



Electronic prescribing in hospitals

Challenges and lessons learned

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This report is one of the outputs of a study commissioned by NHS CFH. The study involved gathering data from people in a number of hospitals in England who had been part of the implementation of ePrescribing systems. The ideas presented here are based on the actual experiences of NHS staff who have worked on ePrescribing implementations.

Any comments or queries about the report should be directed to the ePrescribing programme at NHS CFH at eprescribing@nhs.net

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Executive Summary

1. Current systems for prescribing and administration of medicines in UK hospitals are based on a model established over 40 years ago. Since then medications used have grown in number and complexity, with a resulting potential for greater risk to patients.
2. Electronic prescribing (ePrescribing) systems, where the ordering, administration and supply of medicines is supported by electronic systems, offer the opportunity to address such problems, as well as to support a robust audit trail and enable potential innovations in the medicines use process.
3. A growing number of hospitals in the UK have introduced ePrescribing systems, and the earliest adopters have had ePrescribing successfully in use for over a decade. This report draws on the lessons learned by these pioneers and by those who are currently engaged in moving to ePrescribing.
4. ePrescribing must be understood in the context of the whole medicines use process, not as just about prescribing or exclusively of relevance to prescribers. Nurses use ePrescribing systems to administer medicines, and pharmacists to review orders and manage the supply of medicines. Beyond these central stakeholders – doctors, nurses and pharmacists – are many other healthcare professionals who are potential users of ePrescribing if and when they need to review a patient's medication.
5. ePrescribing systems are widespread in primary care in England, and almost all GP generated prescriptions come from a computer system. In secondary care ePrescribing is, as yet, less widespread though the number of systems in use is growing.
6. ePrescribing is seen today in various forms in secondary care in England. Increasingly ePrescribing systems are implemented as whole-hospital systems covering all, or almost all, inpatients as well as outpatient clinics, and serving the multiple parts of the medicines use process – prescribing, review, administration, supply. Some hospitals have implemented systems that only undertake one part of the process – for example, support for discharge prescribing. There are other situations, such as in oncology or critical care, where specialised systems are used, tailored to the very particular needs of these specialties.
7. The benefits of ePrescribing for all users and all medicines-related tasks starts with the generation of a legible and complete medication order. This information can then be shared among multiple healthcare professionals, allowing reliable access to medicines information without having to hunt down a single paper record.

8. ePrescribing systems can also provide various degrees of clinical decision support (CDS), to help prescribers create orders based on full information about the patient and about the medicines in use. For example, a prescriber can be informed about a patient's allergies, or about potential drug-drug interactions. Similarly, during administration a nurse can have access to decision support, for example access to laboratory tests or additional administration instructions at the time of administration.
9. A major motivation for introducing ePrescribing systems is to improve the safety of medicines use and reduce the current and unacceptable levels of adverse drug events (ADEs). There are, however, other motivations. At the organisation level these may include generating new management data on medicines use, establishing and maintaining formularies, and the opportunity to redesign aspects of the medicines use process and establish new practices.
10. The motivation of individual healthcare professionals to use ePrescribing is equally important. Everybody who will use ePrescribing needs to understand the overall vision of a more robust medicines use practice and the change that accompanies an ePrescribing implementation. But they also need to be motivated by an ePrescribing system that is easy to use, and helps them accomplish their own tasks. To help achieve this, clinical users need an ePrescribing system that is integrated with other hospital systems such as electronic health records, pathology results or patient administration systems, using data drawn from these systems, and feeding data to them.
11. ePrescribing projects require a strong and committed multi-disciplinary team to lead them. Doctors, nurses and pharmacists must work together with other healthcare professionals and managers to prepare for ePrescribing implementation. ePrescribing projects require the active support of senior managers and senior clinical leaders, who must be briefed to ensure that they understand the challenges of ePrescribing, the changes it will bring and the benefits.
12. ePrescribing projects take time to be established and to make all the preparations needed before a system can be put to use – between one and two years. Throughout this period the ePrescribing project team must maintain good two-way communications with senior managers, senior clinicians, information management and technology (IM&T) staff and with the front line clinical staff who will work with the ePrescribing system. Communicating the overall vision of ePrescribing, building trust and commitment from the wider community, and attending to details of procurement, set-up, roll-out, training and support are all important activities for the ePrescribing team. This must all be undertaken with an overall focus on safety.
13. An ePrescribing team needs to communicate across the hospital that ePrescribing will demand changes in work practices, and that this implies a need for an active and open approach to learning how the system can be used to maximum benefit. The ePrescribing team must be open, taking time to listen to concerns of users, their suggestion and enquiries.
14. ePrescribing teams must not underestimate how long procurement and installation of the equipment and software takes. Neither should they underestimate the potential for this technology – networks, computers, software systems – to fail. Many sites which have implemented ePrescribing report difficulties with, for example, wireless networks, authentication and log-in systems and computers. For this reason it is important that the ePrescribing team includes IM&T representatives, and that the demands that ePrescribing will make on IT and network infrastructures is fully understood.

15. The sequence and pace of the roll-out of ePrescribing into clinical areas needs careful consideration. The specialty where ePrescribing is first piloted will usually be chosen because of the enthusiasm of those who work there, but the sequence of subsequent roll-out sites need to be carefully chosen. Experience from other sites suggests that, once a system is fully tested in a pilot location, roll-out to the rest of the hospital should be as fast as is compatible with safety, so as to minimise the period of time where multiple systems are in use.
16. Once an ePrescribing system has been rolled-out the work of the ePrescribing team will change somewhat, but it is not finished. The ePrescribing team that drives an implementation project forward needs to be transformed into an ePrescribing support service maintaining the same interdisciplinary approach and drawing on multiple skills.
17. ePrescribing systems need to be managed throughout their lifetime. New staff will need to be trained, software will need to be maintained and upgraded, and bugs will appear that need to be corrected. More significantly, ePrescribing systems allow many possible innovations in the medicines use process, for example increased use of clinical decision support, restructured formularies and prescribing permissions, or increased interchange of data with other hospital systems. Real additional benefits of ePrescribing come from careful exploitation of these possibilities.
18. ePrescribing will change how people work – indeed that is in part the aim of introducing such systems. Some tasks may become more rigid, demanding a full compliance with a set of procedures, or constraining options. Staff can usually understand why this is needed and is desirable, but it is far easier for them to accept if the broader benefits of ePrescribing are evident. A successful ePrescribing system, however, is not just about more structured tasks. It is also about support for creative use of the data generated, help in prioritisation of work, and the ability to reflect on and review practice.
19. As people start to use an ePrescribing system it will result in various ‘work-arounds’ – ways that people discover to get the job done faster or easier. People will, in effect, configure the ePrescribing system to meet their particular needs. These ad hoc developments may be desirable and useful, or they may be dangerous. In either case work-arounds certainly can tell us about how ePrescribing fits into the clinical environment. The ePrescribing support team will need to monitor and assess such developments, discussing openly the needs of users, the demands of safety, and what it is possible to achieve.
20. Implementing ePrescribing systems is a challenge, but one that has been shown to be very achievable. ePrescribing systems work, are safe, and once in use most healthcare professionals would never wish to return to a paper-based system. They offer many advantages both at the level of medicines related tasks, but also in supporting management and practice development aims, and in particular innovation in medicines use processes.
21. Fundamentally, ePrescribing needs to be seen as part of the overall strategic direction for any hospital, a central part of an evolving set of information systems that serve multiple professional groups, patients and their carers, and that extend beyond the secondary care setting.

Introduction

Medicines are at the very heart of modern medicine.

However, the systems for prescribing and administering them have remained largely unchanged for the last forty or fifty years. Meanwhile the medications used have increased in number and complexity, resulting in potentially greater risks for the patient of medication error.

For UK hospital inpatients, the systems used for prescribing medications and recording their administration are based on a model established in the 1960s. Doctors write medication orders directly onto a paper drug chart or medication Kardex, and the same document is used by nurses to find out the doses due and record administration to the patient. This document is also used by pharmacists to screen and supply medication, as well as by other healthcare professionals when they need to view a patient's current medication.

Systems used for medication prescribing and administration recording are based on a 1960s model

But there are known problems with this system. UK studies show that:

- prescribing errors occur in 1.5-9.2% of medication orders written for hospital inpatients¹⁻⁵
- dispensing errors are identified in 0.02% of dispensed items⁶⁻⁷
- medication administration errors occur in 3.0-8.0% of non-intravenous doses^{2, 8-15} and about 50% of all intravenous doses.¹⁶⁻¹⁸ (These figures exclude errors involving wrong time of administration).

Given these figures, and the general understanding that medication errors are one of the major preventable sources of harm in healthcare, it is not surprising that computerisation of the prescribing and administration processes is advocated as a way to reduce these errors. This, together with growing needs for formulary control and audit, has led to widespread recommendations for the introduction of electronic prescribing (ePrescribing) systems in the UK.¹⁹⁻²¹ Similar pressures are seen in the USA where ePrescribing systems have been in use in some hospitals for some time, driven by the additional requirement for individual patient billing and the greater efficiency gains associated with computerising the more labour-intensive unit dose drug distribution system used in most US hospitals. Based on studies undertaken in the USA the Leapfrog Group <http://www.leapfroggroup.org> argues that ePrescribing can reduce errors, Adverse Drug Events and costs, and encourages hospitals to implement such systems.

To date, only a few UK hospitals have introduced comprehensive ePrescribing systems, although there are some notable exceptions. Queens Hospital, Burton on Trent, has had computerised prescribing as part of a hospital-wide integrated information systems for over 10 years and in 2006 The Royal Hampshire Hospital in Winchester became the first hospital in Europe to replace one ePrescribing system that had been in use for many years with another. The limited uptake of ePrescribing by secondary care in the UK is in direct contrast to the situation in primary care where ePrescribing is now the norm and the electronic transmission of prescriptions from general practitioners to high street pharmacies is being implemented through the Electronic Prescription Service (EPS) (see <http://www.connectingforhealth.nhs.uk/systemsandservices/eps>).

The relatively modest scale of ePrescribing in the UK acute care setting might be explained by a number of factors. These include a perception that ePrescribing is technically difficult and challenging, that available systems are not sufficiently well developed to deliver benefit, that other systems need to be in place before ePrescribing is rolled out, or that the culture change required for adoption into clinical practice is too hard to achieve.

Certainly each of these concerns has some validity, but recent experience in UK hospitals shows that ePrescribing projects can surmount them all. Indeed, attitudes are changing and at the time of writing (January 2009) the planning and implementation of ePrescribing in UK acute care is underway at a growing number of sites. Building on this pool of experience, the work reported here challenges such negative perceptions of ePrescribing. Drawing on the understanding and experience of people who have participated in ePrescribing implementations in NHS hospitals in England, this report conveys a different message; ePrescribing is very achievable, and the benefits are well worth the effort. But ePrescribing does require careful planning and a multidisciplinary team effort to achieve a successful implementation.

Inhibiting factors include a perception that ePrescribing is technically difficult and that culture change is too hard

People who have participated in implementations say ePrescribing is very achievable

A note on terminology

NHS Connecting for Health's formal definition of ePrescribing is as follows:

The utilisation of electronic systems to facilitate and enhance the communication of a prescription or medicine order, aiding the choice, administration and supply of a medicine through knowledge and decision support and providing a robust audit trail for the entire medicines use process (NHS Connecting for Health, 2007).

Elsewhere in the world ePrescribing systems are referred to by various other names. In the USA, and thus much of the research literature, the most commonly used term is the abbreviation CPOE, although what it stands for has shifted from 'Computerised

Physician Order Entry', to 'Computerised Provider Order Entry', in line with the expansion of prescribing authority to other groups of staff.

CPOE, as discussed in the US literature, often encompasses medical orders other than medicines such as those for laboratory tests, physiotherapy and imaging. In the UK, the term CPOE is not generally used and traditional UK practice has been to separate orders for medication from other medical orders. For this reason, in the UK, it is more common to speak about ePrescribing.

Today's ePrescribing systems include electronic medication administration records (eMAR) where medication administration can be documented and screened electronically. Some hospital sites in the UK use the alternative acronym of EPMA for their system, standing for Electronic Prescribing and Medicines Administration

In line with current UK (NHS CFH) practice, we use the term 'ePrescribing' in this report, while recognising that most inpatient ePrescribing systems provide supply, administration and recording functions as well as prescribing, and that nurses are probably the professional group who spend most time working with ePrescribing.

Aim of this Report

The work reported here was commissioned by NHS CFH with the aim of identifying the lessons to be learnt from various UK hospital trusts who have already implemented ePrescribing, and using these experiences to brief those who are yet to do so. This report is largely based on interviews and questionnaires conducted with over 50 staff in 13 NHS trusts who have been involved with the implementations of 20 different systems; we also draw on the national and international literature.

The aim of this report is to communicate the lessons that have been learnt to those who will be involved in future hospital-wide implementations. The study's specific objectives are given in Appendix 1.

The structure of the rest of this report is as follows:

- Chapter 2 gives an introduction to ePrescribing systems and their functions, highlighting the key people who will use them and summarising the benefits.
- Chapter 3 discusses the various motivations that may make a hospital or trust wish to move to ePrescribing.
- Chapter 4 presents the key lessons learned that have emerged from the study undertaken for this report - lessons drawn from people who have actually gone through ePrescribing implementations.
- Chapter 5 is concerned with the safety of ePrescribing, a key concern of all implementers.
- Chapter 6 considers the agenda of issues that an ePrescribing planning team will need to consider, and the make-up of the team itself.

- Chapter 7 is concerned with managing an ePrescribing system in use - remembering that this is not a “fit and forget” bit of technology, but a socio-technical system that needs to be sustained and developed throughout its period of use.
- Chapter 8 discusses the various technical elements that are found within ePrescribing systems, including hardware, databases and networks.
- Chapter 9 concludes the report with a discussion of ePrescribing within the emerging landscape of eHealth.

A list of abbreviations is given in Appendix 3.

Each chapter is written with the aim of being accessible if read alone, although we recognise that this does lead to some repetition. Thus the report and the accompanying materials are intended to form the basis of a toolkit that can be used in a variety of settings to support successful planning for the implementation of ePrescribing. We have aimed to write each chapter using relatively straightforward language so as to be accessible to a wide range of hospital staff.

This report is accompanied by six user briefing notes ('briefs'), which are intended to provide quick and insightful briefing for the key stakeholders: doctors, nurses, pharmacists, information technology staff, project team members and chief executives and senior managers.

Finally, associated with this report are summary PowerPoint presentations suitable for supporting local implementation activities.

For copies of all materials see: www.connectingforhealth.nhs.uk/eprescribing

References

1. Dean B, Schachter M, Vincent C and Barber N. Prescribing errors in hospital inpatients – their incidence and clinical significance. *Quality and Safety in Health Care* 2002;11: 340-344.
2. Franklin BD, O’Grady K, Donyai PD, Jacklin A and Barber N. The impact of a closed-loop electronic prescribing and administration system on prescribing errors, administration errors and staff time: a before and after study. *Quality and Safety in Health Care* 2007;16: 279-284.
3. Franklin BD, O’Grady K, Paschalides C, Utley M, Gallivan S, Jacklin A and Barber N. Providing feedback to hospital doctors about prescribing errors; a pilot study. *Pharmacy World and Science* 2007;29: 213-220.
4. Haw C and Stubbs J. Prescribing errors in a psychiatric hospital. *Pharmacy in Practice* 2003;13: 64-66.
5. Tesh DE, Beeley L, Clewett AJ and Walker GF. Errors of drug prescribing. *British Journal of Clinical Pharmacology* 1975;2: 403-409.

6. Beso A, Franklin BD, Barber N. The frequency and potential causes of dispensing errors in a hospital pharmacy. *Pharmacy World and Science* 2005;27: 182-190.
7. Spencer MG and Smith AP. A multicentre study of dispensing errors in British hospitals. *International Journal of Pharmacy Practice* 1993;2: 142-146.
8. Cavell GF and Hughes DK. Does computerised prescribing improve the accuracy of drug administration? *Pharmaceutical Journal* 1997;259: 782-784.
9. Dean BS, Allan EL, Barber ND, and Barker KN. Comparison of medication errors in an American and a British hospital. *American Journal of Health-System Pharmacy* 1995;52: 2543-2549.
10. Dean BS and Barber ND. The effects of a patients' own drugs scheme on the incidence and severity of medication administration errors. *International Journal of Pharmacy Practice* 2000;8: 209-216.
11. Franklin BD, O'Grady K, Parr J and Walton I. Using the internet to deliver education on drug safety. *Quality and Safety in Health Care* 2006;15: 329-333.
12. Gethins B. Wise up to medication errors. *Pharmacy in Practice* 1996;6: 323-328.
13. Ho CYW, Dean BS, and Barber ND. When do medication administration errors happen to hospital inpatients? *International Journal of Pharmacy Practice* 1997;5: 91-96.
14. Ridge KW, Jenkins DB, Noyce PR and Barber ND. Medication errors during hospital drug rounds. *Quality in Health Care* 4:240-243, 1995.
15. Taxis K, Dean BS, and Barber ND. Hospital drug distribution systems in the UK and Germany - a study of medication errors. *Pharmacy World and Science* 1999;21: 25-31.
16. Hartley G and Dhillon S. An observational study of the prescribing and administration of intravenous drugs in a general hospital. *International Journal of Pharmacy Practice* 1998;6: 38-45.
17. O'Hare MC, Bradley AM, Gallagher T, and Shields MD. Errors in administration of intravenous drugs [letter]. *British Medical Journal* 1995;310: 1536-1537.
18. Taxis K and Barber N. Ethnographic study of incidence and severity of intravenous drug errors. *British Medical Journal* 2003;326: 684-687.
19. Audit Commission. *A Spoonful of Sugar: Medicines Management in NHS Hospitals*. The Audit Commission, London, 2001.
20. Healthcare Commission. *The Best Medicine. Management of Medicines in Acute and Specialist Trusts*. Commission for Healthcare Audit and Inspection, London, 2007.
21. Anon. Electronic prescribing needed in hospitals to monitor use of antibiotics. *British Medical Journal* 2007;334:712.

ePrescribing systems: their functions and potential benefits

Key messages

- ePrescribing is about much more than prescribing, and involves various healthcare professionals who all have a role in ensuring medicines are used safely as part of patient care.
- ePrescribing projects therefore have many important stakeholders; a team approach and senior management buy-in are both essential.
- ePrescribing systems come in a variety of shapes and sizes, as is appropriate to various settings, but most are based on commercially produced packaged software .
- Increasingly we see whole hospital systems being implemented, but many ePrescribing systems are also found in specialist areas such as oncology or critical care.
- The benefits of ePrescribing originate in the generation of legible and complete medication orders, and in the sharing of this information among multiple healthcare professionals undertaking different tasks.
- Based on such data various degrees of decision support can help in both prescribing and administration.
- Additional benefits are seen with ePrescribing systems that integrate with other hospital systems, for example with pathology.
- Successful implementations demonstrate the many real benefits that ePrescribing can bring.
- Careful planning and teamwork are the basis of successful implementations.

What is ePrescribing?

The NHS Connecting for Health (NHS CFH) definition of ePrescribing is as follows:

The utilisation of electronic systems to facilitate and enhance the communication of a prescription or medicine order, aiding the choice, administration and supply of a medicine through knowledge and decision support and providing a robust audit trail for the entire medicines use process.

This definition emphasises that ePrescribing is about communication, certainly more than just prescribing, and encompasses supply and administration as well as other functions such as audit.

ePrescribing involves many types of healthcare professional, and certainly not just prescribers (be they doctors, pharmacists or nurses). Nurses and pharmacists, alongside doctors, are the 'obvious' key stakeholders for functions such as administration and medicines review, but physiotherapists, dieticians and other healthcare professionals also use inpatient ePrescribing systems when they need to know about a patient's medicines.

