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Abstract

This paper is about the enduring challenge of establishing a hospital discharge process that will supply the right medicines to patients as they leave hospital to use when they return home. The paper is written in a 'documentary genre', chosen to show rather than tell. We want to show how sociotechnical this quotidian task is. More broadly, this gives insight on how 21st century healthcare continues to present fundamental sociotechnical challenges, how we slowly chip away at these, and reconfigure in the context of systems use and as digital technologies become more deeply embedded in contexts of care. We hope to show what sociotechnical means in everyday practice, how healthcare work is 'people heavy' and how it spills out of its digital confines into different artefacts, physical places and timelines. Layers of digital innovation enter into and sediment in organizations, and reshape infrastructures, posing questions about the limits of sociotechnical ideas in the face of real life. The paper is based on three ethnographic studies conducted in England (UK) over six years.

Keywords: Healthcare Information Systems, Workflow, CSCW, Sociotechnical Systems.

1 Introducing the discharge in action, beginning from the end

A hospital in the North of England. It's almost 5pm. A nurse is finishing her shift in the elderly care ward. I am standing by at the nursing station, now relatively quiet. I have been here for a few long hours as a non-participant researcher, the kind that "just sits and watches and records everything you're doing", to then figure out how to improve the system (Hutchins, 1995, p.23).

The nurse's last job for the day is to finalise a patient's discharge medications so that she can go home – they both can go home, the nurse and the patient. Part of the final steps for discharge is gathering and checking the medications the patient will take home (known as the To Take Away, or To Take Out medicines – TTAs or TTOs). In England, after hospitalisation a patient takes home with them up to a month's supply of prescribed drugs, to facilitate adherence and continuity of treatment. This hospital still uses paper based drug charts during hospitalisation but has a digital system to produce an electronic discharge note (a system referred to here as ED-2, as we will later meet the earlier system ED-1 and the later ED-3, see Figure 1). ED-2 records and sends the medical discharge summary to the patient's General Practitioner (the GP, the family doctor) including the TTA list. The GP will then provide follow-on care including repeat prescriptions (refills).

The nurse is sitting at the nursing station, in front of the only desktop computer. She has alongside the keyboard a very large transparent plastic bag, recently arrived from the hospital pharmacy, full of boxes of medicines for the patient. The bag is so full that it can hardly be closed. In order to finalise the

discharge, she has to verify the content of the bag – that it is correct and contains all that is prescribed, i.e. that the right patient is being given the right drugs in the right dose at this right time – the 'four rights'. This task requires matching the content of the bag (boxes and bottles) to the patient's (paper based) drug chart and to the TTA list on ED-2, showing on screen. The drug chart is in the form of a booklet of several pages which have to be turned over to find the right entry for each specific medicine; on screen the TTA is presented as a long list that needs to be scrolled up and down. The items on the drug chart are written in a different order from those on the TTA, the drugs in the bag are all mixed-up and the names on the boxes may not be exactly the names in the drug chart (e.g. drugs proprietary names differ from generic names). Matching-up the three is difficult. It would be easy to miss an item.

To facilitate this as a spatio-cognitive task (Bång and Timpka, 2003), to distribute the cognition, the nurse takes all the boxes out of the bag – each is checked against drug chart and TTA list and placed back in the bag if correct. She is working on the little available space on the nursing station desk that is of course full of other artefacts. She looks for the right box of medication in correspondence with the ED-2 screen, and then checks against the drug chart – once checked, it goes in the bag; and then on to the next one. It takes time, and she keeps being interrupted.

Now someone rings up with a question about another patient. To answer it she has to go to the doctors' office. She can't leave the drugs unattended on the desk – among them is a controlled drug (opioids). Will she repack everything and start again? Will she or the patient ever go home. There is no-one else around at this time but me. She takes her chance: asks me to 'watch them with my life', and so I do.

The nurse returns, and finally, when she is almost finished, she finds that one of the drugs does not match – it seems to be missing. At this time in the afternoon the hospital pharmacy is closed for routine business so this could mean delaying the discharge and the patient will not go home today. This would have clinical and administrative implications, affecting this patient's experience, patient flow, and effective use of bed capacity. She asks a doctor who is passing by. Apparently one of the drugs has been discontinued (the patient no longer takes it): it will be reviewed by the GP, but the doctors had 'forgotten to say', or the pharmacists; anyway it was not clear from all the charts, and the nurse didn't know.

