ELECTRONIC TRANSMISSION OF PRESCRIPTIONS

An Evaluation of the Technical Models Used in the English ETP Pilots 2002

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Abstract: This paper reflects on the evaluation of three different technical models of ETP piloted in England in 2002. ETP architectures, message sets, message content, message volume, security and privacy issues, functionality, integration with local legacy systems, and usability were examined. The authors conclude that the technical implementation may be the lesser of the problems confronting successful adoption of such systems, with the critical success factors more closely related to the ways in which ETP models are instantiated in local systems used by prescribers and pharmacists, and their consequent impact on the business practices of those users. Other barriers to successful adoption of ETP were observed, including the requirement for changes in legislation to facilitate electronic communication with digital signatures, and the need to gain patient consent to use of ETP.

Key words: Electronic Transmission of Prescriptions (ETP), Integrated Care Record Service (ICRS), Electronic Health Record (EHR), B2B, B2C, G2B, G2C, Electronic Services for Citizens and Enterprises, Inter-organizational Systems, Informatics Evaluation

1. INTRODUCTION

The development of a system of Electronic Transmission of Prescriptions (ETP) in England is closely related to key strands of UK Government policy in the National Health Service (NHS), described in *Delivering 21st Century IT Support for the NHS*[i] and *Pharmacy in the Future*[ii], which will be supported by the NHS National Programme for IT (NPfIT). It is expected that, as well as being more convenient for the patient, ETP will improve safety by reducing prescription errors and providing better information at the point of prescribing. It will also ensure that prescription information forms part of each citizen's NHS Care Record.

In addition, ETP is expected to deliver important administrative improvements[iii]. Current arrangements require prescription data to be manually entered into different systems on three separate occasions: by the prescriber, the pharmacy, and the Prescription Pricing Authority (PPA). With ETP in place, data will only need to be entered once and then passed between the collaborating systems. With over 624 million prescription items issued in 2002-3 and volumes growing by around four to five and a half per cent annually, ETP is seen as essential to meet increased demand whilst saving staff time and costs.

The overall objective is to implement a National Electronic Prescriptions Service by 2005 for 50 per cent of transactions, with full implementation by 2007. In 2001 the Department of Health (DH) commissioned three ETP pilots in different areas of England, covering acute and repeat prescribing by General Practitioners (GPs), but excluding repeat dispensing, nurse prescribing, dispensing doctors, community dentist prescribing, or the prescribing of controlled drugs. They commenced operation in mid-2002 and were closed in June 2003. The pilots were financed and implemented by private sector consortia: *Flexiscript, Pharmacy2U,* and *TransScript*[iv].

Each pilot offered a different ETP business process model, using a different technical approach. The intention was to explore the technical effectiveness of each model, to develop technical standards for implementation and associated electronic messages, to explore the socio-technical context of ETP, and to assess the change management issues inherent in introducing ETP.

To this end, a formative evaluation exercise was commissioned to run in tandem with the pilots, the key findings of which are summarised in a report to DH[v]. The purpose of this paper is to discuss the technical issues which emerged as key factors in the ETP pilots, and the implications for development of a single implementation model; other themes of the evaluation are not reported here except where they were observed to be a direct consequence of technical factors. A description of the evaluation framework and process, together with a summary of the business process and change management issues observed, is to be published in the UK Journal of Health Informatics[vi].

Table 1 shows the topics covered by the evaluation. The issues discussed in this paper are in plain font; other issues addressed in the evaluation are in italic font.