Physiotherapists, dieticians and other healthcare professionals also use inpatient ePrescribing systems

Who is involved with implementing ePrescribing?

Because all these healthcare professionals have an interest in using ePrescribing, the implementation of ePrescribing systems has to involve a number of clinical stakeholders as well as the Information Management and Technology (IM&T) professionals who are responsible for the technical infrastructures that support ePrescribing. But before anything it is essential that senior managers and senior clinicians are well informed about and committed to ePrescribing. Without such senior support ePrescribing projects will be far less able to weather the inevitable setbacks.

Hospitals undertaking ePrescribing implementations should also aim for an ongoing relationship with the supplier of the software used so as to be able to draw on their experience and knowledge, to resolve problems promptly, and to participate in the future developments of the software's functionality.

The consequence of ePrescribing touching so many peoples' interests is that implementing ePrescribing must be understood as involving more than just a change from paper to electronic prescriptions; it inevitably involves considerable changes to working practices and culture for all who work with it. For example, for a nurse on a ward it can change the structure of the drug round, for a doctor it can change the prescribing process by using order sets – groups of medicines that can be ordered as a whole - for common conditions and procedures, while for a ward pharmacist their visit may be preceded by a review of patients from a remote terminal, allowing prioritization of those who most need attention.

ePrescribing works best when it is approached as a joint or collective project that brings people from different professions together. We cannot stress this enough; one primary finding from our respondents is that in order to make ePrescribing 'work' and deliver the potential benefits, a multi-professional approach is essential, involving all relevant stakeholders. A common commitment to making ePrescribing work and obtaining benefits from it needs to be made by all stakeholders well before implementation starts, and needs to continue long after the initial implementation stage is finished.

To make ePrescribing 'work' a multi-professional approach is essential, involving all relevant stakeholders. Senior management buy-in is crucial

Where in the hospital are ePrescribing systems found?

ePrescribing systems can be, and increasingly are, implemented hospital-wide, serving almost all aspects of medicines use. There are still, however, some areas that prove more complex to integrate into a hospital-wide system, for example Accident and Emergency (A&E) departments, or areas which will use their own

specialist systems, for example critical care units. Similarly, there may be situations when a comprehensive hospital-wide ePrescribing system cannot be achieved, and certainly not overnight, and some specialities may be left out or delayed in receiving ePrescribing.

The following are examples of where and how ePrescribing systems are currently used in NHS hospitals in England:

- Inpatient wards – often with one or two specialist clinical areas (such as critical care or paediatrics) that are exceptions or where implementation is delayed.
- Outpatient clinics – sometimes this area is implemented first, sometimes last.
- Discharge prescribing – many examples of standalone systems used to produce discharge summaries incorporating discharge prescriptions.
- Critical care areas – here, requirements are often served by specialist ePrescribing software with a particular focus on recording administration of continuous intravenous infusions.
- Chemotherapy clinics and day care centres – chemotherapy prescribing is complex, and requires careful and controlled prescribing and administration. Again, specialist ePrescribing systems are often used, sometimes supported by specific funding.
- Operating theatres – ePrescribing may at times be used to prescribe in the operating theatre, but even if not used for prescribing access to information about the current medication will usually be required.
- Dialysis centres and other day-care units.

ePrescribing systems can be specific to one clinical specialty, one stage of the prescribing process or (almost) hospital-wide

We should also add that most ePrescribing systems are implemented in the pharmacy too, facilitating supply and monitoring, as well as allowing discharge prescriptions to be received directly. Indeed, many ePrescribing systems are directly interfaced with the pharmacy software and share common databases, for example formularies and lists of drugs and doses available. This also avoids pharmacy staff having to re-enter details of the medication required in order to make a supply.

What about the ePrescribing software?

Almost all ePrescribing implementations in the UK, be they hospital-wide or restricted to some specialty, are based on commercially available software purchased from specialist suppliers. Such software provides the essential functionality of identifying patients, entering structured and complete prescriptions, screening them and documenting administration.

Additional functionality that may be available includes various degrees of help for prescribers including access to information sources (e.g. online BNF or formulary) and cross checking with available patient data (e.g. for allergies). There will usually also be a database that can support the identification of drug-drug interactions, and perhaps of drugs prescribed in doses outside of a pre-defined range. These aspects are often loosely described as Clinical Decision Support (CDS).

Healthcare professionals interact with ePrescribing software through terminals of various types and via different screens adapted to specific tasks.

Figure 1 shows a representation of a prescribing screen. The medicines that have already been prescribed – current medications - are shown on the left, with dose and frequency. A new order for doxycycline is being selected from a drop down list generated by typing the first three letters 'dox'. This selection has then triggered an allergy alert for this patient. The alert invites the prescriber to cancel their selection as the default action, or they can continue to prescribe this medicine.

The screenshot displays the NHS Clinical system by VENDOR interface for Dr. Jane Smith, Consultant in General Medicine, during a morning ward round for patient Andrew Atkinson (Mr), born 01-Dec-1941 (69 yrs), Male, NHS 246 810 1214. The patient's address is Flat 2, Hughes House, Copenhagen... and his phone/email is 07834 234722. He is located in Rachel Ward, Bay 6, Bed 2. A 'Known allergies' button is visible.

The interface shows a navigation menu with tabs: Overview, Interventions, Labs & Obs, History, Correspondence, and Demographics. The 'Interventions' tab is active, showing 'Current medications'.

Current medications:

- goserelin** - implant
DOSE 10.8 mg - subcutaneous INjection - once every 3 months
First due at 12-Mar-2010 18:00
- latanoprost** - 50 micrograms per mL - eye drops
DOSE 1 drop - ocular - both eyes - once a day at night
Started at 11-Mar-2010 22:12
- furosemide**
DOSE 60 mg - oral - twice a day
Started at 11-Mar-2010 14:12
- erythromycin** - gastro-resistant
DOSE 500 mg - oral - four times a day
Started at 11-Mar-2010 12:46
End date 25-Mar-2010
- enalapril**
DOSE 10 mg - oral - once a day in the morning
Started at 11-Mar-2010 10:16
Reason Heart failure
- digoxin**
DOSE 250 micrograms - oral - once a day in the morning
Started at 11-Mar-2010 10:16
- paracetamol**
DOSE 1 g - oral - four times a day AS REQUIRED
Started at 11-Mar-2010 10:16

A 'Prescribe' dropdown menu is open, showing search results for 'dox'. The results are categorized into 'Commonly-prescribed' and 'Standard matches'. 'doxycycline' is highlighted in orange. A 'Drug allergy warning' pop-up is displayed over the dropdown, stating: 'This patient is at risk of an anaphylactic reaction to tetracycline. View full details. doxycycline is a member of the tetracycline group of antibiotics.' The warning includes 'Cancel selection' and 'Continue to prescribe' buttons.

The footer of the interface shows 'Clinical system by VENDOR' and the date/time 'Wednesday 12th March 2010 10:06'.

Figure 1: an example of an ePrescribing prescribing screen

Figure 2 shows a representation of an administration screen, as might be used by a nurse. The medicines to be administered at this time are shown in the context of the previous two days administrations. Due, overdue and as required doses are indicated. The nurse can then tick and sign off the doses administered on this round. In both figures 1 and 2 the screen also contains information to allow the identification of the patient, name, ward, bed, date of birth and NHS Number.

The screenshot displays a clinical system interface for patient **ATKINSON, Andrew (Mr)**. The patient's details include: Born 01-Dec-1941 (69 yrs), Gender Male, NHS 246 810 1214, Address Flat 2, Hughes House, Copenhag..., Phone & email 07834 234722, Location Rachel Ward, Bay 6, Bed 2, and Known allergies.

The main section is the **Drug chart**, which shows a timeline for three days: 10-Mar, 11-Mar, and Today, Weds 12-Mar-2010. The chart lists four medications with their respective doses and administration times:

- enalapril** DOSE 10 mg - oral - once a day in the morning. Prescribed by A Jones, SHO, Gen. Med. Start 11-Mar-2010. A red bar indicates it is **OVERDUE for 08:00** on 12-Mar.
- furosemide** DOSE 60 mg - oral - twice a day. Prescribed by A Jones, SHO, Gen. Med. Start 11-Mar-2010. Blue bars indicate doses at 10:00 and 14:00. A red bar indicates it is **DUE for 10:00** on 12-Mar.
- erythromycin** - gastro-resistant DOSE 500 mg - oral - four times a day. Prescribed by A Jones, SHO, Gen. Med. Start 11-Mar-2010. Blue bars indicate doses at 07:00, 12:00, 17:00, and 22:00. Checkmarks are present for 11-Mar and 12-Mar.
- paracetamol** DOSE 1 g - oral - four times a day **AS REQUIRED**. Prescribed by A Jones, SHO, Gen. Med. Start 11-Mar-2010. Blue bars indicate doses at 07:00, 12:00, 17:00, and 22:00. Checkmarks are present for 11-Mar and 12-Mar.

The interface includes a 'Refresh' button, a status bar showing '1 OVERDUE', '1 DUE', and '1 as required', and a 'Group by' dropdown set to 'no grouping'. A '4 more' link is visible at the bottom right of the drug chart area.

Figure 2: an example of an ePrescribing administration screen

What functions does ePrescribing support, and who is involved?

Figure 3 represents a very simple generic inpatient ePrescribing system, highlighting the primary functions and the primary actors (people or systems) who interact with the system. Thus a basic inpatient ePrescribing system will support one or more of the following functions: prescribing by doctors and other authorised prescribers, administration by nurses, supply of drugs by pharmacy staff, and screening by pharmacists. Each of these functions are represented by the bubbles in the figure, where each simple bubble (prescribe, supply etc.) represents a more complex set of activities supported by appropriate interactive screens.

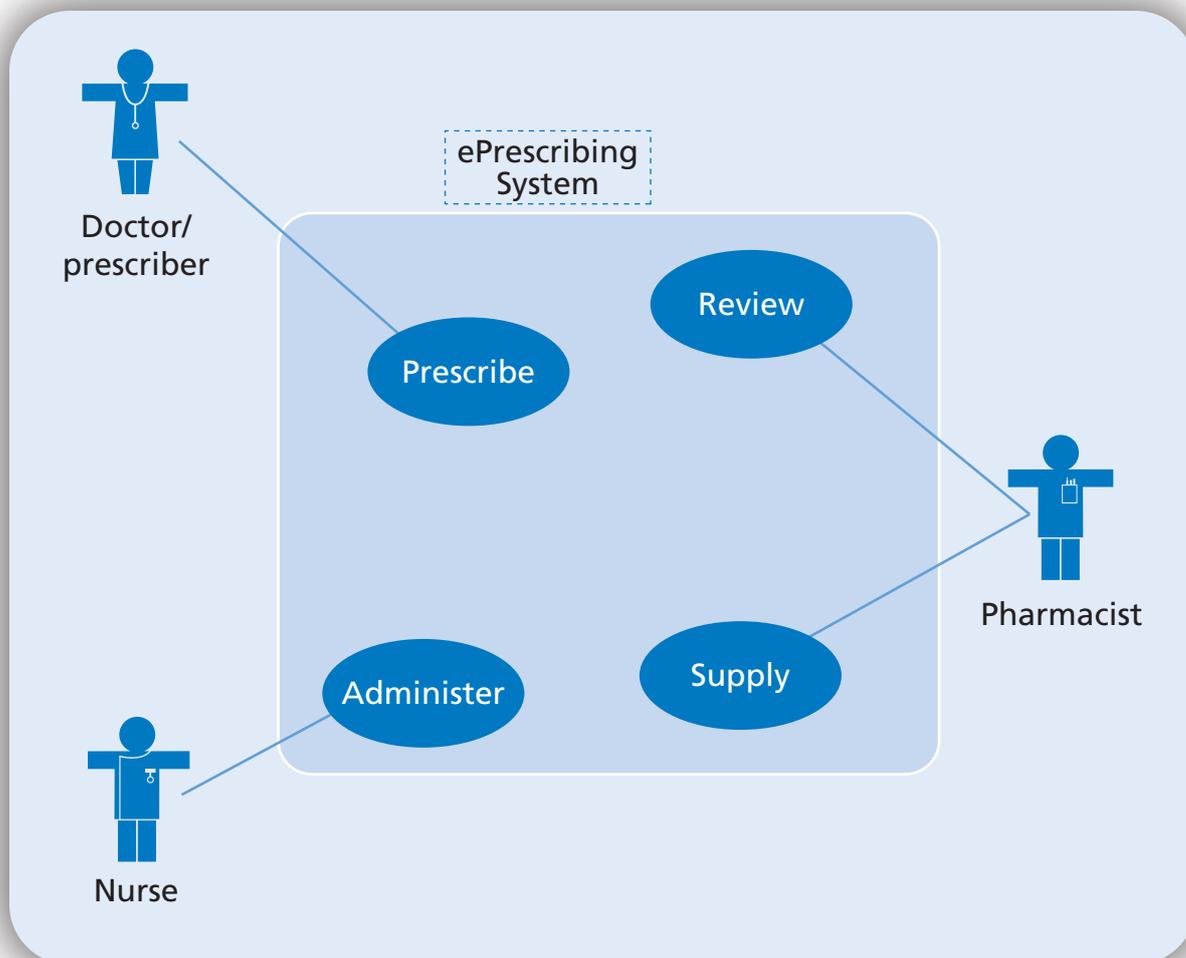


Figure 3: a very simple model of the functions of ePrescribing and the primary actors

The very simple model in figure 3 of course needs some elaboration as the four basic functions identified, in almost all cases, require the attention of more than one actor. Thus in figure 4 we start to see that ePrescribing is much more than separate and discrete functions that cater to distinct professional groups, but rather is a mediating system that helps to coordinate the work of the various actors and thereby help to ensure safe and effective care for the patient.

In figure 4, for example, we acknowledge that both nurses and pharmacists are involved in supply, and that pharmacists may be involved in prescribing for example if a pharmacist attends ward rounds and does the actual input of medicines orders on the medical team's behalf. With increasing numbers of nurses and pharmacists qualifying as independent prescribers, many will also be prescribing in their own right.

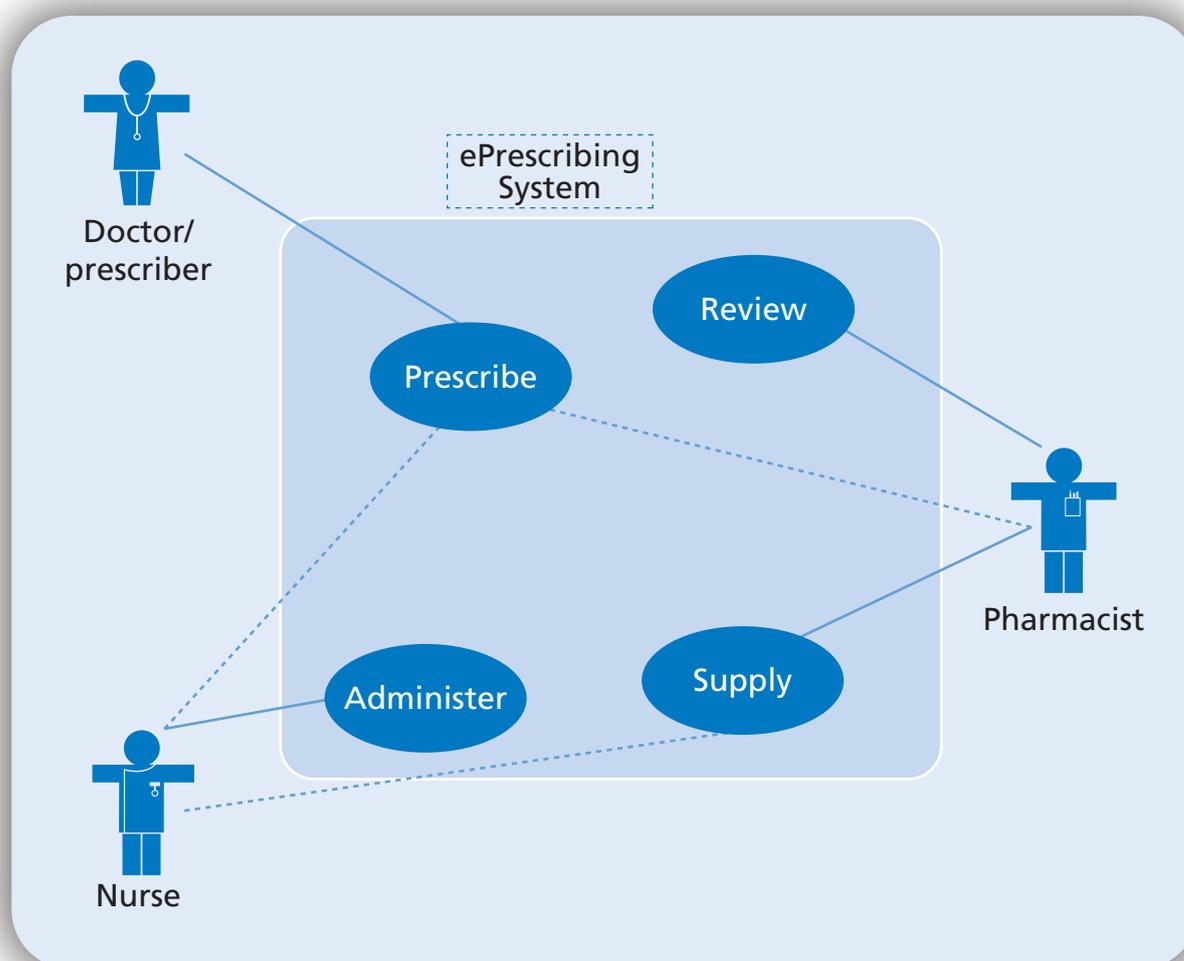


Figure 4: model adapted to show secondary users of functionalities;

Solid lines - principal actors involved; *dotted lines* - secondary actor

Both figures 3 and 4 give a useful overview of ePrescribing systems, but they are still an over-simplification. Figure 5 shows a further set of functions that an ePrescribing system may support, and more of the actors who participate.

The functions identified include patient admission and discharge, as well as the involvement of other healthcare professionals who need to view (read) medication records. These may include such people as dieticians, microbiologists, the pain team, physiotherapists, occupational therapists and others.