She finally packs all items in the bag and quickly moves out of the nursing station to go to speak with the patient. The bag is so full that a box falls out on the desk. She does not see it. So I tell her.

1.1   Policy and incentives

The nurse's task depicted in the field notes recounted above is an activity recommended in medicine reconciliation interventions to improve patient safety (Mueller et al. 2012). ED-2 is one of many electronic discharge systems implemented in England as a result of a Department of Health policy and a new standard contract for NHS funded hospitals (CQC, 2009). This required hospitals to deliver discharge letters to primary care and community settings more promptly, or risk incurring financial penalties. The targets established were the transfer of discharge notifications within 72h by March 2009 and 24h after 1st April 2010 (HSJ, 2009). It was generally agreed that only a digital transmission would enable meeting the 24h target, so NHS hospitals across England sped up their implementation of electronic discharge systems after 2008.
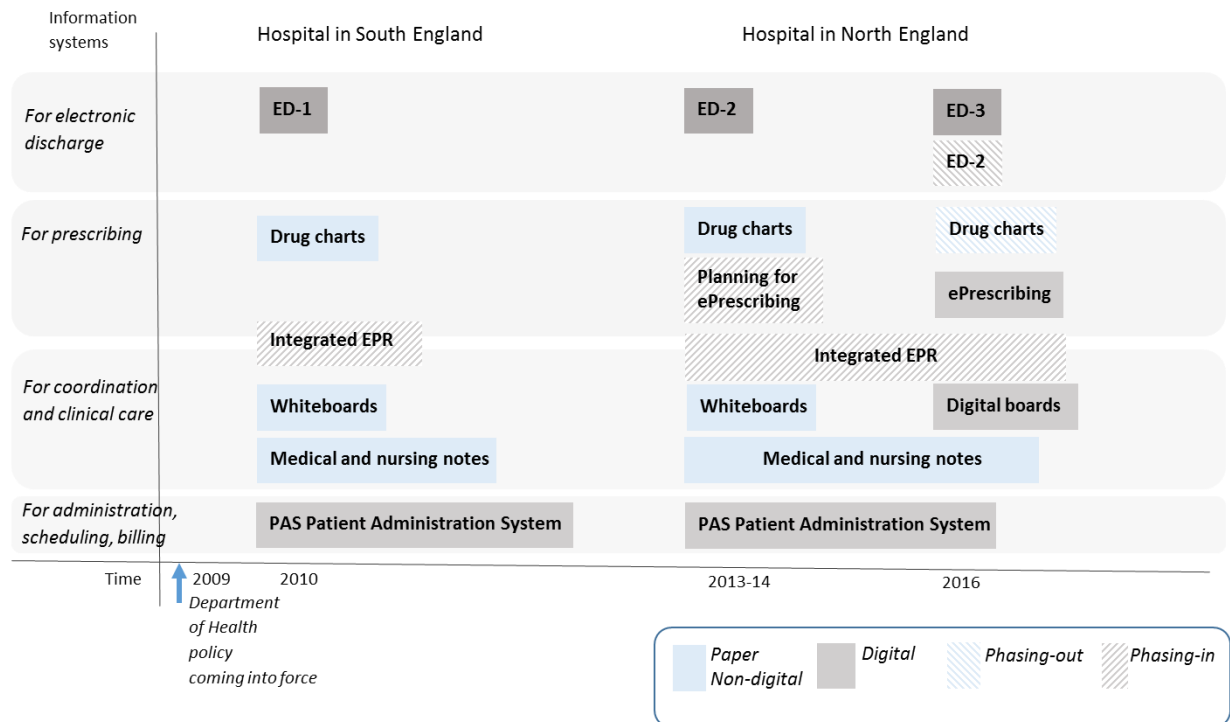
Figure 1.   The background story: three discharge systems, in two places, at three different times, with two evolving infrastructures.

2   Workflow

Another hospital in the South of England, four years earlier. In this hospital an information system already used for the transmission of pathology tests results is chosen for the electronic transfer of discharge notifications (again part of an early response to the national policy). One of the benefits mentioned for re-using this system is that it is "*tried and tested in GP surgeries, who already have a process on how to deal with them when they arrive*" (IT manager, field notes 2010). Still, some GPs do complain that if the discharge is received electronically they may not know – they may not be alerted of its arrival. The IT manager also explains this IT project (the discharge transfer) is "*fraught with difficulties*" because discharges are transmitted not only to GP systems but also to others, such as nursing homes that may or may not have appropriate systems in place to receive them.

