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The Value of Data and the Value of Questions: Achieving Improvement in Hospital Pharmacy and Medication Safety

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Abstract

Medication safety incidents are one of the major patient safety issue faced across all healthcare services and one that is very challenging to tackle. To make progress, data about the supply and use of medicines that is generated and made available in clinical systems can serve both the purposes of patient safety and service quality improvement. This paper shows how the value of data for these purposes can be framed in terms of the value of questions. This theme is developed based on an interview with a quality and safety pharmacist working in a large hospital pharmacy unit.

Keywords:

Task Performance and Analysis; Pharmaceutical Services; Patient Safety

Introduction

"Big Data is not about providing answers to questions we could not answer before; it is about our ability to think of the new questions" [1].

This is the kind of advice the world of business consulting gives to companies wishing to generate value from Big Data. The advice is to focus on questions [1; 2], and especially new ones. This paper explores how this argument applies to the running of hospital pharmacy services. It presents a case study, a pharmacy perspective on quality improvement in medication safety, in the context of an implementation of an electronic prescribing and administration (EPMA) system and the new data it can provide. The case is centred on a conversation with a practitioner. We asked about the value of data, and she reminded us of the value of questions.

There is an extensive body of knowledge on the use of big data in the healthcare domain; data about patients and patient care activities are increasingly researched for clinical purposes (e.g. predictive analytics) and commissioning. In relation to medicines, big data and associated algorithms are offering insight for pharmacogenomics and precision medicine [3; 4]. The recent seminal paper by Google Research team [5] also shows how machine learning through hospital based data (on eye images) can produce diagnostic systems, specifically, in this case, for detecting diabetic retinopathy. Big data research is more limited on how big data are used by practitioners to manage healthcare services, from a business operations perspective, with some evidence emerging from the trade press [6; 7]. Visual analytics, for example in the form of dashboards, are proposed as one way for service managers of dealing with data complexity, for example for purposes of quality and safety[8; 9].

In this paper the main concern is data about medicines for purposes of improving quality and safety in a hospital setting. Medicines are the most used therapeutic intervention and one frequently associated with preventable adverse events. Medication safety is one of the major patient safety issue faced across all healthcare domains and very challenging to achieve.

Methods

The case presented in this paper is taken from data collected for a project investigating the digitalisation of supply and use of medicines in a hospital setting. Data collection included non-participant observations, interviews and documentary analysis. Observations of staff (prescribers and dispensers) work practice were carried out to gather data on the use of data and technology for the supply of medicines in these settings. Semi-structured interviews were conducted with a variety of stakeholders including patients, doctors, nurses, pharmacists and managers. Interviews explored views and experiences with new technologies and services aimed at supporting supply and use of medicines. With participants' consent, interviews were recorded and transcribed.

Overall data were collected through 37 interviews and about 103 hours of observation. This paper focuses on one interview transcript, with a pharmacist, manager of the service responsible for safety and quality improvement in the hospital pharmacy. This interview was chosen for its relevance and for the insight it offers into uses and challenges of data for hospital management. All quotes cited in the Results section of this paper come from this interview transcript.

Results

The setting

The site we studied is a large National Health Service (NHS) teaching hospital, covering five buildings located in different parts of one of England's largest cities. Medicines used in the hospital are managed by the Pharmacy Services Unit, through a number of on-site dispensaries and about 500 professional staff. The Unit also provides specialized pharmacy services for the local and nearby communities. The Unit comprises a number of pharmacy '*service areas'*, including procurement, supply, information services and pharmacy IT, and quality and safety.

From a service perspective, the Pharmacy Services Unit is running a business, servicing other units in and beyond the hospital, such as the clinical wards and local community clinics – these representing 'clients' and 'users' of the services. In the NHS the cost of medicines is covered by budgets held locally by Clinical Commissioning Groups (CCGs), ultimately responding to the Department of Health; the local CCG is thus also a 'client' of the Unit, the one paying for the service.

Pharmacy services' activities are run and managed through a number of digital information systems, including; a supply

management system for generating orders to suppliers and recording the dispensing of medicines to patients in the hospital, 'robots' to store and dispense medicines, a track and trace system of pharmacists' tasks to track dispensing activities, and a patient safety incident reporting system. The Unit also makes full use of the clinical systems in the hospital, including a patient records (EPR) portal to access patients' clinical tests. At the time of the study the hospital was in the early phases of implementing a new electronic prescribing and administration (EPMA) system integrated into the EPR portal. This EPMA system was to replace paper-based drug charts, still in use in most parts of the hospital at the time of the study. All these information systems provided data about medicines (stocks, flows, use, transactions) in various forms.

