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The fungibility of time in claims of efficiency: the case of making transmission of prescriptions electronic in English general practice

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Abstract

Objectives: This paper presents a study of the effects of the implementation of the NHS Electronic Prescription Service (EPS) on time spent on repeat prescribing in English general practice. EPS is a new network service for the electronic transmission of primary care prescriptions, principally between GP practices and community pharmacies. This service is promoted on the basis of the importance of safe and timely supply of medicines, and the level of medicines use by many patients with treatable chronic conditions. The service is also based on presumptions of significant time-savings and efficiency gains for general practices and GPs. Our objective was to assess the time-related changes (including time savings) conditioned by digital transmission of prescriptions, specifically for repeat prescribing activity in primary care practices.

Methods: As part of the official evaluation of EPS in the English NHS we undertook a qualitative research design with field studies in four of the first GP practices adopting EPS. This research was based on interviews with clinical and administrative staff, and non-participant observation of repeat prescribing related activities.

Results: We found that the use of EPS reduced turnaround time and conditioned changes in the workflow, with time-savings found mainly in relation to administrative tasks. But the use of this technology also created additional tasks and shifted existing tasks and responsibilities. Thus elimination of tasks did not automatically correspond to potential staff savings or cost savings. Tasks that were eliminated and new tasks that were created were not equivalent in terms of time spent, quality of attention required, and roles involved.

Conclusions: The wider claim that healthcare information technology saves time and increases efficiency is often based on assumptions of the fungibility of time and people

– i.e. that units of time added or saved on different steps of the workflow can be summed up as if they were all of the same kind, and thus reveal any net efficiency gain. But workflow time savings involve changes in the quality of tasks, redistribution of work and responsibility that mean that time can hardly be added or subtracted to obtain 'efficiency totals'.

1. Introduction

Time is the "rarest commodity" in healthcare [1]. Information technology is often introduced in healthcare settings with the intentions of "accelerating the speed of work and saving time" [2], the implicit assumption being that time is 'fungible' – i.e. homogeneous and exchangeable.

The intention to save time with health IT is also seen in primary care. Efficiency and time pressure have remained a concern for primary care and GP practices in England from the founding of the National Health Service (NHS) in 1948 to the present day [3]. General practitioners (GPs) in England provide NHS health care services to registered patients, either as single family doctor clinics, or, more frequently, in partnerships with other GPs and other clinical staff. The GPs and their practices (the clinics, also known as GP surgeries) are independent contractors, regulated by a variety of bodies, such as the General Medical Council and since 2013 the Care Quality Commission; the majority of their income derives from the NHS, under a variety of contracts [4]. In this 'cottage industry' [5], concerns for efficiency, workload and time pressure have been in part addressed since the 1970s by the computerisation of patient records (now almost universal in GP practices in England). Thus today the vast majority of prescriptions for medicines are recorded on a computerised patient record and issued through a computer. They are nonetheless then printed out on a standard paper form and carried away by the patient or representative to a high street pharmacy. When compared to handwritten paper based prescribing, the computerisation of prescribing has increased efficiency and legibility and thus safety [6] and enabled primary care to cope with increased numbers of patients and volumes of medicines, not least through the adoption of computerised *repeat prescribing* (explained in Box 1 and Figure 1). The Department of Health has in the past decade pushed for further computerisation across the NHS, with several health IT programmes, one of which was aimed at providing electronic transmission of prescriptions between GP surgeries and pharmacies - the Electronic Prescription Service (EPS) [7, 8] (we summarise the programme in Box 2). Among the claimed benefits of EPS [9] is the saving of time in the workload in GP practices, and therefore implicitly costs for both the GP practices and the NHS.

Box 1 – The repeat prescribing workflow – generic model
The repeat prescribing process starts with the initial consultation with the patient and the identification of the need for a prescription (one or more medicines) to be repeated over a period of time. The repeat of the prescription is authorised by the prescriber, and this authorisation is recorded in the patient record. The authorisation usually comes with a review date and/or the number of authorised repeats. This information is used at the time when the patient (or representative) requests the next issue of the prescription (the next repeat). At this time administrative staff – usually receptionists, or dedicated prescribing clerks – perform an administrative check to verify that the issue can be processed. For each issue of a repeat the workflows unfolds as follows: The patient (or representative) requests the next issue (for specific items or all items); the administrative staff performs the administrative check and processes the request; a new prescription is prepared and forwarded to a doctor though not necessarily the doctor who issued the original prescription. This transfer may be through the practice software EPS module (i.e. a new message in the 'in-box') or on paper. The doctor performs a clinical check and signs (or not) the new prescription (the signature will be physical in the case of paper or electronic for software-based transfer). The signed prescription is then either filed at reception for the patient (or representative) to collect, or in the case of electronic prescriptions using EPS, sent to the central systems (the NHS Spine) for the appropriate pharmacy to download. When administrative staff perform their administrative check they will prepare a new prescription for (digital) signing if the items requested meet all of the following conditions: • all items are in the repeat screen of the patient record (patient is not requesting items that have not been authorised); • the items requested are not requested 'too soon' – i.e. there is no sign of overuse (the 'last

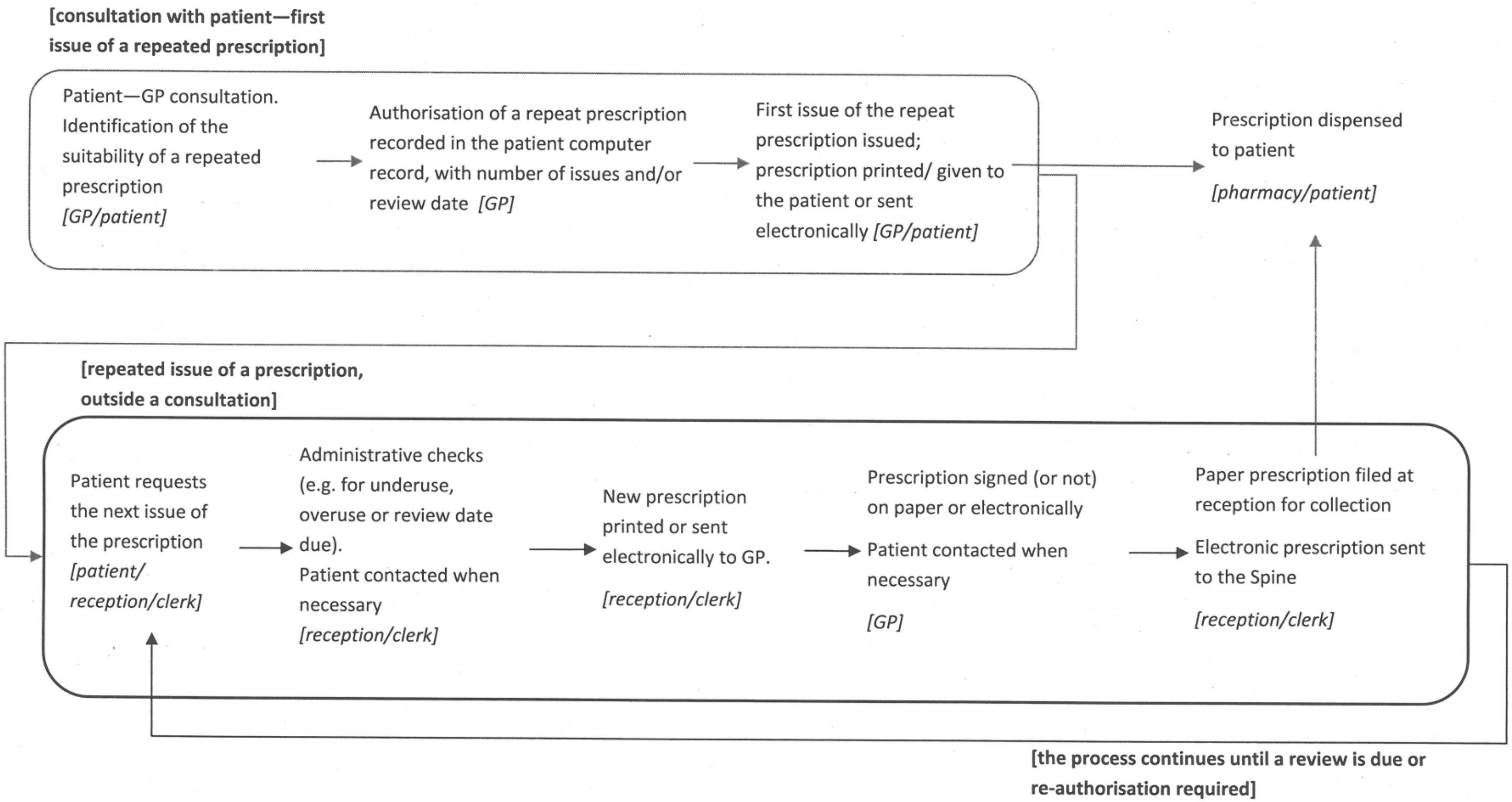
issued' date is not too recent - the date is close to the date for the next prescription as recorded in the system);
• there is no request for change in dosage, or other changes in the prescription as recorded in the system.