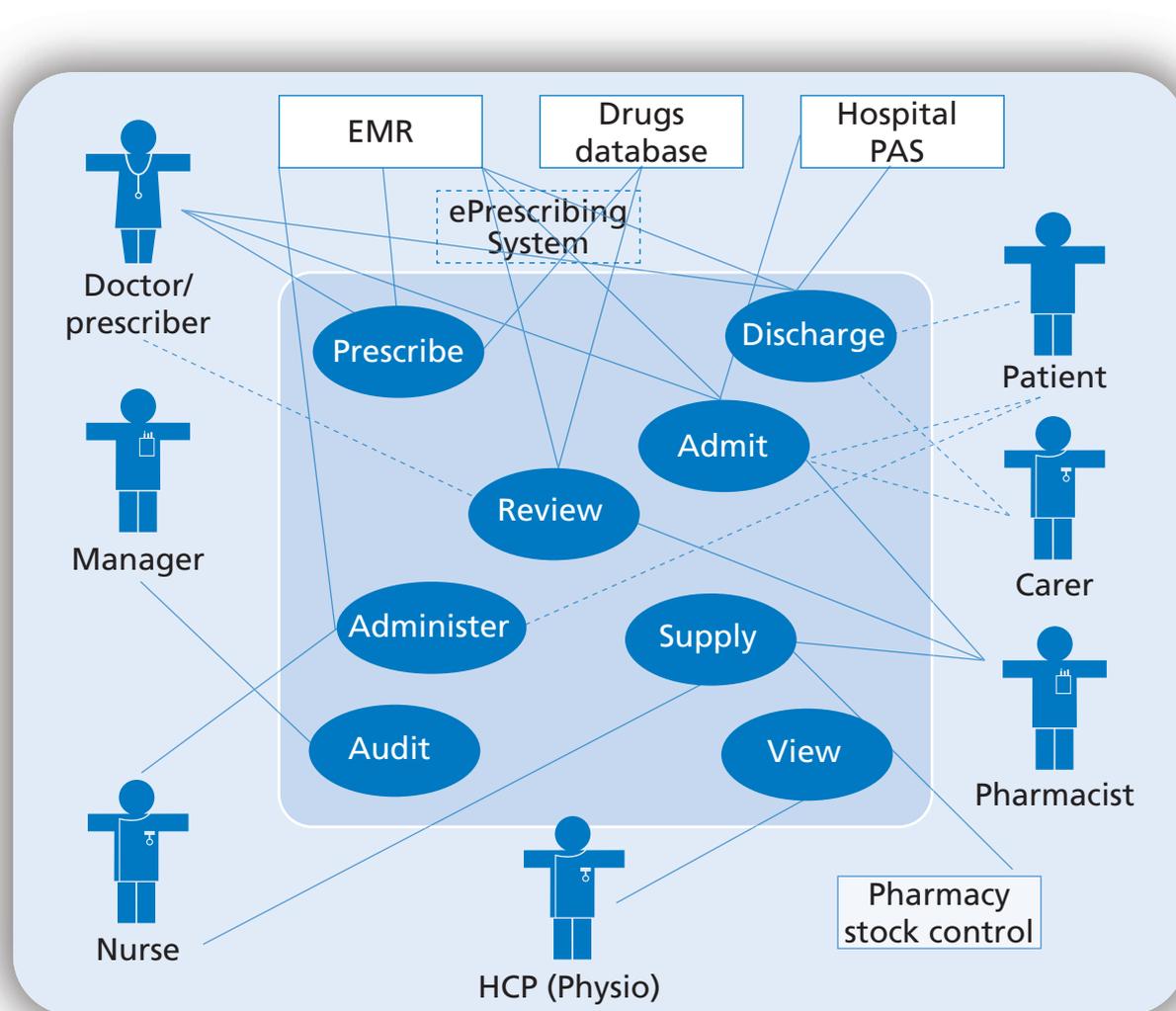


Figure 5: more complex ePrescribing system with more extensive functions and interactions

Solid lines - principal actors; **dotted lines** - secondary actors

HCP: Healthcare professional

PAS: Patient administration system

EMR: Electronic medical record

Note that actors who interact with ePrescribing can be human (e.g. managers, doctors, nurses), but also technical, (e.g. the PAS, drugs database or EMR shown here). We also include here the patient and carers as relevant actors, for example in the process of discharge.

Figure 5 may appear complex, implying the resulting complexity of ePrescribing implementation, but it is exactly because ePrescribing systems can integrate these distinct activities, and these various actors (human and technical), that they are so valuable and able to contribute to improved patient care. Similar diagrams could also be drawn for outpatient and discharge ePrescribing systems to indicate the scope and range of these systems. For a more detailed account of ePrescribing functionality see the ePrescribing functional specification for NHS trusts prepared by NHS Connecting for Health (2007).¹

What are the different types of ePrescribing software in use in the UK?

ePrescribing may not yet be commonplace in the UK, but there is a surprisingly wide range of systems in use across the NHS. Some of the existing systems are specific to one clinical specialty (e.g. critical care or oncology), others are specific to one stage of the prescribing process (e.g. electronic discharge prescription systems), while others are hospital-wide (or almost hospital-wide).

Systems in use today include those that have been developed “in house” by committed enthusiasts such as the system at University Hospitals Birmingham, those that are based on software packages that have been developed out of pharmacy systems (e.g. JAC and Ascribe), and those that form part of a wider implementation of hospital information systems (e.g. Meditech). Some are linked to controlled access cupboards on wards and bar code patient identity checks (e.g. ServeRx).

ePrescribing is a core module of the NHS NPfIT packages iSoft Lorenzo and Cerner Millennium, which are a central part of the NHS Care Records Service. These systems plan to deliver ePrescribing as an integral part of a whole patient e-health record.

The functionality of the systems in use today may include some of the following. Most systems in use do not achieve all of these, certainly not in their initial phases of use:

- Inpatient prescribing with varying degrees of clinical decision support and support for different areas of clinical specialty
- Outpatient prescribing with varying degrees of clinical decision support
- Linkages to other systems including chemical pathology
- Pharmacist screening, usually available remotely to the ward or clinic
- Viewing of current medicines by other healthcare professionals

- Electronic administration and recording with varying degrees of support for drug administration rounds
- Electronic patient identification
- Ward stock control and supply
- Discharge prescribing
- Reporting for clinical staff (eg monthly report, ad hoc reports, audit data)

What are the potential benefits?

ePrescribing can deliver benefits for those who prescribe, administer, screen and dispense medication, as well as those who need to see medication records on a “read only” basis. Each of these will be considered in turn:

Prescribing

When prescribing, ePrescribing can help in a number of ways and various situations:

- Allowing prescribing from remote terminals/sites as well as at the bedside
- Providing prescribers with access to decision support
- Helping to support the use of a trust formulary
- Allowing the use of order sets or combinations of drugs in pre-specified packages
- Allowing access to electronic patient records (as well as medication records)
- Removing the need to rewrite medication charts, and the associated potential for transcription errors
- Supporting direct communication of prescribing information to pharmacy and other departments
- Allowing the easy and direct production of discharge prescriptions

CDS ranges from the most basic (access to a drug dictionary) to the very complex, for example checking medication orders against patients’ laboratory results and documented co-morbidities.

Examples of decision support in use in current implementations of ePrescribing include the following:

- Drug dictionary
- Formulary information
- Enforced requirement for complete orders with no information omitted
- Default doses
- Preventing prescribing of doses that are impossible to administer using the dosage forms available
- BNF lookup

- Drug-allergy checking
- Drug-drug interactions checking
- Checking doses against renal function
- Checking doses against patient's age
- Checking doses and drug choice in relation to patients' laboratory results
- Checking drug choice against documented co-morbidities

As noted above, most systems do not support all of these aspects of clinical decision support, and sites with experience of ePrescribing report the need for careful and incremental inclusion of CDS, undertaken in consultation with clinical staff. Done well CDS is the key to many benefits of ePrescribing, done poorly it can prejudice users against a system.

Done well, clinical decision support is key to many benefits of ePrescribing; done poorly, it can prejudice users against the system

Administration

ePrescribing is just as important and useful when it provides support for the administration of drugs. For example it can help by:

- Supporting the supply of medicines to the ward in a timely fashion
- Facilitating patient identification at the bedside (e.g. using barcodes)
- Removing the problem of missing or illegible drug charts
- Prompting when doses are due
- Allowing easy review of previous medication history
- Extending the amount of information available during administration
- Allowing access to electronic patient records (as well as medication records)

Review, screening and dispensing of medication

ePrescribing can have significant positive consequences for pharmacists as they check ("screen") medication orders, correct errors and follow up queries. There is the potential to change the ways in which pharmacists work, for example doing more screening from the pharmacy department before visiting patients on a ward (although this has both advantages and disadvantages). Benefits are as follows:

- Allowing easy review of previous medication history
- Access to electronic patient records (as well as medication records) and sometimes pathology results
- Removing the problem of missing or illegible drug charts
- Screening is possible at remote locations (although this also has its pitfalls)
- No requirement to check transcription of new paper drug charts

- Many basic prescribing errors (missing information, transcription errors from one chart to another, prescribing doses that are not possible with the dosage forms available etc.) are likely to be prevented and will not need to be corrected
- Clear audit trail for changes to medication
- Identification of each individual prescriber to allow follow up of queries
- Supporting the transfer of information from secondary to primary care and vice versa

Viewing medication records

The traditional drug chart serves often as a quick review of a patient's condition and the medicines they are on. Many healthcare professionals need to be able to access this information as part of their work, and will benefit if it is directly available. ePrescribing can help by:

- Allowing easy review of current and previous medication history
- Access to electronic patient records (as well as medication records)
- Removing the problem of missing drug charts or not being able to access those that are in use by other healthcare professionals
- Viewing is possible at remote locations (although this also has its pitfalls)

Conclusions

Overall, the benefits of ePrescribing can be summarised as improved safety of medicines use resulting from three main contributory factors:

- More legible, complete and available medicines orders
- Decision making backed up by suitable information resources
- Richer and more timely interactions among the care team

However, while the benefits outlined here have been shown in the research literature and are supported by the accounts of the NHS staff who have contributed to this study, there is also evidence that poor implementation of ePrescribing can be hazardous and cause patient harm.² Thus in the following chapters of this report we focus on the details that need to be attended to in order to allow an ePrescribing implementation to deliver its full potential.

References

1. NHS Connecting for Health (2007). ePrescribing functional specification for NHS Trusts. <http://www.connectingforhealth.nhs.uk/systemsandservices/eprescribing/baselinefunctspec.pdf> Accessed 5 December 2008.
2. Han YY, et al. Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system", *Pediatrics* 2005;116 (6): 1506-12.

Motivations for ePrescribing adoption

Key messages

- A major motivation for ePrescribing is greater safety of drug use and the current unacceptable levels of adverse drug events.
- There are other significant motivations for ePrescribing at the organisational level including availability of new management data, efficiency gains and the reinforcement of good practice.
- Individuals also need to be motivated to use ePrescribing. Ease of use and direct task accomplishment are important motivators, but so too is understanding the overall vision that ePrescribing serves.
- Linking ePrescribing to other existing or future information systems is important to users.
- So, too, is a good understanding of the incremental delivery of benefits over time.

Introduction

Much attention in the last decade has been focused on the unacceptable frequency of occurrence and consequence of adverse drug events (ADE); events that occur during or following medication use due to adverse drug reactions, poisoning or errors in the medicines use process. Research has shown the potential for ePrescribing to make a real difference to patient care by preventing errors and reducing ADEs. For this reason ePrescribing has been promoted through national policies and incentives as one of the main ways of optimising patient care and minimising harm.

Though patient safety is usually a main driver for ePrescribing, motivation for implementation and predictors of successful adoption of ePrescribing are more diverse. The reasons for adopting ePrescribing may be very different at the organisational level, compared to that at the user level.¹ For example, at the trust level ePrescribing should be seen as part of a broader strategy of computerisation, information management and the exploitation of new technology. Within this perspective ePrescribing may be just one part of the way forward. For some organisations, with ePrescribing comes the prestige of being at the cutting edge of technology, a pioneer. For others, it is a way of improving processes and practices which will in the long run contribute to improved patient care in general (for example speedy and efficient discharge), as well as safety.

The reasons for adopting ePrescribing may be very different at organisational and user levels

Research undertaken in the USA has shown that CPOE systems that include ePrescribing can be remarkably effective. For example, in one study they reduced error rates by 55%, and serious medication errors by 88%.²⁻³ These improvements are largely attributed to the use of structured orders and checks as well as more extensive decision support by prescribers. Other studies have shown length of stay reducing by nearly a day following implementation of CPOE.⁴ It has been asserted that introducing CPOE into U.S. hospitals could prevent between 570,000 and 907,000 serious medication errors each year.⁵

However these studies, and their findings, must be carefully assessed. They come from a few early adopter sites in the USA, which has a very different health system, usually using an ePrescribing system designed specifically for them. It is not clear if, or how rapidly, or to what degree, these benefits might be seen in the UK. Given the distinct and different context of UK hospitals and prescribing practices, and our use of ePrescribing based on implementing commercial packaged software, we should treat this evidence cautiously. It can certainly point to areas in which benefits might hope to be seen, and it can help implementers to collect appropriate base-line data so that they can monitor outcomes. What it cannot do is set sensible benchmarks for expected benefits soon after implementing a system.

Motivations for ePrescriptions can include:

- Reducing medication errors
- Improving documentation and communication about medication
- Providing information at the point of medicines use
- Enforcing policies and promoting good practice

In these ways ePrescribing can have significant influence on the overall levels of patient care.

But the motivations for ePrescribing should go further and wider. For example, a finance officer may relish the possibility of accurately capturing the costs of medication for individual patients; the drugs and therapeutics committee (D&TC) may see formulary enhancement; the Director of Infection Control may see new ways of monitoring appropriate antibiotic use; while a chief nurse may see it as a way to audit nurse administration. Senior managers, too, gain direct benefits from ePrescribing; one chief executive was reported to us as saying that ePrescribing was the first real-time data system found in the trust.

Individual users may share their organisation's motivations and vision, particularly if they are introduced to that vision and included within it. However, willingness to use ePrescribing is more likely to be influenced by how ePrescribing affects the individual user and their practices and workflow on a day-to-day basis. Performance of an ePrescribing system in terms of the time taken, ease of use, its tailorability (how easy it is to adapt the system to the hospital, ward or profession's needs) and compatibility with other systems will all influence adoption.

Clinical staff who will use ePrescribing will want to know the transitional and long terms effects of ePrescribing on their individual practice. For this reason establishing evidence that the system

is having a positive effect on work practices and safety, and providing feedback on the performance of the system and outcomes in terms of patient care, are very important as a way of gaining support and to keep momentum going. This includes the need to capture information on less desirable effects of ePrescribing, such as new types of errors or unexpected effects on work practices, and to consider changes to the system that can mitigate these. For this reason, among others, an ongoing and appropriately resourced support service is essential to a successful ePrescribing system, both through the implementation period and beyond.

An appropriately resourced support service is essential

Moving to using ePrescribing involves a major change for the organisation.⁶ The magnitude of this change, and the risks associated with it, should not be underestimated. Leadership and support from the top level are imperative to manage this change. It is important that healthcare professionals understand the exact scope and role of ePrescribing at their organisation, and the timescale within which it is being introduced. Organisations planning to implement ePrescribing should consider context-specific answers to the questions below when communicating their motivations:

Is it quicker?

On the face of it, ePrescribing is rarely faster than using paper systems for specific tasks of prescribing or administration, certainly not in the early phases. However, there may be savings in the overall time spent on activities. As one doctor noted, it took longer to prescribe new medicines, but this was offset by not having to rewrite prescription charts every two weeks.

How will ePrescribing fit in with the 'normal' way of doing things?

Some see ePrescribing as an opportunity to improve the way in which things are done. One ward sister found it very useful to remove drug administration times of 8 o'clock as this was the nursing handover time and therefore medicines would not be given at that time anyway.

Others may initially consider ePrescribing more restrictive compared to existing practice, but recognise that it promotes good practice. For example, mandatory allergy status and weight entry in one hospital meant that prescribers could not continue to prescribe unless this information was entered. Such a forcing function needs to be used with care, and depends on the overall understanding of the user to endure the pressure to achieve wider benefits.

Can I have my own menus, screens or reports?

The ability to tailor ePrescribing to local or even individual needs might provide a sense of ownership of the system which is more likely to encourage use. However, the possibility and extent to which local tailoring of ePrescribing is undertaken will depend on individual systems and how they are configured for the particular hospital.

The ability to tailor ePrescribing to local and individual needs can provide a sense of ownership of the system

There certainly should be opportunities, for example, to develop targeted reports from an ePrescribing system according to the needs of different staff, but reconfiguring standard screens for prescribing or administration, for example, would be a serious safety concern.

Will it interact with the other IT systems that I use?

Many users consider ePrescribing more useful if it interacts and integrates outputs from other IT systems, such as pathology results. If such systems exist, then an ePrescribing project should probably link to them from the initial implementation. Where this has not happened, for example where discharge systems are stand alone and separate from the ward-based ePrescribing, this has led to staff frustration at what seems to them a senseless lack of joined-upness.

If multiple systems do interact, then they need to do so in as seamless a way as possible, and one that is demonstrably safe. For example, there should be a single login for the user, not multiple logins, and it should be impossible to mix data from one patient with that of another (e.g. have an x-ray for one Mr Smith on screen, with the medicines for another).

Understanding of scope and role of ePrescribing

A clearly communicated vision sets the expectations of users and is central to successful implementations.

A key message to establish at the outset is that ePrescribing covers the whole drug use process, and does not only serve prescribers or prescribing. In practice, we must understand that nurses are the professional group who probably spend most time using an ePrescribing system, followed by pharmacists and doctors. The biggest change in work practice, however, may be for doctors. Different users of ePrescribing will have different aspirations for the system, and come with different prior understandings of what it can do.

Without a well articulated and shared understanding of the role and scope of ePrescribing implementation can be far more difficult. Lack of inclusion or common understanding can influence other healthcare professionals to be less involved or committed to ePrescribing at the outset, if they believe that it has little to do with them. More subtly, this assumption may skew the ways in which engagement is organised and evaluated.

Another key message that needs to be communicated is how long ePrescribing implementations take, and the various achievements that can be expected along the way. Some benefits will be immediately available, notably legible and available medicines information, while some may be delayed. For example, a key benefit of having an ePrescribing system may be allowing automatic population of the electronic discharge summary, but this benefit may rely upon two separate systems (ePrescribing and discharge) both working and being interfaced. This benefit may be significant and could, for example, compensate doctors for the time they spend typing in orders if they gain a benefit when they come to do the discharge summary.

Some benefits will be immediately available, while some may be delayed

Where and how does ePrescribing fit in the medicines management process?

Depending on the functionality available within an ePrescribing system, its implementation may affect all parts of the medicines management process and not just prescribing. There may be significant improved efficiency in some processes, whilst other elements may change completely. For example, order sets can make it easier to prescribe combinations of medicines; use of barcodes during administration can markedly change the steps involved in patient identification at the bedside; electronic transmission of discharge prescriptions to pharmacy may potentially speed up the supply of discharge medication, though it may be more complex if a ward check of patient's own drugs (PODs) is needed.

Of course, speeding up the transmission of discharge (TTO) orders to Pharmacy will save little time if dispensing is not equally timely, and certainly ePrescribing should not be seen as a means to undertake staff cutbacks. Such savings has been a common theme in some discussions of ePrescribing, and sometimes have been enacted with the result that ePrescribing leads to a weaker pharmacy service. We should, however add that ePrescribing does allow healthcare professionals to improve their effectiveness in many ways, such as pharmacists no longer seeking charts and spending time correcting minor prescription errors and so being able to focus on ensuring that pharmacy services better reflect the needs of the patient.

Where does ePrescribing fit in overall computerisation efforts?

Seeing ePrescribing as a part of a larger programme of beneficial change may influence implementation outcomes. Short term frustration with a system may be seen as acceptable if longer term benefits are understood.

A part of this is explaining how ePrescribing interfaces to other existing or projected systems within the trust (e.g. patient administration system, laboratory results) as well as nationally (e.g. electronic patient records and the NHS Care Record Service). Given the high profile of the National Programme for IT and the very substantial effort that is underway to implement a range of national systems, it is important that ePrescribing is seen as distinct, separate and achievable in its own right, as well as being an important part of the bigger strategic goal, i.e. as part of the establishment of electronic health records.

References:

1. Ash JS, Gorman PN, Lavelle M, Payne TH, Massaro TA, Frantz GL, and Lyman JA. A cross-site qualitative study of physician order entry. *Journal of the American Medical Informatics Association* 2003;10(2):188-200.
2. Bates DW, Leape LL, Cullen DJ, Laird N, et al. Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. *JAMA*. 1998;280:1311-6.
3. Bates DW, Teich JM, Lee J, Seger D, Kuperman GJ, Ma'Luf N, Boyle D, Leape L. The impact of computerized physician order entry on medication error prevention. *JAMIA*. 1999;6:313-21.
4. Tierney WM, Miller ME, Overhage JM, McDonald CJ. Physician inpatient order writing on microcomputer workstations: Effects on resource utilization. *JAMA*. 1993;269:379-383.
5. Birkmeyer JD, Dimick JB. Leapfrog safety standards: potential benefits of universal adoption. The Leapfrog Group. Washington, DC: 2004.
6. Ash JS, Stavri PZ and Kuperman GJ. A consensus statement on considerations for a successful CPOE implementation. *Journal of the American Medical Informatics Association* 2003;10(3):229-34.