The hospital already has in their patient administration system (PAS) a module for 'clinic letters', and the IT team initially tried to use this for the purpose of electronic discharges. However, the clinic letters in PAS did not have an embedded workflow facility for preparing and authorising TTAs i.e. structuring how the doctor enters the prescription, passes it to the pharmacist who has rights for approval/sign off and then passes to dispensing and on to the ward and the patient who is going home and their GP. As the IT manager explains: "*Without an electronic workflow we couldn't guarantee the process*", they could only make recommendations hoping doctors, and pharmacists would follow them and that would not be reliable enough. So the hospital decided instead to purchase an off-the shelf standalone product, although "*it's another system outside PAS*" and went counter to their overall IS (information systems) strategy of having all systems integrated. He also noted that it may imply moving other letters from PAS to this new system which we call ED-1, to have all letters in one place, and "*then you can transfer them electronically to all that need to see them.*"

Once the ED-1 software solution had been selected and purchased, the hospital had to undergo a complex process of standardisation of the existing discharge letters formats, as a prerequisite for the customisation of the discharge software application to their requirements. The hospital discovered that it

had 20 different paper discharge forms in use, and different clinical units had to agree on a common format. The process of standardisation was "*the bulk of the work*" in the implementation and required "*change management, influence and persuasion*" (IT manager).

As indicated above, the timing of the ED-1 implementation, and the decision to go for new software and a stand-apart system, had been in response to the DoH deadlines. But the IT manager suggested that ideally it should have been implemented "*after ePrescribing*" so as to enable TTA items data to be automatically populated from this system. Junior doctors copying prescriptions from paper charts to ED-1, part of the discharge process at the time, was seen as clearly inefficient, unsafe double data entry. Yet, at the time the hospital calculated the economic benefit of ED-1 and electronic transfer of discharges to be about £120,000 a year (the cost of human resources, postage, paper), against a one-off cost of about £40.000, making for a good business case and ROI (on the business case of e-discharge, see for example Mourad et al. (2011)). Indeed further benefits could be envisaged beyond the organisation in so far as the use of ED-1 could benefit patients and the entire health economy[1], for example: overcoming the problem of poor handwriting would improve communication between all stakeholders, including patients who are given a copy of the discharge letter. GPs, at least in principle, would not have to scan-in paper versions to add the letters to their electronic patient records – which was for over a decade the standard practice in England as a largely computerised primary care sector interacted with an often paper based secondary care sector.

3   The writing's on the wall

The making and transmission of the electronic discharge note is not, or not yet, an integrated automated and essentially technical/digital procedure. In the case of both ED-1 and ED-2 there is a large element of the discharge that is in the hands of people, enacted by them in space and time, as specific tasks (such as transcribing, checking and validating), as communication, and as managed and quality assured workflow. After ED-1 roll-out, a reminder was posted on the walls of the hospital's wards:

> *Communication is the key:*
>
> *[ED-1] only replaces the triplicate discharge summary. It doesn't replace communication – all communication processes that are in place, stay.*
>
> *So DOCTORS tell nursing staff you have written a TTA, NURSES tell pharmacy when TTA is written and ask if the drug chart is needed. Pharmacy tells ward when TTA is ready or if there is a query. (field notes, 2010)*

Back in the hospital in the North of England, with ED-2 in use, I ask a nurse how it is going. She answers, "*yes, but it's not all electronic, because you have to tell the pharmacist…*" plus, she said, only half of the recipients receive it electronically, and the other half "*you have to fax it*".

So, despite the workflow management present in ED-2, with limited automating of this distributed process and information transfer, direct communication between healthcare professionals remains crucial for achieving timely and safe discharge of patients (Coiera, 2000). In her ward, another poster explains the meaning of the *tabs* in ED-2 and how it is meant to support the transfer of the discharge-note-in-progress along the distributed work pathway (Table 1).

---

[1] "A health economy is a designated geographic area containing multiple healthcare organisations that between them have numerous financial and clinical interactions" (Monitor, 2014).

