Digital Health: Changing the Way Healthcare is Conceptualised and Delivered
E. Cummings et al. (Eds.)

doi:10.3233/SHTI190792

Co-Design of a Mobile Health App for Heart Failure: Perspectives from the Team

Leanna WOODS[a,b,1], Erin ROEHRER[a], Jed DUFF[c], Kim WALKER[a] and Elizabeth CUMMINGS[a]
[a] *University of Tasmania, Australia*
[b] *St Vincent's Private Hospital Sydney, Australia*
[c] *University of Newcastle, Australia*

Abstract. Using a Design Thinking and co-design methodology, hospital staff and consumers developed a novel mobile health app for heart failure self-management. Various stakeholders engaged in three development stages: interviews, design workshops and prototype iterations. Eleven of 18 co-design team members reflected on the co-design process and design outcomes. A total of 144 data points were collected: 96 about the co-design process and 48 about the design outcomes. Successes and failures reflect the strengths and weaknesses of operationalising co-design in practice. Overall, participants were surprised the design outcomes were achieved. The app was considered a supportive tool for meaningful self-monitoring and patients believed the app would be applicable to their situations. Our findings suggest that local co-design can be achieved through meaningful partnerships, and managing stakeholders was key to the project's success.

Keywords. Co-design, patient engagement, participatory design, heart failure, digital health, mobile app, evaluation

Introduction

In healthcare, co-design refers to the partnership of consumers, carers, families and health workers to improve health services [1]. It challenges the traditional approach to healthcare improvement where patients are only passively involved [2], if at all [3]. Co-design presents an opportunity to realise the potential of the biggest resource providers have to improve care, the patients themselves [2].

Co-design processes can be powerful but also challenging [3]. For patients, resultant healthcare services are perceivably more humane and person-centred [4], contributing to greater satisfaction in care [1]. For healthcare organisations, co-design can facilitate idea generation, tangible service changes and improvements in the day-to-day experience of giving care [1]. However, in clinical environments where co-design could be advantageous, there may be no formal, practical or financial support for its initiation and execution [4]. Practical challenges include patient and caregiver recruitment or retention, and lack of support, resources or managerial authority [4].

An increasing number of healthcare environments are engaging with co-design worldwide [1] but rigorous studies on its implementation and impact are lacking [1, 3] particularly in acute healthcare settings [4]. In understanding how to better operationalise

[1] Corresponding Author: Leanna Woods: Email: leannaj@utas.edu.au

co-design in practice, analysing stakeholders' accounts of co-design processes are needed. In this research, we evaluated the co-design processes enlisted to develop a mobile health application (app) to support patient heart failure self-management. This paper reports the experiences of clinicians, patients and family caregivers engaged in the co-design process and their perspectives on the design outcomes.

Co-design activities required formation of a multi-stakeholder team with the shared goal to design and develop an intervention for heart failure self-management. The co-design team undertook a Design Thinking process of innovation [5]. The development took nine months and was led by a clinician researcher embedded in the health service as a cardiac clinical nurse specialist. While the specific app development processes are reported elsewhere [6-8], stakeholders were involved in three stages of development: interviews, workshops and iterations. These development stages are detailed as follows:

1. To capture experience data and gather stakeholder needs, interviews were conducted with patients, family caregivers and clinicians. Interview content was analysed and creatively represented in posters (journey map, stakeholder map and patient personas) and design brief summarising design priorities.
2. Then, two 2-hour multi-stakeholder design workshops were conducted on the hospital campus. Design sprint activities (lightning demos, idea matrix, greatest hits and solution sketch) resulted in a storyboard of the app on a whiteboard.
3. Lastly, clickable prototypes were developed and iteratively refined based on feedback sessions conducted with individual stakeholders.

1. Method

1.1. Participants

Ethical approval to conduct the research was granted from the University of Tasmania and St Vincent's Private Hospital Sydney. The co-design team consisted of 7 multi-disciplinary hospital clinicians, 7 local patients and 4 family caregivers. Seven clinicians, 3 patients and 1 family caregiver participated in the evaluation reported in this paper.

1.2. Data Collection

Participants completed an interview to gather perspectives and insights about the co-design process and reflect on the design outcome. Interviews occurred between February and May 2018 and were predominantly conducted in person on the hospital campus. Three participants responded via email exchange.

First, the 'Rose, Thorn, Bud' technique from Design Thinking [9] was used to evaluate the process. The technique is a simple, versatile method for identifying issues and insights, to then uncover emergent patterns across all respondents [9]. Participants were asked to respond to the question '*How did the app design process go?*'. The strength of the approach was initial codifying of research data as participants wrote one issue, insight or idea directly on coloured post-it notes. Red notes represented positive aspects of the co-design process, blue represented negative aspects and green represented improvement suggestions if the process was repeated [9].