Lessons learned: how to ensure success

Key messages

- Those involved in ePrescribing implementation in NHS hospitals share many common insights - different sites yield very similar 'lessons learned'.
- Traditional project success factors are as relevant to ePrescribing as to any other change programme: senior management backing, good project management, user involvement, a multi-disciplinary team.
- Preparation and planning are essential, and take time. ePrescribing projects need an appropriate support network. Champions and 'little diamonds' must be found and encouraged, and the backing of senior managers secured.
- Identify where current processes are broken and decide what to fix.
- Often it is the technology and infrastructure that proves to be the weakest link. These need close attention from the earliest days.
- Sell ePrescribing's benefits widely, but also use this activity to share problems and doubts early on.
- Devote adequate resources to monitoring the system, listen to users feedback and act on it.
- Communicate clearly that ePrescribing demands that everyone involved has to be prepared to change the way they work, and be willing to learn along the way.
- ePrescribing needs a strong public face, visibility, publicity, strong messages and celebration.
- The sequence and pace of implementation needs careful consideration; plan for early success and to build momentum.

Introduction

This chapter describes key lessons that others have learnt during ePrescribing implementation projects and as they have experienced both successes and failures¹.

Following in their footsteps, what should you do?

Of course, not all people report the same experiences, and sometimes the 'Lessons Learned' can be contradictory. However, most of the time, people who have experienced ePrescribing

¹This study of the implementation of electronic prescribing is based on findings drawn from questionnaires and interviews conducted with people within the NHS who have experienced the implementation of (or failure to implement) ePrescribing within their own hospital settings.

implementations tell a very similar story, and seem to draw similar conclusions. ePrescribing is about change management and the implementation of a sophisticated IT system. There are thus a number of well worn themes that are inevitably associated with implementing any type of information system in a healthcare setting, though ePrescribing implementation hospital-wide is probably more substantial than most. For example, many people expressed the need for senior managers' support from the initiation of an ePrescribing project throughout its progress, emphasising the role of champions, the importance of user involvement and the need for (and problems achieving) 'clinical engagement'.

These are all necessary conditions for a successful ePrescribing project. However, there are also some subtleties that need to be added and placed within a discussion on the specifics of the implementation of ePrescribing.

The thematic approach used in this chapter gives an experiential and reflective, 'bottom-up' view – ePrescribing as seen by the main groups that have to absorb the new technology and release its benefits as they develop new ways of working.

Getting Started:

"Produce an amalgamated wish list then search out champions."

"Think where to start."

"Present ePrescribing as a BIG TIME clinical system (not something to do with the pharmacy)."

Many respondents had been involved from the start of their hospital's ePrescribing project. Their views, with the benefit of hindsight, were often that the 'vision' of ePrescribing needed to be established and communicated first, both in terms of the big picture (patient safety, modernisation, e-health strategy, innovative clinical systems), but also in terms of the significant details that would shape the ePrescribing system in that particular hospital context.

The vision of ePrescribing in a particular hospital needs to be established and communicated first

Such details include identifying the benefits that ePrescribing offers to the multiple stakeholders and which of these benefits are most important to the hospital. Is there something positive for everybody? Where are the most receptive parts of the hospital? Which specialties can be relied upon to embrace ePrescribing with enthusiasm? Which ones, once convinced, will carry the message loudest? And which ones will be most problematic?

“Build up your team. Get the right people, build up your skills, take the time.”

“Get senior people engaged.”

“It’s good to know that the Chief Exec is behind you.”

“Seek out both medical and surgical sponsors among doctors.”

An almost universal finding is that ePrescribing projects must be multidisciplinary. No single professional group can carry a successful system into widespread use. If significant professional groups are missing, excluded or unenthusiastic, then this is storing up problems ahead. As one project lead said, “Undertake lots of visits and talks, if need be grovel, go everywhere and sponsor events. Do everything to build up visibility.”

*ePrescribing projects
must be multidisciplinary*

An ePrescribing project probably takes two or more years to bring a system into use, so the project team needs to contain a committed set of members drawn from a number of professional groups. Many of our respondents reported a desire for more clinical participation at the outset, in particular from doctors, but they also noted the importance of having IM&T members who really understand what is being demanded, as well as representatives of other service departments.

Management backing is vital too. ePrescribing projects will, inevitably, raise some resistance, perhaps quite a lot from some clinical quarters. If senior managers are anything other than fully supportive, then ePrescribing projects may be wounded or even fatally challenged.

Of course, to attain the backing (and sufficient budget) from senior management requires that they are well briefed and confident both of the ePrescribing team’s ability to effect the transformation and to deliver real benefits.

“If possible implement X-ray and lab test ordering before ePrescribing. This helps users realise the benefits of electronic orders.”

This may not be a feasible recommendation in some situations, however, the wider point – that ePrescribing is part of a broader programme of implementation of innovative clinical information systems, and that success in one area can reinforce success in others, should be taken to heart. There is a wider lesson here that all manner of clinical professionals need to learn; with new information systems there are some costs in terms of comprehensive data entry and more structured work flow, but the benefits do accrue and may be seen elsewhere in the most critical areas. For example, time spent entering a full medication history will save time, reduce error and facilitate clinical decision making throughout the remainder of the patient’s stay.

The build up

“Run ‘road-shows’ on wards and at clinical meetings focusing on ePrescribing benefits: for example, legible medication orders and remote prescribing. Sell benefits by contrasting ePrescribing screens with the worst examples of (anonymised!) handwritten charts that you can find.”

“Use roadshows also to identify potential ‘showstoppers’ - big problems like difficult drugs - before you implement, and keep paediatrics to the end!”

“Having things like allergy checking or dose checking before implementation can help sell the benefits of ePrescribing to senior doctors.”

Successful ePrescribing implementations are not just multidisciplinary in their project team, but also reach out across the range of healthcare professionals both to communicate the benefits of ePrescribing and to bring out into the open any fears, concerns or areas in which ePrescribing may be problematic.

The respondents have learned from experience that ePrescribing is less easy to incorporate in some clinical specialities, and that some drugs have specific regimens that challenge the simple logic of most ePrescribing systems. For example:

ePrescribing is less easy to incorporate in some clinical specialties

- Paediatric prescribing raises many distinctive problems.
- A&E work practices may require that prescribing be undertaken in different ways – e.g. using patient group directions (PGDs).
- Medicines such as insulin, warfarin or heparin pose problems of how exactly they should be incorporated into ePrescribing procedures.

Many ePrescribing systems, though not all, struggle with variable dosing, so often paper charts must be retained. The ePrescribing system should reference these paper charts and incorporate key information such as the administration schedule. Removal of all paper charts should, however, be the long term goal.

These are all tricky problems, and they have to be addressed. However in doing so, and thinking through the ways in which to safely accommodate them in ePrescribing, broader confidence can be built up. Certainly the early adopting ePrescribing sites have already faced these problems and found acceptable solutions that work.

“Know your kit (hardware, software and infrastructure). Specify, purchase and test – allow time to sort out the inevitable problems.”

“Start technical work earlier. You need at least six months: order hardware in good time. Get wireless network in place then have an independent check.”

“Get the infrastructure right. The technology it seems is often the weakest link in ePrescribing. You should certainly not assume that your existing IT infrastructure, or support services, will be able to cope with hospital wide ePrescribing.”

“Identify and monitor wireless network dead spots: the ‘Bay 4’ problem.”

“Design your WOWs [workstations on wheels, or computers on wheels] to fit available workspace; consider issues such as cleaning and storage; check there are enough plugs for recharging! You need one WOW for every six beds.”

It may be surprising (or perhaps blindingly obvious) but the most common ‘lesson learned’ from this study is that hardware and software are often a problem!

In particular, a number of the sites studied have had significant problems with their wireless networks. These manifest themselves in terms of ‘dead spots’ where no network coverage is available (the ‘Bay 4’ problem – meaning the bay at the farthest end of the ward). Wireless problems are also seen in underspecified networks that cannot cope with the volume of traffic once substantial amounts of prescribing transactions are taking place. These kinds of problems are particularly troublesome and difficult as they can mean having to withdrawing an ePrescribing system when it has already been established on several wards.

Implementing ePrescribing

“Spot your ‘little diamonds’ who have computer skills and are willing to try new things. This could help to determine your choice of pilot ward(s).”

“Be prepared to change the way you work.”

“Be prepared to lose a few battles. One new consultant was initially very against ePrescribing. He was won over but still doesn’t use it to prescribe!”

“A surgical sister ‘fought the computer’, saying it was dangerous and she would not use it on her ward.”

The implementation of ePrescribing requires some quite careful planning and reconnaissance. Identifying people who can support and develop ePrescribing is important: people who can deal with information and communication technology, are happy to change the way they work, and who are enthusiastic about ePrescribing and will happily support others. Of course, not everybody falls into this category, and almost all sites studied had their stories of resistance. Nevertheless, successful ePrescribing implementation can go ahead if there is sufficient support among all the key professional groups as well as from senior management. Indeed some of the early dissenters may be won round and then become eager converts.

“Plan, train and work with the system supplier. We say: ‘we don’t do it that way’ and they are listening.”

“You need ‘adaptable’ screens’. Pharmacists should be able to adapt screens to their practice.”

“Databases need to be populated and software configured. This is a way to make it attractive, for example if surgeons’ protocols and order sets are set up from day 1. These ‘goodies’ can save people’s time and help them to appreciate ePrescribing...If a substantial part of this work is not done at the beginning there will never be enough staff and resources later.”

“Decision support implemented at the time of ePrescribing implementation would have been of great benefit and would make the system better to ‘sell’ to professional colleagues.”

Building a good relationship with software and database suppliers is important. In the early set-up phase of an ePrescribing project, interactions with suppliers can help to solve problems. Tap into other sites with previous experience of the same software. That said, in order to take ownership of the system, and make it fit into the specific context, staff will need to work on configuring the software and making it look and feel appropriate for their needs.

This work takes time, and to some degree there may be options as to how much is undertaken ahead of roll-out. That is, a basic system might be rolled out sooner, and extra functionality added to it as time goes by. However, in order to provide the most positive experience of ePrescribing for new users attention to providing as rich a set of features as possible in the initial roll-out is recommended. This is a question of degrees, and it is certain that any successful ePrescribing implementation will continue to identify and implement changes as experience with the system is gained and as requests are made for changes and new features.

“Have a dedicated team for training and support.”

“Budget for double the training manpower than you first thought of.”

“Training must be not too early, and not too late.”

“Training is for two purposes: to understand how ePrescribing works, and to build confidence to do the necessary tasks.”

“Training is straightforward but you need at least three people and it needs to be 24/7. For nurses, emphasise experiential learning and FAQs (frequently asked questions), not lectures.”

“Nurses are good as ‘clinical’ trainers for ePrescribing but still need a pharmacist to support doctors in early stage.”

“Essential to have clinical staff involved in training and implementation.”

Training people to use ePrescribing is necessary. However, opinions differ somewhat as to how much training is needed, and the extent to which it should be on the job, or in the classroom. Classroom training is useful, but only if the classroom is suitable with equipment and software that is the same as in use on wards and in clinics. The counter argument other people make is that if a system is sensibly designed, and if staff have sufficient IT skills, perhaps from using other clinical systems, then the amount of training needed should be minimal – just training to deal with site-specific elements such as log ons, passwords etc.

But training has other roles than just imparting necessary information. It can build up confidence, reveal concerns or pick up important bugs or problems with a system. For this reason trainers are an essential element of the ePrescribing team – not just teaching the system, but also feeding back changes to make it easier to use.

Training, of course, lasts for the lifetime of the system. Sites with a hospital-wide system in use maintain a fully staffed training team to ensure that everybody has access to appropriate information and support. New staff arrive, locums can appear late at night and at weekends, new upgrades of software are made regularly, systems are improved and changed, and experienced people may need refresher training or training for new roles. Training responsibility is usually combined with the technical and clinical responsibility for support and development of the system, allowing trainers to pick up and respond to all manner of concerns and needs that are revealed during training activity.

“Quick roll out to minimise ‘messiness’ of two systems running in parallel. Remember, patients are often transferred between wards.”

“Think through the sequence of implementation by ward/specialty. A ward might take a team of two or three pharmacists to re-enter data from paper to computer over one or two days. Clean up the data first, not during transfer.”

“Keep extra staff available at ward level for the first one or two days of drug rounds.”

“Roll-out requires intensive support with at least four full time trainers available to ‘walk round’ with staff on all drug rounds. Essential to provide support 24 hours a day.”

“Given that the IT must work, the helpdesk has a critical job to do. It must be staffed accordingly.”

Those who have implemented ePrescribing across hospitals are almost universal in their view that, once a system has been set-up and tested in one chosen area – perhaps one or two wards that have particularly supportive staff, then the full implementation should proceed quite fast. There are two reasons for this. First, because having two systems (paper and ePrescribing) in use in the same hospital makes a lot of work when patients cross these boundaries, and second because it is probably less safe. The sequence of this roll-out needs careful attention, perhaps starting with those that are keen, but also incorporating some of the tougher challenges early on to show commitment.

Once a system has been set up and tested then full implementation should proceed quite fast

In any case, almost all sites studied acknowledged the need for a number of dedicated staff to support ePrescribing going live in each location, converting medication orders from the old to the new system, providing on the job training and support, and picking up other nursing tasks when ward staff take time to learn to use ePrescribing.

“Get help, perhaps co-implement across hospitals, sharing experienced staff for the critical periods.”

“Celebrate and publicise with posters and a party.. ‘This is an ePrescribing ward!’”

A number of sites have used locum pharmacists and extra nurses to bolster the staffing levels during ePrescribing implementation. In any case it is probably sensible as far as possible to minimise any other changes or innovations underway during the ePrescribing implementation period. One suggestion from an experienced site was to draw staff from other local hospitals during the key change-over period. In this way experienced people are available, and mutual learning can occur. This will be even more useful if local hospitals are also on track to use the same or similar software in their ePrescribing plans.

Finally, ePrescribing needs to be celebrated. Among the strategies reported by respondents were ward posters, tee shirts, and a party.

Systems in Use

“Keep up the level of support for months after all is live. Problems still emerge and must be fixed - mostly technical or networks.”

“Identify and sort out the quick fixes as soon as possible. Always acknowledge problems and listen.”

“Keep user groups going: it is very important to keep user groups going to ‘get the moans’ and update the list of FAQs.”

“Have 24-hour IT support on call.”

“Encourage ‘warts and all’ user feedback. Keep staff informed about potential problems as well as potential advantages.”

“Provide rapid and sympathetic response to user problems.”

“Encourage staff to report/feedback problems.”

“Reports generated by the ePrescribing system could be used to ‘demonstrate quality for the trust’; generate time and motion data on ward activities, and audit antibiotic prescribing issues.”

Experience of starting to use ePrescribing is generally that there is an initial period of intense activity and support, with mixed reactions by clinical staff, followed perhaps after two or three months by a more positive feeling, and after six months by the start of a feeling of “I would not want to work without ePrescribing”.

Nevertheless, support activity continues to be needed throughout the life of a system. Problems will keep on emerging as well as new ideas for improvements and new understandings of the possibilities ePrescribing offers. Trainers or other designated people still need to be working to pick up people’s concerns and suggestions, and then do something with them. An active and positive support system that feeds back progress on fixing bugs, implementing new features or just answering questions is an important part of sustaining ePrescribing, and the basis for obtaining the full benefits.

A support system that feeds back on progress and answers questions can help sustain ePrescribing

For example, in the early stages of ePrescribing use clinical staff are unlikely to think about the management potential of the data held by the ePrescribing system. But a year later, when available data is substantial and covers a period of time, then reporting, trend analysis or safety audits may become attractive additional system benefits.

Supporting ePrescribing will usually be a task that demands a mix of skills, some IT related, some clinical, and some specific to pharmacy. How to set up and staff such a support operation is not straightforward, and things will not work well if technical questions go to clinical staff or vice versa. ePrescribing sites solve this problem in different ways, but perhaps the most successful is to have a team approach with clinical and technical staff working together.

“Pharmacists’ work will change: prescribing is better so pharmacists need to make fewer interventions.”

“Pharmacists work in a different way here...ePrescribing has made us more clinical.”

“Avoid using agency staff as far as possible. Instead, create a ‘flexi-bank’ of trained part-time staff.”

“You will get greater control over dispensary workload: but workload may go up and ward staff will expect faster turnaround time for discharge prescriptions (TTOs).”

“ePrescribing can have major benefits for stock control. Both nurses and pharmacy workers have a better picture of use, and can quickly request supplies, e.g. by email. Result: a 10% work load reduction in pharmacy.”

ePrescribing has consequences. Some of these are directly related to the benefits that they offer. For example clear, legible and complete medicines orders mean that pharmacists need to spend less time making simple corrections, they may also spend less time supporting the supply of medicines.

On the other hand the work involved in supporting the ePrescribing system – keeping it up to date, improving usability, implementing prescribing policies etc, will probably eat up, and may well exceed (depending on pharmacy’s role), the time savings created elsewhere. This may also lead to some consequential changes. For example, if orders are sent direct to the pharmacy, then expectations will be that they are processed directly. Meeting such enhanced expectations may not be so easy. There may be other situations too where there are unrealisable expectations of immediate response.

ePrescribing has consequences for staffing. For example, agency nurses or doctors that have not been trained to use the system are less useful. A number of ePrescribing sites explained that they had been more eager to build up a bank of part-timers who were trained, had their own passwords, and could use the ePrescribing system directly.

Wrinkles and other observations

“Patient Group Directions [medicines that nurses can give without an individual prescription, e.g. for analgesia and aperients] do not work well with this ePrescribing system. PGDs are used a lot in A&E .”

“Take care with ‘stat’ orders: e.g. furosemide [same example given at a number of sites]. There is no stat alert in the system so staff still need to talk, i.e. tell nursing staff you have ordered a stat dose.”

“Nurses need decision support too, e.g. BNF lookups while doing drug rounds.”

“Once a day orders - take care as they may be scheduled to be 23 hours hence.”

The number and type of wrinkles will be dependant both on the system being used and the way in which it has been implemented. Whilst some issues will be pertinent to all – problems with stat doses and delays to the administration of first doses due to scheduling are commonly reported – others will be more locally specific.

These types of problems are likely to be well known to individual users of a system and may lead to workarounds being developed. It is important that these wrinkles and their workarounds are actively sought and listened for. Understanding what is not quite working, what is irritating people, or what might cause error, is an important job of the ePrescribing team and this understanding should be one of the primary drivers for future development efforts.

Making ePrescribing safe (or dangerous), then safer

Key messages

- Any ePrescribing system is as safe – or as dangerous – as you make it.
- The minimum should be to introduce an ePrescribing system which is at least as safe as the current paper system.
- Preliminary work is required to build comprehensive databases and develop sensible rules to support users and help ensure safety.
- ePrescribing systems must not mislead prescribers as to the level of support or checking that they provide.
- Measuring the baseline of the old system and then re-measuring can help build confidence and ensure safety.
- Running parallel systems is inherently unsafe. Change over from paper to ePrescribing should be swift.
- The really significant safety gains from ePrescribing come from continually developing the system, and using information provided by the system.

