A participatory systems approach to design for safer integrated medicine management

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Abstract

It is recognised that whole systems approaches are required in the design and development of complex healthcare services. Application of a systems approach benefits from the involvement of key stakeholders. However, participation in the context of community based healthcare is particularly challenging due to busy and geographically distributed stakeholders. This study used action research to investigate what processes and methods were needed to successfully employ a participatory systems approach. Three participatory workshops planned and facilitated by method experts were held with 30 representative stakeholders. Various methods were used with them and evaluated through an audit of workshop outputs and a qualitative questionnaire. Findings on the method application and participation are presented and methodological challenges are discussed with reference to further research.

Practitioner Summary: This study provides practical insights on how to apply a participatory systems approach to complex healthcare service design. Various template-based methods for systems thinking and risk-based thinking were efficiently and effectively applied with stakeholders.

Keywords: healthcare ergonomics; participatory ergonomics; systems approach; sociotechnical system; patient safety

1 Introduction

It has been widely recognised that whole systems approaches are required, but underexploited in the design and development of complex healthcare services (Waterson and Catchpole, 2015). Carayon et al. (2014) highlighted the particular importance of a systems approach in healthcare, since any design changes without considering issues across the whole system, are unlikely to have significant and sustainable impact on healthcare practice.

Dul et al. (2012) consider a systems approach as one of the fundamental characteristics of the human factors and ergonomics (HFE) discipline and defined it as follows. When

defining problems and formulating solutions, system boundaries are defined, and the focus of HFE can be on specific aspects of people, on specific aspects of the environment or on a specific level (e.g. micro or macro), but the broader context of the human within the environment is always taken into consideration (contextualisation). Consequently, HFE has adopted and developed various conceptual models and frameworks in order to support the application of a systems approach (Carayon et al., 2014; Hignett et al., 2013; Moray, 2000; Waterson, 2016; Wilson and Sharples, 2015).

Application of a systems approach benefits from the involvement of all relevant stakeholders and the inclusion of their input in system design (Hettinger et al., 2015; Waterson and Catchpole, 2015). Evidence also suggests that involving the various stakeholders in the improvement of health services is challenging, but can lead to more responsive and efficient services (Fisher, 2011; NESTA, 2013).

In the HFE discipline there has been growing interest in the participatory ergonomics by which 'non-experts' can become involved in applying HFE methods to systems design. Several definitions of Participatory Ergonomics (PE) have been proposed with a simple and broad definition being that of Kuorinka (1997) with PE described as 'the participation of necessary actors in problem solving.' It allows for the involvement of all stakeholders in the design process. Various tools and methods have been developed or adapted for PE throughout the design process, from problem analysis, idea generation, solution development to evaluation (Gyi et al., 2015). But at the same time, it has been acknowledged that there are always limits in the participatory approach on what is achievable within the resource constraints. Questions around what processes and methods do we need to use for a successful participatory approach have been considered by a number of authors (Gyi et al., 2013; Vink et al., 2006).

In healthcare, there is growing recognition of the need for the healthcare systems to be redesigned to be more community-based (Amalberti and Vincent, 2016; Holden et al., 2013). However, participation of various community-based stakeholders in health system design is particularly challenging due to their busy schedule, wide geographic distribution and involvement of multiple organisations.

In healthcare, however, there is limited published literature on the application of participatory approach to the design of a community-based system. Some studies focused on physical ergonomic issues related to individual tasks (van Eerd et al., 2010). A recent publication has reported on the application of participatory approach to the system design of the complex care process of family-centred rounds in the hospital based setting (Xie et al., 2015b). This study reported difficulties in representing all relevant stakeholders even in the hospital based setting (Xie et al., 2015b). Buckle et al. (2010, 2006) demonstrated successful application of mapping workshops in both engaging with stakeholders and generating a rich knowledge base for the design. The study suggested a need for more sustained and holistic effort if significant advances are to be made. Robert et al. (2015) adapted tools and methods from participatory and service design and called Experience-based Co-design (EBCD). Here, Robert et al (2015) used observation and filming under the EBCD tool to capture and share the experiences of patients and staff to support healthcare service design processes through participatory activities in the hospital-based setting (Donetto et al., 2015). Reported difficulties and limitations in the application of EBCD include: time consuming nature of the co-design process (typical project duration of 12 months); focus on experience without acknowledgement of other underlying system issues; resulting small-scale changes instead of any systemic changes; lack of design tools and methods (Donetto et al., 2015; Robert et al., 2015).

The appropriate selection and application of design methods and tools in general is not straightforward. It requires careful consideration and balance between various factors such as problem type, design stage, level of stakeholder engagement and availability of resources in terms of time, money, data and expertise (Jun et al., 2011) . It is particularly challenging in healthcare, since there is very limited time for staff, patients and carers to participate in design activities and their skill and knowledge on the design methods are usually very limited. Few studies have holistically investigated an important question, '*What methods and processes do we need for a successful application of a participatory systems approach to complex healthcare service design?*'

Therefore, this study set out to address this knowledge gap. The objectives are twofold: i) evaluate the outputs and the applicability (usefulness and ease of use) of methods for a participatory systems approach to health system design in the community setting; ii) identify practical challenges and requirements for successful application.

An action research approach was taken in a real service design project - care pathway integration for safer medicines management. This service design project, within which the study was carried out, was commissioned by one of the Clinical Commissioning Groups (CCG) in London, England; CCGs are statutory NHS bodies responsible for the planning, designing and commissioning of local health services in England. The CCG for this study was made up of 37 GP practices and responsible for commissioning around £300 million of healthcare services for the population of just under a quarter million. This CCG had faced changing demographics and financial pressures on their healthcare system, which meant that more and more elderly patients with complex medical needs were going to need to be supported by carers, health and social care staff in primary and community care settings.

Recently, the scale of the medicine management problem among the elderly population has become more serious as shown in the following relevant facts and figures (Picton and Wright, 2013). Eighty percent of those aged 75 and over take medicines and more than 1/3 of them take four or more medicines. Up to 50% of medicines are not taken as intended and between 5 and 8% of all unplanned hospital admissions are due to medication issues. This figure rises up to 17% in the over 65 age group. In addition, medicine waste is a significant issue in England - £300 million worth of medicines are wasted annually in primary care alone, about half of which is avoidable (Picton and Wright, 2013).

Given these challenges, the aim of the service design project was to create integrated care pathways for safer medicines management amongst older people living in their own homes, without compromising on cost and efficiency.

The next section presents the action research approach used in this study, including the description of design processes and methods for a participatory systems approach. This is followed by a detailed description of the results from applying these methods, and the participants' feedback on ease of use and usefulness of the methods. The paper ends with a discussion and conclusions including lessons learned and suggestions for future research.

2 Methods

2.1 Overview

An action research approach (Davison et al., 2004) was taken with the dual intentions of creating safer integrated pathways and carrying out research on the application of a participatory systems approach. The researchers were actively and deliberately involved

both in facilitating a participatory design process and conducting research in this project.

A core team consisted of three method experts in the areas of human factors, systems engineering and Lean thinking and three healthcare professionals holding positions in commissioning, pharmacy and general practice. The team was given the opportunity to run three 3-hour stakeholder workshops (9hours in total), which was considered feasible and acceptable to the potential participant groups (healthcare workers and patients/carers).