[Electronic Discharge System - ED-2] Status Change
[in progress] [completed by prescriber] [validated by pharmacy] [being dispensed] [released from pharmacy] [discharged]
The [ED-2] status is set IN PROGRESS when the first discharge drug is added by the prescriber
When the prescriber selects the SEND TO PHARMACY button the [ED-2] status changes to COMPLETED BY PRESCRIBER
This is an indicator for the Pharmacist to start the validation process
When the pharmacist has finished the clinical validation of the [ED-2] and selects VALIDATE ALL button the status is set to VALIDATED BY PHARMACY. This is an indicator for the pharmacy technician to start the dispensing process
To start the dispensing process the pharmacy technician has to select the START DISPENSING button which sets the status to BEING DISPENSED
At the end of the dispensing process, when the quantities dispensed and the accuracy check are done on the system the pharmacy technician selects RELEASE FROM PHARMACY button which sets the status to RELEASED FROM PHARMACY
Finally when the nursing checks have been done and the [ED-2] is printed off the status is set to DISCHARGED

Table 1.   *A4 Poster as seen in the hospital ward during the study. Below this there was another poster with swim-lanes – one for each of the roles and their tasks: prescriber, pharmacist, pharmacy technician and discharge nurse*

3.1   White-boards and digital boards

Same hospital in the North, same year. Another day. The nurses, a pharmacist, a doctor, are standing in front of a whiteboard, placed in full view in the corridor at the nursing station. They are talking about the patients who are getting ready for discharge, including what is happening with their notes and their TTA medicines on ED-2. Discharge planning "*is in full swing*". The whiteboard on its part tells them 'where we are with discharge today', what needs to be done, which doctors the nurses need to 'nudge' next.

There are patients leaving today, and others getting ready for the week after; one should have gone home yesterday, and yet her TTA is still to be completed (Table 2). In doing this planning the discharge notes on ED-2 must be anticipated in advance, especially over the weekend. If discharge notes are completed the day before discharge, the patient can be discharged in the morning rather than the afternoon, and this is believed to make 'a major impact' on admissions and management of bed capacity. It is also believed to be good for patient morale. Here another patient is medically fit to leave the hospital but needs intermediate care in the community; she is waiting for a bed there. The board is a small one, compared to the ones doctors use to plan care on the ward. "*I don't have enough board!*", the nurse exclaims at one point when trying to add another patient.

Back to the same hospital in the North for another research project, about 2 years after. The same nurse met 2 years previously checking and packing medicines, again comments on this electronic discharge system: "*Nothing electronic about it! It's totally people heavy*", and she goes on to explain: *[…] it is people heavy because, it's stop-start, stop-start. I don't [just] electronically send it to you, you [as a pharmacist] have a massive [list of discharge notes] to check […], that you've got verified [sent to you] by a doctor, you don't know which order to do it. You have to wait for the wards to tell you the priority order in which to do it, because you don't know whether something's been written [but] the patient is not going home for two days. Or 'come on we need the bed in half an hour', that sort of thing.*" (transcript)

From her perspective the discharge process is intricately related to the managements of beds, the process of prioritising patients for discharge and thus managing admissions. This is inherent to being in control of the workflow and being aware of the status of each discharge event including the discharge note.

Name	Expected discharge date (EDD)	[ED-2] authorised by the doctor	Pharmacist validated	Location: Pharmacy or Ward
[patient name]	11/7 [today]	✓	✓	Pharmacy
[patient name]	11/7	✓	✓	Pharmacy
[patient name]	15/7 Monday	✓	✓	Pharmacy
[patient name]	11/7	✓	✓	Pharmacy
[patient name]	12/7 Friday	✓		
[patient name]	11/7	✓	✓	Pharmacy

Name	Expected discharge date (EDD)	[ED-2] authorised by the doctor	Pharmacist validated	Location: Pharmacy or Ward
[patient name]	18/7 [yesterday]	To do		
[patient name]	19/7 [today]	✓	✓	Pharmacy
[patient name]	19/7 [today]	✓	✓	Pharmacy
[patient name]		✓		On ward CD
[patient name]	21/7			
[patient name]	FT TBC	To do / anticipatory		

Name	Expected discharge date (EDD)	[ED-2] authorised by the doctor	Pharmacist validated	Location: Pharmacy or Ward
[patient name]	When ICC date	✓ + CDs		
[patient name]	7/8	✓	Pharmacy aware	

Table 2 (a-b-c). A1 whiteboard (59.4 x 84.1cm or 23.4 x 33.1inches) as seen in the hospital ward, with details of patients over three different days and the status of the TTA on ED-2.
CD = controlled drug (opioids); ICC = intermediate care coordinator

At this time, in another ward in the same hospital, I am introduced to their new ePrescribing system. One of its great benefits I am told is its integration with a *digital* whiteboard – a replacement for the 'home made' one at the nurses station. ED-2 is being replaced by a new system for producing electronic discharge notes (ED-3) that is integrated with the newly established ePrescribing. The big digital board, with space for all patients on the ward, shows who is getting ready for discharge and where their TTAs are. Crucially, this can also be accessed by Pharmacy staff at the time of prioritising which TTA to prepare for dispensing.