When all these conditions are met, the prescription is considered a *routine* or *straightforward* repeat. When any of the items requested does not meet one or more of the conditions above, the request is considered *non-straightforward* or a *query* requiring extra consideration. These type of prescriptions are treated differently in different practices but in general, to respond to the non-straightforward patient request, a doctor will have to check the patient record and/or contact the patient.

Note that in this description we have not included any detail on timing or the detailed organisation and batching of tasks- the focus of our study. For further details on the repeat prescribing process and graphical representations of the workflow, see also [10] and [11].

Figure 1. Overview of repeat prescribing cycle – with printed and electronically transmitted prescriptions

A graphical representation of the repeat prescribing process – from initial consultation to the periodic repeated issue of the prescription. The visualization does not include activities outside the GP practice, such as pharmacy retrieval or use of the prescription – i.e. dispensing and patient medicine use.



Box 2 - Electronic Prescription Service • Release 2 (EPS2)

EPS was part of the English National Programme for IT launched in 2002. It builds on the central IT infrastructure this programme put in place for the English NHS, including:

- A central messaging system and repository called the *Spine*;
- A central *Patient Demographic Service* (PDS) for unique identification of patients
- An *Identity Agent* and the *NHS Choices* repository for identification of NHS service providers (e.g. prescribers and dispensers);
- A standard dictionary called *Dictionary of Medicines and Devices* (DM+D) defining the recognised medicines and medical devices and packs and units [12]. This is used for communication and translation across different dispensing and prescribing software otherwise using different drug formularies. DM+D has been approved by the Information Standards Board for Health and Social Care as the NHS standard for communicating medicines information. For messages to be eligible to be transmitted via EPS, items prescribed must be mapped to DM+D. It is worth noting (e.g. in reference to [13]) that controlled drugs as defined under schedules 1, 2 and 3 of the Misuse of Drugs regulations are outside the scope of EPS and require handwritten signature on printed prescription.

EPS has been implemented over two main releases.

EPS1: The first release of EPS introduced the technical and information governance infrastructure, making use of a modified version of the paper prescription:

- Prescribers and dispensers were provided with smartcards to access the Spine;
- Prescriptions were printed with a barcode which provided a unique identifier for the prescription and when scanned enabled the download of an electronic copy of prescription data from the Spine to the community pharmacy, including demographic data about the patient and information about the source of the prescription.

EPS2: The second release was launched in 2009 and introduced a potentially paperless prescription flow:

- A secure electronic prescriber signature was introduced
- The electronic prescription became the legal entity for dispensing
- Patients were asked to *nominate* a preferred dispenser where the prescription would be downloaded and this choice was recorded on EPS (a process known as *nomination*). This allowed a prescription potentially to arrive before the patient and be pre-dispensed and ready for pick-up.
- Patients can be provided with a printed copy of their prescription, known as a prescription *token.*

EPS functionalities were implemented as updates to existing prescribing and dispensing software. They were developed by software suppliers to meet Connecting For Health (CFH) specifications, and evaluated by CFH for compliance. Software suppliers could independently decide to build a new GP system to offer EPS (rather than as an update to existing systems), as was the case for EMIS that built EPS functionalities as part of completely new GP practice software – EMIS Web. Different software providers implemented EPS solutions with different software interfaces and interaction designs.

EPS2 was introduced in England initially through a series of pilot sites, called *First-of-Type* (FOT): FOT GP practices were paired with FOT pharmacies, the prescribing and dispensing software EPS modules rolled-out and EPS2 prescriptions closely monitored by CFH until satisfied of the safety of the software.

In this paper all references to EPS refer to Release 2 of the Programme. The delivery and architecture of EPS2 is further explained and discussed in [8].

As with other health IT applications, the use of electronic prescribing systems (also known as ePrescribing or CPOE - computerised provider or physician order entry) is often in part justified by their ability to streamline workflows and increase efficiency. The literature on this technology is extensive. A search on OVID Medline database (1996 – 2013 July week 3) combined for electronic prescribing, or CPOE (in its variations), or e-Prescribing, with and without hyphen, in the title and subject heading retrieves more than 1500 records (search performed in July 2013). A systematic review of reviews found 185 publications, each reviewing literature on the outcomes of electronic prescribing implementations [14]). Research has shown the complexities and unintended consequences of implementation [15-17], but there is also a drive to identify measurable and quantifiable impact, e.g. in terms of safety, or cost savings (e.g. [18-20]). Research on ePrescribing in secondary care has used time and motion studies to attempt to demonstrate time saving potential by objective measures (e.g. [21, 22]). However, under the broad label of ePrescribing or CPOE, research can include technology for ordering and recording items (with degrees of decision support), technology for facilitating and recording administration of medicine, as well as studies of the transmission and sharing of prescription data (e.g. [23]). Fewer studies have been carried out in primary care to evaluate ‘second generation electronic prescription technologies’ – i.e. those that network prescribing and dispensing computer systems [24]. Even fewer studies address the computerisation of transmission as their primary objective, and these are mainly focused on the receiving end of the transmission process, in pharmacies, and not specifically on its effects on workload or efficiency of clinical practice [25-27]. Thus the evidence on time-savings and efficiency gains achieved by making the transmission of prescriptions electronic is ambiguous and often incidental, emerging out of studies of computerisation of prescribing in general, rather than specifically of transmission of prescriptions. Among the few evaluations that together with electronic prescribing also cover the transmission of prescriptions electronically to high street pharmacy is a study by Agarwal and colleagues [28], which found that ePrescribing "triggered changes in workflow" in physicians' practices. Abramson *et. al.* [29] found that effects of ePrescribing on hospital-based ambulatory physician workflow and efficiency were mixed and ultimately confusing: for example, electronic transmission was thought of as "tremendously time-saving" but few physicians actually used it. Grossman [30] found that with ePrescribing there were efficiency gains from electronic transmission of prescriptions, though these were limited to those steps that require processing or moving paper and the attempt to streamline repeat prescriptions workflow was "not as consistently successful as new prescription routing" [30]. Problems with computerised transmission of repeats were also encountered in [31].