The core team designed the contents of three stakeholder workshops based on their previous experience and expertise in applying systems approach to healthcare (Card et al., 2012; Jun et al., 2014, 2011) and their experience in applying general tools and methods used for participatory ergonomics (Gyi et al., 2015). Design processes and methods were selected based on the following four 'thinking principles': systems thinking (big picture understanding); design thinking (user-focused design); risk-based thinking (proactive risk analysis); and lean thinking (flow and waste-focused).

Given the workshop participants' limited knowledge of design processes and methods, the core team aimed to support the participants to develop a better understanding of design processes and methods. Detailed descriptions of process and method selection are presented in section 2.3.

The applicability (usefulness and ease of use) of the methods was evaluated through multiple data sources and methods: observations, output analysis and questionnaire-based participants' feedback on methods and processes.

NHS ethics approval was obtained from Northampton NEC committee and R&D approval from NoCLor NHS (REC reference: 13/EM/0139).

2.2 Workshop participants

Over thirty people were invited to participate from the following nine stakeholder groups: patients, carers, district nurses, GPs, community pharmacists, hospital pharmacists, hospital doctors, social care workers and commissioners. Healthcare professionals were selected mainly using purposeful sampling to ensure appropriate coverage of those roles and specialities considered by the project team to be of most help. Purposeful sampling was important since general practitioners – independent business entities – had to be paid for their participation to compensate the staff backfill payment. Patients/carers were recruited by one of the project team members through a local community centre.

Table 1 shows the number of the workshop participants by the stakeholder groups. In total, thirty people participated in the workshop at least once. Twenty people on average participated in each workshop (18, 20 and 23 participants for each workshop) and eleven participants were able to attend all three workshops.

Table 1. Workshop participation by stakeholder group

Stakeholder group	Patients and carers	GPs	Practice managers	Community pharmacists	Community nurses	Hospital pharmacists	Hospital consultants	Social care workers	Commissioners	**Total**
Total number	3	5	1	3	4	3	1	2	8	**30**

In each workshop, we formed three discussion groups with 7-10 participants and each group was facilitated by one of the three healthcare professionals in the core team. Figure 1 shows one of the group discussions. The overall workshops were facilitated by the method experts.

Figure 1. Group discussion

2.3 Design Processes and Methods

Three stakeholder workshops, which were planned at three week intervals, were the main part of the design process and there was a series of semi-structured interviews prior to the workshops and a series of steering group meetings after the workshops. Each workshop was planned with a specific objective: i) whole system understanding and issue prioritisation; ii) idea generation and solution development; and iii) implementation planning. The core team aimed to make a sustained impact or real changes in care practices, so the final third workshop was dedicated to implementation planning.

The workshops incorporated a range of tools and techniques to help the participants gather and structure issues, ideas and proposals. Table 2 summarises the overall processes, methods used and intended outputs from each activity.

Table 2 Overall processes, methods and intended outputs

Activities	Objectives	Participants	Methods/Tools used	Intended Outputs
Stakeholder Interviews	To prepare materials for workshops	10	- Semi-structured interview - Graphical elicitation	- Location map - Stakeholder map - Process map - Persona
Workshop 1	To develop a whole system understanding and identify/ prioritise problems	18	- Design process models - Various system maps - Persona - Template for Risk Analysis	Top priority problems
Workshop 2	To generate ideas and develop solutions	20	- Template for Five Whys and Ideal Final Results - Benchmarking solutions	Solution models
Workshop 3	To plan the implementation of the solution	23	- Template for implementation planning (Business Model Canvas)	Implementation proposals
Steering group meetings	To follow up implementation plans	8-10	- System maps	Piloting/Implementation

2.3.1 Semi-structured Interviews

Prior to the workshops, semi-structured interviews were carried out with five representative stakeholder groups (general practitioners, social care managers, community pharmacists, and commissioners). The interviews were 30 – 45 minutes in length and ten participants consisted of 3 general practitioners, 2 social care manager, 1 community pharmacist and 4 commissioners. The following questions were used as an interview guide:

- Describe a typical elderly patient living in their own home and taking four medications or more (persona development)
- Describe existing medication-related care providers and pathways for elderly patients (stakeholder and process mapping)
- How do you want us to run the workshops?

2.3.2 Workshop 1

The objective of the first workshop was to develop whole system understanding and

identify top priority issues to be addressed. At the outset, a workshop facilitator introduced the squiggle (Newman, 2010; Stickdorn & Schneider, 2012) and double diamond design process models (British Design Council, 2007; Stickdorn & Schneider, 2012) to illustrate the nature and stages of design processes to the participants (non-designers) and manage their expectations. The squiggle model (Appendix 1) was used to assure that the participants should take it for granted to feel uncertain at the early stage of the design processes. The double diamond model (Appendix 2) was used to help the participants understand divergent and convergent thinking stages in each workshop. The persona (Appendix 3) developed from the interviews was then presented to help the participants stand in the shoes of the users and focus towards resolving real user needs. The location map (Appendix 4), the stakeholder map (Appendix 5) and process maps (Appendix 6) developed from the interviews were also introduced to support the participants to identify and prioritise issues in the broader context of the whole system. Each group was asked to shortlist five top issues through group discussion, to assess the risk of them using risk-analysis template (Appendix 6) and to choose one issue to be addressed at the 2nd workshop.

2.3.3 Workshop 2

The objective of the second workshop was to generate specific ideas and solution models to address the issues identified in the first workshop. Two methods were introduced: the 'five whys' to identify root causes of the issues of their choice and 'ideal final results' to describe the best desired outcome for the problematic situation. The 'Five whys' method, which the Toyota Production System evolved (Ohno, 1988), simply asks 'why' five times and answers each time, with the aim of discovering the real cause of a problem. Ideal final result (IFR), one of the TRIZ (Theory of Innovative

Problem Solving) tools, is a description of an ideal end state without any mechanisms or constraints attached from the current issue. The IFR encourages “outside of the box thinking” by removing real or perceived barriers (Phinney, 2014). A template for “five whys” and “ideal final results” and an example (Appendix 8) were provided.

A number of solution concepts implemented in different healthcare settings (e.g., medication passport idea, etc.) were then presented to provide stimuli for idea generation. After brainstorming, each group was asked to choose one solution for the third workshop.

2.3.4 Workshop 3

The objective of the third workshop was to plan the implementation of the solutions generated in the second workshop. The business model canvas concept (Osterwalder & Yves Pigneur, 2010) was presented and a template (Appendix 9) was provided as a visual way to guide their group discussion on implementation planning. At the end of the workshop, each group was asked to present their solution and implementation plan and a head commissioner was invited to judge and award the most cost-effective, feasible and sustainable solution and implementation plan.

2.3.5 Post workshop steering group meetings

After the workshops, six-weekly steering group meetings were arranged to take forward the implementation plans. The steering group was 8-10 members and comprised of the core project team members and additional healthcare professionals with experience in the field of medicine management. The majority of them attended some of all of the workshops, but a few newly joined the group without attending any workshop. The

potential impacts of the implementation plans outlined at the end of the third workshop were reviewed and the process of implementation was further discussed.

2.4 Evaluation of participatory systems approach

Multiple data sources and data collection methods were used to evaluate the applicability of design processes and methods used in this project. The observations were complemented by the analysis of the documents and content of the outputs of each workshop. In addition, a questionnaire was carried out with 20 workshop participants to evaluate participants' perceived ease of use and usefulness of the applied methods (utilising a five point scale, from strongly agree to strongly disagree) and to collect their general qualitative feedback.