Overseeing quality and safety

As part of the senior management running the pharmacy services, the unit had a pharmacist responsible for dealing with medicines related data generated by the pharmacy and hospital activity. As explained by this pharmacist, her overall purpose is to assist the managers of each service area *"to understand their measures of performance and then to help them turn that measure of performance into something we can be assured about in terms of the quality and safety of our [overall] service delivery"*.

In order to do this, the first thing to do is *"to work with each of the teams to see what is important to their service, what data they have and also what data they should have (and there is a difference), and then to work on how we, as a whole service unit, pull together that information and look at it as a senior team to make sure it's telling us how our services are being delivered and the quality and safety issues we might need to look at.*"

Feedback through dashboards

The overall purpose of this work is to achieve constant improvement and the elimination as much as possible of patient safety risks. For the purpose of improvement, data is shared with managers and staff in different pharmacy areas through the use of dashboards (digital interactive ones and printed summaries displayed in work areas – e.g. Figure 1). Dashboards are summaries of a selected number of metrics, with more or less granularity.

"…the dashboard is to focus people's attention on certain things so that we get everybody knowing that those are the things we need to improve. […] whether there's anything going pear-shaped, going wrong, looking as if it's drifting off where it should be …"

The focus of most dashboards is on problematic areas and safety incidents, balanced with achievements. The premise is that alerting staff of issues and safety incidents can generate learning and 'focus people's mind' towards improvement.

"More recently we've had a dashboard where things have looked quite good most of the year and so the question is now, 'Well why do you keep telling us the same information?' […] So this quarter we're talking about, 'Well, shall we now pick six things that we're not very good at and re-energise that conversation about improvements?"

Figure 1– Example of Pharmacy dashboard (source: hospital documents available online)

Analytics out of layers of data

The dashboards are an aggregate of *layers* of data, each answering specific needs.

"… you can see it in layers of data …"

Each service area is different (e.g., procurement, dispensary, manufacturing, information management), each requiring therefore different metrics, and different data (different ways of gathering data and different data they can gather). These layers of data are then re-assembled into dashboards for overall summaries, but also provided in detail to each specific unit.

"… each unit has their own set of much more detailed indicators which tell them what their activity is, how much money they're getting, what their staffing level is, all of that sort of stuff."

"… what you use that data for depends on how you're actually collating it and displaying it and using it and sharing it."

Tracking and assessing operations' performance

Performance is most obviously measured in terms of meeting service targets, such as delivering required medicines to clinical areas within certain time frames (e.g. 2 hours from receiving an order). In order to have the data to assess activity against these set targets, the overall process is structured into separate tasks (e.g., receiving order, processing items, verifying, delivering), each transaction given a barcode, and then scanning of these barcodes during each task. The 'track and trace' system dashboards could then display in real time any delays with respect to the time targets, *and* provide data on overall performance over a given period.

However, other performance measures are also important so as to assess whether the services achieve their overall business objectives – i.e. in terms of patient needs.

"…we have used the data coming from the dispensary tracker in the past as part of one of our initial measures, […] to check how many of the prescriptions for patients going home, our discharge prescriptions, are dispensed within our two hour target. […] but when we measure it being completed in pharmacy is not necessarily the same measure as 'is it with the patient ready to go home?"

This requires thinking new metrics (new questions), beginning from the perspective of the patient (the ultimate user of the service):

"Well what is it that the patient wants us to measure?"

Answering this question leads to a more specific metric, suitable to be answered with available data:

"…the patient wants to know how quickly can [their medicine] be with them, ready for them to take it home, and we know that there's a bit of a delay between it being ready in the dispensary and it then getting to the ward, and so you could argue that one of our measures ought to be: when it's ready in the dispensary how long does it [then] take to get to the ward?"

Gathering the data

The data for performance assessment, and the layers of data displayed in dashboards, come from a number of systems – some digital, other requiring purpose-built auditing tools which are mainly paper based. The processing of digital data and especially data *collection by hand*, are resource intensive and time consuming, and not to be lightly introduced.

"…they are different [pharmacy units], and there is no one system of data collection that we use across all …"

"[data] come from a collection of systems and a collection of manually collected, or data that's taken from other systems and then amended or extracted for our own purposes. So […] currently it's a very [pause] I was going to say it's very manually heavy. *It's, it's less so now because we've worked really hard to only use electronically-collected data, but there are still some bits of data we have to collect by hand."*

At the time of the study the hospital was implementing an EPMA system integrated into a patient record portal and the expectation was that these integrated systems would be able to provide data, without the need for manually auditing paper charts or using data collection forms.

"… when every patient has their drug chart in [EPMA], then that will sit within [the EPR] and the data will be shared and you will just be able to extract it in one transaction."