We carried out an evaluation of EPS, investigating the consequences of its implementation in general practice in terms of time spent on repeat prescribing activities. This focus was chosen because the EPS programme business case was predicated on generating efficiencies and time saving for GPs and their practices for this specific class of prescribing. Repeat prescriptions (also known as repeats, and in other countries as renewals or refills) have been found to take large part of receptionists and clerks working time [32], and some surgeries employ dedicated repeat prescribing clerks in recognition of the scale of the task and volumes of repeats processed every day. Repeat prescribing involves the periodic re-issuing, outside of a consultation, of pre-authorised prescription items intended to be taken for a period of time. Patients may also request the re-issuing of acute prescriptions received in the past but not pre-authorised. This type of request may raise more issues for consideration by the doctor. We have included this type in our comprehensive definition of repeats as ‘prescriptions issued outside of consultation’. We offer a brief description of the repeat prescribing process in Box 1 and our conceptualisation of this in the method section.

Our study took place among some of the first GP practices using EPS and integrating it with their practice software. At the time of our study (2009-2012) the software and the wider infrastructure was still in the testing phase. At the time of writing (summer 2013), the implementation and roll-out of EPS across GPs and pharmacies in England is still in progress.

The paper is structured as follows: in the next section the research methods are described; we then present and discuss the findings from our evaluation in terms of time-savings and changes to workflows, patterns and rhythms of work, both for individuals and the GP practice. We conclude by making explicit the assumption of fungible time that is implicit in expectations that new technology implementations will ‘save time’. Making this assumption explicit should contribute to a reframing of temporal expectations of IT implementations in healthcare, towards expectations for more realistic and complex outcomes.

2. Method

This study investigated the effects of EPS on the time spent on repeat prescribing in general practice, as well as any changes to work practices and staff satisfaction with the system. For the purpose of this research we conceptually subdivided routine repeat prescribing work into 5 steps (with an additional one only as a non-routine occurrence) (Table i). These steps correspond to time-consuming work activities for administrative or clinical staff. It should be noted that wide variation in the detail of how these steps are organised was found in our work as well as in previous studies of

GP practices (e.g. [11]). However, the high level of abstraction of this conceptualisation is sufficient to cover for variations we saw.

Table i. A 5 step repeat prescribing process

A conceptual representation of the routine repeat prescribing work, involving 5 steps: from receipt of a prescription (Rx) request to the filing of the new prescription for collection by the patient or representative. Additional work is required when a new repeat prescription appears to have been 'lost' (a non-routine occurrence).

Step	1. Processing Rx requests on screen (for transmission to printer or GP inbox)	2. Processing of new Rx (paper based, for distribution to GP pigeon-holes)	3. Processing for signing (signing or not signing new Rx as requested)	4. Filing for collection (paper)	5. Collecting	Dealing with a Lost Rx (if needed)
Description	A request for a Rx is received and processed by admin staff. Tasks include: searching patient record; selecting items; adding a query note for the GP to consider; printing or sending by EPS.	The new printed Rx is annotated with messages for the GP (if necessary), possibly stapled, and sorted in appropriate GP in-tray	The GP receives the new Rx (and/or the request) and signs (or not). EPS Rx are sent to the Spine at the time of signing. Paper Rx are passed to reception for filing.	Reception staff files newly signed Rx into filing tray at front desk or in pharmacy collection baskets	Patient or representative collects the Rx	When at step #5 the Rx is not found, a search process takes place within the practice. If the Rx is not found a new one may be issued.

We applied a mixed method approach [33, 34], collecting qualitative and quantitative data. The research methods were applied with some variation in seven GP practices (each identified with a letter – from GPA to GPG), depending on access arrangements agreed locally. Field visits to three of these sites (GPA-GPC) were pilots; the four practices GPD-GPG formed the main research sites and data collected in these sites are the basis for this paper (more information on these 4 GP practices is given in Table ii). A 'recruitment meeting' was first held in each site with clinicians and/or managers, to agree and plan research activities. Researchers then returned on site at the agreed dates. Field visits lasted up to 3 days, with a minimum of 15 working hours spent in each practice. During these field visits two researchers (VL and RH) carried out observations of repeat prescribing activities, timing of administrative staff tasks with stop-watches, semi-structured interviews, distributed specifically designed diary forms (e.g. for doctors to self-report time spent on signing repeat prescriptions) and collected documents for analysis. We interviewed and/or observed a mix of stakeholders: GP practice partners (owners of the business), salaried GPs, nurses, practice managers, information managers, receptionists and other administrative staff (more details provided in Table iii). The GP practices participating in our study were pilot sites at different stages in the adoption of EPS, e.g. using functionalities of electronic transmission for all possible prescriptions, or only for specific straightforward cases. Together with new EPS prescriptions, paper based processing of prescriptions was still in use at all the practices, for example for prescription of controlled drugs (not at present eligible for EPS electronic signature and transmission). The sample of four practices covered three different GP software systems, with different designs for EPS functionalities and use of messaging and inboxes (for the purpose of this paper, we use the term inbox to describe the GP system screen in which the GP sees a list of prescription messages and interacts with these messages to act upon them).

Table ii. – Overview of main research sites at time of visit

Overview of the four First of Type GP practices participating in the study. The practices differed in terms of size, organization and part-time (pt) and full time (ft) staff employed, prescribing system and their implementation and use of EPS. The role of staff is indicated as described by the local practice manager. Titles may differ from practice to practice: a 'coding and scanning' clerk usually refers to the person responsible for opening clinical letters received by the practice, scanning and uploading them to the patient record with appropriate coding. Practices may employ a person to help with reviewing and management of medications ('medicine management' or 'practice pharmacist'). Prescribing is not exclusive prerogative of physicians in England – other roles, including nurses and pharmacists can prescribe (e.g. as independent prescribers, or supplementary prescribers, depending on qualifications). The prescribing systems have been anonymised (trade names replaced with fictitious ones). The time of visit refers to the days of the field study, not the initial recruitment meetings.

Site ID	**Size / N. Patients (approx)**	**Other staff**	**Prescribing System**	**Calendar days EPS in use (at the time of visit)**	**Use of EPS (at the time of visit)**
GPD	12,000	- 5 GP partners - 3 (2f/t + 1pt) salaried GPs - 1 practice manager - 1 information manager (pt) - 8 receptionists (1ft + 7pt) on shifts) - 1 dedicated repeat prescribing person - 3 secretaries (f/t) - 3 admin persons responsible for scanning and coding (pt) - 2 nurse prescribers (ft) - 4 practice nurses (pt) - 3 health care assistants (pt)	Roi	**360** days [Since Nov 2009]	Full use of all EPS available functionalities. Patients receiving EPS prescriptions receive tokens from community pharmacy; GP practice does not print tokens for patients. Repeat Rx requested urgently are printed even if they could go via EPS.
GPE	4,000	- 1 GP partner - 2 (f/t + 1pt) salaried doctors - 1 GP in training - 1 practice manager - 6 receptionists (p/t) - 1 secretary (p/t) - 2 nurse independent prescribers (p/t) - 1 practice nurses (p/t) - 1 Medicine Management person	Theta	**194** days [Since Sept 2010]	EPS not used in case of Rx with queries. A 'note' is sent by e-workflow to GP for all EPS Rx to alert GPs of the electronic nature of the Rx.
GPF	8,500	- 5 GP partners - 1 (pt) salaried doctor - 1 (pt) locum GP - 2 GP in training - 1 practice manager - 1 deputy practice manager - 1 head of receptionists - 7 receptionists (p/t) - 1 secretary (p/t) - 3 (pt/ft) practice nurses (p/t) - 1 Medicine Management persons	Theta	**298** days [Since June 2010	EPS not used in case of Rx with queries. Tokens are printed for all EPS Rx (filed for later use, in case of problems)
GPG	12,000	- 8 GP partners - 1 GP in training - 5 medical students - 4 practice managers (1f/t, 3p/t)	Gamma	**112** days [Since May 2011]	Full use of all EPS available functionalities. In case of Rx 'with updates' needed, reception sends EPS

