* [46]. From their observations in practices the authors gained the opinion that the professionals involved would love to spend more time educating the patients but presently they are restricted by the paper based system. Clearly if more practitioner's time can be freed up by ETP then this could increase patient care. However, the authors doubt that ETP in itself will do this, since the efficiency gains for the pharmacist are likely to be minimal. In fact ETP could lead to less patient education and care, as is the case in one UK ETP pilot, where the prescriptions are sent to an Internet based pharmacy. Here the drugs are dispensed from a central warehouse and then despatched by road to the patient's house, so there is zero contact between the patient and the pharmacist.

The generation of extra statistics and increased communication between healthcare providers has the potential to improve public health nationwide. But this will need to be managed carefully. More statistics could be used to coerce prescribers into prescribing less costly and less effective drugs, or could be used to show best practice.

6. Summary

In this paper we have identified four major categories of issues that will influence the implementation of ETP. When these influences are categorised as positive or

negative, this results in eight positive influences and nine negative ones as shown in Table 1.

The eight positive benefits are realisable with the carefully managed introduction of ETP, whilst the nine negative barriers need to be avoided in order to make the transition process successful. We believe that whichever ETP system is chosen nationally for the UK, the government should provide clear details about how each of the potential benefits are to be realised, and how the potential barriers against implementation are to be overcome.

Looking at Table 1 the positive impacts will come from reduced fraud and costs, and changes to process and practice, whilst the biggest hurdles the NHS faces is obtaining the acceptance of all the stakeholders and overcoming a culture of failure in large governmental IT projects. ETP is a risky path for any government to take. If the project is eventually a success and leads to improvements in patient care and the efficiency of the UK NHS, the government will be met with widespread public praise, whilst delayed transition, escalating costs, or system failure will result in public condemnation. Consequently, the choice of ETP system and implementation strategy must be considered with extreme care.

Table 1 Positive and Negative Factors in the Implementation of ETP		
Major Influences	Positive (+)	Negative (-)
The Influence of Stakeholders		(-) Government Led (-) Senior Management and Clinician Resistance to Change (-) GPs and Pharmacists Concerns about its effect on Practice and Patient Care
The Influence of Technology	(+)Better Communication Channels	(-) Privacy and Security (-) Technical Problems and Process Complexity
The Influence of Cost	(+)Increased Efficiency and Decreased Costs (+) Fraud Reduction	(-) Cost of Transformation
The Influence of Process and Practice	(+) Medication and Transcription Errors (+) Repeat Prescribing Benefits (+) Improved Quality (+) Improved Public Health (+) Improved Practice	(-) Legalities (-) Multiple Drug Codes (-) Education and Implementation

Whilst this paper has focused on the introduction of ETP into the UK health service, parallels can be drawn with computerising other healthcare systems. A number of the identified influences will affect the successful integration of any IT system into the health service. If the government and NHS can instil in their stakeholders a culture of change through for example, education, awareness and involvement, then there is the potential for the influence of stakeholders to become a positive rather than a negative factor. We believe that there is the potential for the government's investment in

reform to result in a modernised NHS as long as the change is well planned and the stakeholders' requirements are well catered for.

7. Acknowledgements

References

[1] NHS, "The NHS plan - a plan for investment - a plan for reform", Presented to Parliament by the Secretary of State for Health, Available at http://www.nhs.uk/nationalplan/nhsplan.htm, (February 21 2002)

[2] The Economist, "The Health service's IT problem", October 17th 2002

[3] Brennan, S and Spours, A, "Barriers to the succesful and timely implementation of electronic prescribing and medicines administration", The British Journal of Healthcare Computing & Information Management, October 2000, Volume 17, Number 8

[4] All-Party Pharmacy Group, "Electronic prescribing – A report to Health Ministers", January 2002

[5] Middleton, H, "Electronically transmitted prescriptions – a good idea?", The Pharmaceutical Journal, Vol.265, No.7107, pp172-176, July 29,2000