3 Results

3.1 Interview outputs

Three maps including a location map (Appendix 1), a stakeholder map (Appendix 2) and a process map (Appendix 3) and a persona (Appendix 4) were incrementally created and validated through a series of interviews. The location map was created to show the geographic locations of various service providers including GP practices, hospitals, community pharmacies, community health services and social care service offices. The stakeholder map was created to identify and represent various levels of stakeholders around patients. The patient state transition-based process map was created to describe a repeat prescription process. Persona was generated to describe a fictitious user, called Jeff Abbensetts, who is 77 years old with multiple medical conditions (COPE, Diabetes, Hypertension and Mild depression). He is on fourteen different medications and some are in a blister pack and some are not. In response to the question on the workshop

requirements, some participants highlighted the importance of inviting a wide range of stakeholders to the workshops to get a wide canvas of opinion across various representative stakeholders.

3.2 Outputs from workshop 1

A broad range of problems were brainstormed and identified. Two groups actively used the stakeholder map and captured potential problems using sticky notes as shown Figure 2. The other group, on the other hand, did not actively use the maps and sticky notes, but instead the facilitator took minutes during group discussion.

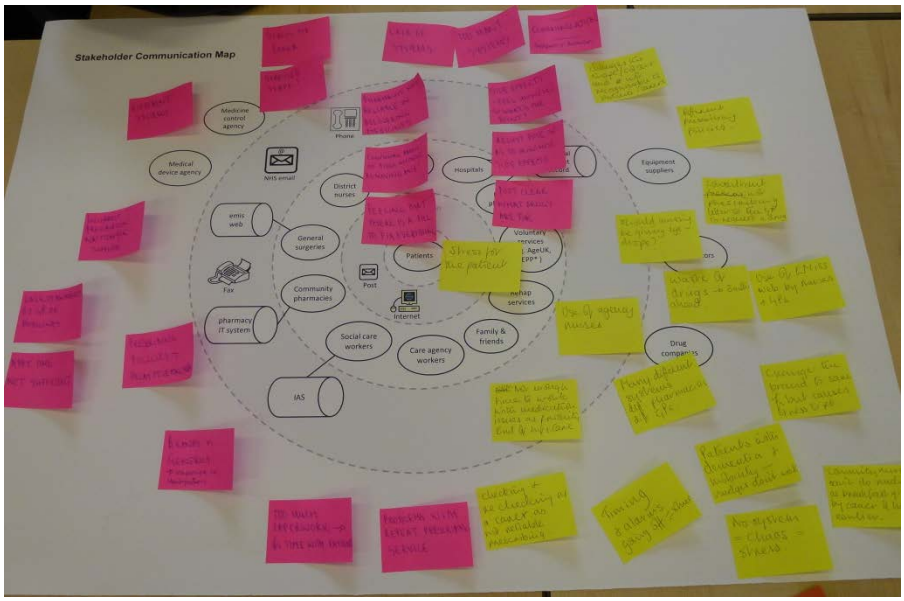

Figure 2 Stakeholder map-based problem identification

All the problems identified were prioritised through group discussion and the top three to five problems were further analysed using the risk analysis template (Appendix 7). All three groups used the template and Table 1 summarises the risk analysis results along with six process steps of a repeat prescription process. It shows that the combination of human (e.g. forgetfulness), technology (e.g. communication technology) and organisational factors (e.g. poor coordination, limited supply) contributed to the medicine management problems.

Table 3 Risk analysis results

Process steps	What can go wrong	Causes	Consequences
1. Prescribing medicines	Prescribe too many medicines	– Poor coordination between prescribers – Poor or no medication review	Hard to take all the medicines Complex regimen
2. Reordering medicines	Reorder medicine too late	– Patient forgets	Running out of medicine
3. Getting medicines	Fail to get medicines on time	– Limited pharmacy opening time – **Poor communication between healthcare professionals (Group 1)**	Running out of medicine
	Get too much medicines	– Automatic repeat dispensing service by community pharmacy	Stock piles of medicines (wastage)
4. Taking medicines (Group 3)	Take wrong medicines	– **Poorly informed patient (Group 2)**	Patient harm, Hospital admission
	Unintentionally do not take	– Too complex regimen – **Poorly informed patient (Group 2)** – Ineffective use of adherence devices (blister packs, etc) – Limited support by social care workers	Worsening condition
	Intentionally do not take	– Side effects – Uncounselled patient – Too many medicines	Worsening condition
5. Managing changes	Delayed changes	– **Poor communication between healthcare professionals (Group 1)**	No medicine
	Fail to implement changes	– Clinical disagreement – Uncounselled patient	Wrong medicine
6. Reviewing medication / medication use	No (infrequent) review Poor review	– No turn-up – Selection criteria	Over prescription

After the risk analysis, the following top priority problems (bold in Table 3) were identified by each group.

- ***Group 1:*** *Poor communication between healthcare workers (Inter-professional communication)*
- ***Group 2:*** *Lack of patient understanding about prescribed medicines (Patient engagement/education)*
- ***Group 3:*** *Non-adherence to prescribed medicines*

3.3 Outputs from workshop 2

The three top-priority issues were fed back to the participants in the second workshop to fully inform any newcomers to the workshop series (less than half of the participants). All three groups used the template for 'five whys' and 'ideal final results' (Appendix 8) and all the solutions generated afterwards are summarised in Table 2.

Table 4 Solutions generated in the second workshop

Categories	Solutions	Pros	Cons
Inter-professional communication	Common IT systems to all staff	No duplication of work	Long term investment
	Memory stick - patient held medical information (Group 1)	Patient in charge	Potential of losing it Confidentiality
	Patient passport - patient held medical information	Patient in charge	Writing is time-consuming and hard to update
	Online - patient held medical information	Patient in charge	Similar concept to an existing solution
Patient engagement /education	Patient engagement in decision making	Better informed patients	Training is required
	Teach back (Group 2)	Good practice proven in other healthcare context	Longer consultation time
	Patient education	Thorough training	Unhelpful if patients have memory loss
Non-adherence to prescribed medicines	Care coordinator	Patient's trusted relationship with one key person	Who is playing this role?
	Practice-based specialist pharmacist (Group 3)	More time with difficult case	Additional cost

Each group chose one solution (bold in Table 4) and further elaborated below. These solutions range from technology-centred (Group 1), human-centred (Group 2) to organisation-centred one (Group 3).

Group1: Patient-held medical information using memory sticks to provide healthcare workers access to the same patient information

This solution is proposed to give health professionals access to the patient's summary health information using a patient-held smart card. This would enable all health professionals to have access to accurate health information about the patient. This would help achieve improved information flow, reduced time waste and a more efficient system for updating patient information.

Group 2: Teach back to educate/engage patients about their prescribed medicines

Teach back represents a system wide change that is underpinned by the principle that well informed patients are more likely to manage their medicines effectively without wastes and errors. Patients are asked to explain back to the professionals what their medication plans are at any interaction with healthcare professionals. This proposal aims to shift all health and social care providers to systematically checking patients understanding of medication management issues at every interaction on medicines related matters.

Group 3: Practice-based specialist pharmacist to proactively address non-adherence issue

This solution proposed an integrated, co-ordinated approach to supporting at-risk patients to take their medicines effectively by adopting a GP-based specialist pharmacist model. It involved developing a new role for proactively identifying patients who need help with medication and referring them for specialists' inputs.

