Co-designing Community Dental Services software

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A dentist working in Community Dental Services (CDS) in the Northumberland Healthcare Trust of the NHS wanted to develop open source software to use in their clinics since most of the systems that they currently use are paper-based. The question was, what should the software look like? Here, where teeth are the easy part, oral health services are provided for patients with very complex or special needs or disabilities including autism, dementia and phobias. All NHS Trusts deliver these services and four Trusts with varying software systems agreed to second staff for half a day a week for six months to take part in the discovery. Co-design workshops were facilitated by the care analyst every second week and in alternate weeks staff were given tasks to do at their Trust clinics; observing, timing, collecting forms and data. Each Trust has its own version of every piece of management form. At first people act as though their document flow represents the pathways that should be “automated”. Software specification in the NHS is often done by people without special skills or experience but persistent co-design delivered an agreed patient care pathway as well as an extended narrative for future software development.

Keywords: Open Source Software, Healthcare, Special Care Dentistry, Co-design

Context and setting

Where it started

OpenOdonto CIC launched a project setting out to frame the functions, reach and purpose, or discovering the user needs, of new, open source software that will be used in Community Dental Services (CDS), the providers of special care dentistry in the NHS in England. Essential to the brief was the aim to make open source software using an Agile software development methodology.

OpenOdonto CIC, a clinician-led Community Interest Company (CIC) was established in 2015, by a senior dentist practising within Community Dental Services in the North East of England, with funding from NHS England Open Source programme via Apperta CIC. The lead dentist was frustrated at having to use paper systems for everything from referrals and appointments to patient care notes.

Community Dental Services

Community Dental Services (CDS) is the part of each NHS Trust which ‘does’ Special Care Dentistry, oral healthcare provision for patients with complex disabilities or medical conditions. Clinicians practicing in CDS work hard to ensure dental care is available, despite complex difficulties in communication and access.

Clinicians and admin staff will say that “the teeth are the easy part” and patients’ additional needs are complex and widely varied in their complexity. Examples of treatment complexity core to CDS and which are
outside of the mouth includes providing domiciliary care for people unable to leave home, providing care under sedation or General anaesthetic theatres for people unable to accept care with local anaesthetic alone, the use of hoists to transfer patients from wheelchairs to dental chairs, modifying communication to maximise understanding for people with dementia or learning disabilities and using interpreters when languages are different, balancing risks and benefits for older people on multiple medications. What is now clear is that for CDS, the ageing population will continue to place increasing pressure on these services (Lievesley & Wassall, 2015).

Why do it this way

While the earliest drive for this project was from clinicians demanding a better way in the clinics where paper-based systems are in use, it is also fuelled by the frustration that dental software is available and is in use at some Trusts in other parts of the NHS, but it is seen as not fit for purpose and is almost impossible to improve or change. This crystalized into the OpenOdonto discovery project: what does fit for purpose would look like for CDS?

Studies on the non-adoption of technically detailed automated procedures note a lack of consideration of usability issues i.e. the “world of people and human purposes” for how the records, forms and letters are used (Thyvalikakath et al., 2007). Where “truth” about a patient is often arrived at through careful repeated questioning and patients have complex truths and have difficulties communicating, heuristic technical systems for populating electronic health records (EHRs), or making decisions, easily become too rigid and then clinicians will deviate significantly from the programmed methods (Walji et al., 2013).

The project team at Newcastle University – care analyst and living lab specialist – was contracted because the usual means of extracting the user needs for software in the NHS has proven insufficient. Currently where NHS software is bought using a ‘specify and procure’ process, clinical practitioners do much of the specification though often without the language and the agency to negotiate with software suppliers. The national programme for IT in the NHS highlights the consequences of implementing software that is ‘bought off the shelf’; it “imposed uniformly derided systems that few if any wanted, delivered late, and ran up costs never seen for an IT project planet-wide” (Maxwell et al., 2010). However, there is an ‘alternative way’, in which digital tools are viewed as part of the continuous improvement of services (Government Digital Service, 2017) and open source is embraced.