Site ID	Size / N. Patients (approx)	Other staff	Prescribing System	Calendar days EPS in use (at the time of visit)	Use of EPS (at the time of visit)
		- 10 receptionists (p/t) - 2 secretaries (f/t) - 2 Medicine Management (MM) receptionists (p/t) - 1 Practice Pharmacist (PP) in charge of the Medicine Management Team (MMT) - 6 scanning and coding (p/t) - 3 practice nurses (p/t)			Rx to GP with the addition of electronic notes: one with details of receptionist; one with items that need updating. Manual disabling of EPS mode in case of split Rx.

Table iii. Overview of field studies: research participants' roles and documents collected

The table presents an overview of the visits to the practices: time spent in the practice, roles of staff observed or interviewed, documents collected.

Site ID	Research days/time spent on site (approx) / *Dates* / [Researchers]	People/Roles observed/interviewed	Documents collected
GPD	2h *over 1 day, Sept. 2010* [VL/RH]	- 1 Information Manager - 1 Dedicated prescribing person - 1 Pharmacist	/
	20h *over 3 days Nov 2010* [VL/RH]	- 1 Information Manager - 1 Practice Manager - 1 Dedicated prescribing admin person - 3 Reception staff	- Pharmacy Rx request form - Pink slip for Rx queries - White internal message form - Blue Rx request form (e.g. for reception desk to fill in with patient) - Example of token (showing names of doctor who signed and doctor responsible for Patient)
GPE	2h *1 day, Dec 2010* [RH/TC]	- 1 GP partner - 1 Practice Manager	/
	2h *1 day, Feb 2011* *[RH]*	- 1 GP partner - 1 Practice Manager	/
	15h *over 3 days March 2011* [VL/RH]	- 1 Practice Manager - 1 GP (partner) - 2 GP (salaried) - 1 Prescribing Nurse - 2 Reception staff - 7 Patients	- Rx request form - Repeat dispensing printed message to Patient - Repeat Rx protocol
GPF	2h *1 day, Dec 2010* [RH/TC]	- 1 GP (partner)	/
	1h *1 day, Feb 2011* [VL]	- 3 GP (partner) - 1 Deputy Practice Manager - 1 Head of Reception	/`
	27h *over 3 days March 2011* [VL/RH]	- 2 GP Partners - 1 Deputy Practice Manager - 1 Head of Receptionists - 1 Medicines Management Officer - 1 Prescribing Support Pharmacist Salaried - 5 Patients	- Query slip - review slip - Repeat dispensing card - Non-antibiotics Rx NHS form - Software supplier requested changes list
GPG	1h *1 day, June 2011* [RH/DP]	- 1 GP (partner)	/
	18h 2 days Sept. 2011	- 3 GP partner - 1 GP (registrar) - 1 Practice Pharmacist	- Yellow form for urgent Rx with repeat items for update - Form for (non urgent) Rx with repeat items

	[VL/RH]	- 1 Practice Manager - 2 Receptionists (on repeat prescribing shift) - 1 Receptionist (front desk) - 1 receptionist dedicated to Med Management - Pharmacist	for update - Form for items non on repeat list - Form to Request Repeat Rx - Printed message to attach to documents/letters for scanning, containing Rx requests - Form for informing patients of items not issued - Form for patients on Warfarin medication (to attach to Rx request) - Electronic Prescription protocol - EPS Problems – log

This paper is based principally on the qualitative data deriving from observations and interviews recorded in field notes. All field notes were typed and indexed with qualitative data analysis software (TAMAnalizer). Data analysis was first carried out site-by-site (as case studies) and then with a cross-site thematic analysis. Themes emergent from the data were interpreted and framed within the structure of the steps of the repeat prescribing process in Table i. In the following pages we describe and discuss the themes emerging across the cases.

For ethical reasons data was anonymised and no audio/video recording was used. One exception was one interview with a doctor conducted in conjunction with other research activities, which was audio recorded and transcribed.

The study was part of a wider research project for the evaluation of EPS [8, 35]. The project ‘The Evaluation of the Electronic Prescription Service in Primary Care’ was classed as a service evaluation by the Cambridgeshire I Research Ethics Committee (REC Ref.: 08/H03040/58). Local NHS Research Governance bodies in England were consulted and site recruitment only proceeded with their agreement.

3. Findings

EPS may save time in single administrative tasks

Most of the easily identified potential time-savings deriving from EPS for repeat prescribing pertained to administrative staff work (step #2, #4, #5 and 'lost prescription work', Table iv). EPS eliminated the need to handwrite messages to doctors, sort and staple paper forms, log prescriptions in books. The time spent sorting new prescriptions after printing and dropping them into GPs in-trays was also saved when e-prescriptions were transmitted electronically to the doctor.

Table iv. Potential time savings per different repeat processing steps

Summary of EPS time-saving potential for different roles, at the different steps of the repeat prescribing workflow. In case of 'lost' prescriptions, this includes both the time it takes administrative staff to look for the missing prescription and well as the time for re-processing/signing a new prescription (if necessary), as the process starts again from step #1.

Step	**1. Processing Rx requests on screen (for transmission to printer or GP inbox)**	**2. Processing of new Rx (paper based, for sorting distribution to GP pigeon-hole)**	**3. Processing for signing (signing or not signing new Rx as requested)**	**4. Filing for collection (processing paper)**	**5. Collecting**	**Dealing with a Lost Rx (if needed)**
Role	*Admin*	*Admin*	*GP*	*Admin*	*Admin and Patient/ Representative*	*Admin / GP*
	No major difference in terms of time between processing requests for paper and EPS prescriptions. Some additional tasks in comparison with prior to EPS roll out.	Clear EPS time saving associated with elimination of existing tasks	Time saving depends on a variety of factors: interface design, operating procedures for queries	Clear EPS time saving associated with elimination of existing tasks	Clear EPS time saving associated with elimination of existing tasks	Potential EPS time saving

Potential time savings depended greatly on the nature of the prescription – i.e. being straightforward or not (see Box 1 for the difference between straightforward and non-straightforward repeats). In case of non-straightforward requests receptionists were required to fill in a pre-printed query form with a request for instructions, or would issue the new prescription but complete and attach a query form to alert the doctor. Thus processing non-straightforward repeats without EPS was time consuming, requiring filling in forms and possibly log books, and waiting for a reply. About one third of all prescriptions processed each day were non-straightforward requests. As a receptionist commented:

"This is time consuming, all the writing..." (field notes, R, GPG).