> *I think actually without this integration and without the notion of the [digital] white boards and the task list, I think the whole thing wouldn't hold together, hang together quite so well. So, essentially we can use, we have access to a number of different sources that are connected together which help us to determine what our priorities are for a ward, which I think is really important, it's like a jigsaw puzzle that is fitting together. (pharmacist IT, transcript)*

4   Accounting, history and reconciliation: a dream of medicines' automated links

The work for the implementation of this new ePrescribing system had begun a few years earlier. We can go back to my first visit to the Hospital in the North. The medical consultant is telling me she is involved in the evaluation and selection of the ePrescribing system, to do away with paper drug charts during a patient stay. It will be an EPMA system –electronic prescribing *and* medicine administration. "*It must launch through our electronic patient record portal and it must speak to whatever we're using for our electronic discharge summaries because… If it doesn't I'm resigning. Because it's not going out with my name on, unless it does both those things, because to me why would you introduce a system that doesn't immediately join-up in the way it should? We'll probably have to have compromises, like to re-enter your password or something like that, because of IT issues, but I can live with compromises but I absolutely won't allow it out unless it speaks to our discharge*".

The consultant has a vision of linked up systems and flowing data that will fit into the hospital context of use. She also knows that technology ('IT issues') won't altogether cooperate…

"*[…] ultimately [ıt] will pull the drugs in from the GP surgery, it won't do that yet, none of them [the systems available] can do that at the moment but the idea will be it's much, much safer, […] the drugs come in automatically, we look at them and go 'yeah, carry on with that, carry on with that, oh no, stop that for three days because of this, ooh definitely stop that altogether and I want to add this one', bingo: there's your chart and then at the end [of the patient stay in hospital] that, that, that, not that for outpatients and off you go. […] and then the absolute Holy Grail is that then updates itself on the GP system*".

She is referring to the work of working out at the time of admission what medicines a patient is currently taking (a primary form of medicine reconciliation), then deciding which ones to continue or stop during a hospital stay, and whether then to start them again, or add new ones to take after discharge, and then tell the GP and the GP's patient record of all the changes. At the point of making the discharge note, all the history of what has been paused, stopped, changed, or continued, and what has been given in the bag of TTA medicines, should all be accounted for and communicated to the GP. There's reconciliation at the start, when the patient arrives in hospital, and reconciliation at the end, when the patient leaves. If you used the same system for prescribing and discharge notes, then it should be logical to be able to allow drug items to flow from one step to the next, one status (stopped, started) to another.

When two years later I return to the hospital, I find that some of this vision seems actually to have been achieved:

… that process has become better with [ePrescribing and ED-3] because you have the medicines on admission from one screen, medicines that they're on now from another screen, and the medicines they want to go home on, you know, they just click to choose them and then there's a function where it's called Discharge Reconciliation and then it pulls up a screen and it tells you, you know, from the discharge medicines have they just been continued, and how they relate to those other things, so it'll then tell you all the medicines from admission that are still on there, or all the medicines that are on the inpatient drug chart that haven't made it to the discharge, so it's that comparison, which […] takes a bit of time and is often done badly, becomes more straightforward, has become better with this system. (Ward pharmacist, transcript)

Still, the way that doctors use the system does not always fit with the work-as-imagined (Blandford, Furniss and Vincent, 2014), or the underlying workflow management model embodied in the system (Figure 2). The ward pharmacist again:

'in order for the system to recognise the differences between the screens <u>you</u> have to make that link, so, if say for example somebody's on Paracetamol 100mg four times a day on admission, and the doctor's prescribed it on their inpatient charts, but <u>hasn't</u> populated the admission bit, if you [as a pharmacist] come along, ..there's two ways of populating that medicines on admission, you can either copy

