

# Networking Hospital ePrescribing: A Systemic View of Digitalization of Medicines' Use in England

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**Abstract.** Medicine management is at the core of hospital care and digitalization of prescribing and administration of medicines is often the focus of attention of health IT programs. This may be conveyed to the public in terms of the elimination of paper-based drug charts and increased readability of doctors' prescriptions. Based on analysis of documents about hospital medicines supply and use (including systems' implementation) in the UK, in this conceptual paper electronic prescribing and administration are repositioned as only one aspect of an important wider transformation in medicine management in hospital settings, involving, for example, procurement, dispensing, auditing, waste management, research and safety vigilance. Approaching digitalization from a systemic perspective has the potential to uncover the wider implications of this transformation for patients, the organization and the wider health care system.

**Keywords.** ePrescribing, CPOE, innovation, transformational change, value

## 1. Introduction

Since May 2013 the Department of Health in the UK has made available a £260 million 'Safer Hospitals, Safer Wards' fund for hospitals in England to implement ePrescribing and electronic patient records. To this, a further funding of £250 million was later added (the 'Integrated Digital Care Technology' fund) [1]. In total, "over 40 e-prescribing projects were funded. Hospitals at the top of the list for funding included Leeds Teaching Hospital, getting £7.7 million for an integrated health record and e-prescribing project, and Guy's & St Thomas' £3.1 million for an e-prescribing project" [2]. A Nursing Technology Fund was also established "to support nurses, midwives and health visitors" use of technology with the overall aim of delivering "safer, more effective and more efficient care" [3], and included mobile technology to support ePrescribing, administration of medicines and bedside data collection (e.g. at Oxford University Hospitals NHS Trusts and The Whittington Hospital NHS Trust). These are just some of the recent examples of a series of large investments in the digitalization of hospitals' activity.

This short conceptual paper argues that electronic prescribing is only one aspect of an important wider transformation in the supply and use of medicines in hospital

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settings – a move we have referred to as the coming of ‘digital drugs’ [4]. This transformation involves connecting ePrescribing related activities into the wider networks of supply and use of medicines within (and beyond) the hospital; it involves a range of regulatory, technological and organizational innovations and has implications for the delivery and measurement of value both to patients and the organization.

## 2. Methods

This conceptual paper draws its data from documentary analysis. Documents were retrieved online about ePrescribing, hospital drug supply and pharmacy activity. In particular, information was retrieved about Leeds Teaching Hospital NHS Trust (LTHT) which is a local organization where one of the authors (VL) has conducted research in the past years. Among the other documents considered were articles in the trade press, hospital bids, business cases, and implementation documents.

Conceptually the analysis ‘followed the drug’ across a hospital system; mapping the movement of medicines (as material objects and as engaged in events/transactions) and associated information/digital representations. This mapping approach provided a structure for understanding of the wider system of supply and use of therapeutic drugs. The scope of the analysis presented here is limited to the boundaries of a hospital, but this overall approach can be applied on a larger health system/health economy scale.

## 3. Flows and stocks of medicines

Millions of drug items travel through a hospital each year, for millions of patients. In LTHT, for example, “there are over 1.3m patient attendances” each year and practically all patients require medication during their stay [5]. As a financial commitment drug budgets are generally the second largest running expense for a hospital after staffing costs.

Some medicines are obtained in ready-to-use form from manufacturers, and other medicines require preparation before administration. Medicines enter the hospital mainly through supply and procurement processes, which are a pharmacy services responsibility. Some organizations may allow or even encourage patients to bring in hospital their own drugs [6, 7]. A small number of drugs may also enter the hospital through research activity (clinical trials). Most medicines are stocked and handled in the pharmacy – though patients own drugs may be managed on the ward. Generally dedicated teams manage the different phases of procurement and distribution – for example, with a Distribution team, Returns and Recycling team, Stock Replenishment Unit, Procurement team, Store keepers, and Medical Gas Team [8].

Drugs may leave the hospital with in-patients at discharge or with out-patients supplied from the hospital pharmacy; or they may return to pharmacy as and when recycling is allowed in the hospital. Indeed, “the logistics of managing returned unused, unsold or damaged goods back into the supply chain and the associated activities of handling, consolidation and disposal of such products is becoming of increasing interest in reducing costs and maximising efficiencies” [9]. Drugs may have to be disposed of in special bins, and destroyed. The possibility of medicines being lost in the system, or possibly stolen needs to be minimised. Systems need to be put in place for the management of all these flows and the associated stocks.

#### **4. Digital representations and flows of data**

Data about medicine use in hospital may be accessible in individual and aggregate forms as needed by pharmacy staff, clinicians, managers and for investigators, for reviews, audits, and research. Data are also reported to the commissioners (the NHS), and (standard) national reporting requirements will have wider influence on how data is entered, aggregated, analyzed and reported. It should also be noted that data about clinical use (about use of drugs and combined with other patients data) are increasingly used for 'Big Data' research, aimed at identifying new therapies or making old therapies work better for certain patient profiles – an emerging practice known as personalised or precision medicine [10]. The influence that the movement to Big Data services will have on the wider digitalization of drugs in hospital settings is as yet unclear but many have identified the start of a shift of focus in health informatics towards the needs of stronger 'data analytics'.