The choice of software development methodology affects the project fundamentally. Agile methodology has as one of its core principles that it values “individuals and interactions over processes and tools” (Highsmith & Cockburn, 2001) and therefore suits participatory design. In addition, it features works in small cycles emphasizing incremental development and small design steps guided by frequent interactions with customers (Martin, 2003), (Goldman & Gabriel, 2005). Working towards open source code also as has benefits of easier collaborations and higher quality (Government Digital Service, 2017).

For the living lab process real users are taken out of their place of work, guided in conversation and supported to make things together. To promote discourse, and thereby allow for the development of confidence among participants who then participate in co-designing the software that they require, extensive use is made of boundary objects (Sapsed & Salter, 2004) and prototypes (McLoughlin IP, 2016). The facilitator was the author who has training in computer science, industry experience in software development, and many years as a business analyst before joining academia.

The narrative

The four Trusts

Implementing new software at a CDS clinics means that there will be systems change through technology that solves particular problems and so it is essential that the most important problems are solved, as defined by the people who are working with the current systems on a daily basis (Mumford, 2006), who feel the frustration and will potentially be the people who would be working with a new system. These are the people who must be able to recognise the design of the proposed new system as being something true and that it will support better work (clinical care in this case).
Stakeholders were, in this first instance people from Trusts who could reasonably travel to Newcastle University on a regular basis because co-design works best when the community works together in person and do so over many meetings.

In addition to the directors of OpenOdonto CIC the lead dentist recruited four northern Trusts who seconded staff members to the OpenOdonto project for half a day a week from September 2015 to March 2016. Those involved were dental clinicians, including nurses, and administrators and managers of the service.

Participants were active, current staff employed in the Community Dental Services (CDS) of the Trusts listed below who were seconded by their Trusts.

<table>
<thead>
<tr>
<th>Trust</th>
<th>Description</th>
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<tbody>
<tr>
<td>Trust 1</td>
<td>Northumbria Healthcare NHS Foundation Trust (Northumbria)</td>
</tr>
<tr>
<td>Trust 2</td>
<td>The Newcastle upon Tyne Hospitals NHS Foundation Trust (NUTH)</td>
</tr>
<tr>
<td>Trust 3</td>
<td>County Durham and Darlington NHS Foundation Trust (CDDFT)</td>
</tr>
<tr>
<td>Trust 4</td>
<td>Pennine Care NHS Foundation Trust (Pennine)</td>
</tr>
</tbody>
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Each participant in our exploration had a particular experience as Trusts have unique geography, clinic type, and composition of patient cohort.

For example the patch for the Pennine Trust in Manchester is urban and densely populated though it is geographically smaller than the Northumberland Healthcare Trust which includes more rural areas and clinics are widely spread out. Dentists have to see patients in multiple clinic locations; some clinics are in hospitals, some are part of community health centres, for domiciliary appointments patients are seen at their own homes and some elderly patients are seen at care homes. One patch has a large number of adult patients with autism, one patch has a lot of children currently looked after within social care services.

Differences mean that there is a legacy of accumulated systems: of the forms, letters and the piecemeal acquisition of software, and expensive hardware such as radiography. This is set against the similarities in training of clinicians and the straightforward expectations of the patients, the regulatory requirements and the practises that build up around this.

**Co-creation and co-design: In the Living Lab with the care analyst**

Discourse and sense making was the process whereby space was allowed for co-designing and preserving ambiguity. On alternate weeks all participants gathered in Newcastle University Business School KITE research centre’s Living Lab workshop, a flexible and enabling space with large tables, computers and wall display and screen, wraparound whiteboards, flipcharts – material to represent whatever things that arise.

When the author identified herself as a business analyst it was very quickly made clear this has a specific meaning within the NHS, often being linked to specific software companies and, as such, not really trusted and later, when the author had to be given a named role, this became the care analyst. The researchers who were part of the design process were the care analyst, care system architect, and living lab specialist.

Since the enquiry has its own purpose i.e. to generate guidelines for eventual software development, workshops were iterative and data was allowed to flow naturally under the direction of the care analyst. Participants were given tasks before each meeting and for the first meeting participants were asked to find and bring along every form or document in use within their Trust and talk us through the processes that these represent. This was shocking to the researchers and the first stark reminder that while each CDS delivers the same care to a similar patient population that each one had evolved to be, seemingly, mutually incompatibly different.