it back from their inpatient drug chart and then obviously the computer will be able to tell you, yes that Paracetamol has been continued, but if you don't do that, you come along and populate the medicines on admission as a <u>separate</u> prescription [and] enter Paracetamol – even though you [then] have] Paracetamol on medicines admissions, [and] Paracetamol on the regular drugs during [hospitalisation], the system [...] treats them as two different prescriptions [...] so then when you come to the discharge [...] there'll be a section that says, 'Drugs started Paracetamol, drugs stopped Paracetamol,' because [...] the medicines on admission hasn't made it to the discharge. (ward pharmacist, transcript)
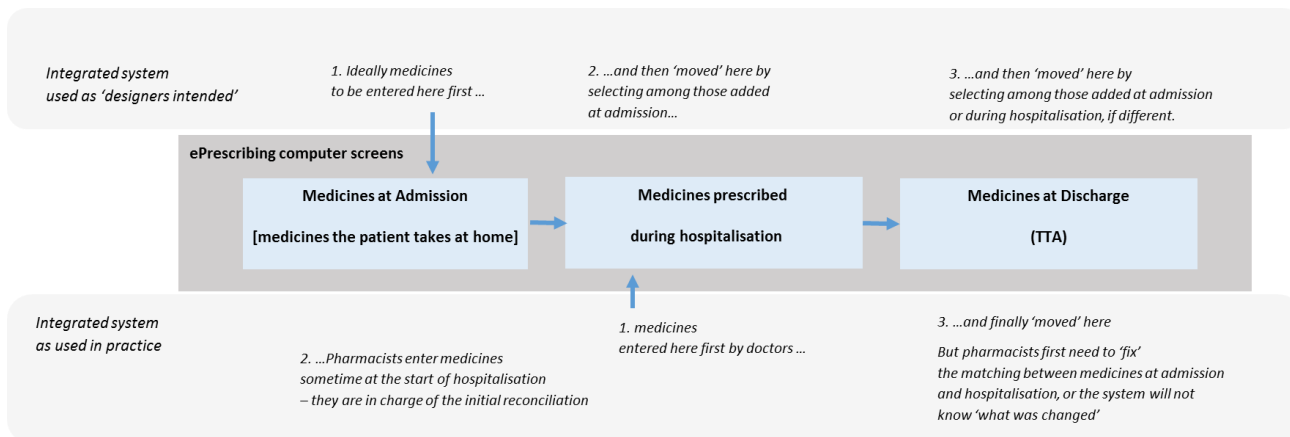

Figure 2.   Integration of ePrescribing and TTA (ED-3), with 'flow' of medicines from admission to hospitalisation and then discharge – designed and actual use.

5   Back to the end: dispensing quantities for a TTA

The TTA is written by doctors, edited by pharmacists, and sent on to be dispensed in the hospital pharmacy by a pharmacy technician. For this task of dispensing, another information system is used: a stock management system. So a technician re-enters the TTA items on this system, and the computer then prints labels that the technician can stick on the medicines, with patient details and directions for use.

The 'pick list' (of which medicines and in which quantities) is printed from the electronic discharge system. This must tell the dispenser whether the item in the TTA is already available to the patient (no need to dispense), and the ED-2 standalone system will also have details of how much is already with the patient (parts of a full pack, for example), so fewer quantities of a medicine can be dispensed to make up the two weeks/month TTA supply. This extra information about quantities already with the patient is not available in the ED-3 system and therefore TTA items will be dispensed in full even if patients already have some available.

> *... In the [ED-2] system you can put exactly the number of tablets the patient has already and those needed from dispensary. But on [ED-3] 'you can't put numbers in'. So if the patient does not have enough, you have to give the entire prescription [e.g. a box] even if the patient has some left. There is no space for multiple sources. (Pharmacy technician, field notes)*

So an extra step is required in the ward *before* sending off the discharge note to pharmacy – the data entry of data on sources and possibly (for ED-2) quantities. The pharmacy-technician explains that 'it's all about assigning sources' - where the medicine supply will come from - either patient own medicines, or the ward stock, or the dispensary.

In pharmacy, once dispensed, the medicines are checked by a technician or a pharmacist and then that technician or pharmacist will add to ED-2 what they have dispensed in terms of quantities. So, at this step too, it's people who do the linking.

> *So yeah, so for example this patient, [...] somebody will dispense this, so dispensing Senokot syrup, and they've dispensed like 150ml for example, so I would put in here that we've supplied 150mls of the syrup; Codeine you could potentially say that you've got them at home, [...] and then you go down the list and see everything that you supplied, and then eventually, yeah, Accuracy Check them [button] to say that you've accuracy checked them, and then after you've clicked this button there'll be another option to release from pharmacy, so then that is the end of pharmacy.*

> *Researcher: And this screen would be transferred to the nurses here [in the ward]?*

> *Yeah, so here, rather than say being 'dispensed', it will say 'released by pharmacy', so then the nurses will have to check that all the quantities we've dispensed here are what they've got in front of them to give to the patient, if there's anything on the ward or at home [...] and just make sure that they've got everything that they need, and then [...] it'd be an option down to discharge them [change the status of the record].*

6 Afterword: Closing remarks on theory and methods

Show, don't tell is the genre rule of most writing for the screen, for fiction and non-fiction. In this paper we borrowed this rule as in the documentary genre, to *show* how sociotechnical a core activity in the healthcare system is, how complex it is to 'computerise' or 'automate', and how enduring the issues are. Our focus is the process of hospital discharge and in particular the information systems used for documentation and supply of medicines To Take Away.