Table 1. Evaluation topics addressed

Topic	Scope
1 Dependability of communication	Reliability, availability, speed, security and safety of ETP architecture, messages and systems
2 Content of information	Clarity and persistence of information passing between systems *Errors, irregularities and changes to risks of fraud*
3 Changes in processes of communication	GP practice procedures for ordering, checking, authorising, producing, and collecting prescriptions *Pharmacy receiving, checking, dispensing and endorsing prescriptions* *Potential change in PPA procedures for assessing and paying dispensing claims for prescriptions* *Ways that patients and carers order and collect their prescriptions* *Changes in advice given to patients and carers* *Changes in communications between stakeholders*
4 Service and quality of care	*Patient satisfaction with ETP service including convenience and willingness to participate* *Pharmacy and GP practice assessment of ETP service and quality*
5 Workload and work practices of stakeholders	*Potential change to PPA workload and work practices* *Change to pharmacy workload and work practices* *Change to GP practice workload and work practices*
6 Stakeholders attitudes to ETP and beliefs about ETP	*Attitudes and beliefs of GPs, GP practice managers, and administrators* *Attitudes and beliefs of pharmacy staff* *Attitudes and beliefs of patients and carers*
7 Use of ETP	*Barriers and drivers for use of ETP* Usability and functionality of the pilot ETP systems System 'work around' strategies employed by users *Training and education issues*
8 Implications for roll-out	*NHS strategy and policy issues* *Analysis of the costs involved with aspects of ETP* *Legal and regulatory issues* *Ethical and professional practice issues* *Patient confidentiality and recruitment issues* Most appropriate technical and infrastructure (including network and security analysis) Most appropriate message design (including standard and solution-specific/proprietary messages) Most appropriate public key and digital signature infrastructure (including analysis of potential future technical developments) *Barriers and drivers for national implementation*

Prior to this evaluation, there has been little published research worldwide on experience of the implementation of ETP. Although there is a considerable body of literature on electronic prescribing (in excess of 90 articles were identified during a literature review), few of these actually refer to a process by which prescriptions are transmitted electronically from GP practice to pharmacy, and none to any subsequent transmission to an equivalent body to the NHS Prescription Pricing Authority (PPA). The majority of UK literature on this topic has not been published in peer-reviewed journals but has been undertaken by market research companies for an organisation contracted to deliver one of the ETP pilots. Studies of ETP implementation in Denmark suggest that ETP confers benefits for GPs, pharmacists, and patients[vii viii], whilst studies from the USA have explored technical issues with a view to future implementation of ETP[ix x].

2. THE ETP MODELS

Whilst there are many differences in the technical approaches adopted by the three consortia, it should also be recognised that the architectures adopted in the pilots are not the only ones possible. Two of the pilots used a point-to-point connection between GP and pharmacy, whilst the third used a centralised messaging service ('relay' model) where the pharmacy called down the prescriptions when dispensing was requested by the patient.

The data flows in prescribing between GP, patient, pharmacy and the PPA are shown in figure 1. The minimum flows include GP to pharmacy and pharmacy to PPA (data flow Y), mirroring the flow of the current paper-based system. In addition there are two other possible flows between GP and pharmacy: query resolution between the pharmacy and the GP (data flow 'β'), and confirmation of dispensing to the GP (data flow Z). For the pilots, a copy of all prescribing messages (known as the *'gold script'*) was forwarded to the PPA directly from the GP practice. All three pilots facilitated electronic claims for payment by sending 'endorsed' prescription messages from the pharmacy to the PPA, and messages could also be sent from the PPA to the pharmacy if any claims for payment were rejected.

A paper form signed by the patient was required for initial registration for any of the ETP services. Similarly, in accordance with current legislation, the patient (or patient's representative) was required to sign to verify prescription charge exemption status if appropriate (either a paper copy of the prescription, or a special-purpose 'exemption declaration form, depending on the pilot).