Doctors signing prescriptions

In dealing with *paper* prescriptions, different doctors had different routines even within the same practice: some preferred to sign prescriptions between consultations at agreed times, others left them for the end of the day; some would sign prescriptions at reception while others would take them to the consultation room. Similar differences were found in signing EPS prescriptions. However, some doctors changed their pattern of work when using EPS: while signing paper prescriptions continued to take place in batches at agreed intervals, EPS prescriptions would be signed in between consultations, as they arrived in their inbox:

> *"Electronically I would only sign 2 or 3 in between patients" (field notes, GP, GPG).*

In one practice electronic signing was also possible from home, as GPs were given a secure laptop and remote access to patient records. Working from home made their work more flexible or expandable. The practice manager noted that this would not have been possible without EPS:

> *"GPs can work from home. They couldn't otherwise, [as paper] prescriptions can't leave the practice" (field notes, PM, GPD).*

In general doctors disagreed on whether EPS saved their own time. They also noted that system response time and the upload to the central network (the NHS Spine) affected the time they spent on electronic signing. A doctor explained that signing electronically could take longer than on paper "*because you have to wait once signed that all go through [to the Spine]*" (field notes, GP, GPF). A workaround had been found at this practice to overcome the waiting over the response time – opening the prescribing application again in another window, to keep working while the upload to the Spine took place. This workaround was not observed in other practices and indeed may or may not be available with other software.

Similarly to the effects on administrative tasks, time saving in prescription signing (step #3 – Table iv) depended greatly on the nature of the prescription. For straightforward repeats, the task of signing batches of paper prescriptions was a matter of seconds and unlikely to be made faster by digitalisation. However, in cases of non-straightforward prescriptions, time could be saved with EPS for the doctor if the software enabled easy linking of the digital prescription to the patient record. A query usually required accessing this record and a hyper-link eliminated the task of searching for the patient record. Doctors' expectations in interviews were that EPS would speed up the processing of queries for non-straightforward repeats and stop them needing to handle paperwork:

"I wanted all queries done electronically. Do away with these white slips, will be my dream" (field notes, GP, GPF).

"…the benefit will come when the practice will decide to deal with the queries online [via EPS]" (field notes, GP, GPF).

Additionally, time could be saved when communication back to reception or with the patient (through/at the pharmacy) could be made via the software, or by using pre-set electronic document templates rather than having to handwrite on paper. For example, a GP explained that with EPS he could now type a message to the patient, such as '*your medication is for review, please visit the practice'*. These messages had been pre-set in the system, as templates. He pointed out that:

"It takes a click to put this message on [selected from pre-set template]. While it would take 30 seconds to do it on paper, we have some [pre-printed] stickers but you have to put the sticker on..." (field notes, GPD).

Repeat prescriptions turnaround

Repeat prescriptions were usually intended to be completed and ready for collection within two working days from the receipt of a request. The time of signing was critical in the achievement of this turnaround. With EPS, prescriptions were ready for collection in shorter periods of time if and when they were signed in-between consultations. As a Practice Pharmacist explained:

"they get signed more quickly, you don't have to move [to get the prescription to sign], it gets in the room" (field notes, PP, GPG).

However, as disembodied electronic messages there was also the risk that EPS prescription were 'forgotten' and delayed, and processes had to be put in place to avoid this risk:

"...you have to think of a process that says, right, at the end of the day, somebody needs to check that there are not prescriptions there waiting to be signed. Somebody has to do it. So it's a mindset, really, remembering to do it" (transcript, GP, GPG).

Depending on the GP system in use, electronic prescriptions could appear both under a 'bulk signing tab' and in single doctors' electronic inboxes. GPs could choose to sign on behalf of colleagues by accessing this common 'tab'. This design mapped existing practices around paper prescriptions, when all routine repeats are placed in a common basket for any doctor to sign rather than in personal in-trays or 'pigeon holes' (though this is not a practice we found in all GP surgeries we studied). Using the 'bulk signing tab' added potential for sharing workload and making for a faster turnaround. A doctor recounted how he took on prescription requests that had been sent to colleagues helping them when they were struggling with workload, something he would not do with paper prescriptions:

"I wouldn't go to their pigeon holes to pick up their [paper] prescriptions, otherwise" (field notes, GP, GPD).

Thus EPS in this respect could make the overall process faster, even though it may not save time for all persons involved. In the words of a doctor:

"I am a bit altruistic. EPS is not saving myself time but it is easier for the practice or the patient" (field notes, GP, GPG).

Searching for missing prescriptions

In terms of the last step in the process - looking for lost prescriptions - not all practices experienced a high frequency of prescriptions 'going missing', yet this was usually reported to be a recognised problem. In one practice time-consuming workarounds were devised so as to always keep track of paper prescriptions. It must be noted that prescriptions reported missing were often easily found – they might just have been where they were not supposed to be, still to be signed, already at the pharmacy, or collected by the patient.

EPS prescriptions leave a digital trail and this reduces the time spent searching or re-issuing them when they are lost. Even EPS prescriptions could be reported missing (e.g. as a GP explained, you could have nominated the wrong pharmacy, sent it to the wrong place), but tracking them was potentially faster:

> *"with EPS you always know where a prescription is" (field notes, MM, GPG).*

At one site, the automatic prescription download from the Spine to a local pharmacy was arranged in batches – items on a given prescription would be in different messages, transmitted at different times (not all elements of a given prescription would be in one batch). This increased the frequency of calls from the pharmacy to the practice – having received the first instalment of a prescription the pharmacy would call the practice to report a missing prescription when a next instalment was still in transit. In such cases it was quite fast to find the 'missing' prescriptions, but this system 'feature or bug' meant one had to look more often. From the practice perspective, this was *"time wasting"* and the concern was that with increasing numbers of prescriptions going digital, this would happen more frequently.

Additional tasks post-EPS implementation

Processing *both* paper and EPS prescriptions would take slightly longer post-EPS than prior to EPS, because of the additional interaction with the Patient Demographics Service (PDS) and the risk of split prescriptions.

All the practices' prescribing software would automatically connect to the Spine to check the national PDS record each time a patient record was accessed as part of processing a prescription (whether it was to be issued on paper or electronic). This programmed check of patient demographic data was more or less time consuming in terms of response time and updating, depending on the system and the network speed. We observed this activity taking place regularly in GPF, where the receptionists handling repeats were displayed the PDS record at the time of processing each prescription request and at that point had the opportunity to make updates on screen before undertaking the data entry to issue the repeat.

Not all new prescriptions qualified to be transmitted via EPS, such as in the case of controlled drugs or non-DM+D items. For EPS, it is required that the prescribed items appear in the Dictionary of Medicines and Devices (DM+D) (as explained above in Box 2). In some cases both DM+D and non-DM+D items were prescribed in the same repeat, with the potential for a "split prescription" – partly printed on paper and partly sent via EPS (see Box 3). Some software systems left it to the prescriber to choose how to deal with split prescriptions i.e. either split, or deselect EPS options and print all. The most common view was that split prescriptions should be avoided as they could confuse patients and staff. Time would be spent checking whether all items in a prescription would be sent via EPS or not. As a receptionist explained:

"we are all the time looking and checking" (field notes, R, GPF).

Box 3 – Split Prescriptions
The phenomenon of a *split prescription* occurs when not every medicine listed in the prescription has a corresponding match on the Dictionary of Medicines and Devices (DM+D). Only DM+D mapped items are transmittable to the Spine, leaving the others to be printed. Thus the prescription is potentially split between an electronic and a printed version. Different software suppliers implemented different solutions for this type of event: 1) the prescribing software leaves to the user the choice to either split the prescription (sending by EPS part of the prescription and printing out the remaining items) or print all items; or 2) all items are printed by default, making a split prescription a non-EPS prescription by default.