Introduction

We reported earlier that the reduction of medication errors and hence Adverse Drug Events (ADE) is the main reason why ePrescribing is introduced. In this chapter we raise some of the issues that are important to consider if a system really is going to deliver on the promise of reducing ADEs.

People often ask if ePrescribing is safe and reliable - the honest answer is that it is as safe and reliable as you make it. It is highly likely that the system you are introducing is being used safely and reliably elsewhere, however it is the responsibility of everyone to ensure that the system is used safely in *your* hospital.

In this section we pass on some of the advice we have been given, and ways in which others have learned, often the hard way, how ePrescribing needs to be introduced if it is to be used safely and reliably. One person we interviewed said:

“The mistakes are all out there, in the literature, but you have to make them yourself to learn.”

We hope to save you going through this by passing on advice from others and linking ePrescribing to general safety thinking. These lessons are here to protect patients, to protect you and save you time. We have heard several anecdotal cases, from the UK and from abroad, of patients harmed as a result of the introduction of ePrescribing. While we think this is very rare, it illustrates the importance of safe implementation.

Safety is often, correctly, described as a 'systems issue'. The 'system' here is not only the ePrescribing system, but everything that humans do to it, and the way in which we all work with each other and with the ePrescribing system. Once the whole is up and running, it is important to keep refining the system and making it safer.

Before implementation

There is an old saying in computing – 'Garbage in, garbage out' - which illustrates the importance of first building up the drug database that will be used for ePrescribing. This may be developed from the current pharmacy database (although it will probably be quite different), or obtained from a third party source. Here are some tasks that need to be done:

- The data files must be double checked for accuracy.
- There needs to be work to ensure all prescribable items are on the database (for example oxygen is easily forgotten).
- Quite a bit of work can be done at this stage to implement Drugs and Therapeutics Committee policy, for example by restricting the access of certain classes of prescribers to non-formulary drugs, or for using the drug off-licence.
- It may be necessary to consider whether certain items would be safe if prescribed using paper charts during preliminary stages. As we discussed, any specific ePrescribing system may not be appropriate for drugs which need frequent dose adjustment in response to physiological monitoring. Warfarin, heparin, insulin and intravenous fluids are common examples, but your hospital may have other 'difficult' drugs to add to this short list.
- Although some actions will definitely need to be done with the ePrescribing system, there can be a lot of flexibility in who does what when. Introducing an ePrescribing system is a good time for staff to try to rethink how they work, and how they can monitor their work.

Setting sensible rules

One of the ways in which computers improve safety is by setting rigid rules that cannot be broken. This can also be a source of error too, for example some systems link the dose form to the route of administration, to stop oral liquids being injected. This can cause problems on occasion, for example vancomycin injections can be prescribed orally in practice, and the ePrescribing system must not block this sort of need. These kinds of problems have often been experienced by ePrescribing sites, and can be anticipated and built into the database and rule sets before implementation.

Another common source of errors can be addressed at this stage by considering the order in which medications are listed. Most systems allow the prescriber to type in a few letters, and a menu of drugs starting with those letters will be shown in alphabetical order, usually in a long list which shows every formulation of each drug. It is common for prescribers not to read to the end of each line and hence pick the wrong formulation (and sometimes the wrong drug, such as penicillamine instead of penicillin).

Rigid rules that cannot be broken can improve safety – but can also be a source of error

“One example I keep remembering is methotrexate which was prescribed every day. I thought that’s wrong, straight away, fair enough. But when I went into it I couldn’t understand why they were on methotrexate and it was supposed to be methotrimoprazine. They were next to each other on the look-up.” [Pharmacist]

One hospital identified many selection errors where ‘paracetamol 500mg soluble tablets’ were selected instead of ‘paracetamol 500mg tablets’, as the ‘s’ of soluble made it come before the ‘t’ of tablets on the alphabetical list. By altering the list so that the ordinary tablets were listed first, the problem was resolved. A similar problem has occurred with suppositories being prescribed instead of tablets.

Consider the medication listing order in the drug menu

Establish a baseline

“More resources - especially staff time - before implementation would have been useful, to do baseline audits on medication errors, time delays etc to quantify impact of the system.” [Pharmacist]

It is very helpful to measure the effectiveness of the paper system, before introducing the electronic one. ePrescribing can lead to existing errors becoming more visible (for example, by showing red exclamation marks on a screen), hence people can believe the system is more dangerous when it is not. At one site this led to a consultant demanding the system be removed on the basis of safety. However, because the manual system had been audited beforehand, it could be shown that the electronic system was indeed safer, he had just never realised how unsafe the paper system had been. Here are four baseline measurements that are easy to do:

ePrescribing can lead to existing errors becoming more visible

- Missed doses on drug rounds (do this by getting nursing staff to record more carefully than normal). Find the number and the causes why missed (no drug on ward etc).
- Prescribing errors. These can be found by the clinical pharmacists recording them when on their rounds.
- Legibility. What proportion of drug chart entries are illegible or open to misinterpretation? Photocopy the worst to show when introducing ePrescribing.
- Number of missing drug charts.

These studies can sometimes be done in partnership with local universities and can certainly be an opportunity for enthusiastic staff to develop their own understanding of ePrescribing's role in promoting patient safety.

Checks and checking

There is a widespread perception that ePrescribing increases safety by introducing decision support such as allergy checks, interaction checking, linking to relevant pathology data etc. These can all deliver benefit, but may also cause harm if not implemented or used properly, or if people are unsure if they are available.

It needs to be decided early on whether any of these types of decision support can be delivered safely and reliably in the initial implementation, and not automatically assumed that these features should be implemented. However, if not implemented, this needs to be made very clear during prescriber training. Some hospitals are very good at this, but we have found others in which the prescribers have become less careful (e.g. stopping checking in the BNF doses or interactions they were unsure about) because they assume that the system will spot any mistakes they make.

Decide on specific checks and decision support early on

"...pick up a BNF, go through the pages, look at the back. That takes time. Meanwhile... people around are doing their job, and it looks as if I'm just sitting reading a book when I should be working...The computer gets the job done quickly." [Junior doctor]

Resources and commitment

The implementation of ePrescribing needs to be suitably resourced, otherwise it can pull staff from other safety-critical activities.

"Have lots of hands and floaters about...We had extra nurses on duty for the roll-out as the drug rounds took ages and the rest of care would be left." [Nurse]

There need to be procedures so that patients can still receive drugs, and be prescribed them, if the whole system crashes. These backup procedures need to be put in place, and tested, for every system software release and hardware upgrade. Testing these procedures is a good way to build confidence in the robustness of the ePrescribing system and can reveal problems such as printouts that are hard to read or take hours to print, and/or distribute to the wards.

Test system crash procedures

"If it's planned, the paperwork comes up, we have notification that the system will go down. If we are lucky it will be after you have done your big ward but if not all the paperwork comes up and you get a backup system which you then use and you file in the notes. Then the computer girls go back and put all the drugs back in."
[Nurse]

"I've seen events where you think, oh gosh – that was lucky. You know what patients are like: 'I haven't had anything for the pain for ages and ages' and the system has gone down and luckily a nurse has remembered they had...something half an hour ago. It's a nightmare if the system comes down and you are on call. Everyone talks about it. It can be down for three hours and it is the worst thing that could possibly happen."
[Junior doctor]

The first few days...

"Use one unit as a pilot. Audit to ensure systems can be streamlined before mass roll out." [Pharmacist]

"Have trainers and support on hand wandering the wards to troubleshoot. Have comments sheets to correct any problems as soon as possible." [Nurse]

Do not be afraid to close down the system if there are serious concerns about its safety. It is not unusual for the first roll-out to fail; some sites never recover from this, but most are able to be successfully rolled out a few months later (one of the purposes of this guide is to reduce the chances of a failed initial roll-out).

"Once system was launched, support...fell on the IT support team out of hours, who have great knowledge of the system but less of the medical aspects. Time is everything; system should have been thoroughly checked before launch with some 'dummy patients.'" [Pharmacist]

"Need 24/7 technical support for troops on the ground." [Senior doctor]

Many of the comments elsewhere about implementation also impact directly on safety. For example, substantial 24-hour support (professional and technical) is required seven days a week during roll-out and beyond. People need to be available to guide and give advice. While initial, pre-implementation piloting will have been done, only so much can be achieved before going live, and it is inevitable that final testing must be on the live system, and therefore there must be plenty of informed, able staff on hand to trap problems as they occur. ePrescribing will reduce some risks but introduce others, so be alert!

“Staff will always choose what they are familiar with so will try to keep the paper going when it gets tough. Don’t let there be any paper left after the roll-out, not even for emergencies.” [Nurse]

At some point the paper prescriptions of existing patients on the ward will need to be transferred to the electronic system. This stage has potential for error, and should be checked by a second person. The transfer from drug chart to computer must be absolute and undertaken quickly; a ward cannot have both ePrescribing and drug chart prescribing at the same time, as this is dangerous. Having said this, some paper may be inevitable; some ePrescribing systems are unable to cope with absolutely all items that need to be prescribed. In these cases there may remain paper systems for some of the most dangerous drugs such as warfarin, heparin and insulin. Prescribing of intravenous fluids can also be problematic.

“Before, you might have written up saline and say OK, run a couple of hundred mls in fast and then slow it down a bit and then if the blood pressure comes up, run it over six hours, and if the blood pressure doesn’t come up then run it over two hours. A rigid system doesn’t allow you to have that flexibility.” [Senior doctor]

This mixture of both an electronic and paper system is in itself a risk factor. Transferring these paper systems to computer will also be a risk factor, and techniques such as the use of dummy drugs on the ePrescribing system (described in chapter 7) need to be used to ensure that doses are not missed.

The transfer from drug chart to computer must be done quickly

Technical limitations and failures can have safety implications. For example, if the wireless network does not cover all beds, data ends up being written on scraps of paper and entered, with variable accuracy, later.

Continuing development

In this section we describe some common issues, and finish with a short comment on how the safety of ePrescribing can be improved, and how ePrescribing can improve safety.

"The support required is far greater than anticipated." [Pharmacist]

"Can't have too much - especially visible support early on." [Senior doctor]

"It's phased plate spinning." [Nurse]

Once people become dependent on ePrescribing there needs to be constant availability of support, 24/7/365. There must always be more than one person, usually in each profession, who fully understands the system, in case of holidays, illness etc. A good training programme and provision for locums etc. must be maintained.

In some areas you can use the computer's reporting ability to identify problems and incidents and monitor progress.

Hardware and software can still raise issues:

- Active replacement of faulty or worn out equipment must be budgeted for. If wards have to pay for their own equipment they may prioritise other issues first.
- Faulty keys on a keyboard (such as keys which stick, or do not always work) can lead to error, for example by adding an extra '0' to a dose, or missing a decimal point. We heard of one keyboard, still in use, which had had a faulty key for nine months.
- Batteries may need replacing in laptops; in one ward staff were unplugging a computer on wheels, then running with it down the ward to plug in again to see another patient, before the computer closed down through lack of power.
- Software can also be a problem. One site which had a system for some years found it could not access or read the notes of the first patients put on the system, as a recent software release had made the old files unreadable. New software releases always have to be treated as a potential risk, with staff on alert to spot unexpected consequences.

ePrescribing systems mean that patient information can be accessed without seeing the patient. In some cases this has reduced time and activities spent with the patient. For example, in some sites pharmacists predominantly check prescriptions without seeing the patient. This reduces the information available to them, stops them checking on things such as intravenous drug delivery, and reduces their communication with the patient.

The system needs to be easily used by occasional users. There is a risk that those who do not regularly use it, such as some senior doctors, may lose their ability to use the system.

Once the system has been introduced and reached some form of stability, there will need to be continued changes and updating, and as a consequence there needs to be a quality assurance process in place to oversee this.

Improving the safety of healthcare is not a one-off task, it is a continuous process. ePrescribing will really improve safety when and if this constant development process is in place. This in turn implies good constructive partnerships between users and with the suppliers.

The essence of improving the safety (and quality) of a system is simple: decide what matters, measure it to see how well (or badly) you are doing and, if you do not like the result, introduce improvements, then re-measure. Has it worked? If not, repeat using different improvements; if it has worked, move onto another area of importance.

An understanding of this process is important for two reasons. First, it can help make the use of ePrescribing safer and help over time to build stronger confidence in the system. Second, ePrescribing can provide data which allows things to be studied that could not be measured, or measured easily before. This is the beauty of ePrescribing; it offers a much safer future for patients.

Planning for ePrescribing

Key Messages

- Planning for ePrescribing needs to be done by a multidisciplinary team, and team members must maintain links back to their professional and operational groups.
- This team has primary responsibility for developing a vision for ePrescribing that can be communicated to the wider community.
- The ePrescribing team should look beyond their own institution, and talk to and visit other sites using ePrescribing, as well as software suppliers.
- ePrescribing can share infrastructure and technical resources with other information systems; but there is no free lunch.
- The ePrescribing team will need to specify and procure software, database and technical infrastructures for ePrescribing. This takes time.
- The ePrescribing team must think through the various changes in work practices that ePrescribing will necessitate, and monitor such changes once it is in use.
- Thinking through the sequence of pilot testing and rollout is essential. Many subtle decisions and trade-offs will need to be made.
- Technical and clinical support is needed during the roll out phase, and much of this support needs to be retained for the operational life of the systems.

Introduction

ePrescribing systems are delivered by a multidisciplinary project team.

Membership of this team needs to include doctors, nurses, pharmacists and Information Management and Technology (IM&T) professionals as a minimum, but also probably allied health professionals, estates staff and others. Experience indicates that the more clinical participation at the early stages, the better. Clinical staff, in particular senior doctors, both physicians and surgeons, are needed to communicate with their own professional groups and to represent these groups' interests as ePrescribing is planned.

The ePrescribing team must be multidisciplinary for two reasons.

First, because ePrescribing demands multiple professional inputs into numerous decisions about how the system will work. ePrescribing is a real-time clinical information system that cuts directly across multiple professional domains and closely supports care pathways and the patient journey and this poses distinct challenges. As a consequence, a premium is placed on joint commitment and active involvement in planning new ways of working.

The second reason for the team to be multidisciplinary is because people can make or break an ePrescribing project. ePrescribing will challenge all healthcare professional groups to consider their current practices, identify weaknesses or inefficiencies, and to be prepared to change. This can lead to resistance, fear or feelings of loss of control or status. A well constituted project team, with the right people connected to the right communities, can do a great deal to overcome such concerns.

ePrescribing will challenge all healthcare professional groups to consider their current practices and to be prepared to change

If there is understanding, communication and commitment, then many good things are possible. If there is the opposite – ignorance, isolation and doubt – then the likelihood of failure is increased. Put another way, professional interests must be understood and respected, and the best way to achieve this is to have them represented in the ePrescribing project team.

The team's agenda

The ePrescribing team has a substantial agenda to address: scoping and scaling the ePrescribing system that is appropriate to the particular site, communicating with the user community and establishing a vision and mandate for the system.

They will lead the tasks of analysis and design that must underlie the new work processes for medicines use and they will also be responsible for the detailed project management activities required to deliver the various elements of ePrescribing on time and to budget. Finally, this project team has to oversee the process of moving from the previous, probably paper-based, system to the new system, managing this change against clear criteria of safety.

Experience in the UK suggests that between one and two years in planning is appropriate before live use when commercially developed ePrescribing software is being used. The main tasks that need to be undertaken in this period include:

Between one and two years planning is appropriate before live use

- Working to secure wide stakeholder commitment.
- Establishing and communicating the vision for ePrescribing and its relationship with wider strategy.
- Building and sustaining links to senior management and clinical leaders.
- Talking to other people and other sites that have experience with ePrescribing.
- Specifying, selecting, procuring and installing software and equipment.
- Configuring software and building required databases.
- Establishing the changes in work practices that are necessary, desirable and safe.
- Establishing training and support resources.
- Collecting baseline data against which to monitor implementation outcomes.
- Identifying pilot sites and the roll-out sequence.
- Continuing to ensure that ePrescribing is an actively managed system, with ongoing support and a development trajectory.

Successful ePrescribing implementations are planned carefully and undertaken in parts that can be implemented swiftly and demonstrate benefits soon. Over-ambitious plans can prove un-implementable, while under-ambitious systems might not reveal benefits or may exhaust commitment. A related problem is the dead-end sub-system which works very well for limited functions but offers no route forward and cannot be integrated with other systems – e.g. a stand-alone discharge prescribing system.

Scoping and scaling the project

ePrescribing projects vary in their scale and ambition. They range from introducing systems that embody the whole medicines use process on the scale of a whole hospital, through to systems intended to support a specific clinical specialty, or systems that are just focused on one part of the medicines use process such as prescribing, administration or discharge. A 'whole hospital' project is different in scope and scale to smaller pilots, but might in some ways be easier to manage and safer too – fewer handovers or multiple systems in use. Put another way, integration of ePrescribing with the overall clinical work flow is a challenge, but also is the basis of the benefit.

The wider scale (whole hospital) and wider scope (whole medicines use process) is certainly desirable in order to exploit the possibilities for improved and safer care. The biggest benefits of ePrescribing for a hospital or trust come from wide-spread use in joined-up care giving. Fragmented or partial use, and lack of care continuity, at best dilute the benefits and probably lead to new risk. Limited approaches may also undermine the economies of scale in the support and infrastructure needed for ePrescribing – for example in justifying the required training and technical development resources. Experience suggests that systems that only serve one part of the medicines use process, for example handling

The biggest benefits of ePrescribing come from widespread use in joined-up care

discharge prescriptions (TTA), while offering an 'easy' entry into ePrescribing also represent a potential dead-end that offers no strategic route forward to integrate ePrescribing with other systems and work practices.

Having a vision of a whole hospital, whole medicines use process system is important, but that is not to say that this is achieved all at once, or that there may not be good reasons to make specific alterations, adaptations or refinements to reflect a particular context. For example, in some areas of care (e.g. critical care, oncology) there may be sound reasons to choose and use specialist systems that are different from those designed for more general implementation. Nevertheless, these kinds of development need equally to be seen as part of this vision.

Integration

ePrescribing systems can be, to degrees, more or less integrated with other clinical information systems that are in use or are planned. Integration here meaning sharing data with other systems: both using data – e.g. patient demographics from a patient administration system (PAS), or providing data e.g. inpatient medication orders transferred to a discharge system. Integration can also be seen from a user's perspective as meaning that electronic resources appear as a 'single system', with for example a single login and a consistent user interface across various applications – for example, PACS, ePrescribing, PAS, pathology reports.

The aim of almost all hospitals is for an integrated approach, and such data sharing and a common interface for users are central for delivering the NHS Care Record Service. However, when ePrescribing is being planned, and as the choice of software is being made the question of how such integration will be achieved, how soon and using what technical means, is a key issue.

Specifying and selecting software

In most cases, an ePrescribing team has to make a choice as to what software they purchase, there being a number of system suppliers active in the UK marketplace. This decision needs to be carefully approached on the basis of a full analysis of needs, functional requirements and constraints. It is beyond the scope of this report to discuss good procurement practices in detail. But among the specific issues that the ePrescribing team will need to consider are:

- The existing systems and databases in use with which ePrescribing will need to interface.
- The technical infrastructure and devices that may be shared with the new system.
- Reference sites offered by various suppliers or identified independently.
- Peak transaction loads expected and their consequence for databases and networks.

The ePrescribing team will probably want to assess some areas of functionality in detail for which purpose the ePrescribing functional specification for NHS trusts (2007)¹ prepared by NHS Connecting for Health makes a useful starting point, particularly the functional requirements given in the mandatory/essential category.

The experience of some UK sites suggests that building a good relationship with the software supplier is an important factor in successful systems implementations. At an early stage the project team needs to start to assess this, for example investigating other sites that use particular types of software, and seeking information on how supportive the supplier is during implementation and how responsive they are to change requests and reported system faults.