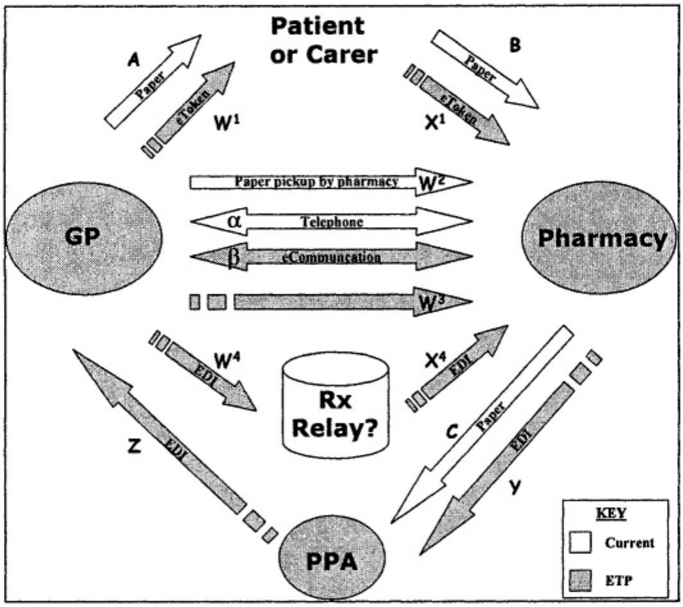

Figure 1. Current and ETP Prescribing and Dispensing Process Messaging

Table 2. Explanation of data flows depicted in Figure 1

Flow	*Description*
A	Paper FP10 prescription form (GP to patient)
B	Paper FP10 prescription form (patient to pharmacy)
C	Paper FP10 prescription form with pharmacy endorsements and exemption status information (pharmacy to PPA: used as claim for payment)
W^2	Prescription collection service (GP to pharmacy)
W^1	Information flow analogous to 'A' with prescription information or method of accessing prescription information using a token (e.g. bar-coded FP10) (GP to patient)
X^1	Information flown analogous to 'B' with prescription information or method of accessing prescription information using a token (e.g. bar-coded FP10) (Patient to pharmacy)
α	Telephone communication (between GP and pharmacy)
β	Electronic communication (between GP and pharmacy)
W^3	Electronic prescription (GP to nominated pharmacy)
W^4	Electronic prescription (GP to relay)
X^4	Electronic prescription (forwarded by relay to nominated pharmacy or called down by pharmacy)
Y	Information flow analogous to 'C' or paired with 'C' (prescription with pharmacy endorsements and exemption status information (pharmacy to PPA: used as claim for payment)
Z	Confirmation of dispensing (primary compliance feedback) from PPA to GP

The term ‘acute prescription’ is used in this paper to describe those for which it is not anticipated there will be a repeat request, and also those that initiate medication for which a repeat prescription is possible. Repeat prescriptions are usually requested by patients using the practice administration staff as an intermediary, but can also be made via a pharmacy ‘prescription collection service’, or direct to the GP in a face-to-face consultation.

2.1 Pharmacy2U

This model uses point-to-point messaging between GP practice and pharmacy to replicate the existing processes for acute and repeat prescribing.

For acute prescribing a prescription message is sent from the GP direct to the pharmacy. For a repeat prescription request made directly to the GP, the GP initiates a prescription message to the pharmacy. For a repeat prescription request via GP practice reception, administration staff generate a repeat prescription which is sent to the GP for approval, who then either applies a digital signature for authorisation and forwards the message to the pharmacy, or rejects the request. Where a repeat prescription is requested via a pharmacy the pharmacy sends a request message to the GP practice. The GP can then generate a digitally signed prescription message to the pharmacy in response, or a message to communicate any reason for rejecting the request.

As the prescribe message is received in the absence of the patient, the pharmacy can pre-dispense medication before the patient arrives to collect it. When collecting the prescription items, the patient is identified verbally, in line with current practice where prescription collection services are used. With the current paper system, it is estimated that up to 20% of all prescriptions are never presented by patients for dispensing, and automatic direction in this way may lead to an increase in the proportion of prescriptions actually dispensed. Note that the pharmacy should not claim for dispensing unless the patient actually collects the prescribed items, even though the pharmacy has automatically received the prescription and may have dispensed the items in anticipation of collection.

Patient registration for the service is initiated at the pharmacy, which then sends a registration message to the GP practice, with the practice system returning an acknowledgement. De-registration is initiated at the GP practice, which then sends a message to the pharmacy. Patient feedback indicated that they liked the ability to de-register or change their preferred pharmacy at the GP practice rather than at the pharmacy.

In this model, ‘current medication’ information is sent with every prescription message, and also with the initial registration confirmation message. This facilitates intervention by the pharmacist, e.g. drug interaction checking; reminders to the patient of repeat medication they may need. A unique mail-order home delivery service was operated by one of the pharmacies involved in this pilot (confusingly named ‘Pharmacy2U Ltd’). This service also telephoned patients (with their prior permission) to remind them to request repeat prescriptions. This feature was well-liked by those patients who took advantage of the mail-order service.

2.2 TransScript

This model also uses point-to-point messaging between GP practice and pharmacy to replicate the existing process for repeat prescribing. For acute prescribing, the GP issues a bar-coded paper prescription form to the patient to carry the prescribing information to the pharmacy, rather than an electronic message. The use of a bar-coded acute prescription allows the patient complete flexibility in choice of pharmacy, and as the information is also in printed form, a non-ETP pharmacy can also be used. For the patient, there is no difference from the current paper system for acute prescriptions. For repeat prescriptions the prescribing, dispensing and collection processes are similar to those for *Pharmacy2U*.

Patient registration for the service is initiated at the pharmacy, which then sends a registration message to the GP practice, with the practice system returning an acknowledgement. De-registration is initiated either at the GP practice or pharmacy, initiating a message to the other party informing them of de-registration.