The availability of the right data needs planning

When data need to be collected manually, you have to plan ahead for that data collection; thus have to know your question. Once data are digital, at least in theory, there is a potential to answer emerging questions that were not planned for. However, in practice there may be a digital system in place but the data may not have been entered appropriately, or the system may not actually record the data you were expecting to have. Thus you still have to plan ahead, and 'be clear what you are going to measure'.

"Well I think it depends because you can only extract the data that you put in, and so if your system is not collecting the data that you require, then you still have to plan."

"… so a good example is: on our [paper] drug chart we have something called a Day 3 Antimicrobial Review section, so at the moment if you do a Day 3 you tick that box [on paper] and put a code in it, and we go along and [manually audit the charts] we measure the number of patients who've had a Day 3 review. Interestingly in [EPMA], there is no such box to tick and so the question is: how would you extract the data from [EPMA]? What data is recorded to show that a Day 3 review has occurred?"

"…, you still have to plan and be clear what you're trying to measure, because just saying 'it will be there', isn't always the case."

Some data are still imperfect answers to your questions

Despite planning and efforts of data collection, the data that can be available and collected, are not necessarily matched to the question of interest. The case of monitoring for antimicrobial use in hospital is again one such example:

"Well you can go on and there is a box for each ward to use which says, 'Is the patient on antimicrobials?' and you can actually manually put it in. […] It just says they're on antimicrobials, 'yes, no'. So we're working with imperfect data because the data we can often get doesn't answer the question we want answering …"

The question must be worth the effort

Furthermore, not all questions are worth the data collection efforts (especially the manual audits); the overall aim is achievement of improvement and this gives a measure of the value of the data (and the value of the questions).

"… we were using our pharmacy teams to collect huge amounts of manually-collected data […] and we felt that actually we were spending a lot of resource in collecting data that was disproportionate to the improvements we were looking to achieve."

From operations' performance to medicines' questions

Beyond the performance of the Pharmacy Unit, achievement of overall business objectives is the safe and appropriate use of medicines – the right medicines given to the right patients at the right times (the 'three rights' that are the goal of most pharmacy services' activities). The hope is that digital data about medicines will enable answering questions about the right (or wrong) supply and use of medicines. These will be expressed in increasingly complex questions – e.g. not just about actions but about rationales for actions. The hope is also that answers to these types of questions will be able to inform different ways of improving quality and safety and medicines use.

Questions about the use of antibiotics are an example because they encompass both the safety of individual patients, the outcomes of patients treated with that medicine (e.g. for reasons of research), and also more generally stewardship to tackle the challenges of antimicrobial resistance [10] and achieve wider societal benefits. Using antibiotics (antimicrobials) as an example, the extracts below show the connection between the different steps in the process, from one question, to data and then more questions, and eventually identification of areas for improvement (such as providing training or better information for doctors).

"So antimicrobials is a really good example and […] [we have] very specialist people who are very interested in the fine detail of which drug by which consultant to which patient, …"

"…, but then there is another element [of interest, about patient safety] of which patients: has anybody tried to prescribe a drug, an antimicrobial say, to a patient who's classed as allergic to an antimicrobial? …."

"… because there are some patients who the risk of giving a medicine to, is much less than risking them having an allergy, but then is equally the one in a million where it's a serious life consequence. […] our job is to identify the patients it's okay to do it in and make sure that there's a good rationale for doing it, and the ones that it's not *okay to do it in…"*

"… [with the data from EPMA] we will have, if you like, the ones who have tried to prescribe it and continue to prescribe it - and then we'll have for those a reason for them continuing to prescribe it - and we'll also be able then to see how many doses the patient had and the outcome of the patient.".

"We'll also be able to see the number of doctors who tried to prescribe [for] a patient who was allergic a drug and then chose not *to proceed. And they are, they're equally of interest to me because actually they tell us something about whether the system […] has introduced a barrier to improve safety or not."*

"So what we would then need to know is: were those doctors or prescribers trying to prescribe something because they had lack of information or just because they didn't think about it, or what

was the rationale, and at the moment the only thing we can explore is, is where it's gone wrong, …"

From (retrospective) questions to (prospective) guidance to use

The meta-question posed is 'what are we really trying to achieve' with the data and by answering those questions. The overall aim of knowing whether patients have been given the right (or wrong) medicine is to make sure that it does (or does not) happen again, and that it does (or does not) happen to other patients. The digital system may enable a shift from retrospective data collection and use, to prospective 'decision support' and behavioural change. The idea is: instead of, or as well as, trying to collect digitally the same data that were collected on paper (such as a 3 day antibiotic review), change the data points to generate different behavior *at the point of care*.