Patient discharge recurred for us as a theme across three different research projects in two hospitals in England, over six years and three different time periods. It emerged across three different experiences of electronic discharge systems in time: (1) a new one being implemented, (2) a well-established one and (2) the replacement of this with one integrated into ePrescribing. Methods for data collection for the three projects are summarised in Table 3. They shared an approach that emphasised the ethnographic sensibility both in the collection of data and in its interpretation and presentation. This paper reflects on the findings from these projects as a whole and in so doing does not seek to decompose ideas between sites, technologies or implementation stages. Rather, similarities and differences between these, across sites and times, are recombined to show the sociotechnical, complex and evolving nature of the overall experience.

The patient discharge from hospital and the discharge note that goes with it, are the outcome of the work of a variety of healthcare professionals - contributions independently carried out, but also dependent on other people's actions. In this sense, the discharge is a collaborative outcome (Fitzpatrick and Ellingsen, 2013). The computerisation of this kind of work is nowadays often done through the implementation of workflow management systems (Gooch and Roudsari, 2011). For the TTA, the belief is that embedded workflow facility for authorising the medicines, provides some form of 'guarantee' on the overall process. But the many posters and printed instructions that accompany these systems and the difficulty of covering for all exceptions to the 'typical workflow' are testimony of the challenges of making safe use of such systems. In part, the challenges are linked to the "illusion of communication" (Campbell *et al.*, 2006), or "loss of feedback" (Ash, Berg and Coiera, 2004) identified as potential consequences of the computerisation of healthcare information systems – "the sender of the information mistakenly assumes that the computer will take care of notifying the receiver, the nurse", or the assumption that the electronic alert, when implemented, is actually received by the right person (Ash, Berg and Coiera, 2004).

	2010 – Hospital in South of England [1]	2013-14 – Hospital in North of England [2]	2016 – Hospital in North of England [3]
Discharge system observed	ED-1: workflow management system for discharge note and transmission, integrated into PAS	ED-2: workflow management system for discharge note and transmission, integrated into PAS	ED-3: workflow management system for ePrescribing, including discharge note and transmission, integrated into PAS
Data collection methods			
Observation (hours) – also including talking with participants about their work (staff) or illness (patients)	68h, over 14 days (in the period February – August 2010)	161h, over 59 days (in the period May - March 2014)	103h, over 28 days (in the period February – September 2016)
Interviews (number of participants)			
• Staff (mainly nurses, pharmacists, doctors, healthcare assistants)	7	24	35
• Patients and/or their family	-	1	2

Table 3. *Research methods and settings.* [1, 2, 3] *For details of research projects see Acknowledgements section; note that the discharge and its systems were not the focus of the three studies, thus data collection activities were not exclusively about these but covered a variety of aspects of the hospital activity and systems in use.*

The time targets imposed by the Department of Health incentivised hospitals to implement a dedicated electronic discharge system, even if not integrated into a comprehensive electronic patient records hospital infrastructure. Single purpose systems may be pragmatically the best option for a timely implementation, given an existing infrastructure (the 'installed base'), rather than implementing it 'optimally' as part of multi-purpose patient records systems. These may include clinical notes, ordering and reporting clinical tests, and most importantly prescribing and administration of medicines, integrated into the discharge management workflow and discharge transmission. Digitally available and coded discharge summaries and letters were also one of the key Clinical 5 elements of electronic patient record systems identified as essential for secondary care – part of the "minimum specification of functionality that would make a system acceptable to [clinicians], […] [and that] will create a pull effect from clinicians who see it as useful and valuable in conducting day-to-day business"(DoH, 2008, p.26).

An electronic discharge is an important contribution to high quality patient care. Speedy and timely communication hospital-GP is important as it also reduces the risk of re-hospitalisation (Callen, McIntosh and Li, 2010; Walraven *et al.*, 2002). But at the time of the national policy incentivising more promptly transmission of discharge notes, the Care Quality Commission had found that only 53% of GPs were receiving these in time to be useful 'all or most of the times' (CQC, 2009, p.3). Furthermore, beyond safety and quality of care, efficient discharge processes are paramount to hospitals operating within increasingly constrained budgets.