After each workshop the care analyst gave the participants “homework”, these were direct observation tasks and paper chases and timed activities about patient care at their clinics.

The care analyst’s “homework” was to be ready for the next workshop; to process the data and stories and quantitative data and forms to ‘make sense of it’, gain specialist input such as from other future potential users of the software or other participants from NHS Trusts. Representations were developed: these are care pathways or models or physical pictures of the care and responsibilities or the roles that interrelate in a clinic / Trust and beyond. These are further boundary objects and these are then presented at the following Living Lab meeting. The boundary object / the model / prototype / architecture is shared and commented on and fixed,
iterated, discarded; omissions are added and misunderstandings pointed out in ways that does not happen
with straightforward questioning. Through it all each participant’s collective knowledge is grown.

*Discussions off the topic – “they have no idea how long this takes us”*

A fair amount of time was spent on discussions that seemed peripheral to software. As an example,
participants compared the management structures in their Trusts or procurement processes or the X-ray
machines in use at their clinics. These and other unrelated discussions were moments of rest that did not add
to the boundary objects but these times of stillness seemed to allow new information to arise, general insights
almost like revelations. The most important of these – information that nobody thought was important or
necessary – was the insight about undocumented care.

For weeks the discussions followed formal processes, explaining data capture, what the forms mean, and
harmonising understanding between Trusts around processes. Once participants trusted the format enough to
reveal deep frustration in connection with correcting patient data in referrals documents they burst out with
“They have no idea how long this takes us”. Only then could we start to tease out all instances of what we
came to call ‘undocumented care’. This work is almost routinely done at some points in the care pathway,
work which is essential to good continuous care but which is not recognised, nor planned in, nor paid for.

*Direct Observation: Setting: Clinics*

The care analyst conducted field trips, visiting clinics in Trust 1, Trust 2 and Trust 3, to observe the practises
and processes in clinics directly, to ask questions and see and hear how staff explain what they do and why
they make choices. Visits were done when there were no patients present and all available staff were queried;
clinicians, dentist and dental nurses and admin staff walked the researcher through the systems – be they
letters, forms, software, and people – that manage patient referrals, appointments and interactions and the
management reporting that is required to record and arrange payment for care.

*The final pictures and the show and tell*

Within the timeframe of the project, there was a level of saturation (Bowen, 2008) and agreement about
the following

- the patient care pathways (figure 1), (figure 2)
- User personas (figure 3)
- Paper prototypes of the referral system (figure 4)
- the video prototype of the preferred patient experience (Wassall, 2016)
- the reference architecture (figure 5)

Show and tell events were held to engage more widely with NHS managers, commissioners and healthcare
software (open source) professionals. We hoped to gain more data for the business processes but they also
provided a proving ground for the robustness of the boundary objects for clear communication and
confirmed that these other stakeholders recognise this reality.

*Figure 1 Patient care pathway from referral to treatment complete*
Figure 2 Patient care pathway from referral to treatment complete – showing ‘undocumented care’ (clouds in orange)

Figure 3 User: Persona for software development

Persons:
Referring Dental Team

Photo
Fictional name: Linda Jones

Job title/major responsibilities: Associate dentist at Apple Road Dental Practice / Do clinical dentistry efficiently and in a way that is a practice builder

Demographics:
- 31 years old
- Lives with partner in flat
- No kids
- Has a Post Graduate Diploma in Conscious Sedation

Goals and tasks: She is focused, busy, task-oriented within a strong desire to ‘make a difference’ to her patients. One of her concerns is maintaining quality within the increasing pressures to maintain productivity even though she now sees lots more poorly older patients.

Spends her work time:
- Working chairside with a dental nurse doing oral health assessments, X-rays and Treatment Planning
- Working chairside with a dental nurse making crowns and partial dentures
- Supervising a dental nurse who records, collects and curries documentation necessary for every course of patient care.

Environment Busy 5 surgery dental practice. There are always lots of patients in the waiting room, the reception has one shared PC and the phone is always ringing.