2.3 Flexiscript

This model uses a centralised messaging service or ‘relay’ between GP practice and pharmacy to replicate the existing processes for acute and repeat prescribing. Communication between GP practices and the PPA, and between pharmacies and the PPA, was by point-to-point messaging.

For acute prescribing a prescription message is sent from the GP to the relay. A bar-coded paper prescription is also printed and issued to the patient with a Unique Prescription Identifier (UPN). The patient takes the printed prescription (as a token of identification) to the pharmacy, which then connects to the relay and requests the prescription details electronically using the UPN.

For a repeat prescription request made directly to the GP, the process is as for acute prescriptions. For a repeat prescription request via GP practice reception, administration staff generate a repeat prescription which is sent to the GP for approval, who then either applies a digital signature for authorisation and forwards the message to the relay, or rejects the request. A bar-coded paper prescription with UPN is also printed and collected by the patient or passed on their behalf to a pharmacy of their choice.

Where a repeat prescription is requested via a pharmacy the pharmacy sends a request message to the GP practice, via the relay. The GP can then generate a digitally signed prescription message to the relay in response, or a message to communicate any reason for rejecting the request. A bar-coded paper prescription is also printed and collected by the patient or collected on their behalf by the pharmacy. If the pharmacy collects the prescription, it can then contact the relay and dispense the medication prior to collection by the patient.

The use of a relay allows the patient flexibility in final choice of pharmacy for both acute and repeat prescriptions, and as the bar-coded prescription information is also in printed form, a non-ETP pharmacy can also be used. The prescribe message is received only when the patient contacts the pharmacy, so the pharmacy can only pre-dispense medication if the patient has contacted them prior to collection. This can be done by telephoning the pharmacy and quoting the UPN to allow the pharmacy to access the prescription information.

Patient registration for the service is initiated at the pharmacy, which then sends a registration message to the relay, for which an acknowledgment is returned. When a GP practice connects to the service, a list of all current ETP-registered patients for that practice is downloaded to the practice system. De-registration is also initiated at the pharmacy, which then sends a message to the relay, for which an acknowledgment is returned.

In this model, 'current medication' information is sent to the relay with every prescription message, and also with the initial registration confirmation message. This could be retained on the relay to form the basis of an electronic health record, although for the purposes of this evaluation this feature was not implemented.

3. EVALUATION FINDINGS

As noted above, this paper describes the technical issues which emerged as key factors in the evaluation; other themes are not reported here except where they are observed to be a consequence of technical factors.

3.1 Implementation and Trends in Use

The pilots demonstrated that ETP is technically viable, and all three consortia successfully implemented ETP based on three different models and using three different message sets, all of which eventually operated as expected. Many of the performance and usability shortcomings identified appeared to be caused by system designs which conflicted with existing user business processes, or were poorly integrated with existing local systems. The consortia identified and overcame a number of these problems before closure of the pilots. For the majority of GP practice and pharmacy systems ETP was implemented on existing hardware, with bar-code readers and suitable printers being added where required. In all systems, software changes were required to support ETP.

When the evaluation was designed it was anticipated that observation and data collection would take place over a period of six months of live processing in the three pilots, and that during this time there would be at least 100,000 electronic prescribe/dispense messages. Initial methods used to recruit patients resulted in a very slow take up of ETP, and additional recruitment methods were eventually employed to increase the numbers of patients using ETP. Specific constraints on functionality were imposed by the Department of Health for policy reasons, which required some re-engineering of the initial models developed by the consortia. This had to be taken into account when evaluating certain aspects of the pilots.

Final commissioning of the pilots was also delayed by problems encountered during a rigorous programme of technical testing for each site connected, devised by the PPA. The volume of messages was therefore lower than expected, although in the last two months of 2002 it reached significant figures (an aggregate of nearly 15,000 dispensed prescriptions from 34 GP practices and 23 pharmacies) and continued this upward trend in the early part of 2003, after the evaluation had ended.

It is estimated that by 2007 NHSNet (and its successor, N3) could need an additional annual capacity of up to 193TB (Terabytes) to carry sufficient message traffic to support 100% of all prescriptions issued. Between 26TB & 61TB could be required in 2005 to support transmission of 50% of prescriptions, depending on the architecture employed. Although there may be some advantages in adopting a 'relay' approach to message forwarding, this could as a consequence generate more message traffic. A compression algorithm for messages could be implemented, and should that be specific to ETP messages, could also offer additional security.