Additional cognitive load

The repeat prescribing work process also involved greater attention (cognitive load), for both administrative and clinical staff. The following four issues were noted:

1. Avoiding split prescriptions

As mentioned above, receptionists and clinicians had to check if all the items were DM+D mapped, to avoid splitting prescriptions. As a doctor commented, *"They say it's for the person to decide. But this is another thing you have to think about when prescribing. And it is not immediately apparent whether a drug is mapped or not." (field notes, GP, GPE).* When prescribing for prescriptions to be printed on paper, the GP can make use of any item presented by the ePrescribing system, even if not DM+D compliant.

2. Nomination and pharmacy opening hours

With paper prescriptions, when the patient receives a prescription from the doctor, she can take it to any pharmacy that is open at the time. With EPS, clinicians had to keep in mind the possibility that the receiving nominated pharmacy would be closed, such as on Friday afternoon: *"you have to remember to change [to not EPS] so that the patient can collect it… But it is another thing to remember" (field notes, GP, GPE).*

3. 'Being careful' with the system

More generally staff needed to take care in using the system 'correctly'. As a doctor explained to colleagues, "*be careful*" in using EPS screens: *"…there are multiple pharmacies with the same name and different addresses";* the interface provided different ways of cancelling prescriptions, but with different effects on the data recorded in the patient record or the Spine: *"if EPS repeat dispensing prescriptions need to be deleted, always delete them [this way] rather than [another way] …" (field notes, GPG).*

4. Personally administered items

Finally, nurses and doctors prescribing items to be dispensed and administered locally ('personally administered items') had to remember to 'tick off the EPS button' so that the prescription would not be sent to the pharmacy.

Doctors explained how, at the time of signing, while with paper all attention is taken by patient details and items prescribed, when faced with EPS prescription requests, attention must also be paid to these EPS related factors.

Prescriptions cycles and redistribution of work

For each patient, the repeat prescribing process involved a time span longer than that for one repeat prescription issue. Part of the work when processing a repeat was also to check the future stages of this longer process and, if necessary, prepare for the next stage, e.g. the next issue of the prescription, due, for example in a month time. This check and preparation work was usually a responsibility of administrative staff. For example, in one site for any request for a repeat of warfarin (usually a long term medicine), the clerk took care of informing the patient to make sure that blood tests were done before the next request. This saved time when the next request came in, as the GP would then have the results of the blood tests necessary to inform the signing or re-authorisation of the repeat. Such preparatory work saved time in the medium term. However we found that with EPS some of this work was shifted to the GP, and not necessarily carried out. A Practice Pharmacist noted that with EPS they were redistributing this work to the doctors, though she was not sure that the GPs "will do it".

Redistribution of work also occurred in other contexts. For example, in one practice we found that whenever medication reviews were needed, the nurse would take responsibility for informing the patient. However, given the system design of EPS functionalities, sending the EPS prescription for digital signing shifted this work and responsibility from the nurse to the doctor: the nurse was now 'out of the loop' and needed to ask the doctor to add a message to the prescription to inform the patient that a medication review is due.

EPS needs time to set up and time to maintain

Depending on the prescribing software used and the implementation strategy applied, getting ready for EPS required some time consuming activities, with implications for practice staff and potentially associated costs for the organisation. Before each GP practice could 'go live' with EPS, prescribing data in patient records had to be made compatible with the DM+D as far as possible. This data cleaning activity was 'one off', at the start of EPS usage, but it was relatively time consuming (e.g. three weeks in GPD, for one person full time).

Before going live, patients also had to express their wishes in terms of which pharmacy they preferred to use (i.e. 'nominations' had to be entered on the Spine – as explained in Box 2). In the First of Type (FOT) sites such as the ones we studied, general practices did not usually have to acquire and process nominations from patients, as this responsibility was left to the Pharmacy. Other practices (FOT sites but outside our sample) did start taking nominations themselves, and this potentially time consuming activity may become a GP practice responsibility in the future, probably as a new administrative task:

> *"We have not thought how we would [capture nominations]. If it had to be done by the GP, it would be a waste of GP time." (field notes, practice manager, GPD).*

The FOT sites we studied were piloting new functionalities or entirely new systems. At times they suffered slow response time, crashes and freezes, and time had to be invested in investigating and reporting problems. The latter was a task usually assigned to one person in the practice – e.g. the Practice Manager or the Practice Pharmacist. In GPG, initially they had to *"call the help desk every day"*; in GPE after 9 months use, the manager still had the impression to *"have done nothing except"* working on the system. Even in the Pharmacy paired with GPG, it was reported that 'taking care of the system' is an "*all day every day*" activity. A FOT period can be considered a special case. As EPS systems were tested and corrected or redesigned, network speed checked and possibly improved, all stakeholders and users could reasonably expect a reduction in the number of calls needed to the help desk, and generally a more reliable system eventually requiring less time to maintain it:

> *"[EPS] changed 'my' day, I have to call the help desk every day. For doctors, it's too early to know what the impact is. For me it is taking more time since we have been going electronic. But in 6 months' time we hope... If in the long time we have more EPS and only a few paper [prescriptions] then we may have a bigger difference. I expect it would be better. Otherwise why go through all this." (field notes, PP, GPG).*

4. Discussion

The larger practices we visited received hundreds of prescription requests each day. Repeat prescriptions were a constant presence, made tangible by stacks of paper prescriptions on desks and in-trays and – in one case – by dedicated phones ringing non-stop. In the words of a clerk, repeat prescriptions took *"a lot of work"*. In this section we discuss the findings of the effects that EPS had on this workload: potential time savings and changes to patterns and rhythms of work, both for the organisation as a whole, and for the people involved. We also reflect on the assumption implicit in claims of temporal efficiency – that time is fungible.

Time as duration: time savings and time redistribution

Table v gives a summary of the changes in time spent on repeat prescribing activities with the use of EPS. Our study suggests that transmitting the prescription electronically reduces overall turnaround time for repeat prescriptions. But the simple question 'does EPS save time?' requires a nuanced answer and a range of caveats. Computerising the transmission of a prescription will objectively save time for a person or role whenever the use of the technology removes one or more of her tasks from the workflow. On this limited basis, and considering just repeat prescriptions, we see that the use of EPS removes the receptionist' task of printing, annotating, stapling or looking for paper. In other aspects of the process the technology does not remove a task but replaces it, changes it and/or shifts it to a different person. In these cases, the evaluation of any time saving, for either or both the organisation and the people involved, is more complex. It depends on how the task changes, and for whom. Furthermore, as with much organisational innovation based on the use of IT, EPS creates additional tasks and - being used in parallel with the traditional paper-based process – these new tasks are not fully offset by the elimination of paper-related ones. Finally, these effects are all dependent on a variety of contextual sociotechnical factors. Software in use, system response time, organisational arrangements, people interaction needed to ensure safe and timely processing, all have an influence on time spent on the repeat prescribing activity and thus the potential for EPS to increase temporal efficiency.

Table v. Summary table: time-related changes from paper to EPS repeat prescribing

Overview of the potential impact of EPS in terms of time-saving and time-accruing effects. The effects are limited to the repeat prescribing modality; the table does not include EPS related changes in relation to other modalities such as acute prescribing; the table does not include one-off activities (such as data cleaning) necessary for getting EPS ready to work.