In her surgery Linda’s dental nurse uses the PC most of the time to manage patient appointments, record history & clinical findings & outcome of Treatment Planning discussions on behalf of the dentist. In the 1 minute between patients Linda ‘checks and approves’ each record. Linda squeezes making referrals into her dinner hour.

Quote “Can I talk you through your treatment options and then you can make the decision that is best for you?”
Figure 4 One of many versions of paper prototype - the referral system

Figure 5 Care system reference architecture (Mike Martin)
**Software that leaves room for care**

In clinics where software is in use it is thought of as having value and people do not want to lose what they have, they like it when electronic patient data can be shared across the patch, when patients are more easily triaged, and appointments can be set up centrally. However the care analyst observed clinicians in practise and it is startling; their interactions with the software user interfaces were often a torture to watch.

In those clinical spaces insiders stop noticing the workarounds – the double data entry, pages long drop-down lists, transcriptions, data faking/placeholders that they later return to fix. But it was not a surprise to hear that it can take up to six months to be able to use the system properly. Since clinicians and admin staff at clinics prioritise patient care and “just get things done” their extra work becomes automatic enough so as to be almost invisible. Difficulties with software were hardly mentioned in the workshops, this is a testament to the adaptability and skill of all of the users.

In the meantime the extra work that this software adds takes up lunchtimes and extra time after hours. It also suggests that no software system should dictate what care should look like, software should support care and software should leave room for care.

**The key learnings**

**Providing excellent care despite frustration**

It was seen that when clinician time is taken up with administrative tasks that seem unnecessary or repetitive that not only will the clinician see fewer patients, they also feel deeply ill-used as they catch up with admin at their lunch breaks. When admin staff time is taken up by phoning and faxing around to complete forms and gather data, or fix data on the computer system after workarounds, all tasks that could have been collated more securely through digitally linked sources, there are more errors and fewer patients are processed and seen. Less time means that patients wait longer to be seen for acute dental care, the backlog on recall appointments is longer, and the CDS clinic “bills” for fewer units of dental activity (UDA’s).

**The sense-making tools of co-design**

The co-design research provided the opportunity for sense making with the data allowing the emergence of the essential user needs for digital tools in community-based dental services. Mapping, personas, storyboarding and narratives allowed stakeholders to engage with data and create new user journeys based on their collective experiences, especially activities that take a lot of time, are necessary for safe care, but are not currently recognised, captured, or rewarded.

By producing prototypes, we make research findings more tangible – making it easier to imagine a better system and how those recommendations would affect the provision of services. Paper prototypes are so easily understood that administrators were developing proposed software interfaces.

A working prototype reduces the risk of misunderstanding and allows people to engage immediately with how such a tool is relevant to their own pressing needs in practical service delivery. When building digital tools for use by people in multiple roles and within different organisations we have found an iterative cycle of storytelling & prototyping allows divergent user needs to converge around the prototype. It also emphasises the stages of development that must be accomplished by actual clinical users.

A video prototype was made to demonstrate a preferred (ideal) patient journey which translated the vision of what the digital tools need to accomplish beyond the initial participants to the managers and commissioners and ultimately the software developers and funding agencies for that software.

**Final software elements**

It was agreed that every Trust Community Dental Service needs, at least

- a referral system including triage
- appointments management system
- a way to manage recall appointments
- manage patients’ records
- patient communications
- chairside access to patient records
- chairside access to the payment system or FP17’s
- flexibility in management reporting

**Collaborative exploration means inclusive discovery**

Extracting the software requirements by interviewing or observing people in a single Trust has often been done at these Trusts. However software user needs based on one Trust, no matter which one, would lead to a poor picture and software built on that poor picture would be less universal and less robust.

Working with participants from four Trusts with significantly different management and systems was long-winded. It is when participants contribute, listen and respond to one another, reflecting back and interrogating the stories over time, that they improve the quality of the narrative. That is when they start to talk about workarounds and accept that their superfluous activity has value and may be necessary for patient care.

Co-design was the tool that allowed delving into the stories of many clinicians over time, allowing for real constructive disagreement, significant empowerment of the participants, and the distillation of a believable common vision. This is more likely to support the development of software that leaves room for judgement and complexity and variability - and work in many Trusts.

**References**


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