3.2 System Architectures

Of the three architectures implemented, the 'relay server' architecture is the most technically complex, although on the other hand it offers a more flexible service to patients. The relay implemented by *Flexiscript* is an 'unknowing' or 'un-trusted' relay, which was a constraint imposed by the Department of Health. This required additional encryption with a consequent impact on data volumes due to increased message sizes.

Implementing a 'trusted' relay with closer integration between the relay and the PPA would remove the need for the 'gold script' original copy of the prescription message which is matched with the dispense claim message from the pharmacy, and thus reduce data volumes and the number of messages required.

Closer integration between a relay and the PPA would also facilitate additional functionality such as checking prescription charge exemption status, information on which is held on PPA systems. This could remove the need for a patient signature to declare exemption status, and would facilitate a further reduction in the amount of manual processing at the PPA. Automated exemption status checks could also be implemented through dialogue between pharmacy and PPA systems.

A hybrid model could be envisaged, whereby the majority of prescriptions could be 'pushed' immediately to a pre-determined pharmacy, with the remainder held in a 'relay' server awaiting a pharmacy request to 'pull' it down on behalf of a patient. It has been estimated that 'push' would accommodate 70% of all prescriptions without difficulty, with 10% of patients requesting a deferred decision on choice of pharmacy. The remaining 20% of prescriptions would continue to require use of the existing paper forms for various reasons until policy, legislation and practice are changed to facilitate extended use of ETP, including mobile use.

3.3 Electronic Messaging

A standard message set was designed by an independent group prior to pilot implementation. In practice this did not fully support the pilot implementations. Some additions to the message set were required to support the full scope of the ETP business process, and some amendments were proposed as a more complete understanding of the business processes emerged from the evaluation.

For example, an addition to the message set was required to enable a GP to inform a pharmacy that a repeat prescription request made by a patient via the pharmacy had been refused. Another proposed amendment arising from observation that the actual process of repeat prescribing is more complex than envisioned in the original message set design is where the prescriber handling a repeat request is not necessarily the prescriber that authorised the previous issue of the medication. Also administration personnel are often involved in processing requests for repeat medication. As such there is a requirement for ETP to allow messages to be routed securely via administration personnel, who can then direct the messages to an appropriate prescriber as in the current paper based system.

The NHS has adopted XML as a messaging standard, and this was used for the ETP pilots. It is proposed that any future message developments will also accommodate standards such as HL7[xi], and frameworks such as eGIF[xii]. It is also proposed that XML schemas (in preference to DTDs) should be used in future implementations as they minimise the management required for version control, can express shared vocabularies, and can offer more constraint on the type and form of message content (e.g.. constrain quantities to be expressed only as integers).

Message acknowledgement was not effectively implemented initially, operating only at the transport level (TLA), and it was agreed that the receipt of all messages should be acknowledged at the application level (ALA) as well. TLA alone only confirms that the message has 'arrived', not that it has been successfully accepted for processing. To communicate the receipt of a usable or useful message the recipient application should validate the structure of the message, and acknowledge only messages with valid structures. An important issue is whether the sending of an ALA is dependent on the content of the message as well as the structure. If data that is required is not present or invalid in a message does an ALA get sent or not? One approach is to send an ALA if a message has an acceptable structure. If the content is in any way unacceptable then a separate query message could be sent to request re-issue or a re-send with any required amendments. It was not possible to experiment with the practical use of these alternatives in the pilots.

Other message content issues include the need for a common drug dictionary, as currently the pharmacy may spend time searching for the item which most closely matches what has apparently been prescribed. Prescription item and quantity fields can also be populated in different formats on different clinical systems. The NHS Primary Care Drug Dictionary (PCDD) will be used in future implementations of ETP, and clinical terminology will ultimately migrate to a common form via SNOMED-CT, to ensure that messages between systems are not misinterpreted by a recipient system using a different coding scheme.

There was insufficient evidence from the pilots to indicate any patterns in message sending. However it is imperative that patients gain access to prescribed medication without delay. Therefore prescription messages and prescription requests are unlikely to be suitable for batching, but administrative messages (e.g. claims for payment for dispensing) not associated with the patient getting medication may be suitable for batching.