Thus, notwithstanding the external push of the financial incentives, the rationale for electronic discharge summaries are nevertheless multiple. They arise out of concerns for medication safety and quality of care, and efficiency and costs of running hospital services. The discharge is so crucial for the patient concerned and the hospital flow of patients that across the (western) world "Finalizing discharges before noon can feel more important than getting to know new patients" (Rosenthal and Verghese, 2016).

Electronic discharge systems implementations are based not just on assumptions about the nature of the focal task (continuity of care), but also to wider contextual elements – in particular those related to technical infrastructure and parallel developments including electronic patient records. For example, if an electronic discharge system is integrated with electronic prescribing, and this in turn with electronic health records, this has the potential to reduce one class of TTA list (prescribing) errors, by eliminating the manual re-entry of information from one system (an inpatient chart) to the next (a discharge summary) as well as saving clinicians' time in data entry and manipulation. Further systems integration, with pharmacy dispensing systems, may also improve safety, efficiency and timeliness. In the case above, ED-2 improves communication and information flow with the GP seen in the speed of delivery and the readability of information. And as integration extends beyond the hospital, with an extended infrastructure of data integration, technical standards and coherent information governance regimes, discharge systems may eventually encompass data interchange between hospitals and GPs systems, so that the TTA list can automatically populate the GP patient record, and at future hospital visits, the hospital physician can import all of a patient's current prescriptions from the GP system. The evolving nature of the wider context and infrastructure is apparent in more recent DoH policy that makes the electronic transmission to GPs mandatory: "As part of the move towards common digital standards, interoperable clinical information systems and *a paperless NHS*, new contractual requirements are being introduced with effect from 1 October 2015 in relation to Discharge Summaries […]" (NHS Standard Contract Team, 2015, p.48, emphasis added). A new NHS "Transfers of Care" Interoperability Toolkit also accompanies the policy development (NHS Digital, 2016).

This paper offers a view onto the use of digital information systems for discharge, how the implementation (the coming and the becoming) of these interlinked technological resources occurs, and how they affect healthcare professionals' activities and patient care (on this, see for example, Campbell et al. (2009) and Vikkelsø (2005)). The consequences may also include new risks for patient safety. The unexpected consequence of the partial integration achieved in this case is the triple matching that the nurse was undertaking at the start of the paper, with material objects, papers and electronic documents. There is also evidence that other similar communication breakdowns occur when pharmacists check the TTA lists from the distance of their work desk computers instead of in the ward at the nurses' station (Savage *et al.*, 2010). Safety improves at one end, and new risks may be introduced somewhere down the chain. Risks occur not only as a consequence of the interaction of professionals with these systems. Risks also occur because of consequences of how the distributed activity changes as it adjusts to the ever more connected new systems – for example where in an integrated system checks and reassessments (of the medication being correct and appropriate) occur, or where seamless data integration eliminates the kind of de-coupling that protects from harm occurring (Perrow, 1984).

What we hope we have shown is a kind of evolving, possibly recursive, sociotechnical state of being that characterises (also, still) the early 21st century: layers of digital innovation enter into and sediment in organizations, permeating their practices and reshaping their infrastructures, without ever achieving stability. This we may call sociotechnical changing (Petrakaki, Cornford and Klecun, 2010). Since these digital layers are perhaps different from the technological layers of the last century, it may be useful to give it a new name - *sociodigital*, or *sociodigital changing*. From the perspective of sociotechnical theory and sociotechnical history (Berg, Aarts and van der Lei, 2003; Baxter and Sommerville, 2011), we recognise the subtle challenges (for efforts of design and socio-technical fit) presented by technology as it enters organizations and become engaged with human actors and human lives – be they coal miners, clerks or medical professionals. However the sense of unfolding, emerging and becoming, is accentuated for us because the insights into the discharge process and the associated information systems that inspired this paper, were gained while studying other things, surfacing from the background. The overall vision may be of digital automation and paperless activities, but work still spills out of the computer onto corners of desks, into corridors, away from patients, and over the horizon to other times and places. As work spills out across the organization from digital forms, it poses 'wicked' questions about coordination, workflow and communication, and lead to older responses – the poster, the white board and the telephone call.

Acknowledgements

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