3.4 Outputs from workshop 3

Implementation plans were created using the business model canvas template (Appendix 9) and sticky notes as shown in Figure 3. All the groups actively used them and presented their plans to the whole group and the head commissioner. All three solutions and implementation plans were positively commented and responded by the

head commissioner and ‘Teach back’ was awarded for being a potentially effective solution and a well-thought-out implementation plan.

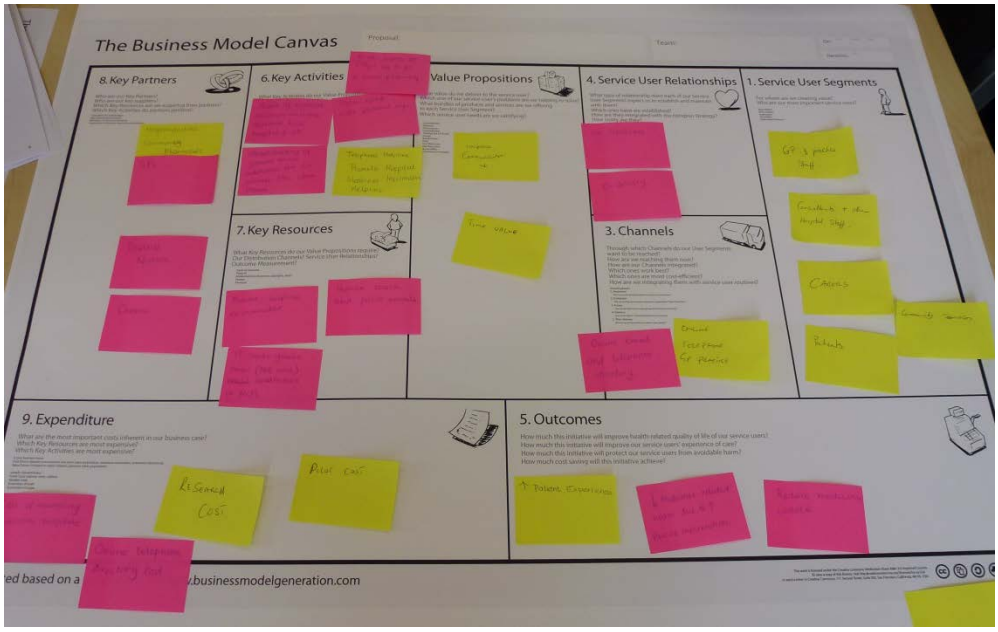

Figure 3 Implementation plan

3.5 Post workshop steering group meetings

As the results of the further discussion on all the three solution models and implementation plans, one implementation plan was decided to be taken forward for piloting. The patient-held memory stick idea was considered conceptually similar to the on-going initiative for making the GP’s electronic patient record widely accessible. The concept of ‘Teach back’ was further expanded to a social campaign idea directed towards raising awareness of medicines adherence issues amongst professionals and patients, but challenged on cost grounds. The practice-based specialist pharmacist model was considered to have a potential wide impact and decided to be taken forward for three month piloting. The results of the pilot study suggested that there were good efficiency and safety arguments to make for a potential role for pharmacists in GP practices. The detailed results of the piloting have been published separately (Shah et

al., 2015).

3.6 Applicability of methods

Among those who attended the third workshop, twenty participants responded to the questionnaire. The workshops were perceived carefully planned and effectively facilitated, helping to ensure that a very heterogeneous range of views was heard. Methodologically, the support from the method experts was generally very well received by the majority of the respondents. Figure 4 shows the participants' ratings for how easy to understand/apply and how useful were each of three maps and three template-based methods. It shows a slightly higher percentage of positive responses towards the three template-based methods. It might indicate that the workshop participants found methods easier to use and more useful when they are involved in completing them by themselves with some guides (i.e. the templates and examples) rather than when they are given something completely produced by others (i.e. the maps). All the groups actively used the template-based methods, but the maps were used to a very different degree by each group. One group did not interact with the maps at all and the other groups actively used sticky notes on the maps. As shown in Figure 4, among the three maps, the stakeholder map was particularly well received and observed to be most frequently used during the workshops.

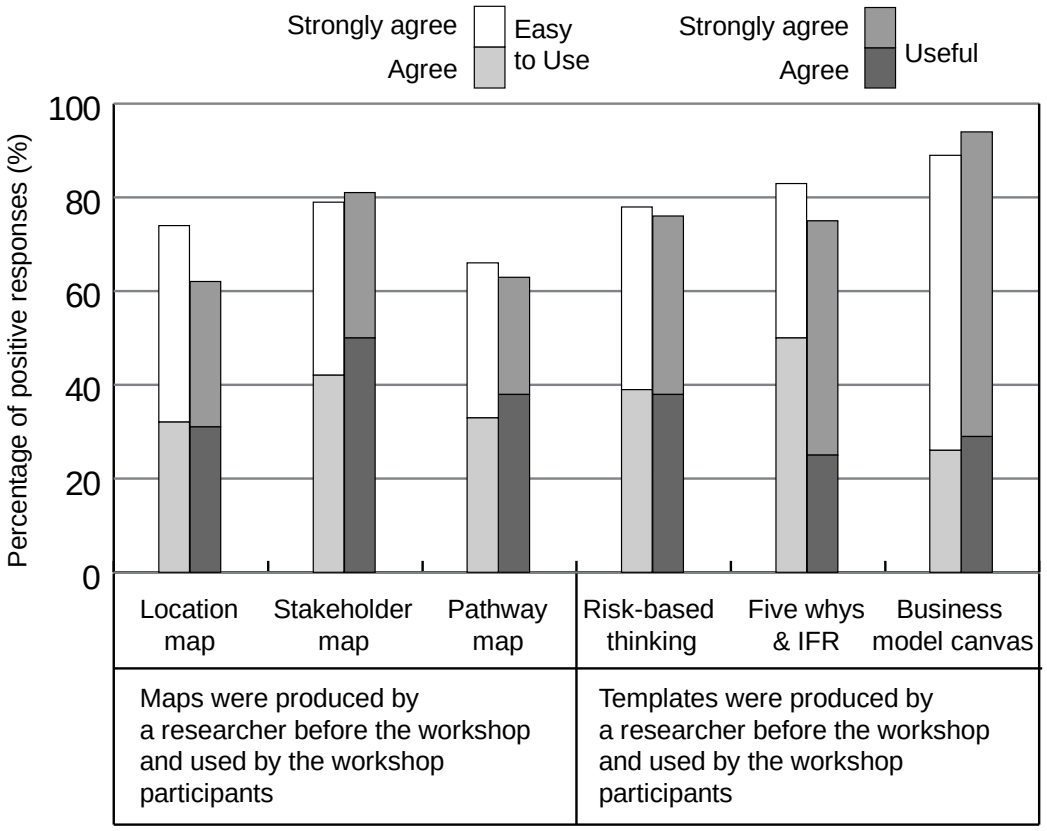

Figure 4. Ease of use and usefulness of the applied methods

3.7 Participation patterns

It was observed that the participation of stakeholders in the workshops was inconsistent and uneven as shown in Figure 5. Healthcare professional participants mentioned work commitments as the reason why they could not attend one or more workshops. Some healthcare professional stakeholders groups, notably social care workers, had a limited representation in spite of their potentially important contribution to this project. It was reported that this was due to the reduced number of staff available at social care organisations. On the other hand, one community pharmacist indicated that he would be able to attend only the first workshop, but changed his work schedule to attend the remaining workshops after attending the first. Patients and carers had a consistent representation, with at least one patient or carer participating in each group discussion. Patients and carers were especially hard to recruit in the first place and a more continual

communication with them facilitated their recruitment and consistent participation across the workshops.