Thinking through work practice changes

One key responsibility of the project team is to think through the various changes in work practices that ePrescribing will necessitate, and how this relates to the functions of the ePrescribing software and the equipment that is available. For example, a work process that assumes that all doctors have immediate access to a computer may not work if they do not.

Among the issues that will need to be considered are the details of changes in professional roles, details of timing and durations, and questions of where work is undertaken. Here are a few examples of such issues that need to be addressed by the relevant professional groups; in few cases can the answers to these questions be provided by just one group.

- Who will enter medication orders into the system during ward rounds? Traditionally this has been the job of junior doctors, but in at least one hospital the ward pharmacists join the round and undertake this task.
- It may not make sense to schedule medicines rounds at the time of staff changeover. Tradition might indicate an 8pm round, but if this round is inevitably delayed by staff changeover the system may treat these doses as delayed or missed doses.
- How will the possibility of off-site prescribing be managed? Can any authorised prescriber do it? Under what circumstances?
- What effect will the electronic transmission of discharge prescriptions have on the organisation of the pharmacy?
- Should ward pharmacists use remote access to the medication record to undertake checking (screening) and to prioritise their ward activity?
- Can the data in the ePrescribing system help support a more efficient or timely medicines supply process, and if so how?

There is also a need to work out what configuration of hardware devices will be needed by each ward or clinic (e.g. what combination of fixed workstations, workstations on wheels (WOWs), tablet computers, PDAs etc.), including standby and backup devices. Considerations include the type of work activities and their intensity (e.g. ward rounds and their frequency; whether access to information is also needed for a teaching role, periods of peak activity), as well as practical space considerations. For example, where will five mobile trolleys fit on a ward? At the same time, it is necessary to think about how replacements and upgrades will be funded once the implementation of ePrescribing is over, and any special project funding is no longer available.

What choices are available to structure the planning of the roll-out of ePrescribing?

As with other information systems projects, ePrescribing can be rolled-out in a number of different ways. Among the elements of choices are:

- A pilot site – perhaps one or two wards or clinics – where software, equipment and re-designed work processes can be tested out.
- Parallel running, where a new ePrescribing system is run alongside an older system for a period of time to validate its outputs.
- Incremental implementation in which a system is launched with limited functions, and further functions are added over time.
- A big bang, where work is moved in one swift activity from old system to the new.

All of these approaches can be a part of an ePrescribing plan, although parallel running should be very carefully evaluated since parallel systems, far from enhancing safety, can introduce new opportunities for error and certainly put an additional load on those who have to do everything twice.

A sensible approach, as adopted by a number of the UK sites studied for this report, is to include a pilot site running for a period of two or three months, followed by a swift roll-out across the rest of the hospital – not quite a big bang, more rolling thunder - but certainly a speedy move from paper to ePrescribing.

The impetus to do this faster rather than slower is to minimise the period of time in which people and patients have to cross the boundaries between one way of working and the other. There is also the possibility of other parallel change programmes going on. By limiting the period of this change, it is possible to limit the problems of interference between different change initiatives.

Within any approach there will almost certainly be some incremental implementation too. For example a function such as enforced allergy checking may not be part of the initial roll-out, but can be implemented in a second or subsequent phase.

Support services

What ever the decision on how ePrescribing is rolled out, the period of initial use will require extra resources. The level of availability of these resources will influence how fast the roll-out can be. With more spare capacity, including in particular nurses and pharmacists, a faster rate can be safely sustained. Equally, there needs to be coverage in depth by the technical support team at this time. Experience suggests that at 'go live' the most annoying and debilitating bugs can emerge. For example, in one UK site it was only on go live that it was discovered that there was an arbitrary limit on the number of log-ins to the system, dictated by the size set for a file. This was easy to fix, but only once it was diagnosed. System testing and pilot site usage will reveal some such problems, but it cannot reveal all of them, so a rapid and intelligent technical response may well be needed.

The most annoying and debilitating bugs emerge at 'go live'

Training, too, will peak at the time of changeover, and must be planned to make sure that it is timely (not too early, not too late) and delivered in an appropriate way. However, both technical support and training will continue to be required throughout the life of a system.

References

1. NHS Connecting for Health (2007). ePrescribing functional specification for NHS trusts. <http://www.connectingforhealth.nhs.uk/systemsandservices/eprescribing/baselinefunctspec.pdf> Accessed 5 December 2008

Managing ePrescribing in use

Key messages

- ePrescribing brings benefits to nurses, pharmacists and doctors in terms of access to information and helps them to plan and to organise their work.
- In terms of changes in professional role, the benefits and risks may be greatest for pharmacists.
- Training and support for ePrescribing is needed round the clock for as long as ePrescribing is in use. The provider(s) of this training will vary – different departments take it on at different sites - but it is essential to have clinical staff involved.
- ePrescribing forces a structure onto routine tasks, making them more rigid. While staff performing the task will be well aware of this, colleagues in other professions may not appreciate the extent to which particular tasks (such as doing a drug round or writing or screening a new prescription) have changed.
- Staff using ePrescribing will develop workarounds; ways to get the job done. Some groups of staff will also start to configure the system to meet their particular needs. These *ad hoc* developments need to be monitored and discussed with staff.
- Mobile technology used for ePrescribing raises handling, security, storage and infection control issues.
- With experience, people may expect to get reports from information inside the computer system. Often this is not easy and data analysis facilities may be restricted to a small number of staff with specific technical knowledge. The ability to generate and use reports from ePrescribing systems is the key to many second order benefits.

Moving to ePrescribing

"People are naturally wary of change." [Nurse]

"The most advanced hospital computer system in the country!" [Junior doctor]

Switching from a time-honoured paper system to ePrescribing is a big step. Staff not actively involved in the planning process may feel a sense of pride, but will also be anxious about what the change will mean for them, and how well they will cope with it.¹

Hospitals which started to implement ePrescribing as part of the Resource Management Initiative pilots in the late 1980s faced up to those fears many years ago. Nurses feared that “everything will take longer”, junior doctors worried that the need to plug into terminals on ward rounds would make them more remote from their patients.² For hospital pharmacists, ePrescribing had the potential to substantially affect the way in which they practised, as it might reduce their presence on wards. They feared they would be stuck in the dispensary scrolling through screens, or spend their time entering orders for clinicians, as happens in the USA, and that clinical posts might be lost.^{3,4}

A year later many of these initial concerns had dissipated⁵ and the hoped-for benefits had risen to the fore. Over a decade later, those same perceived benefits – legible, complete, accessible medication records; remote access to all clinical records; better formulary controls; and more and better clinical audit data – were found repeatedly in our interviews and survey data.

In order to achieve these benefits, as a detailed evaluation of one pilot ePrescribing implementation⁶ makes clear, ePrescribing does affect the way people work because it reshapes routine tasks such as writing and screening a prescription, and doing a drug round, which become much more structured and rigid. The system forces the user to do things in a set order whereas with paper, steps can be skipped and returned to later. With ePrescribing, each step is made explicit but a degree of flexibility is lost. The art is to ensure that this is a strength and not a weakness.

The change in ways of working

“The “rigidity” of the system highlights variation in practice.” [Senior doctor]

Staff awareness of this change depends on their viewpoint, and also how much they reflect on the detail of a familiar routine activity. Senior doctors might think that the drug round was ‘still done in the normal way’ apart from the fact that a computer was now involved, while nurses in our interviews tended to see changes in terms of the benefits. They had a clear, complete list of medications due for individual patients, allowing them to focus on the patient rather than spend time looking for drug charts and medicines during the actual round. However, not all nurses saw a change in their work on the wards and some missed seeing the ‘full picture’ of the paper chart with up to two weeks’ worth of data on one sheet. The presentation of this data, so familiar from the drug chart/Kardex, varies significantly between systems.

Comments in our interviews and questionnaires point to significant changes in the way things are done, partly because ePrescribing makes preparing for tasks such as ward visits (pharmacists), ward rounds (junior doctors) and drug rounds (nurses) more efficient.

“Most junior nurses like the system, especially as it is almost paperless on the wards. We still have nurses who think it too ‘technical’ and are worried that they do not understand it. Many do not remember all the extra things they can gain from it – and they often lose their training information, or keep it at home! These are not all the older nurses either.”
[Pharmacist]

“Workflow is different as medication orders and history available allowing dispensing to be done immediately once an item has been clinically validated on the ward.”
[Pharmacist]

“We have computers on wheels, which can be moved to the bedside during consultant rounds, and prescribing can thus take place at the bedside, often done by a pharmacist and signed by a doctor...Dispensary workload is flattened – though not reduced – by ePrescribing. Not reliant on nurses going to tea etc. to bring down drug charts, or on pharmacists visiting wards to transcribe. Supply is more immediate – the orders arrive in the dispensary immediately -which means that great things are expected of our dispensary.” [Pharmacist]

Pharmacists can check all the charts before they set out to visit their ward and then target patients with medication-related problems. Doctors can delegate part of the prescribing (order entry) process to pharmacists by getting them to key in the drug product and/or schedule administration times for doses.

In the dispensary, some sites report that peaks and troughs in workload can be reduced (although there is some evidence the peaks just shift to a different time⁷) with less delay for clinical screening, and fewer phone calls or staff being sent down to ask if a patient's drugs are ready. Nursing and junior doctors may notice that they see pharmacists on the ward less often than before, and some young staff who have only known ePrescribing may not know where the Pharmacy department is. Senior staff may sometimes use ePrescribing as a way of monitoring/auditing what staff do.

ePrescribing changes Pharmacy supply and clinical monitoring

“You say ‘I have seen this patient’ when what you have actually done is prescribe for them.” [Junior doctor]

In general, it is possible for a lot more things to be done remotely. This has implications for direct patient contact, particularly for pharmacists though also for junior doctors. Pharmacists may spend less time on the wards with ePrescribing and, like doctors, may be more likely to see many of their patients ‘through the data’ than in the flesh.⁶ While a doctor on nights may be more likely to prescribe promptly and accurately from their residency, pharmacists who screen from their desk in the pharmacy will miss being able to speak to patients and check the notes and IV lines,

Doing things remotely has implications for patient contact

reducing their patient safety function and, in some cases, stopping becoming part of the ward team. Even when pharmacists still visit the wards it was sometimes reported that they spent much of their time there at the computer.

Changes in communication

“What we used to have in my last hospital, which I liked ...you used to know your ward pharmacist and they would have little post-its and if you wanted to discuss something... you would ring them when it was convenient, whereas here it is quite a detached phone call.” [Junior doctor]

When we asked pharmacists, nurses and doctors if ePrescribing has changed the way they communicate with others the response varied. In our survey, most thought communication had stayed the same, some thought it had increased, and a small number that it had decreased.

“More as we do a lot of hand holding in clinics and run the medics training.” [Pharmacist]

“Less - you don’t need to communicate or interact if you can message or propose but there is an audit trail. Interactions often don’t provide an audit trail to prove the interaction happened.” [Nurse]

Two people told us that ePrescribing had led to less interaction with other health professionals. At their trust, the fact that charts can be reviewed remotely, so staff did not need to come to the pharmacy, and that pharmacy staff could leave messages for doctors and nurses without needing to come to the ward, were seen as advantages because all these activities could be audited by the ePrescribing system.

Other sites had differing perspectives, with some acknowledging the need to make sure that there were still appropriate opportunities for face-to-face interactions between healthcare professionals and staff – and patients.

Security and PINs

“I still have my PRHO mnemonic because I went on the system as that. So sometimes you get a phone call saying, I know you’re only a House Officer, what are you prescribing this for?” [Doctor]

There are several security protocols for accessing ePrescribing. The one you choose needs to trade-off theoretical with practical security benefits. It also needs to trade-off security with staff time spent on tasks, and their consequent (dis)satisfaction and motivation to create less secure workarounds. Some hospitals had multi-level ID entry with a mnemonic login and a PIN they entered each time they actioned an order. Others

had just one login but with a short active time so staff could not wander off and leave a screen open for others to use.

Who has responsibility for issuing ePrescribing passwords is also variable. In some sites, the Information Technology (IT) department had this role while in others, trainers, or 'super users' issue logins, or a less formal system with ward sisters able to issue a "single shift" login. It is worth seeing if there is the opportunity for using the same sign-ins to other systems, so that for example the same code is used to access ePrescribing, PAS etc.

The frequency with which logins and PINs (personal identification numbers) were changed also varied, and procedures for cancelling logins for staff leaving the Trust were not clear. Frequent changes provided extra security - but also posed memory problems, with some staff writing PINs on their hands, or on the back of ID badges. Some prescribing 'by proxy' did occur when staff did not have (or had forgotten) their logins. If, for example, nurses have a 10 character PIN then it can slow down their working (particularly if it is decided PINS need to be entered frequently); this also encourages workarounds.

Removal of authority is as important as creating it. One junior doctor, who had completed her pre-registration experience at an ePrescribing hospital then left, told us that she had come back to a more senior post and found that her old login still worked.

Workarounds

As staff get used to their ePrescribing system, some of them start to find ways to make it do what they want, such as bending the rules on who does what. Sometime these tricks are the only way to get the job done, however they may also be safety time bombs. The good aspects of workarounds are that they can be a way of identifying how to do things better. Workarounds can be a way of helping re-configure the system (see next section) and make it more workable in day-to-day use. The bad aspects are that often the workaround can be a very inventive way of by-passing a necessary safety feature.

What is more, the people who develop them often have little knowledge about the system as a whole, and those with the system knowledge are unaware of the reality of daily practice. Workarounds need to be known about and monitored to ensure they are safe. We have identified the following examples of workarounds:

Workarounds can be a way of identifying how to do things better – but need to be known about and monitored to ensure they are safe

Barcoding bedside lockers rather than the patient

If the ePrescribing system is linked to barcoded patient identification and the barcode ID on the patient wristband will not scan in, then medications cannot be accessed. So the nurse prints off another barcode label and sticks it on the patient's bedside locker or table, with all the associated risks.

Change the system clock or give first dose as a stat

“One of the biggest training issues for us for doctors is training them that time does matter and if you schedule a weekly drug and it is due at 8 o’clock and you are writing it up at 9 o’clock on the day it is due, then if you want today’s dose then you have to put 9 o’clock in because if you don’t it is not going to be due until next week.” [Pharmacist]

In ePrescribing, doses of a regular medicine need to be scheduled to a particular time window. If this is not done, the drug will not appear on the list of drugs due for a particular drug round and the nurses cannot administer it. Some doctors get round this by resetting the start time in the system. The other way to do it is to write up a stat (give now) order and put a note on the ePrescribing system to say that this is actually the first dose of a new regular medicine. These stat orders stay on the system longer, but with some ePrescribing systems if the patient has a long list of medications, they can fall off the bottom of the screen and be missed.

Delegated tasks (seniors to juniors, or doctors to nurses or pharmacists)

On ward rounds, consultants have always delegated prescribing to junior staff. However, with ePrescribing those juniors may then delegate further, for example, by entering the drugs and then asking nurses or pharmacists to schedule the administration times. The ability to do this will depend on the ePrescribing system and local policy, and may not be possible with all types.

Because consultants usually do less prescribing, they may be less familiar with ePrescribing and so find it quicker/easier to delegate to a junior on their team. Another practice is to have pharmacists on rounds inputting orders for consultants.

“Simple drugs, given once or four times daily, work incredibly well. Giving stat drugs works less well and then variable dose things, Warfarin, can be a bit of a trial to prescribe and the same with anything fluid that is infusing. Seems to me to be beyond my capabilities to understand so I let somebody else do it.” [Consultant]

Use of paper

Non-formulary drugs or new drugs may not be in the ePrescribing drug dictionary so usually cannot be prescribed by junior doctors. But doctors can prescribe a medicine on a paper chart, regardless of its status. If paper charts are available (e.g. in case of unplanned downtime) then doctors may use them to get round a formulary restriction.

Newly admitted inpatients – or those coming up to a ward as a day case – may need to be admitted onto the ePrescribing system before any prescribing can be done. This can prevent advance prescribing of medication. Using a paper chart can be one way round this. However this is also potentially risky procedure and, if paper is used in such circumstances, then extra checks will be needed and the prescription put on to ePrescribing as soon as possible.

In-use configuration

As user experience with ePrescribing grows, some groups start to learn how to configure systems to their needs. This is an essential step in improving the usability of the system; it needs to be carefully managed, but can significantly improve usability and safety. We identified the following examples:

Dummy drugs: Flexible/variable dose medicines (warfarin, heparin, insulin, IV fluids) do not fit easily into ePrescribing and most hospitals still use paper charts to prescribe these. This could mean that items are not administered, or are missed off a discharge prescription. To help to minimise this risk, some hospitals have created 'dummy drug' entries in their data file, e.g. 'on warfarin, see separate chart' which can be prescribed on ePrescribing.

Order sets: (e.g. post-operative regimens for individual surgeons/ syringe-pump formulations): These sets, each containing several drugs, speed up prescribing, ensure a full regime of correctly prescribed drugs, and can make life easier for doctors. Provided you know what is in a set, it is easier to prescribe one and then delete elements you don't want than to build it up from scratch. Some respondents were concerned that sets could be ordered without thinking whether the individual drugs were all safe for the patient concerned, for example, non-steroidal anti-inflammatory drugs in a patient with aspirin allergy. Some sites ensure that each drug has to be individually selected to mitigate this risk. The risks need to be emphasised in training and monitored to identify problems.

Formulary control: Non-formulary drugs may not normally be prescribable by junior doctors, but doctors can prescribe a medicine on a paper chart, regardless of its status. As noted earlier, if paper charts are available then doctors may use them to get round a formulary restriction – this may be a dangerous workaround and should probably be discouraged. One approach is to make several, more sensitive, levels of access to drugs. For example some sites are developing multi-level formulary control (not all ePrescribing systems support this), in which certain high-risk cytotoxic drugs are only available for ePrescribing prescribing by named people, and in which other drugs can only be prescribed by ePrescribing after discussion with an appropriate person eg: a microbiologist.

Switching elements of decision support on or off: Many people assume that the main patient safety benefit of ePrescribing comes from decision support. This is rarely the case (although it may well be in a few years time). Decision support can be powerful, but it is an area fraught with complexity, and it is unwise to attempt too much too quickly.

A really good decision support system needs large amounts of resource behind it, and some have become so complex that they delay implementation of new prescribing policies, perhaps by months. It is a huge task to maintain a system with rules relating to

the BNF, NPSA, local PCTs, formulary and DT&C decisions, new drugs introduced to the market and new uses of existing drugs. Unless resourced properly, this interconnecting web of knowledge and directions can easily become unstable, with conflicting rules for the same drugs. For example, to change a first choice statin may take many weeks as people have to alter rules and ensure there are no conflicts. With decision support it is better to start simple and build up over time.

A really good decision support system is a huge task to maintain

Decision support can be crudely divided into two distinct areas: decision constraint, which stops people doing daft things, and decision support, which guides and helps prescribing decisions.

Decision constraint can be very effective and is often implemented first. Configuring ePrescribing at this level is mostly decided early on before roll-out begins, and usually involves choosing those functions that will be used, and disabling others. Interaction warnings, for example, may be disabled if there is concern that there are too many unhelpful ones or they are coming up at the wrong stage in the process.

Setting of default doses, frequencies, routes and treatment lengths varies from hospital to hospital. The level of control also varies, depending on the situation, from 'warning boxes' (which can be bypassed if a reason is entered) to absolute blocks (e.g. making it impossible to prescribe oral methotrexate daily). One of the hospitals with the most experience of ePrescribing only has warnings of the most dangerous drug interactions.

Where decision support is enabled, it is important to monitor it, for example the number of warnings produced and the number overridden, and to react to the findings.