[6] Daly, M, "Where to start with electronic prescribing – learning from the difficulties experienced by others", The British Journal of Healthcare Computing and Information Management, May 2000, Volume 17, Number 4, pp 40-41

[7] Liew, A, "E-Prescribing applications benefit patients, providers and health plans", Anderson Consulting

[8] Hanseth, O. and Moneiro, E., "Changing Irreversible Networks", Proceedings from the ECIS'98, Aix-en-Provence, 4-6 June, 1998

[9] Hu, P. J-H., Chau, P.Y.K and Sheng, O.R.L, "Investigation of Factors Affecting Healthcare Organization's Adoption of Telemedicine Technology", Proceedings of the 33rd Hawaii International Conference on System Sciences, 2000

[10] Chadwick, D. W., New, J. P., McDowell, D. M., Mundy, D.P. 2001, 'Providing Secure Access to Confidential Patient Information Detailing Diabetic Condition', Proceedings Of The International Conference On Internet Computing 2001, Editors P.Graham, M.Maheswaran, R. Eskicioglu, CSREA Press, vol. I, pp. 535-541.

[11] Kember Associates, "Focus Groups with GP's and Pharmacists", November/December 1997, available at http://www.pharmed.co.uk/text/reseach7.html (April 2003)

[12] Bell, D., Marsden, P. and Kirby, M, "Are Users Ready For Electronic Prescription Processing?", Proceedings Volume 2 of the 16th British HCI Conference, London, September 2002

[13] Walley, P and Davies,C, "Implementing IT in NHS hospitals - internal barriers to technological advancement", Int. J. Healthcare Technology and Management, Vol. 4, Nos.3/4, 2002

[14] Pharmed, "Electronic transmission of prescriptions – A view from PharMed on how electronic prescribing can support pharmacy development", once available from http://www.pharmed.co.uk now unavailable

[15] Barber, B., Louwerse, K. and Davey, J., "HC1028 Implementing Secure Healthcare Telematics Applications in Europe - White paper on Health Care Information Security", ISHTAR Final Project Deliverable, NHS Executive's Information Management Centre, 1998

[16] Cheong, I, "Privacy and Security of personal health information", Journal of Informatics in Primary Care 1996, March:15-17

[17] Kember Associates, "Gp Attitudes Towards Electronic Prescribing", November 1998, available at http://www.pharmed.co.uk/text/reseach6.html (April 2003)

[18] Kember Associates, "Pharmacists Attitudes to Electronic Prescribing", July 1999, available at http://www.pharmed.co.uk/text/reseach2.html (April 2003)

[19] Weinstein, D and Worman, H.J., "Electronic prescription services offer potential savings and improvements in efficiencies", Gastroenterology Section, Temple University School of Medicine, available at http://www.temple.edu/gisection/aganew19.html (April 2003)

[20] Ford,N, Paul, P and Curtis, C, "The use of electronic prescribing as part of a system to provide medicines management in secondary care", British Journal of Healthcare Computing and Information Management, October 2000, Volume 17, Number 8, pp26-9

[21] British Broadcasting Corporation (BBC), "Prescription for Fraud", BBC Panorama Programme, June 23, 1997

[22] National Association of Co-operative Executive Pharmacists, "Moving Towards electronic transfer of prescriptions", The Pharmaceutical Journal, Vol. 267, No. 7170, pp564-565, 20 October 2001

[23] Davis, E., "Electronic transfer of prescriptions in primary care", The British Journal of Healthcare Computing and Healthcare Computing and Information Management, October 2000, Volume 17, Number 8

[24] Pharmed, "Research into Pharmacy and Script Collection Services", April 1999, available at http://www.pharmed.co.uk/text/reseach4.html (April 2003)

[25] Clark, C., "Information Technology in Action", Hospital Pharmacist, April 2002, Vol.9

[26] Sharples, S., Woodhead, A., "Improving Security: electronic transfer of prescription data in primary care", The British Journal of Healthcare Computing and Information Management, February 1996, Volume 13, Number 1

[27] Warden, J, "UK Aims to Deter Prescription Fraud", BMJ, 1998 : 316 :pp 167-172