Potential time-saving effects	**Description**
Faster repeat prescribing turnaround	Prescriptions can be ready on the same day, or in a few hours, instead of the traditional 48h
Time saved for receptionists/prescribing clerks in their work	Eliminates the task of sorting and filing paper prescriptions, and the task of searching for prescriptions at the time of collection. Eliminates the task of writing prescription transfers details in log-books (e.g. for pharmacy collection) Facilitates the retrieval of prescriptions when these are reported as 'lost', reducing the time it takes to look for them.
Time saved for GP for collecting prescriptions to sign	Eliminates the task of going to administrative office/pigeon-holes to collect prescriptions to sign
Time saved for GP clinical checks in case of prescriptions with queries	Eliminates the task of searching for a patient record as this is hyper-linked to the prescription.
Time saved for patients	Eliminates need to visit the practice to collect the prescription
Potential time-accruing effects	**Description**
Time added to GP signing task	Any task of adding messages for patients that was originally responsibility of the nurse or prescribing clerk is now shifted to the GP
Time added to monitor Spine responses	Time needed to check and if necessary update the patient's PDS record. A time lag exists between the time when messages are sent to the Spine and the time when the system responds with failed-message/error message, if any. It creates an additional task of monitoring responses and if necessary reconcile them with messages (e.g. issuing new prescriptions).
System response time	Network speed connections and system response time can affect those processing and signing tasks that were otherwise done on paper.

We also see that increased temporal efficiency in the repeat process will not necessarily bring a reduction in costs for a practice. For example, eliminating the task of filing prescriptions at reception for patient collection would not enable the practice to do away with a receptionist (reducing labour costs), as this task is usually carried out in multitasking mode while minding the desk and answering the phone. A task shifted from a receptionist's desk to a doctor's screen may save time, but doctors cost more than receptionists.

Unsurprisingly, our research participants disagreed on whether EPS saved time for them. The difference between objective time (quantifiable with a stop-watch) and subjective time (as reported by the person completing the task) has been used in software design as a measure of usability and satisfaction with a system [36]. It is also not a unique finding that perceptions are of savings, while the stop watch reports the opposite [23]. Following Seow [36], it can be argued that whenever users of EPS functionalities perceived the task as more time consuming than using paper, and more time consuming than shown by stop watch, there may be room for improvement in the design of the system. Similarly if perception is of time saved, which the stop watch does not confirm, this may be evidence of other user benefits from the system. In any case, such findings make the narrow fungibility of time a precarious proposition upon which to base an intervention.

Time frequency, patterns, rhythms of work

Computerising the transmission of the paper prescription led, as one would expect, to changes in patterns and rhythms of work. In three of the four practices we visited, green NHS paper prescription forms were omnipresent. They coloured the desks of receptionists and GPs. Prescription work set the rhythm of receptionists' work, and beat the time of their days – busy days and 'catching up' days. Thus paper repeat prescriptions were found to be a form of organisational Zeitgeber – a cue, 'time giver' or 'pacing agent' [37]. Days were divided into time slots dedicated to repeat prescriptions. And these times were entrained [38] with doctors' rhythms organised around consultation slots. Breaks in consultation times became breaks in receptionists processing times, giving opportunities to 'grab a doctor' and get paper prescriptions signed. This entrainment with its physical and shared temporality is not required or sustained with the electronic prescription process - doctors could access the electronic prescription any time and administrative staff could send work to inboxes whenever they needed to. EPS thus affected the organisation of time by releasing constraints.

EPS enabled doctors to 'sign on the go', signing e-prescriptions as they arrived in their electronic inboxes. They alone perhaps were beneficiaries of a fungible time, able to utilise the brief waiting times between consultations to sign single e-prescriptions. For this reason doctors may have perceived greater personal efficiency because they felt they were making use of every minute in their work day. Ticking the prescription off in the inbox is getting work done, while pieces of paper sit on desks among the "*things to do eventually"* (field notes, GP, GPG). What was previously potentially 'dead time' (or thinking time) could now be made productive time - a process known as "intensification" [39].

Signing between consultations can also be seen as a change from monochronic to polychronic work, a shift not unusual in IT implementations [40]. Still, not all doctors signed EPS prescriptions as they arrived in their inbox; some left them to specific times - their preference perhaps being for not changing their otherwise monochronic pattern of work.

Furthermore, when secure remote connection to the system was enabled and authorised, the digital prescription allowed more flexible work for some clinicians.

With GPs able to do this work from home, work and personal time may blur, and the length and intensity of working days change. EPS could then be an example of “work extending technology” [41].

Change in work patterns and locations of work, and the reduced need to visit reception to sign prescriptions, might diminish opportunities for face-to-face communication with administrative staff and those informal but informative exchanges perhaps necessary for a smooth running of a practice. A similar change in communication patterns was encountered in hospitals, when after the introduction of electronic prescriptions there were “fewer opportunities for interaction between staff, and between pharmacist and patient” [23].

Finally, the shift to e-prescriptions made the repeat prescribing work more ‘visible’. A doctor lamented that while his time with patients is ‘visible’ (and recorded) his administrative workload remains usually invisible to the practice. Similarly, in cases of ‘lost’ prescriptions, with EPS the prescription’s location becomes immediately apparent, and there is more data about the actions performed (or not performed). Computerisation makes work visible through the automatic generation of information about the activity in parallel with the carrying out of the activity. Through this process, information technology brings “a deeper level of transparency to activities that had been either partially or completely opaque in the past” [42]. The visibility that EPS brought about for repeat prescribing activity enabled new work practices, such as monitoring, auditing and having a more accurate picture of prescribers’ workload. The visibility of GP repeat prescribing in electronic inboxes led, in one case, to increased sharing of tasks, with GPs helping each other in signing prescriptions when colleagues were struggling to cope with workload. Receptionists could also more easily monitor the state of repeats waiting to be signed.

EPS, time and safety

Depending on a system's design, EPS electronic signing screens may require doctors to open each e-prescription before signing. This may well take longer than bulk-signing a pile of paper prescriptions, though it might give the opportunity to detect and prevent prescribing errors that would go otherwise undetected with paper (the record is seldom accessed by doctors when signing paper prescriptions). Conversely, another system makes scrolling down the list of prescriptions on screen compulsory to be able to sign, but does not require the user to open each patient record. The process may be faster, but, as a GP explained, scrolling down does not necessarily mean "*you have seen them all*".

Furthermore, because electronic prescriptions can be signed fewer at a time, in between consultations (instead of a large number of them in bulk, possibly at reception or during meetings, as happens with paper prescriptions), it could be argued that EPS enables more focused attention on each prescription.

Both the interface design - facilitating access to the record - and the changes in work patterns, could potentially contribute to safer prescribing outcomes. The safety of prescribing in primary care is less well studied than in secondary care settings [43]. A risk inherent in repeat prescribing work is that patients may fail to receive treatment or receive inappropriate, ineffective or dangerous treatment. In repeat prescribing, "There are many opportunities for things to go wrong or for potential 'near misses'" [10] and Dreischulte and colleagues [44] go as far to suggest that primary care prescribing in the UK is so risky that it represents, "a public health threat." The opacity and repetitiveness of the repeat work, the perception of a low level of risk associated with most items seen as 'innocuous', and "the monotony of the mundane" [1] can give doctors (and receptionists) a false sense of security.