It is important that staff training emphasises the extent of decision support offered by the system. It has been found that some staff automatically assume an ePrescribing system will have decision support, so reduce their own vigilance when prescribing – for example not checking if the patient has an allergy to a drug because they assume that, on prescribing it, a warning will appear if an allergy exists.

A sophisticated decision support system would be expected to not only improve the safety of prescribing, but also the quality and cost-effectiveness. If a hospital wants to achieve these benefits they need to adequately fund staff to run decision support. Assuming that existing staff will be able to absorb this workload is unrealistic.

Interfacing with pathology test results: In a number of the sites studied the ePrescribing system was linked to laboratory results systems. This can provide a useful support for prescribing and administration activity, e.g. when warfarin is prescribed, the most recent INR result can be displayed.

Discharge prescribing: The discharge prescription should be easily constructed from the inpatient prescription, however some ePrescribing systems may need to be configured specially to do this. There may also be the opportunity to extend the interface further into the pharmacy. At one site, ePrescribing discharge orders interfaced directly with the dispensary labelling machine and could be linked with a robotic dispenser.

ePrescribing and professional practice

For pharmacists: ePrescribing probably has more sustained effects on pharmacy than any other profession, in that it changes supply and clinical monitoring functions. These changes will become greater over time. Ultimately this could lead to the supply function predominantly being delivered by dispensing robots (already in use in many pharmacies), or being outsourced. A negative impact has happened in some sites because of unrealistic expectations of hospital management, who assumed that ePrescribing would replace the pharmacist's clinical role, and hence they cut the pharmacy establishment.

The reality is that ePrescribing currently only replaces a small part of the clinical role. What is more, it takes a lot of pharmacists' time to set up and maintain the ePrescribing system if it is to deliver the hoped for benefits to patient safety. Hence pharmacy may need to have their staff increased, or re-structured, as ePrescribing implementation is undertaken.

Ultimately pharmacists, technicians and technology are interlinked in what need to be constantly evolving roles which increase patient safety and the quality of medicines use.

For doctors: It is important that senior medical staff are fully engaged, and that they influence their juniors. Both seniors and juniors should have been involved in the planning and implementation of ePrescribing. Time and priority needs to be given to training, and senior doctors should monitor and influence the performance of their junior staff. Junior doctors are sometimes too accepting of a system as it is, perhaps feeling that they will have moved on before their comments are responded to and the system is improved. However this just maintains problems for their peers.

Junior doctors (and pharmacist and nurse prescribers) should find some efficiency savings with ePrescribing, such as order sets, easy construction of TTAs, no need to rewrite drug charts, and the ability to prescribe from other places in the hospital (or sometimes other hospitals). Speed of prescribing varies with the system and with experience, but we have seen computerised prescribing which was far faster than hand writing.

ePrescribing will provide information to prescribers, clinical directors and others, from which they can audit practices and compliance with policies far more rapidly and accurately than at present.

For nurses: In our interviews and survey, nurses tended to be the most cautious in their comments, while still generally positive. ePrescribing does have great advantages in terms of clear, complete, and available records but nurses feel they need to shout more loudly about their particular needs for an ePrescribing system. Having said that, ward sisters can make or break the success of ePrescribing roll-out, so they need to be heavily involved. To ensure nurses get the best from ePrescribing they should have good representation on implementation groups: should be involved in focus groups in early implementation and should be invited to contribute feedback. Their presence should not only be on clinical groups but also on groups making decisions about space, choice of technology etc.

Drug rounds will be different with ePrescribing systems, although how different depends partly on the system in use and partly on local implementation decisions. For example, some sites record a dose as given before taking it to the patient, however if the patient refuses it they need to be careful to alter the record; the alternative is to enter the drug as given once returning to the computer. The way in which patients' own drug schemes are used with ePrescribing can also be an issue. It can be helpful for a pharmacist to accompany the first rounds to help identify problems, sometimes this can improve the pharmacy service to the ward; sometimes it just creates shared understanding of the constraints of the system. The process of double sign-off of controlled drugs also needs to be agreed.

Nurses have a vital role, often going beyond their current role, in training and support, often undertaking the training for other professions.

For ward sisters, managing small herds of COWs (WOWs) in an already crowded workspace could pose a problem (and a possible infection risk?). Some hospitals have used ordinary laptops but these are much easier to steal, so impose additional security that could be burdensome on a busy ward.

ePrescribing future: Specific questions

How do you foster and manage feedback and mutual learning?

"Training is needed forever, IT support forever, a group will need to keep updating."
[Nurse]

The message from the ePrescribing sites studied is that providing training and support needs more people and training than you think (one trust suggested budgeting for doubling initial manpower estimates) and is needed round the clock for as long as ePrescribing is in use.

On-call support for the ePrescribing system, and managing planned and unplanned downtime, is also required. In some trusts, pharmacy has this role; in others, it is the

IT department. For training, the provider(s) chosen will depend on local circumstances and preferences, but it is essential to have clinical staff involved. Nurses (and in some trusts, pharmacists) are used as clinical trainers for doctors; pharmacists usually train their own staff.

The aim of training is to get new staff up to speed with basic ePrescribing functions, so they can work effectively. The aim of support is to answer calls for help when the user cannot make the system do what he or she wants it to, or it goes down. Across the NHS there is a culture of not making a fuss and doing the best we can; staff grumble to their colleagues about specific issues but do not report them until they become critical. Our data suggest that current ePrescribing support services only pick up critical problems when users have been unable to get around these themselves. It is important that there is an active programme of identifying niggles and resolving them where possible.

“The most difficult part has been how reliably we can access the support, what their limitations are and how they escalate problems. Communication between the support team and the users is key – so the users feel able to ask for assistance before a difficulty becomes a problem.” [Pharmacist]

However, as staff become familiar with ePrescribing, they will start to develop workarounds and some groups will also start to reconfigure the system to meet their particular needs. These ad hoc developments tend to stay with the person or group that originated them, and most are only picked up by direct questioning or observation. It is important that there is a formal mechanism for monitoring these adaptive (or developmental) changes to the ePrescribing system and discussing them with staff. For example, this can be a role undertaken by trainers or support staff as they interact with their user community. It can be helpful to make it clear that such innovations are, in general, seen as positive, and perhaps to reward people for discussing them – for example with a ‘tip of the month’ competition.

How do you deal with agency staff, assign passwords etc?

Agency staff will probably not be trained on ePrescribing, or have authorisation to use the system. This means that agency nurses cannot give drugs, making them expensive for what they can do. Many of the ePrescribing hospitals we spoke to only used them if there was no other alternative. Instead they set up their own “bank” of trained part-timers, or made existing staff cover. For medical and pharmacy staff, the strategy was to use “regulars”. This is feasible in trusts where staff turnover is low and people tend to stay living in the hospital area but poses a larger problem for hospitals with a rapidly changing staff base. A related issue is the issuing and maintaining security of passwords/logins/PINs for ePrescribing, which will be a much larger task in a large hospital with high staff turnover, particularly if it is in an area where on-site IT-related thefts and other crime are problems.

What else can you do differently once drug use data are online?

“ePrescribing allows us to produce detailed prescribing reports on clinical areas and down to individual consultants. Using antibiotic prescribing as an example, this has had a dramatic effect on the use of drugs known to increase the risk of C difficile and MRSA infections. There is an added bonus of now being able to identify prescribing costs by clinical areas.” [Consultant]

“Senior nurses can do complaints, investigations, monitor infections, see if patients are in beds, see how many beds are in use, which patients are on which areas, who is on duty.” [Nurse]

Participants in our survey thought mainly about getting data into the system, and the task at hand in the immediate context of use. They did not think about getting data out. It may be assumed that, because the data is in the ePrescribing system, that it can be easily extracted and analysed in any way you want. This may not be true.

People tend to think about reporting or possibilities for analysing aspects of their practice rather late in the day. Most nurses we interviewed did not immediately see a need to have reports but could, if pressed, imagine useful audit data on the drug administration process. For example, they saw ePrescribing data as a way of monitoring and confirming what individuals had (or had not) done. Pharmacists could see uses for data in clinical prescribing audits, but not as a tool to look at their own activities. In some sites, ePrescribing does in theory allow pharmacists to audit their interventions but this data does not seem to be generated, or examined, routinely.

Those who did want to extract, relate and interpret data – e.g. for clinical audit, research, management or to support other process changes - were often frustrated, for several reasons:

- in some cases the data structure of the system would not allow it.
- in some cases because writing a report needed specialist technical knowledge or access to a particular person.
- sometimes because the supplier company wanted too much money to do the necessary work within a reasonable time frame.
- sometimes because a technical group used their ability to generate reports as a way to retain control of the system.

From the information we gained it appears that at present, reports mostly have to be specifically ordered, or a template for one requested. Sometimes a member of the pharmacy staff has the necessary expertise to do this; sometimes a request is handled by a completely separate department. Either way, the need for the report has to be clear, and the person requesting the data has to be fairly senior. Staff are not usually encouraged to learn how to get relevant data out themselves. While this protects the

privacy and security of personal information as well as system performance, it also reduces the likelihood of solving problems and identifying useful information such as important trends. The wider exploitation of the data stream and how to manage this (within appropriate privacy and security concerns) should be an initial part of any ePrescribing project's goals.

References

1. Georgiou A, Ampt A, Creswick N, Westbrook J and Braithwaite J. Computerized Provider Order Entry – What are health professionals concerned about? A qualitative study in an Australian hospital. *International Journal of Medical Informatics*, 2009 Jan;78(1): 60-70.
2. Editorial. Clinical pharmacy “mugged” by resource management schemes. *The Pharmaceutical Journal* 1990;244:758-9.
3. Barber N. Hospital computer prescribing: opportunity or threat? *The Pharmaceutical Journal* 1990;244:786.
4. Bouchard CA, Horne RW. Pharmacy resource management. *The Pharmaceutical Journal* 1990;245:5.
5. Editorial. Clinical pharmacy fears with resource management “unfounded”. *The Pharmaceutical Journal* 1991;246:795.
6. Barber N, Cornford T, Klecun E. Qualitative evaluation of an electronic prescribing and administration system. *Quality and Safety in Health Care* 2007;16:271-8.
7. Slee A, Farrar K. What are normal working hours for hospital pharmacy? *The Pharmaceutical Journal* 1998;260:923-5.

The technologies of ePrescribing

Key messages

- ePrescribing is reliant on a number of technologies; each has its own role, but also its own potential problems.
- Software may be bought as a 'package', but it may need extensive work to install it in any particular hospital setting.
- Developing a good relationship with the suppliers of software and hardware is important.
- Mobile devices are helpful to take ePrescribing to the care setting. However their choice needs to be carefully considered.
- Experience among NHS hospitals suggests that wireless networks are often the weak link in ePrescribing implementations.

Introduction

By definition ePrescribing makes use of information and communications technologies. Most contemporary implementations use hand-held or mobile devices and wireless networks, as well as fixed workstations and wired networks. Similarly, almost all systems rely on standard packaged software to provide the basic functions of prescribing, administration and recording medicines use, and almost all make use of standard drug dictionaries and databases to allow these systems to offer decision support to prescribers.

Feedback from experiences of those who have implemented ePrescribing systems suggests that most of these technological elements have potential problems or issues associated with them. It is seldom wise to assume that technology will work the way it is presented. In other words, 'what it says on the can' may not be your best guide to what actually happens.

Our interviews with people who have worked to make ePrescribing systems work in real hospital settings often reveal that the frailty of technology only becomes clear as implementation proceeds, and the bland assurances of technical and IT staff that it is all OK and will work can come unstuck.

It is not the purpose of this report to offer detailed guidance on the choice of hardware, networks or software packages, but rather to report lessons learned. The chapter is organised as a catalogue of various technological elements of ePrescribing systems

broadly divided into three sections: software, hardware and networking, and paper. We provide a brief description and some account of how each of these technologies have proved useful, but also problematic. We hope that for those who have to manage future ePrescribing projects forewarned will be forearmed.

Packaged software

In almost all cases, electronic prescribing implementations are based upon packaged software provided by specialist developers. The market for ePrescribing software can be roughly divided between three (or four) major types.

Developments of pharmacy based systems (e.g. JAC, Ascribe). At present the majority of implementations of ePrescribing in England are based around extensions of existing pharmacy software packages. This is understandable if you see ePrescribing as an extension of such systems, and as sharing many common parts. For example, a database of drugs, pack types and sizes and as undertaking essentially similar tasks such as stock control.

Clinical specialty based (intensive care unit - ICU, oncology). Some areas of medicine have distinctive needs for ePrescribing because of the style of care they offer, or the complexity of the medicines regime they employ. ICU and chemotherapy are two areas in which there is great interest in ePrescribing and fairly wide spread adoption of systems. Another specialist area is prescribing Parenteral Nutrition (PN). There are a small number of software products from suppliers that are targeted at these specialities.

Components or modules of larger hospital information system packages (Cerner Millennium, iSoft Lorenzo, Meditech). At present neither of the principal packages that are used within the National Programme for Information Technology has an ePrescribing module in use. However, ePrescribing figures as one of the modules that will be available in phase 2 of the roll-out plans of both iSoft Lorenzo and Cerner Millennium. The Meditech package is in use in a number of UK hospitals, and supports ePrescribing. For example, Queens Hospital, Burton upon Trent, has used Meditech ePrescribing for over 10 years, and Sunderland has implemented it hospital-wide in the past few years.

Home grown software. In the past the pioneers of ePrescribing had to develop their own software because none existed. For example, a few hospitals have built and implemented their own systems across the hospital, notably University Hospital Birmingham, but few we suspect would embark on this route today. The exception might be for limited functionality systems that implement some partial elements of ePrescribing, in particular discharge prescription/TTO systems. This is a limited area in which a hospital or trust may see it as appropriate to develop their own software, though they should understand the risk this poses of building a system that cannot integrate with and develop alongside other parts of the hospitals' information systems. There are also issues of the legal basis of prescribing and managing medicines orders that need to be addressed.

Whatever software is used, it is important to fully understand the scope of the system and manage how this relates to local needs and expectations. There are certain common issues that need to be considered. Here, based on our study of ePrescribing implementation experiences, we consider four: customization, installation, configuration and templates. Each of these are important activities in setting up ePrescribing software, and each needs to be resourced with an appropriate management structure and appropriate skills.

Customization, installation, configuration and templates;

Packaged software cannot be put to work straight off the distribution disk or in a matter of a few days. It will always need to be 'set up' before it can be used. This is a complex and time consuming activity that needs to be resourced.

Packaged software set-up is complex and time-consuming and needs to be resourced

Customization: Customisation occurs when we get the code adapted because of our special needs or requirements. In general customization is a **bad thing**. It may be possible to persuade a software supplier to do such work (at a price), but this is almost always stocking up trouble for the future. For example, a customized version of a standard product will probably require re-customization (at a price) if and when the standard version is updated and released as version n+1. Customization may also introduce new errors into the code, errors that may not be detected until too late. Local customization should not be confused with local configuration (below).

Customization is almost always stocking up trouble for the future

Installation: Software for ePrescribing will need to run on a number of different computers. There will be servers to hold the shared data on medicines orders, stocks, drug names etc, as well as laptops or workstations around the hospital to be used to input and check data. Each of these machines need some software loaded on to them and this software will need to be periodically updated. ePrescribing systems will also need to be interfaced to other systems, for example to obtain patient numbers and demographic data from the PAS, to integrate with an existing EPR, or to validate individual logons by staff and enable relevant prescribing privileges.

Managing and maintaining the installation in an efficient and safe way takes time and the specific skills of IT professionals. Some software makes this easier than others. For example some ePrescribing packages can run in a 'fat client' or 'thin client' mode. In the latter, the main programs are maintained on a limited number of servers, and the clients (laptops, tablets, workstations) use a web browser or similar software to access them. The result is to make it far easier to manage and update the software over time.

Configuration: If customization is a bad thing, installation a necessary thing, then configuration is **good thing**. Packages for ePrescribing are (certainly should be) designed to allow system sponsors to make many specific decisions as to how, in their own context, the software will behave.

For example, what degree of decision support will be offered to prescribers, how will antibiotic durations be set (or not), when will alerts trigger, how large a time window is allowed for an 'on-time' administration of a medicine. These questions constitute a very long list, and each one will need to be thought about and answered. One of the most substantial parts of any implementation of ePrescribing will be to work through these questions, establish the appropriate answer for the situation, configure the software appropriately, and then test it. In many cases current practice may be clear, consistent and appropriate, but in many areas they will be none of these, and it will take time to work out the appropriate configuration.

It is worth investing some time to learn about all the configuration options before making any decisions. Once made, decisions should not be set in stone; system sponsors must be prepared to review and alter configurations in light of experiences during initial set up and ongoing use.

Invest time to learn about all configuration options before making any decisions

Templates: Templates are standard descriptions of how a certain set of data is managed, collected or displayed. Templates may be seen as a special case of configuration, but deserve their own consideration because they are one of the most powerful ways of obtaining the benefits of ePrescribing. Examples of a template might be the content of a discharge summary, the definition of order sets, or the allergy entry screens. Each of these cases could be seen as a detail of configuration, but while many configuration decisions are made once early on in an implementation, these types of decision are able to be adjusted over time, extended and reworked.

Migration and versions

As alluded to above, software systems are almost always delivered over time in different releases - version 1, version 2 etc, and perhaps with minor revisions in between as version 1.1, version 1.2 etc. Almost all computer users are familiar with this characteristic from their experience of Windows (2000, XP, Vista). Shifting up as new versions are released may be wholly desirable if the new version is better, faster, safer... but it may equally be a problem if the new version requires substantial re-working of work practices, technical infrastructures etc.

Experience suggests that moving between versions can cause difficult periods, when problems become apparent. Upgrades to software that should be simple, transparent to users and wholly desirable, can become nightmares of lost data, poor performance and compromised safety. New versions should always be tested before implementation in the live environment.

The question of choosing a version also arises for initial implementations. For example, given the choice of an initial implementation of the old, tried and tested version 3 of an ePrescribing system with three years use in other similar hospitals, or the new, enhanced (but un-tested and un-tried) version 4, which should you go for?

Relationships with suppliers,

The suppliers of software we must assume want it to work for you, and should therefore be prepared to put in a substantial effort to help their customers get the best out of their software. For example, people interviewed during the study appreciated suppliers who could supply training materials (probably for local configuration), speedy technical support, on-site support during go-live and help to make contacts with previous sites that use their software.

Suppliers should help customers get the best out of their software – and be ready to hear about what is not working well

Suppliers also need to be ready to hear about what is not working well, of features and functions that the software does not support but should. While we have suggested the customization is not a good practice on a site-by-site basis, it certainly is the case that the supplier should be actively canvassing ideas to be fed into the next release that they develop. This may be a cycle that takes two or three years to complete from request to possibly a new function being delivered, but it is central to the thriving of any software product.

Drug dictionaries and databases

All ePrescribing systems involve the selection of a drug from a 'pick-list'. These 'pick-lists' or drug dictionaries may be built locally but more commonly come from a commercially available (third party) supplier of drug information. It is advisable to use a drug dictionary that is compatible with dm+d (a dictionary containing unique identifiers and associated textual descriptions for medicines and medical devices), as this is anticipated to become the NHS standard for medicines and device identification.

Use a drug dictionary that is compatible with dm+d

Any ePrescribing system that goes beyond simple data entry also needs a database of drugs and their properties. Drug databases in use or under development in the UK to support secondary care currently include the British National Formulary (BNF), the Multilex Drug Data File from First DataBank Europe (FDBE) and Multum's Drug Information. These databases receive regular monthly updates and the time to do this for a live real-time ePrescribing system needs to be planned carefully. Similarly, release alterations also need to be tested for, especially if they are substantial.