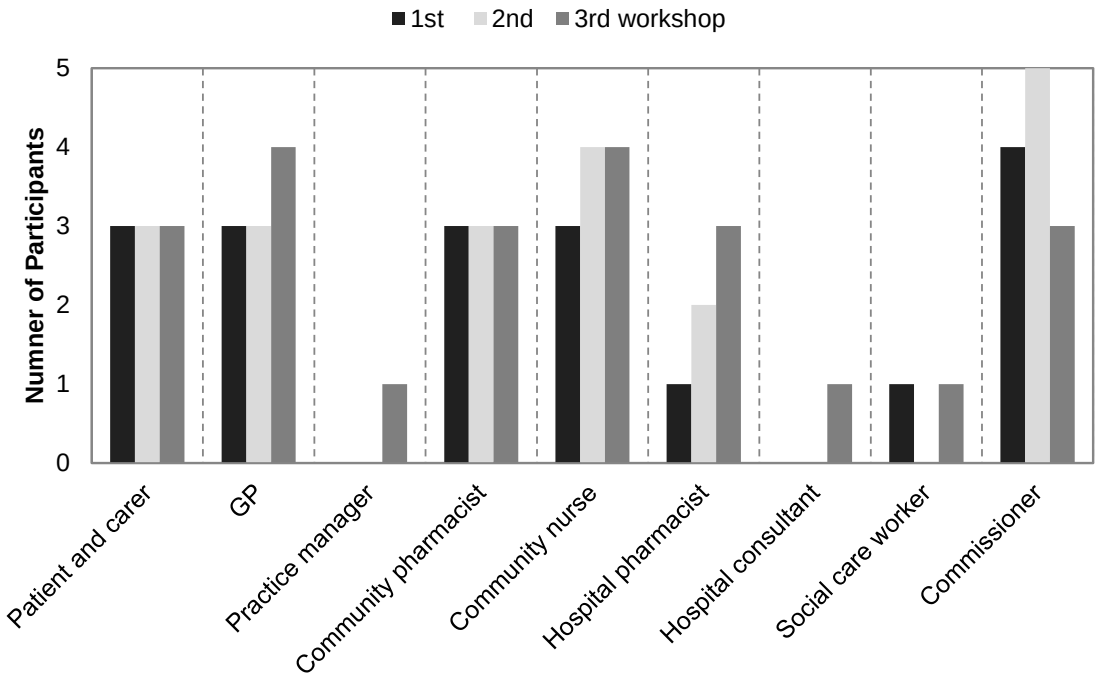

Figure 5. Workshop participants

In spite of such limited circumstances, sixty percent of the respondents indicated the value of speaking with various health and care professionals and patients/carers together. In particular, patients/carers were considered as sources of inspiration (particularly regarding their medicine management stories) and as sounding boards for new ideas.

3.8 Participant engagement

Overall, the majority of the workshop participants (93%) responded very positively about the engagement process and showed their enthusiasm towards the workshop outputs. Three quarters of the participants responded that they were willing to continue to get involved in the project after the third workshop. The well-structured and facilitated workshops with method experts' support were positively mentioned as

below.

"It was a great opportunity to explore ideas from different professional and patient perspectives" (Pharmacist)

"Have this design process for every service the CCG commission" (Pharmacist)

On the other hand, there were comments on needs for more participants and time. One participant requested a more inclusive and considerate group facilitation as below.

"Our (group) coordinator took control of writing post-its and presentation. I did not feel like we could put own ideas forwards." (Pharmacist)

"All day workshop with lunch should have been arranged to allow all to really get them into subjects" (GP)

"More workshops – three are not enough to discuss such an important topic" (Patient/carer)

4 Discussion

This study demonstrated that a participatory systems approach can be effectively and efficiently applied to designing community-based care pathways in the context of stakeholders' limited time for participation and their limited design knowledge. The participants valued the opportunity to explore problems and ideas with other stakeholders, but the use of appropriate methods and processes was essential to turn simply interesting discussion into efficient, structured system-wide discussion for actions. It helped the participants to identify a broad range of issues and solutions at human, technology and organisation levels.

In terms of the overall processes, the interviews with key stakeholders prior to the workshops and a series of steering group meetings after the workshops made it possible to apply an efficient and effective participatory systems approach during the stakeholder

workshops.

In terms of methods, three 3hr stakeholder workshops were efficiently facilitated with various mapping and template-based methods. The combination of method templates and example were particularly well received by the participants and worked very efficiently and effectively.

Some of the methodological issues emerging from this finding relate to striking the right balance between rigour and practicality in method application. Various methods had to be adapted to accommodate the time-constraint. For example, various maps were produced by a method expert prior to the workshops, rather than produced with stakeholders during the workshops. It is well known that group-based process mapping itself could be very beneficial because it can help stakeholders understand each other's work practice (Buckle et al., 2010) . However, it was considered too time consuming to run group-based process mapping since it was necessary to go through the whole design process from problem identification, idea generation and implementation planning, not just system understanding. We found another example of this balance between rigor and practicality in the risk analysis. Risk analysis, like HFMEA itself can take many hours – even hundreds of hours – to carry out (Esmail et al., 2004; Linkin et al., 2005; van Tilburg et al., 2006). When we identified several potential failures in the system through group discussion, we did not systematically analyse the risks of all the potential failures. We asked participants to prioritise the top five issues from their group consensus instead of analysing all the potential failures. Once shortlisted, we asked them to apply the risk analysis template to further prioritise them into one issue to be addressed at the following workshop. The risk analysis had to be applied in a less rigorous way to make it practical under tight time constraint. Our additional intention was to teach the

participants the basic concept of risk-based thinking through this practical method application.

Consequently the roles of method experts changed along with the design process. The method experts' initial role was to apply mapping methods by themselves and share the outputs with the participants later in the workshops. During the workshops, the method experts' role was the educator and facilitator. Some methods had to be explained how to use to the participants and the application had to be facilitated. During the post workshop steering group meetings, the method expert's role was again to apply mapping methods for communication and detail planning.

Three main themes emerged in relation to the challenges in applying participatory systems approaches and further research is suggested for each.

4.1 Representation of stakeholders

The highly-distributed nature of the target service required the participation of many different stakeholders, as it is recognised that the involvement of all key stakeholders is crucial for the success of design projects (Smith and Fischbacher, 2005). However, the project core team had difficulties in recruiting and involving some key stakeholders. Busy professionals, low levels of staff and hard-to-reach patients and carers translated into some key stakeholders missing one or more workshops.

Challenges in recruiting and maintaining involvement of patients have been reported in the application of participatory approach to healthcare in the emergency department setting (Iedema et al., 2010; Piper et al., 2012). More broadly, concerns over the representativeness of patient samples in participatory approaches are raised in a discussion of Experience-Based Co-Design (EBCD) methodology (Bate and Robert,

2007). Xie et al. (2015a) found challenges in involving a representative sample from each stakeholder group while maintaining an effective team size, and experienced difficulties in scheduling meetings in their application of a participatory approach to health service design.