3.4 Bar Codes

Electronic messaging has been shown to work by *Pharmacy2U* without the need for paper or bar-coding, although this solution does limit patient choice to those dispensers that are ETP-enabled. Where a bar-code solution was adopted, appropriate bar-code readers were required at pharmacies, with upgraded printers at GP practices. A two dimensional bar-code could contain the actual prescription item information as well as a unique prescription identifier, as in the *TransScript* pilot. Patients may prefer the prescription information to be printed in human-readable form as well as bar-coded, and this also allows processing during times of system unavailability, or by pharmacies not using ETP.

3.5 Security and Privacy

All three pilots achieved integrity and confidentiality of the electronic prescriptions by using variants of Public Key Cryptography (PKC). Lack of a single standard for all three pilots caused additional difficulties in integration with existing GP practice, pharmacy and PPA systems. There were no major concerns with the security provided by the pilots, although theoretical security compromises were identified, caused by poor physical security of the installation and networks, incorrect software behaviour, and insecure user behaviour such as leaving systems unattended whilst logged in.

Security compromise was deemed most likely to occur through lack of protection of the stored private key and by people being irresponsible with their passwords. If a private key is compromised then it will be possible to create messages as if they came from the person issued with the private key, to alter messages signed by the private keys owner without detection by using the private key to resign the altered message, and to decrypt messages intended for the private keys owners' eyes only. To ensure that private keys are not compromised both electronic and physical safe guards must be in place, such as encrypting a private key, keeping passwords safe and controlling computer access.

Only authorised users of ETP should be allocated with keys, requiring adequate user identification mechanisms. The pilots used either documentation or face to face recognition to identify people for authorization as ETP users. It was not a requirement of the ETP pilots to provide pharmacists with individual keys, and consequently, all of the solutions only provided keys to a pharmacy as a whole. If there is more than one pharmacist at a pharmacy then it is not possible to distinguish who has sent an ETP message, and if fraudulent activity is detected at a pharmacy it would not be possible to identify who is involved.

Security analysis also proposed that improved methods are needed for the secure identification of patients when collecting medication from pharmacies, to replace presentation of the paper prescription. When addressing these concerns, it is important to compare the proposals to current practice. For example a pharmacy dispensing repeat medication to a patient using a pharmacy collection service commonly uses only verbal identification of the patient. Identification token methods based on paper prescriptions, barcoded paper prescriptions, and 'unique prescription numbers' were successfully used in the pilots. Other possible solutions, such as patient entitlement or 'smart' cards, were not used in the pilots.

3.6 User Business Processes

Several changes in business processes were observed as a consequence of the technical models implemented, affecting all participants in the process. It was immediately apparent that the point of contact between pharmacy and GP practice had shifted from practice administration staff (via prescription collection services and telephone calls from pharmacies) to individual doctors (via electronic requests for repeat prescriptions and electronic messaging to resolve queries on prescriptions). This was partly responsible for a reported shift in workload from administration staff to GPs, and also caused problems when the original prescriber was unavailable for any reason. A system design which more closely mirrors existing collaborative workflow for repeat prescribing in GP practices[xiii] would probably be more acceptable, which would require routing of messages from pharmacies (and to a lesser extent from the PPA) to the GP via practice administration staff.

Current legislation requires a handwritten signature from the prescriber on issue of the prescription, and also from the patient or the patient's representative on collection of dispensed items, when prescription charge exemption status is declared. A number of alternative methods were used in the pilots to replace this: digital signature of electronic messages by GPs, and the printing of prescription charge payment exemption forms at pharmacies for patient signature. In two of the pilots, the prescriber still had to sign paper prescriptions as well as electronically signing each prescription message. The electronic signing of repeat prescriptions was facilitated by a 'bulk signing' option. This may be a useful option to save time, but the implementation observed in the pilots raised questions about user attention to individual patient circumstance, and the majority of users avoided using this facility for this reason.

4. CONCLUSION

Evaluations of healthcare IT applications are by necessity multi-perspective and multi-disciplinary. In order to understand the mechanisms which cause new systems and procedures to succeed or fail, it is necessary to take account of the social and work environment within which they are being introduced, as well as the technology adopted for implementation. The advantages of this holistic or multi-method approach to evaluating interventions and the social systems, or context, within which the intervention exists, have been described and demonstrated by others[xiv, xv, xvi].