Implementation of ePrescribing technology in hospitals has been found on "average" to have a positive impact on safety, though not necessarily leading to a reduction of medication errors [45]. Medication errors in repeat prescribing in primary care may be more difficult to detect and study than prescribing errors in secondary care – for example, because 1) adverse events are only detected when patients end up in hospital instead of returning to the practice (and the practice misses the feedback on prescribing actions); 2) the 'errors' may be connected with the continuation of the prescription, rather than with specific issues of a prescription, requiring a more longitudinal assessment approach. Retrospective case analysis of prescription issued as part of an audit of the GP practice, before and after IT implementation, is an option for study design. However, audits of prescriptions could extend to 'the whole process' – from prescribing to dispensing, from GP practice to pharmacy and, where applicable, hospital settings. Additionally, lab-based user-testing studies of the task of signing prescriptions (with simulated or real tasks) could be carried out to test the comparative safety, albeit out of context, of different interface designs [46].

One of the fundamental assumptions underlying EPS is that time is there to be saved, and that time saved will be directly translated into efficiency and saved costs. In short, it is assumed that "time is money" (as the saying goes) and, as a scarce resource, it must be managed more efficiently (for "saving time is equivalent to making profit" [47]). However when risk or safety is considered, this assumption is too simplistic, for accelerated time could equate to reduced mindfulness – a less nuanced appreciation of context [48] and the working on "automatic pilot" [49]. Safety for patients might thus instead require a slowing down of the activity of repeat prescribing, injecting greater mindfulness – i.e. thoughtful consideration of the problem as opposed to automatic robotic type action. The “unlimited virtues of acceleration” [37] may not apply to a clinical setting – “driving costs at the sacrifice of quality is not a desirable outcome” [50].

Assumption of fungibility of time

A focus on the quantity of time consumed implies assumptions of fungible Newtonian time – every minute being the same, linear and reversible, homogeneous, objective, abstract (and eventually exchangeable with money) [37]. But time is, as we see in this study, always relative. From an individual’s perspective, time perception depends in part on personal values, the cognitive and emotional experience, conscious information processing load [51], the task at hand, or all other activities to be performed in the time. From an organisational perspective, time-savings are relative when assessed along the overall workflow, in terms of output quality, and over a longer time span (e.g. covering a patient’s entire repeat prescription regime). The accounting of savings is also relative to the definition of the unit of the analysis, as boundaries are necessarily set for measurements within the organisational setting (e.g. in terms of tasks) or across settings (e.g. to cover also pharmacy dispensing activity or patients’ use of medicines). As or when a new technology is introduced in support of a set of related tasks, it changes the nature of work and almost inevitably work is redistributed among different people and different roles [52]; new technology changes “the nature and meaning of tasks and work activities, as well as creating new material and cultural practices” [47]. The calculation of ‘savings’ implies the possibility to quantitatively compare (sum and subtract) such differences as if its elements – not just time, but people, work and outcomes - were fungible. Clearly they are not.

Limitations of the study

We are aware of the limitations of our research. Our data greatly depended on the software in use in the research sites, which differed substantially in terms of interface design. The GP practices we studied were pilot (First of Type - FOT) sites, and they were all at different stages in the adoption of EPS –having had it in use, at the time of our research, for varying periods of time. All practices had parallel running of EPS and paper prescriptions, and volume and proportion of EPS prescriptions varied between practices. All practices studied varied greatly in terms of organisation of work and artefacts used for the process of repeat prescribing, and this also affected their use of EPS. For example, two of them used the same software application but in conjunction with different paper artefacts and with different 'organisational workarounds' in putting EPS functionalities into use. The practices had chosen different strategies in adopting EPS, with either a 'big bang' or staged approach – using functionalities of electronic transmission for all possible prescriptions, or only for specific straightforward cases until confident of its functioning for the practice. One of the software systems was completely new to the users, introducing therefore many other changes relating to other aspects of their work, while other sites had familiar software that only required learning the new functionalities related to EPS. One lesson from this research is the difficulty of separating activity impacted by the GP system from that impacted by the EPS functionalities and infrastructure. As we described and discussed in this paper, features (and constraints) in the GPs system can impact time as significantly as the underlying system, and it is hard (perhaps even impossible) to disentangle this.

These limitations to the generalisability of our findings are consistent with the nature of this research – the evaluation of a distributed technology and infrastructure at the early stages of implementation and adoption. Especially when conducted in the field, this kind of research presents specific methodological challenges, which can also constitute barriers for evaluations of this kind to take place. Thus, such studies are relatively infrequent, yet they can inform system development, 'national roll-outs' and give insight into the use of distributed technology and infrastructure in practice.

5. Conclusions

This study provided a unique opportunity to investigate a new distributed system of transmission of prescriptions (EPS), implemented over an existing set of electronic prescribing systems, prescribing norms and practices. We found the arrival of EPS in general practice to have effects on both objective and subjective time, with different effects for administrative and clinical staff. The organisation of the repeat prescribing workflow (structure, processes and people involved), patterns of work (e.g. processing prescriptions serially, in batches, or as they come), infrastructure and software system in use (network speed, system design, and response time), users' familiarity with the software, workarounds and training needs, were all factors that seemed to have an influence.

Greater clock-time savings seemed to be associated with the elimination of paper processes such as stapling and annotating, or locating a prescription. The nature of the prescription – this being a straightforward or non-straightforward repeat – was also found to have an impact on time to complete tasks both on paper and with EPS.

But as single tasks were eliminated or made faster, new tasks were also created, or the nature of work changed (e.g. with more cognitive load required to complete a task with the new system). Patterns and rhythms of work also changed, and tasks were shifted e.g. from administrative to clinical staff. Overall, EPS may reduce working time at certain stages, and increase it in others, with a not necessarily equal redistribution of the savings among clinical and administrative staff. Also the change in the repeat prescribing technology may eventually bring new social practices, resulting in people doing different things, at a different pace, or interacting and communicating differently.

We however contend that future research and implementations should focus on the potential for reducing individual or organisational mindlessness and increasing mindfulness in prescribing practice – rather than focusing on clock time per se.

Given the limitations of our research, our findings may not be representative of the effects EPS will have on GP practices workload in England after national roll-out, full use of EPS functionalities, and once GP practice staff has gained complete familiarity with the system. Still, we believe this research provides a useful analysis of the role of time in the evaluation of early-stage health IT systems implementation. We also believe this initial study offers a useful reminder to system vendors and implementers that technology does not 'save' time but 'changes' time – it is not just a matter of performing the same given tasks faster but of changing nature and distribution of tasks.

Authors' contributions

NB and TC were principal investigators for this work. VL and RH contributed to research design, collected and analysed the data. VL led the writing of this manuscript with co-authors commenting on the paper and revising it critically. All authors had final approval of this manuscript before submission.

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Statement on conflicts of interest

No conflicts of interest to be reported.

Summary table

What Was Already Known on the Topic

1. GP practices distribute the processing of repeat prescriptions amongst staff according to local conventions in order to minimise GP working time.

2. The Electronic Prescription Service is a new system for the electronic transmission of prescriptions (ETP); as of computerisation in general, this system is believed to lead to increased efficiency (i.e. further reductions in time spent on prescriptions)

3. Previous studies of ETP systems have focussed on outcomes in pharmacies, rather than on the consequences for workflow and time in GP practice.

What This Study Added to Our Knowledge

1. Addresses the question as to whether making the transmission of the prescription electronic in primary care leads to saving time in GP practice, and how the organisation and quality of time changes within the practice.

2. Identifies change in the workflow that emerges from the introduction of an electronic transmission system over existing ePrescribing in use in a GP practice, and the consequences of this for the management of prescriptions.

3. Provides evidence that contradicts the assumption of fungible time that is otherwise implicit in expectations of efficiency gains through computerisation.

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