There is potential for geographically distributed and asynchronous involvement in the design process through online-based activity such as the use of social media. Given the fact that the digital and virtual spaces have shown potential as a dynamic environment for further stakeholder engagement innovation (Hagen and Robertson, 2010; Nambisan, 2002), further research is therefore required to understand how online communities can contribute to establishing further engagement with key stakeholders.

4.2 Application of systems methods

The complexity of the target service required a detailed analysis of the problematic situation and the proposed interventions. In particular, it highlighted the need for a whole-systems approach to the design and planning of health services (Edwards, 2005). However, some participants had difficulties in applying a level of analysis consistent with the goals of the workshop. Their analysis was constrained by the limited duration of the workshops and some participants found some pre-produced maps less easy to understand and less useful. It is important to keep the balance right between 'how much method experts should produce in advance to save time' and 'how much stakeholders should be involved in method application to fully appreciate the utility'. This work showed that an appropriate use of templates and examples can facilitate more active engagement of stakeholders' method application. The prior development of complete maps could inhibit the development of system understanding, and the usability and utility of the maps amongst stakeholders. However, time constraints may necessitate

some pre-production to save time. The use of mapping templates and partially completed maps could be further investigated.

4.3 Information management

Within the workshops, information capturing and sharing were found to be important but challenging issues. With method experts not always present at each group discussion, the importance of capturing and sharing the information generated was highlighted.

One way of improving information capturing during the workshops would be to have method experts as group coordinators. A new role of method experts as a group facilitator who enables collaboration between various stakeholders has been highlighted (Thackara, 2005) and become increasingly important. Experience-Based Co-Design projects have used external graphic designers as part of the core team who produced project materials and tools (Bate and Robert, 2007).

The web also could provide a base for information sharing in the health service design projects and further study is therefore required to understand how to streamline information visualization, capturing and sharing between offline and online.

5 Conclusion

This study set out to evaluate processes and methods for a participatory systems approach to community-based health service design. This study has demonstrated that a participatory systems approach can be effectively and efficiently applied in the context of stakeholders' limited time for participation and their limited design knowledge. This study has also shown that appropriate use of processes and methods can turn simply interesting group discussion into efficient, structured system-wide discussion for actions. The findings of this study suggest that a careful balance is required between rigor and

practicality in method selection and application, and between two different roles of the method experts (facilitator vs analyst). Simple templates for method application along with examples (completed templates) were shown to be more engaging to the participants than fully pre-built system maps.

Further work needs to be done to explore the potential of the online-based participatory approach in order to address the challenge of bringing all the relevant stakeholders at the same place and the same time. More research is also needed on how to efficiently engage participants with system maps and how to capture and share information during participatory processes.

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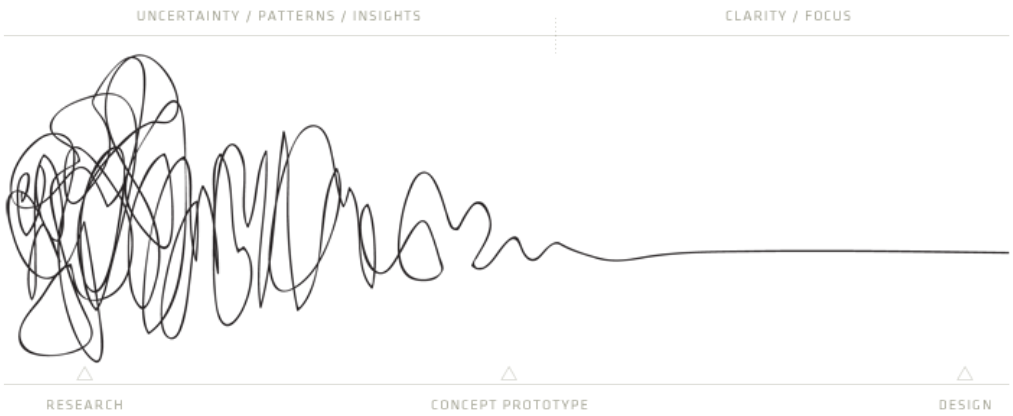
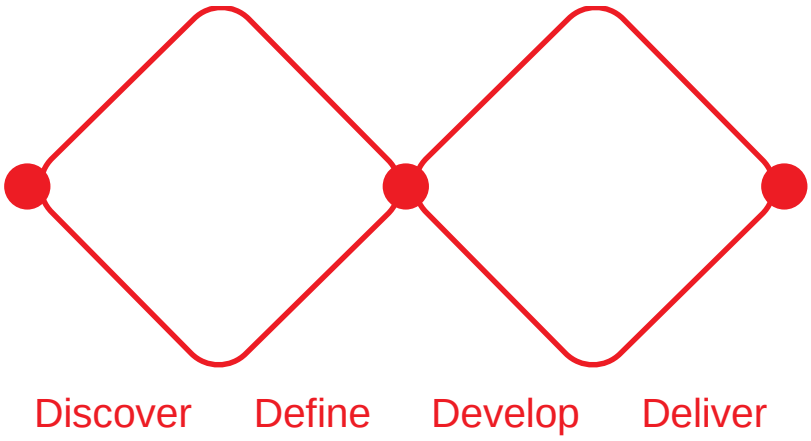
APPENDIX



Appendix 1. Squiggle model - design starts with uncertainty, so it is very natural to feel confused at the beginning of the design process (Newman, 2010; Stickdorn & Schneider, 2012)



Appendix 2. Double diamond model - design is an iterative divergent and convergent thinking process (British Design Council, 2007; Stickdorn & Schneider, 2012)

Jeff Abbensetts

Age: 77

Ethnic Background: Afro Caribbean

Residence: Live alone between Upper Holloway and Crouch Hill (North Islington) on the 2nd floor of a tower block (no lift)

Family & Support Network: Grown-up children who live Manchester visit once or twice a year; he has limited interaction with other people

Hobbies & Leisure: quitted smoking a few years ago, reduced mobility (scooter) and mostly TV watching