Whilst the three models described here offer some differences in the service offered, the majority of patients perceived little or no difference from the existing paper system, apart from those who opted to use the mail-order pharmacy. There was some concern by pharmacies that where the model required patients to pre-select a pharmacy, the prescriber might unduly influence the 'direction' of prescriptions to a particular pharmacy. Otherwise, users in practice found little difference between the models offered apart from detailed implementation issues.

This evaluation, and research elsewhere[xvii], indicates that the continuing use of paper prescriptions will feature regardless of the introduction of ETP, for reasons including patient comfort (being able to read what was prescribed), GP/patient interaction (issue of a prescription is the prime signal that the consultation is over), staged implementation, and back up in case of failure of the overall message-handling system or a participant local system.

The critical success factors for users of ETP were the poor fit to their existing business processes, and initial difficulties experienced with software bugs. These problems were compounded by variations from agreed messaging formats and the different application program interfaces (API's) offered by each model, causing difficulty in successful integration with existing GP practice, pharmacy and PPA systems. Consequential impacts resulted in clumsy work-around solutions and shifts in workloads between different classes of user.

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REFERENCES

[i] Department of Health, 2002, UK, *Delivering 21st Century IT Support for the NHS* (April 2004) www.dh.gov.uk/assetRoot/04/07/16/76/04071676.pdf

[ii] Department of Health, 2000, UK, *Pharmacy in the Future* (April 2004) www.dh.gov.uk/assetRoot/04/06/82/04/04068204.pdf

[iii] Strange, M., March 2004, *Why should the National Programme for IT include the electronic transmission of prescriptions?,* British Journal of Healthcare Computing 21, No2, 30-32

[iv] Prescription Pricing Authority, ETP Pilot Consortia, (April 2004) http://www.ppa.org.uk/news/consortia.htm

[v] Sugden, B., 2003, *Report on the Evaluation of Pilots for Electronic Transmission of Prescriptions* (April 2004) www.dh.gov.uk/PolicyAndGuidance/Medicines PharmacyAndIndustryServices/Prescriptions/ElectronicTransmissionOfPrescriptions/fs/en

[vi] Sugden, B. and Wilson, R., Integrated Care and Electronic Transmission of Prescriptions: Experience of the Evaluation of ETP Pilots, Health Informatics Journal, Sage Publications, ISSN: 1460-4582 (to be published 2004)

[vii] Moorman PW, Bernstein K, eds. Regional Health Care Networks in Europe, *The CoCo Project Report,* Deliverable 4.2, CoCo Project, HC 1074/ HC 1008, 1999, ISBN 87-90839-00-5

[viii] W.J. van der Kam, P.W. Moorman, M.J. Koppejan-Mulder, *Effects of Electronic Communications in General Practice,* International Journal of Medical Informatics, 2000; 60: 59-70

[ix] *Secure System for Transmitting Prescriptions and Related Patient Information Between Prescribers and Pharmacists,* 2000, Study for the National Association of Pharmacy Regulatory Authorities (NAPRA), (April 2004) www.napra.org/practice/information/calian.pdf

[x] *A Proposal for Electronic Prescription Security Standards,* 2001, National Association of Pharmacy Regulatory Authorities (NAPRA), (April 2004) www.napra.ca/pdfs/practice/erx_security.pdf

[xi] Shafarman, M., March 2004, *HL7 Version 3: Developed Globally, Implemented Locally,* (April 2004) www.hl7.org.uk/version3group/downloads/MS_HL7v3_masterclass.ppt

[xii] (April 2004) www.govtalk.gov.uk/schemasstandards/xmlschema.asp

[xiii] Wilson, R., Sugden, R. and Jones, N. *Responsibility in GP Repeat Prescribing,* DIRC Workshop on Dependability in Healthcare Informatics, Edinburgh, UK, 22-23 March 2001, DIRC workshop proceedings, pp - 10-14

[xiv] Heathfield, H.A., 2001, *Evaluating clinical systems: the social programme perspective,* Health Informatics Journal 7, 8-12

[xv] Heathfield, H., Pitty, D., and Hanka, R., 1998, *Evaluating information technology in health care: barriers and challenges,* British Medical Journal 316, 1959-1961

[xvi] Anderson, J.G., Aydin, C.E., and Jay, S.J., 1994, *Evaluating health care information systems: methods and applications,* London: Sage Publications

[xvii] Mundy, D., Chadwick, D., and Ball E., March 2004, *Some Expectations and Perceptions of Electronic Transfer of Prescription Systems,* British Journal of Healthcare Computing 21, No2, 34-36