"… actually you could […] say, "Well you might change your measure from Day 3 to a 48 hour review", so if the system has something that collects a 48 hour review in it, you would ask yourself, "Well do I really need a Day 3 box ticked?" So yes, there is a bit of what are you trying to achieve with that number, and actually if you go back to the patient experience and the patient safety bit, we're trying to make sure that only patients who need antibiotics get them, and part of the reason for the Day 3 is that's the point at which you should have all of the information to make a decision. Well, you might be able to, if our systems were slick, […] make a decision at 48 hours, which would be even better because that would mean that you're not exposing patients to a longer treatment than they need to have of a certain antibiotic, and so it might help us smooth that out, absolutely, and I'm a great believer in once you can scan data you might say, "Well actually I'd rather have that data than this data," and that data will help me answer a question differently. So I absolutely think it will do that…"

The business of the pharmacy meeting 'clients' and patients' needs

Returning to the service delivery perspective, data is only a means to an end, and the overall goal is client satisfaction - mainly patients, but also clinicians using the services of the hospital pharmacy, and the clinical commissioning groups paying for them. Satisfaction and user experience are better assessed through gathering qualitative data and user feedback. It is not all about data points, but just as much about relationships, communication and trust. And it is also about being able to answer or pre-empt *their* (commissioners', patients, clinicians) questions.

… for me, data is a single tool that we use to ensure quality and safety, so my bigger remit around governance quality and safety is about making sure that we do everything that we should be doing, that the outcomes are the outcomes we are looking for and that our patients are looking for, and so data is only one element of that because data is only about numbers, not about experience, and you could have the best numbers in the world and have a poor experience.

Because if the delivery of the service is spot on but doesn't have your patient as the focus, then you're not getting the outcome.

So there's a bit of qualitative data and a bit of quantitative data that you need to look at in tandem.

[...] So patient, direct patient feedback about their experience is probably the gold standard, but also not forgetting that what we do is also with our staff, so nursing staff's feedback about the availability of medicines in their workplace. Feedback from doctors about their training on prescribing or the availability of information to help them prescribe safely, that type of information about our service providers is also really important to us.

"And our commissioners… […], because our commissioners commission us to use medicines in certain ways and so some of what we monitor is to make sure that as an organisation we're only using those medicines to treat the patients that we're asked to treat, […]. So there are some very expensive medicines usually, or medicines with a poor safety profile, and collectively we might say, "Well we only want to use […] that drug to treat those patients with a specific condition or a specific set of circumstances", and part of our job is to make sure that that drug is only ever used for those patients. […]"

"So [for example] there are some medicines that we are told by commissioners that they only want us to use in patients with cystic fibrosis who have a very low respiratory measure and what we have to ensure is that we only ever prescribe it to those, that group of patients. It's a bit like a NICE guideline, you know, NICE guidelines will say, "Only use this drug in these circumstances", and that's where eMeds will come into its own, because we will be able to say, "Tell me all the patients who've got that drug and tell me if they [meet] that criteria", and then we'll be able to say, "Yes that drug is only being used in patients with that criteria" or "There's ten patients who you used it in who didn't meet those criteria. Let's go and have a look at the circumstances of that". So, but actually part of our assessment is, "Do our commissioners trust us that we're doing what they're asking us to do?" and some of that's around data but some of that's also around how we interact with our commissioners."

Discussion

In this case study of a pharmacy service unit, *concerns about data* are framed in terms of *concerns for questions*: what are the questions to ask and what questions data might be able to answer.

Digitalization of clinical care can certainly make data collection at the point of care less resource intensive and less time consuming, potentially making some of it available in real time. However, it also inevitably changes the type of data that is gathered, the opportunity costs implied. The data that were available in the past may not be available through the new digital systems, and traditional collection methods may need to be still used.

Overall, this may change the questions that can be asked and answered, and leads to a rethink of what the original questions were for, whether new questions would better achieve the overall aim. In particular new data ecologies can offer the potential for more holistic and overarching types of question relating to customer service, rather than task performance. Furthermore, the act of gathering data at the point of care (through clinician's data entry into digital systems or by embedded technologies) for purposes of retrospective data analysis, can be transformed into information points for prospective guidance for action – such as when asking about patients' allergies to antibiotics turns into a change in prescribers' choice of medicine to treat the patient's bacterial infection.

Limitations

This study is limited to only one interview, in one hospital, in one specific context, and should not be taken to represent the business of hospital pharmacies across all NHS hospitals in England or beyond. The interview is however taken from a larger dataset, and informed by observations of pharmacy and clinical activities across different hospital areas.

Conclusions

Digital data gives us the possibility of answering new questions, changing the questions we ask, and making questions and data-driven responses a more active part of health care delivery. It is by posing the right question that improvement in quality and safety can be achieved - not by access data alone.

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