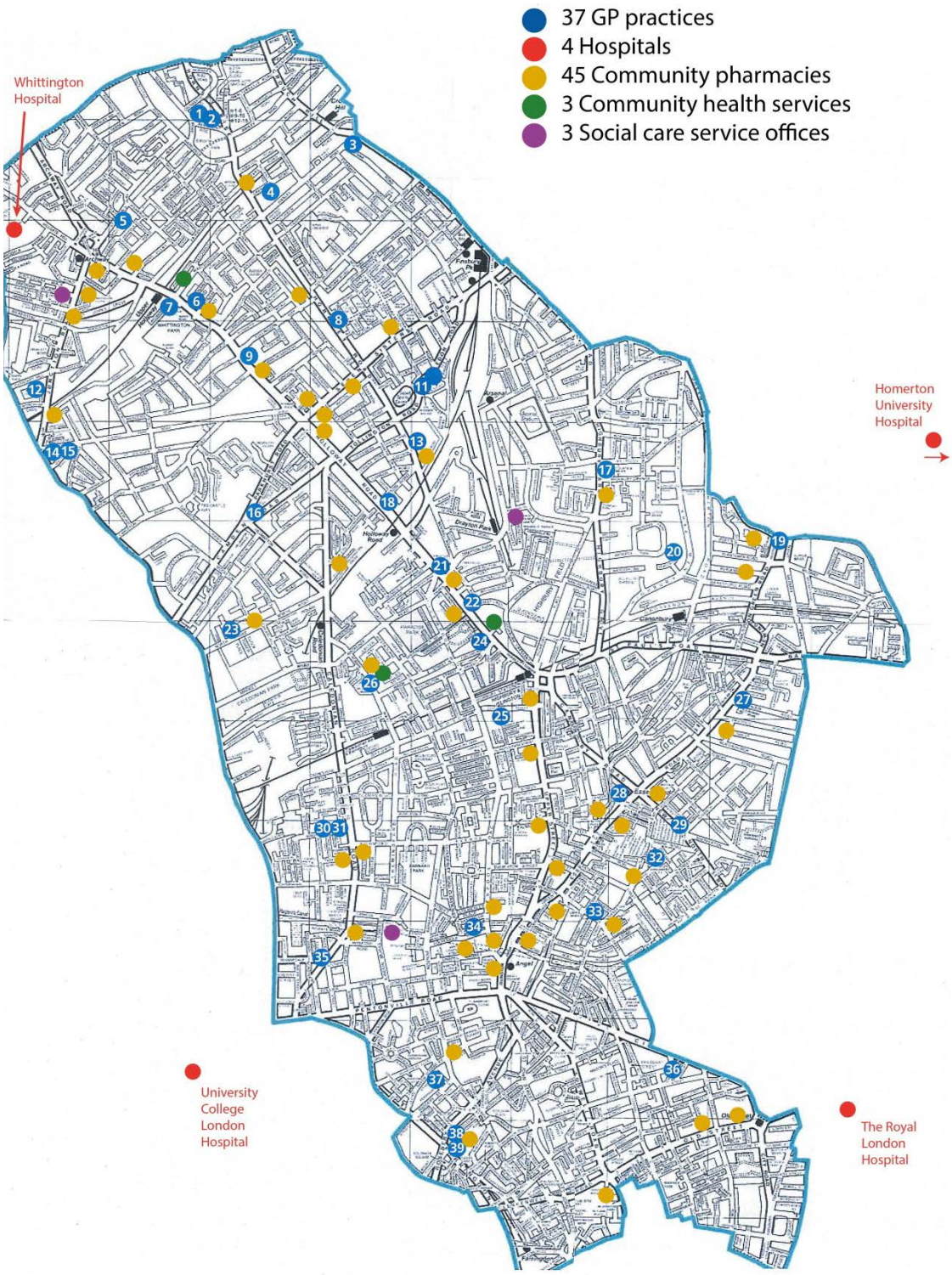
Value: reduced motivation to continue with healthy lifestyle or medication.

Medical History: COPE, Diabetes mellitus, type 2, Hypertension and Mild depression

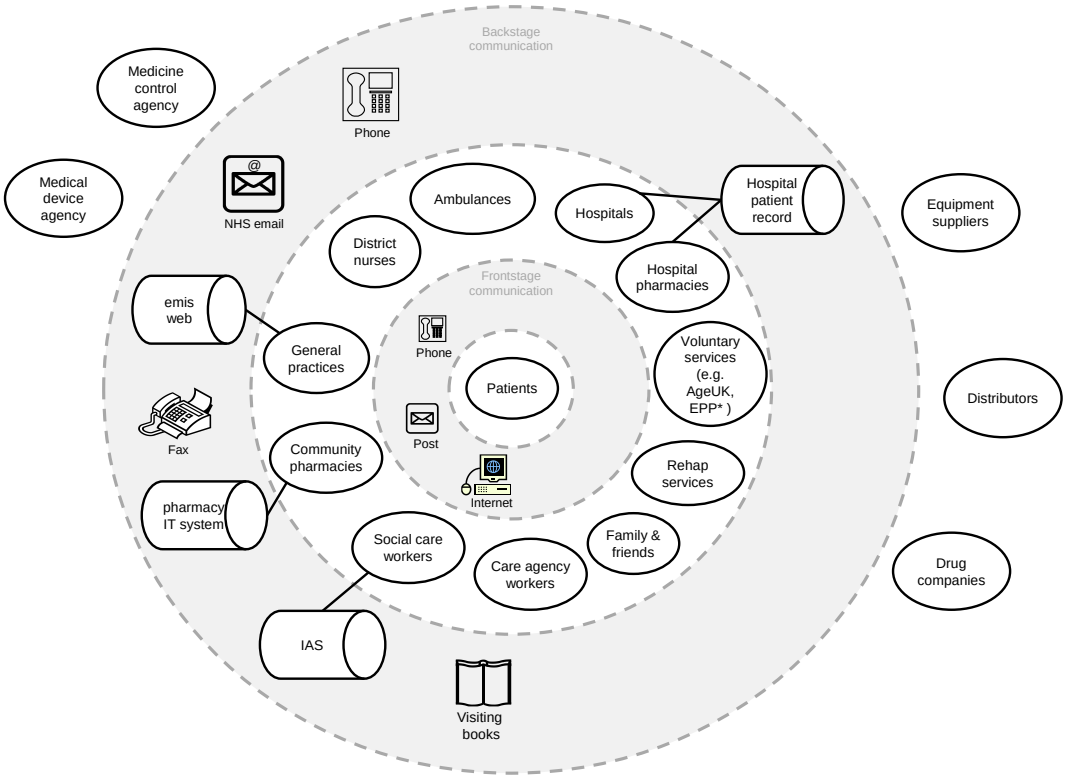
Current medication: delivered to patient's home each month by the local pharmacist

Medication in a blister pack		**Medication outside the blister pack**	
Medication	**Dosage**	**Medication**	**Dosage**
Atorvastatin 20 mg tablets (cholesterol)	One tablet at night	Calcium and vitamin D tablets	Two tablets daily
Amlodipine 5 mg tablets (blood pressure)	One tablet each morning	Paracetamol 500 mg tablets (relief of pain)	1-2 tablets four times a day when required for pain
Clopidogrel 75 mg tablets (blood thinning)	One tablet each morning (with or after food)	Tramadol 50 mg capsules (relief of pain)	One capsule four times a day when required for pain
Sertraline 50 mg tablets (depression)	One tablet each morning	Tiotropium inhaler 18 microgram inhalation capsule (shortness of breath)	One capsule inhaled each day via handihaler
Gliclazide 80 mg tablets (diabetes)	TWO tablets Twice daily (just before or with food)	Budesonide / Formoterol 200/6 microgram inhaler (shortness of breath)	Inhale Two puffs twice daily
Metformin 500 mg tablets (diabetes)	TWO tablets THREE times a day (with or after food)	Salbutamol inhaler (relief of breathlessness)	Two puffs when required for relief of breathlessness
Sitagliptin 100 mg tablets (diabetes)	One tablet each morning		
Folic acid 5mg tablets (supplement)	One tablet each morning		