For any and all of these purposes, data about the clinical use of drugs captured through Electronic Prescribing and Medicine Administration systems (ePMA) operating on the wards will need to be integrated with hospital eProcurement systems, data from system(s) for stock control and dispensing, and safety reporting systems for the identification, reporting and investigation of drugs related errors. However, supply chain, pharmacy and clinical systems may not integrate easily, in part because of how drugs are represented in each type of system. For example in timed doses for clinical use, in pack form for dispensing, and in other aggregates for stock management use. In each case the 'attributes' associated to a drug record will be different – for example manufacturer may be important in dispensing (for pharmacovigilance), but less so in (generic) prescribing.

Standardization in these areas can help integration, but this may pull in different directions. The future implementation and use of GS1 standards for identification and tracking of medicinal products in the supply chain with Global Trader ID numbers may facilitate data integration for the hospital with the wider pharma industry and NHS supply networks, but may be less efficacious within the hospital and in clinical domains.

#### **5. Decision support for clinical use of therapeutic drugs and its wider implications**

The main benefits deriving from use of ePMA systems often lie with the embedded decision support functionalities – the benefits being mainly in terms of patient safety and prevention of errors. However, the inclusion of hospital formulary and guidance (decision support) in ePMA modules is also a factor in achieving organizational benefits, such as savings in the hospital drug budget, through increased control over what is used in the hospital at the time of prescribing, dispensing and/or administration and through increased transparency of the fungibility of drugs (generics vs branded medicines). It may also serve other objectives such as implementation of infection control (anti-microbials) and local antibiotic policies.

Benefits listed in hospitals' business plans are often valued in monetary terms. In the case of LTH, for example, up to £1.33 million a year including improvements to medicines management processes (eliminating waste and loss of inventory), real time information on use of antimicrobials (enabling targeted reduction in antimicrobial expenditure), fewer inappropriate prescriptions and greater consistency of prescribing

through prescribing to protocols [11]. A system supplier estimated that by improving antibiotic prescribing, an ePMA system (with decision support) can “help reduce the incidence of hospital acquired infection. [...] [and] could result in a 10 per cent reduction in the number of MRSA or C.difficile cases” [2].

Savings from the elimination of paper prescription charts (reduction in stationery costs) contributes about 3% of these total yearly savings (£41k).

## 6. Discussion and conclusion

The digitalization of the activities of prescribing and administration of medicines with ePrescribing systems are often the focus of attention of national implementation projects, and conveyed to the public in terms of the elimination of paper drug charts. For example, the large funds made available in England for the implementation of electronic prescribing in hospitals were justified in terms of the ‘modernization’ of ‘traditional’ paper based prescribing and eliminating the risks associated with handwritten prescriptions. The funds were to be used to “replace outdated paper-based systems for patient notes and prescriptions” [2] within a more general drive for the entire NHS to go paperless by 2018.

However, through an analysis of the movement of drugs within a hospital context, a more complex set of network(s) of supply and use of drugs becomes apparent, associated with a range of existing or emerging digital systems, covering a variety of activities: procurement, stock control, dispensing, auditing, ordering, prescribing, reviewing, disposal, recycling, administration, safety vigilance. Transformation is occurring across these areas, involving regulatory, technological and organizational innovations.

This digitalization of supply networks in hospitals is occurring against the background of two sets of initiatives proposed respectively by the Department of Health (DH) and the European Union. In the case of DH, attention has been given to new models of procurement, through its e-Procurement program, and initiatives to better understand activity through the tracking of patients, therapeutic drugs use, devices as well as the other products and substances that are part of the delivery of patient outcomes [12]. In this work it is proposed that coding of the artefacts and participants in the delivery of healthcare is based around global and not health specific GS1 communication standards, which define standards for the creation, use and sharing of machine-readable coding. This initiative is also associated with the EU Falsified Medicines Directive (FMD) for the implementation of which machine-readable coding and tracking of drugs are expected to become an integral part of service provision within the NHS over the next five years.

This complex sets of digitalization initiatives around the procurement, supply and use of drugs has implications for the delivery and measurement of value deriving from IT implementations, looking beyond efficiency savings in general or ‘going paperless’ in particular. For the patient, real time data, more/greater range of data and decision support should facilitate a more accurate tailoring of the therapy to the patient profile, needs and response. Digitalization can add value for the patient by shortening the time for the often empirical (trial and error) approach in drug therapies. But reduced time for a more effective therapy also has implications for value at the organisational level – e.g. reduce costs for a given tariff. Beyond the patient and the organization, better use of medicines has also an impact at health care system level, as evident in the case of

antibiotics and the problem of antibiotic resistance (effective use of antibiotics represent a “shared societal benefit” [13]). We argue that approaching digitalization from a systemic perspective can contribute to identifying the wider ramifications of the consequent transformations. In this we subscribe to the definition of medicines management provided by the Audit Commission:

*“Medicines management in hospitals encompasses the entire way that medicines are selected, procured, delivered, prescribed, administered and reviewed to optimise the contribution that medicines make to producing informed and desired outcomes of patient care” [14][p5].*

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