Hardware and networking

As well as ePrescribing software, specific computer hardware and networking are also essential parts of ePrescribing. A detailed specification is beyond the scope of this report, and in any case varies with the particular situation and the computers, workstations and networks that are already in place. Below we summarise the key elements of hardware that are needed. This is followed by some detailed descriptions and a discussion presenting some of the issues faced by ePrescribing implementers.

The key elements of technology required as minimum when ePrescribing is planned are as follows:

- **Server computers:** to run the ePrescribing software, store prescriptions data, hold the necessary databases that underpin ePrescribing and as backup.
- **Desk-based computers (sometimes called 'workstations'):** these are needed in all wards, pharmacy departments and other areas where prescribing, administration or review of medication takes place - including potentially off-site. For some tasks only a desk based machine will do.
- **Mobile devices:** most implementations of ePrescribing use mobile devices of some sort to allow tasks to be completed at the patient's bedside. These may include workstations on wheels (WOWs), laptop computers, pen tablets or personal digital assistants (PDAs). Increasingly, specially developed Mobile Clinical Assistant (MCA) devices are being used in a range of clinical systems including electronic prescribing.
- **Networks:** in order to link devices and allow sharing of data a secure and reliable network infrastructure is needed. Where mobile devices are used, a secure and reliable wireless network is essential.
- **Interfaces to other systems:** among the other computer-based information systems that may be interfaced with ePrescribing to send data one way or the other are patient administration systems (PAS), pathology laboratory systems, bed management systems, electronic medical records and pharmacy stock control systems.
- **Back-up systems and devices:** when any part of this technical infrastructure stops working, as it will inevitably do one day, there needs to be an appropriate backup device, or a backup procedure. Thus it is common to have duplicate 'shadow' servers which can be quickly brought into use if one of the main servers fails. Another common practice is to have separate computers and printers on standby holding a recent (perhaps up to 30 minutes old) backup of the patient prescription data. These machines can print out paper charts if it is anticipated that the ePrescribing system is going to be unavailable for any length of time.

Ward based work-stations or mobile devices?

Depending on the clinical setting, ePrescribing systems need to use some appropriate computers in the direct settings in which care is delivered. On a ward, this will usually mean at the bedside for prescribing as well as administration and recording. In outpatients this may mean standard desk based workstations, while other settings such as A&E or ICU will pose their own problems and require their own choices be made as to the appropriate devices to use.



Working at the bedside reading a barcode



Computers at the nurses' station



Working on a tablet pc



Sharing a laptop

Once we move away from the desktop work station, which devices to choose is not straightforward. Consider the possibilities: WOWs, laptops, PDAs, tablet PCs or MCAs?

Most people agree that a truly portable, pocketable device such as a PDA has too small a screen to be able to safely display enough information for most ePrescribing situations, plus the screens may not be 'sharable' if two or more people are engaged in the same task. Laptops, taken alone, are unwieldy to use in a ward situation. Where do you put them down when you move to some other task? There are now available specialist tablet devices such as the MCA which attempt to address some of these problems by allowing for suitable handles and hooks, as well as cleanable keyboards, powerful batteries and a bright screen. Some versions also come with extras such as a bar code reader built in.

However, in most ward situations, 'mobile' means 'on wheels'. And so computers are fixed to a trolley, perhaps the notes trolley or the drug trolley, as a compromise solution. But the ergonomics can easily be very wrong if the trolley is inappropriate in design. Using a keyboard and a mouse or pointing device, as well as viewing a screen, is not best done when bending over. For this reason the choice made is often to use purpose-built WOW stands to hold a computer with the screen, keyboard etc. These can be height adjustable so that an adult standing up can comfortably use them.

WOWs, however, pose their own problems. As mobile battery powered devices, WOWs need to be regularly recharged. The ability of a standard lap top to hold a charge may be frustratingly just short of what is needed for a full day on a ward. One solution that is sometimes used is to have larger more powerful batteries on these trolleys, but in that case they become heavier to move and more bulky. The most significant issue when used in a ward setting is perhaps the extra clutter they represent. Most wards have enough equipment on wheels already, and it is not easy to find room for four more in the corridor, as well as access to sockets to recharge their batteries. These devices also need to be regularly cleaned, and therefore designed to be cleanable.



ePrescribing system operating in the pharmacy



Using an MCA

Another important consideration is the number of computers. How many desk-based workstations and how many mobile devices? Too many may have financial, storage and maintenance implications, but too few may have a negative effect on the users willingness and acceptance of ePrescribing as a whole. What happens when the only MCA or WOW on the ward breaks down? It is a good idea to let nurses and other clinical users trial different styles and numbers of mobile devices to decide what best suits their needs before ordering large quantities. Space is often a determining factor, and the most obvious choice of device in theory may not work out in practice. Likewise, wards or clinics may overestimate the number of devices they need.

Remote work-stations (off ward/off site)

One of the positive aspects of ePrescribing that is often reported is the ability to access prescribing/medicines functions away from the ward setting. A pharmacist can, perhaps, screen patients before a ward visit while still in the pharmacy, or a doctor on call at night can enter/authorize a prescription from another ward or the mess.

Bar codes, bar code readers, bar code printers

Some ePrescribing systems that are in use today make use of barcodes as a means for data entry. For example, if patients have barcodes on their wrist bands, then positive identification is possible at the time of administration. Although this is eminently sensible thing to do, and may help to prevent some errors occurring, bar coded wrist bands are not as yet very commonly integrated with ePrescribing.

Experience of those who have used them is that, in general, they work. The straps themselves survive life on a ward, and the printers and readers that are necessary work too. However, as in most other areas, if such devices are an essential part of an ePrescribing system in use, then there should be backups or spares available all the time.

Radio Frequency Identification (RFID)

In the future a RFID tag may play the same role, allowing a patient to be identified by just passing a wand close to them. However, as yet, we are not aware of any RFID usage in live ePrescribing systems, though they are being piloted for patient identification, and are used to track blood products. See <http://www.connectingforhealth.nhs.uk/systemsandservices/bloodpilot/gs1aidc>.

Wireless networks

One technology that we want to focus on is wireless networks (WiFi). As noted above, almost all whole hospital ePrescribing implementations make use of WiFi to allow mobile devices to be used. The issues of security and safety that such networks raise have generally been solved, and they are in widespread use in hospitals. However, from the sites studied we have found a very common concern with the performance of such networks. In almost all sites that use WiFi the ePrescribing system has gone live only for the hospital to discover that the wireless network is incomplete, has black spots or is liable to crash.

Problems with WiFi performance and coverage can be very disruptive

Two linked problems seem to occur. First, good experience with wired networking may lull people into a false sense of security about the ability of a wireless network to take on more traffic. Wireless networks degrade far more rapidly than wired ones as more devices and more data seek to share their capacity.

The second common problem is that the coverage of WiFi is inadequate, and certain places, perhaps some bed bays on a ward, are not able to locate or maintain a signal. These types of problem can be very disruptive of a successful move to ePrescribing. Indeed one hospital had to take much of its ePrescribing out of use for a period of months while the network inadequacies were identified and fixed. In another, it took a frustratingly long period of time before the IT managers and the responsible contractors agreed that indeed there was a problem. Meanwhile, a debilitating general feeling of frustration built up among the users.

Paper

The last technology that we want to consider is paper. ePrescribing systems are about using less paper, in particular not using a drug chart, but they are not about using no paper at all. Indeed, paper plays a very important role in most ePrescribing implementations.

Four main roles for paper might be found:

The first is as part of the **backup** system. If and when an ePrescribing system fails, then paper will be needed to continue to manage medicines. This may be paper that is printed off by dedicated computers from a backup of the live system. There also needs to be paper available to undertake administration, keep records etc if any part of the system fails. In some sites wards have an emergency box with set of pre-printed forms for use if and when needed.

The second use of paper is as an **adjunct** to the computerised system. For example, most current ePrescribing implementations cannot support the prescribing of warfarin. This requires a paper form to allow for the prescribing of a daily variable dose based on the blood results/INR (international normalised ratio) value. A reference to the paper can be made in the computer, which allows safe prescribing to be undertaken. Another area where printed paper might be an adjunct to ePrescribing would be when a patient is taken to theatre, and a print out of current medications accompanies them.

The third use of paper is as a short term **memory support**. In some ePrescribing implementations, for example, a nurse can 'print off' a patient's medications record as a reminder to undertake some task – perhaps to ensure re-supply of some medicine. Using paper in this way may be controversial in that it seems to undermine the purpose of ePrescribing to banish paper.

The final use of paper is as a means of **reporting results** from ePrescribing. For example, in many situations, medicines records may need to be printed off to be included in a patient's paper file, at least until a full EHR is working alongside ePrescribing. Similarly, all manner of summary and management reporting from ePrescribing will be required on a daily, weekly, monthly and ad hoc basis, and for this usually paper will be the desired final output medium.

Reducing reliance on paper is a valid objective for ePrescribing implementations, but its elimination is probably not. Paper remains a very flexible medium to share information, a useful way to transmit data, and a vital means of providing backup.

Reducing reliance on paper is a valid objective; its elimination is probably not

Looking forward - integrating ePrescribing into infrastructure and practice

Key messages

- Medicines are the commonest form of treatment, and the most expensive part of healthcare after staff costs. ePrescribing can provide comprehensive information about the uses and costs of medicines, and can control and influence the use of medicines. Hence ePrescribing is essential for any provider organisation to thrive in healthcare.
- ePrescribing systems of the future can, potentially, be developed to offer a more integrated medicines supply chain and more real-time monitoring.
- They can equally be developed to provide benefits in a number of areas; to offer more information to patients, for research purposes, for practice review and development, for education and for professional development.
- ePrescribing systems are not, primarily, about increasing efficiency of individual tasks, though they may be able to offer such benefits in time, but they can serve to support the efficient management of medicines and contribute to efficiencies of scale as they become integrated with other systems.
- To the extent that ePrescribing can reduce ADEs and support safety improvements they can potentially generate cost savings.
- Commitment to any given system can have long term negative consequences, for example if you become locked in to a particular supplier, particular hardware, or particular data standards.

Introduction

We conclude this report by considering the bigger picture of ePrescribing and its potential as part of the hospital infrastructure, once it has been established for several years.

There needs to be a vision for where the ePrescribing system fits into the healthcare organisation as a whole. Medicines are the commonest form of treatment and the most expensive part of healthcare after staff costs, which makes their management of more than passing interest. Hospitals with ePrescribing systems also need to appreciate that commitment to any given system can have long term negative consequences, for example if you become locked in to a particular supplier, particular hardware, or particular data standards.

The vision for ePrescribing needs to consider longer term aims

The vision for ePrescribing in strategic terms needs to go beyond the current software and hardware, and the current uses, and consider longer term aims. For example, the original vision of the National Programme for IT was improve the quality and convenience of care by ensuring that those who give and receive care have the right information, at the right time, and to use information technology to directly improve the patient experience and clinical care. The creation of Foundation Trusts and existence of a competitive provider market place means that ePrescribing systems are now more likely to be addressed as part of a process of strategic planning for information systems, and to be evaluated as part of the development of an integrated set of systems.

Taking this wider view, ePrescribing systems can be considered in relation to three key dimensions; safety, quality and efficiency. In the next section we spell out some of the visions for the future of ePrescribing in these terms.

Safety and quality

Safety and quality can be seen as a continuum and so we bring them together here. We not only want to reduce the number of errors in prescribing, dispensing, administering, monitoring and transferring information about medicines, we also want to improve the quality of these processes.

The integration of information systems will be important in achieving this, and must be seen as an important goal. Within the hospital, links to the patient administration and care records systems are important, and to pathology results and ultimately to the Summary Care Record, to support the transmission of information to the GP and community pharmacy.

Thought also needs to be given to linking ePrescribing to other technologies, for example once there is integration with pharmacy dispensing systems, there can be links to robotic dispensers, which could be in the pharmacy, on the ward, or in accident and emergency. There could also be links to 'intelligent' IV pumps and cytotoxic reconstitution machines. The dose provided by an IV pump could be adjusted according to feedback from sensors that measure parameters such as pulse, blood pressure, blood oxygenation etc; indeed, drugs could be prescribed or stopped from such algorithms.

While such systems may sound very futuristic now, even dangerous, there is a great deal of development work going on in these areas. Thinking through the possibilities for ePrescribing systems to migrate into such areas can be an important contribution to assessing the desirability of such a future.

In addition to making systems safer through accurate capture, storage and transfer of information, more can be done by using and relating the information in the system in different ways.

- Identification of any new error types that occur with ePrescribing, together with appropriate remedial action.
- Ongoing monitoring of certain error types, for example by conducting regular 'programmed' missed dose audits and audits of prescribing errors identified by pharmacists. Incident report data cannot be used to assess error rates, but can be useful in identifying new types of error that are reported.
- New drugs can be monitored to see how they are prescribed in practice and, if related to other data, can be monitored for new side effects, and also for the real costs of use. There is great potential for a national database relating this information in large pharmacoepidemiological and pharmaco-economic studies.
- Professional staff can become more involved in improving the safety of their practices. Provided the databases are set up appropriately, it should be relatively easy for professionals to test the accuracy and quality of their actions (prescribing, monitoring etc). For example, an ePrescribing system could be used to identify any patients who have not been prescribed an ACE inhibitor, statin and aspirin following a myocardial infarction, or any surgical patients who have not been prescribed a heparin as thromboprophylaxis. It will also be easier to evaluate new practices for their safety.
- ePrescribing system records can be the basis of training databases for all professions, both as students and as continuing development and specialisation. The ability to review and follow the medicines use process in a large sample of patients could offer the opportunity to improve doctors knowledge of prescribing.
- There may also be potential for patients to use ePrescribing systems to access information on their medication, for example by providing information sheets at the time of discharge, or as follow up.

Efficiency

Staff may well find that working with an ePrescribing system takes longer initially. However, in time increases in efficiency should become more apparent, certainly if the whole task cycle is considered. Extra time on one task will often be outweighed elsewhere on the medicines use process. Such efficiencies are more likely to be realised with systems that are integrated into other hospital systems (pharmacy computer system, patient administration system, etc). There are also economies of learning if systems have common features.

If safety improvements reduce adverse events, potentially substantial cost savings can be made. An important part of managing and developing ePrescribing systems is to carefully collect and analyse data that might support such claims. ePrescribing systems also make it possible to accurately charge for drugs, for example in the case of private patients.

If safety improvements reduce adverse events, potentially substantial cost savings can be made

Conclusions

ePrescribing systems require an ongoing governance strategy. ePrescribing systems need to be constantly monitored and developed for themselves, but they equally need to be managed within the evolving context of broader developments of information systems in and beyond the secondary care setting. Implementation of ePrescribing needs to be about medicines management innovation first, the evolving broader environment of clinical data second, and the technical details last.

Medicines, as noted above, are the commonest form of treatment, and the most expensive part of healthcare after staff costs. ePrescribing can provide comprehensive information about the uses and costs of medicines, and can control and influence the use of medicines. For these reasons ePrescribing is essential for any provider organisation to thrive in healthcare.

Objectives

Original specification from NHS Connecting for Health

The original aim, objectives and outputs from the NHS Connecting for Health work package specification were as follows:

Aim

The ePrescribing programme would like to commission a piece of work that identifies the lessons learnt and how users and culture developed and changed with the implementation of ePrescribing.

The work should focus on sites that have implemented ePrescribing within the NHS (this may include successful implementations as well as those that have failed providing there is insight that can be utilised). Lessons learnt in arenas other than the NHS should also be reviewed and relevant lessons incorporated.

Objectives

There should be particular emphasis identifying and outlining the following objectives:

- Processes undertaken to manage implementation and the scope of the implementation (e.g. whole hospital, specialist clinical, specific process etc).
- How system rollout was managed – the challenges and lessons learnt.
- How behaviour changed and the challenges associated with this.
- How the users and the culture developed and changed.
- Lessons learnt that should be shared and which mistakes to avoid.
- Identifying resources that might be shared.
- Identifying what has not been possible, why and whether these remain aspirations.
- Describing how systems have been used to support the development of practice.
- Identifying benefits that have been realised as result of ePrescribing deployment.

Outputs

The work will form the basis of a toolkit that can be used in a variety of settings to support education and training for the implementation of ePrescribing. Outputs should be produced with this in mind.

The main output will be a detailed report outlining all of the information obtained. There should also be shorter documents produced that highlight the main learning points that can be used as an educational tool for clinical staff and managerial staff. The number and type of these should be determined according to the information obtained and different types of focus that have been highlighted.

Coupled with the written reports there should also be summary PowerPoint presentation(s) produced that can be used to support local implementation activities. These may be supplemented by workshop material if this is felt to be appropriate.

All outputs must be written in a manner that invites reading by front line staff – detailed technical and results driven output is not acceptable. The steering group would expect to review, comment and sign off copy before it is produced in final format.

Study objectives

The objectives of our study were as follows:

- To accumulate and summarise the varied experiences of NHS hospitals as they have implemented various versions and styles of ePrescribing.
- To review the relevant international literature on the implementation of ePrescribing, commenting on the messages that can, and cannot, be extrapolated to the UK.
- To develop a set of short and informative practitioner-facing briefs that address key aspect of ePrescribing.
- To prepare a summary PowerPoint presentation on Implementing ePrescribing.

To validate these outputs by the review of the draft work by a selected international panel of experts.

Benefits of ePrescribing

The web site of NHS Connecting for Health contains the following accounts of ePrescribing, <http://www.connectingforhealth.nhs.uk/eprescribing/benefits>

Over time ePrescribing systems will provide for:

- Computerised entry and management of prescriptions.
- Knowledge support, with immediate access to medicines information, e.g. BNF.
- Decision support, aiding the choice of medicines and other therapies, with alerts such as drug interactions.
- Computerised links between hospital wards/departments and pharmacies.
- Ultimately, links to other elements of patients' individual care records.
- Improvements in existing work processes.
- A robust audit trail for the entire medicines use process.

If ePrescribing systems are developed and implemented effectively, they have the potential to deliver a wide range of benefits, including:

A reduction in the risk of medication errors as a result of several factors, including:

- More legible prescriptions.
- Alerts for contra-indications, allergic reactions and drug interactions.
- Guidance for inexperienced prescribers.

Process improvements as a result of:

- Improved communication between different departments and care settings.
- Reduction in paperwork-related problems, e.g. fewer lost or illegible prescriptions.
- Clearer, and more complete, audit trails of medication administration.
- Improved formulary guidance and management and appropriate reminders within care pathways.
- Computerised links to hospital pharmacies, facilitating quicker supply.

Abbreviations

A&E	Accident and Emergency
ADE	Adverse Drug Event
CDS	Clinical Decision Support
COW	Computer on Wheels (see WOW)
CPOE	Computerised Provider Order Entry
CRS	Care Records Service
EHR	Electronic Health Record
eMAR	Electronic Medication Administration Records
ePrescribing	Electronic Prescribing
EPICAL	Electronic Prescribing Implementation: Challenges and Lessons
EPMA	Electronic Prescribing and Medicines Administration
EMR	Electronic Medical Record
EPS	Electronic Prescription Service
FAQ	Frequently Asked Questions
HCP	Healthcare Professional
IM&T	Information Management and Technology
ICT	Information and Communication Technology
MCA	Mobile Clinical Assistants
NHS CFH	NHS Connecting for Health
PACS	Picture Archiving and Communications System
PAS	Patient Administration System
PDA	Personal Digital Assistant
PN	Parenteral Nutrition
PODs	Patients' Own Drugs
TTO	To Take Out [discharge prescription]
WOW	Workstation on Wheels

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This report can be downloaded from our website at:
www.connectingforhealth.nhs.uk/eprescribing



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