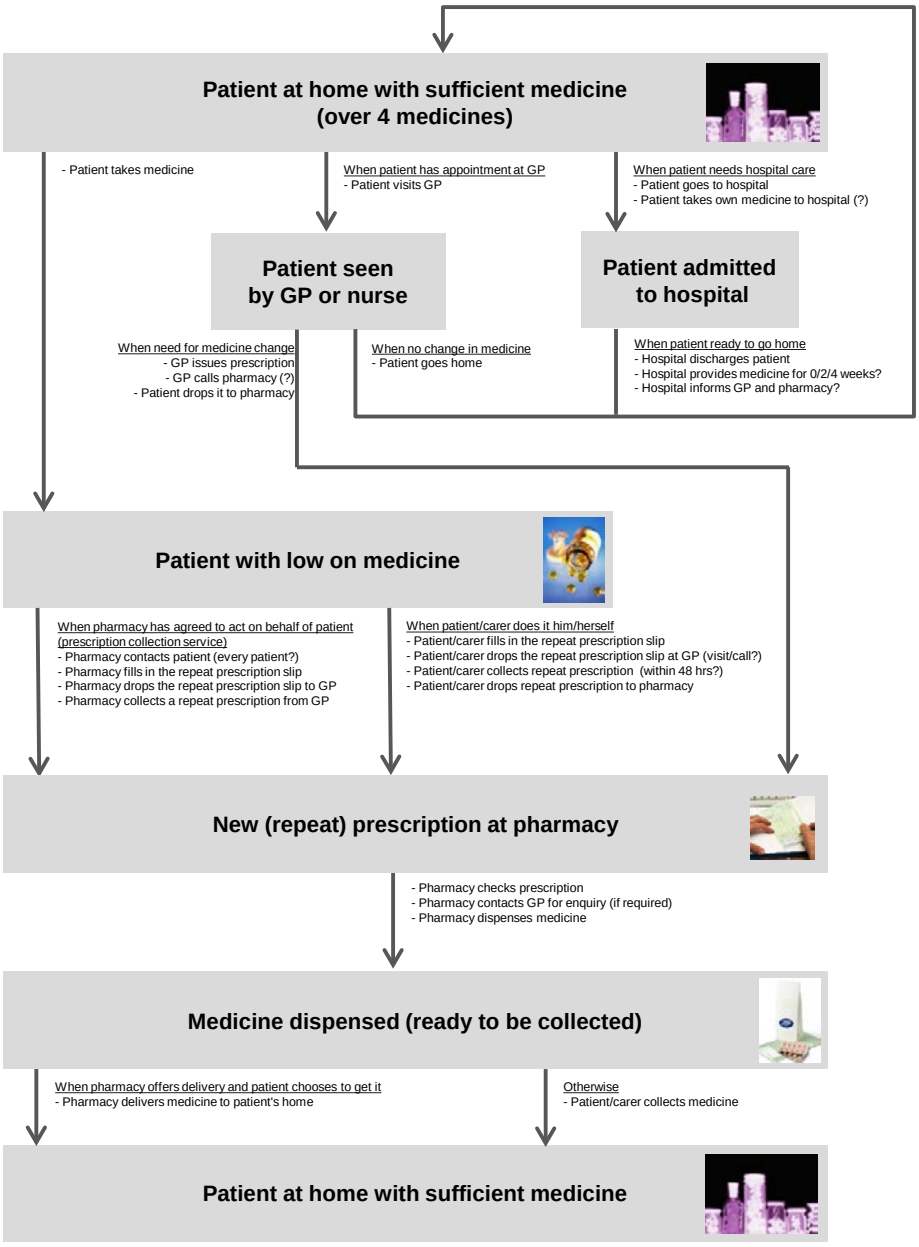
Appendix 3. Persona (descriptions of a fictitious user)



Appendix 4. Service location map



Appendix 5. Stakeholder Map



Appendix 6. Repeat prescription process map

Medication management risk assessment – Workshop 1

1) Issue description

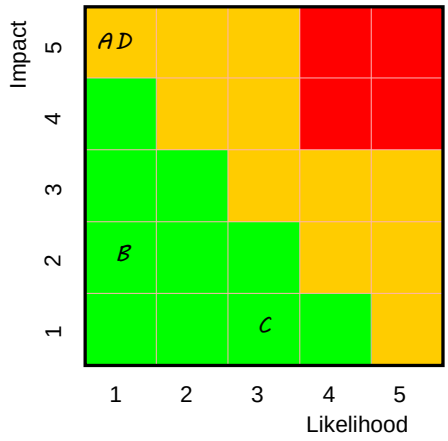
*Patient presents repeat prescription at a community pharmacy· **Pharmacy checks the prescription**· (See Repeat Prescription Process diagram)*

Group No. *2*

Page *1* of *1*

	2) What can go wrong (and why)?	L	I
A	*Wrong drug / strength / etc· issued, leading to drug overdose and harm to patient· Occurs because the Rx is wrong and the pharmacist does not know the patient and has no local record of patient's medication history·*	*1*	*5*
B	*Patient loses the prescription*	*1*	*2*
C	*Pharmacy cannot get in contact with GP to clarify Rx· Patient gets frustrated at having to wait· Line is busy / GP is busy·*	*3*	*1*
D	*Pharmacist dispenses wrong drug to patient*	*1*	*5*

3) What is the risk?



Appendix 7. Template for risk assessment with an example

Medicine Management – Workshop2

1) Issue description

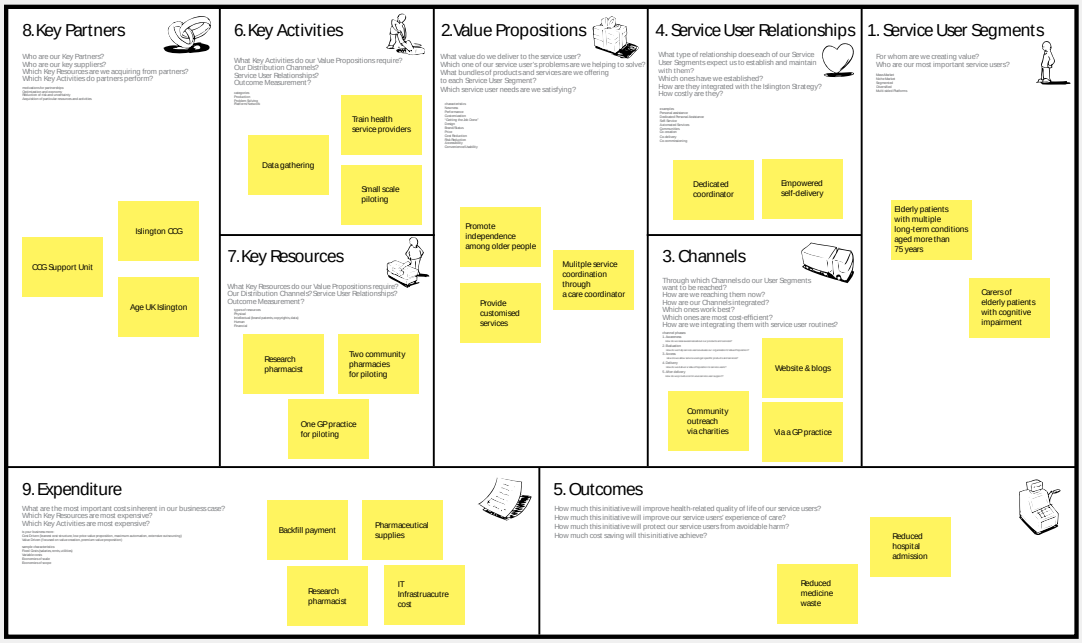
*How do we make medicines that require **special consideration**, available to patients in a **timely** manner?*

Group No. *2*

Page *1* of *3*

2) The Five WHYS	3) Ideal Final Results ; a description of the desired outcome
1. Why can patients not get a prescription from the doctor recommending it? *2. Why does it take so long to get a prescription which requires hospital approval?* *3. Why is there communication breakdown between hospitals and GPs?* *4. …* *5. …*	*Medicines (right amount and type) are always available when needed without any system using existing resources?*

Appendix 8. Template for five whys and IFR analysis with an example



Appendix 9. Modified Business Model Canvas with an example