[28] Chadwick, D.W. and Mundy, D.P, "Policy Based Electronic Transmission of Prescriptions", accepted for Policy 2003, IEEE 4th International Workshop on Policies for Distributed Systems and Networks, Lake Como, Italy, June 4-6, 2003

[29] Moore, J., Farrar, K., Hughes, D. and Spours, A., "Electronic Prescriptions – The Perfect Prescription", Electronic Record Development and Implementation Programme, Version 1, November 1995 see http://www.nhsia.nhs.uk/erdip/pages/publications/wpresc.asp (February 2003)

[30] Quinlan, F., "Electronic Prescribing in general practice : one small step", Australian Prescriber, 2000;23;pp50-51

[31] Booth, N, "Sharing patient information electronically throughout the NHS", BMJ, 2003;327:114-115

[32] NHS, "Pharmacy in the Future – Implementing the NHS Plan", NHS, September 2000

[33] Royal Pharmaceutical Society of Great Britain, "Repeat Prescribing Audit", 1998. Available from http://www.rpsgb.org.uk/pdfs/rep_pres.pdf

[34] Cousins, D, "Just what are the benefits of hospital electronic prescribing systems", The British Journal of Healthcare Computing & Information Management, March 2001, Volume 18, Number 2

[35] Cavell G.E., Hughes, D.K., "Does Computerised Prescribing Improve The Accuracy of Drug Administration?", Pharmaceutical Journal, 259, pp 782 –784, 1997

[36] HMSO, "Statutory Instrument 2001 No. 2887 The National Health Service (Charges for Drugs and Appliances) (Electronic Communications) Order 2001", Crown Copyright 2001

[37] HMSO, "Statutory Instrument 2001 No. 2888 The National Health Service (Pharmaceutical Services) and (Misuse of Drugs) (Electronic Communications) Order 2001", Crown Copyright, 2001

[38] HMSO, "Statutory Instrument 2001 No. 2889 The Prescription Only Medicines (Human Use) (Electronic Communications) Order 2001", Crown Copyright 2001

[39] HMSO, "Statutory Instrument 2001 No. 2890 The National Health Service (General Medical Services) (Electronic Communications) Order 2001", Crown Copyright 2001

[40] Transcript Model, see http://www.ppa.org.uk/news/etp-consortia/transcript_model.htm (February 2003)

[41] Tucker, A, "NHS ETP Pilots: Pharmacy2U Consortium's solution goes live", The British Journal of Healthcare Computing and Information Management, May 2002, Volume 19, Number 4, pp 30 – 32 see also http://www.ppa.org.uk/news/etp-consortia/pharmacy2u_model.htm

[42] Flexiscript, see http://www.ppa.org.uk/news/etp-consortia/sema_model.htm, see also http://www.flexiscript.co.uk/ (February 2003)

[43] NHS Primary Care Drug Dictionary, for further information, see http://www.ppa.org.uk/systems/pcdd_intro.htm (April 2003)

[44] Farrar, K and Slee, A, "Computerised Prescribing And its Impact On Medication Error Rates", The British Journal Of Health Care And Information Management, May 2003, Volume 20, Number 4, pp28-30

[45] Kember Associates, "Patients and Script Collection Services", October 2000, available at http://www.pharmed.co.uk/text/reseach9.html (April 2003)

[46] Audit Commission, "A Spoonful of Sugar:Medicines Management in NHS Hospitals", Audit Commission 2000

[47] Giversen, I.M., Gattiker, U.E., "IT in medical practice: an exploratory case study in Denmark's publicly financed healthcare system", Int. J. Healthcare Technology and Management, Vol. 3, No.1, 2001

[48] Kember Associates, "Research with Patients", May 1999, available at
http://www.pharmed.co.uk/text/reseach3.html (April 2003)
[49] Martin, S., Yen, D.C. and Tan, J.K. (2002) 'E-health: impacts of internet technologies on various
healthcare and services sectors', Int. J. Healthcare Technology and Management, Vol. 4, Nos. 1/2,
pp.71–86.