Second, to gather opinions about the design outcome, participants were asked to respond to two questions by writing directly onto post-it notes. The questions were: *What do you think of the app?* and *Would you use or recommend the app?* In answering these

questions participants were encouraged to provide rationale or examples and consider the healthcare context in which the app would be implemented.

1.3. Data Analysis

The research team used an affinity diagram, modified for application as a Design Thinking technique [10], to find connections in the data and identify themes. Data points (participant response on a post-it note) were reviewed collaboratively and placed alongside other, similar data points. Consistent with this methodology [10], the process was repeated until all data were clustered, then headers were created to label what connects the data within the cluster. The headers generated from this data analysis process informed the findings of the study. Headers from the co-design process data were reported as either successors or failures to reflect the strengths and weaknesses as expressed by participants. Headers from the design outcome data represented participant opinions of the app itself.

2. Results

A total of 144 data points were collected from 11 participant interviews. Clinicians included a cardiac nurse consultant, cardiologist, physiotherapist, dietitian, pharmacist and two heart failure nurse practitioners. Two male patients, a female patient and a male caregiver participated with an age range of 51-80. First, the co-design process evaluation is reported and second, the design outcome opinions are presented.

2.1. Co-design Process Evaluation

Ninety-six data points were collected representing 64 positive aspects, 14 negative aspects and 18 improvement suggestions. Data analysis resulted in a list of successes and failures as experienced by participants. See **table 1**.

Table 1. Successes and failures of the co-design process as reported by various stakeholders

Success/ failure	Key finding	Stakeholders
Successes	Structured approach with regular feedback	Predominantly clinicians
	Involving many stakeholders including patients	Clinicians, patients and family
	Co-design activities that were quick, flexible and involved ongoing communication	Clinicians, patients and family
	Participation was a research engagement opportunity	Clinicians
	Participation was an opportunity to give back	Patients and family
Failures	Inadequately diverse stakeholders	Clinicians and patients
	Not reviewing comparable health apps	Clinicians and patients
	Not adequately addressing the app's implementation	Nurse practitioners only

2.1.1. Successes

The structured development approach with regular feedback, was efficient. Described by clinicians as 'organised chaos' (clinician 1), workshops were 'well organised, productive and ran to schedule' (clinician 2). Clinicians were positive about their ability to provide

regular feedback during the design and the efficiency of the process, exampled by the response '[it was a] time efficient process throughout development' (clinician 3).

Involving many stakeholders including patients was beneficial to the quality of the final design. Responses demonstrated the positive impressions of including various stakeholders from early in the design process: 'including patients in development process to get their ideas and perspectives' (clinician 4), 'incorporating key stakeholders into process from the beginning' (clinician 3), and a 'multi-focused consultation all together in the same room with all stakeholders including patient with feedback' (clinician 5).

Co-design activities that were quick, flexible and involved encouraging, ongoing communication were reflected on positively. Clinicians needed to manage their existing workload stating 'I'm too busy for a whole day [workshop]' (clinician 1). Patients and family caregivers commented on the ongoing communication during the project, for example: 'our email correspondence was informative and encouraging' and the 'project lead [had] intuition to ask the correct questions' (patient).

Participants reported their motivation to participate in the project. For clinicians, co-design was a research engagement opportunity. Clinicians communicated their professional responsibility to be 'involved in campus research' (clinician 1) and found the learning process interesting 'by participating in [the] process I also learnt about the app design process and Design Thinking tool' (clinician 2). For patients and family caregivers, participation was an opportunity to give back to the health service, as one patient described 'they're doing lots for me . . . I would do something for them'. Patients responded positively to their invitation to be involved in the co-design process in the example responses: 'glad to come in and help' and 'I feel honoured to be asked'.

2.1.2. Failures

The stakeholders involved were inadequately diverse to capture a wide variety of perspectives. Suggestions included engaging more patients to get 'a better representation of patient's view' (clinician 2), especially 'early in the design' (patient). Involving younger patients, more caregivers and a public health nurse was also recommended.

Reviewing comparable health apps may have been beneficial for the design. An 'overview of similar products' and 'other chronic disease applications' were improvement suggestions from a patient and a clinician, while the physiotherapist would have 'researched options for exercise videos' if they had anticipated the challenges associated with designing the exercise section of the app.

Both nurse practitioners responded with several unanswered questions regarding the app's implementation. These responses included: 'where to now?', 'can we use this [app]?' and 'who takes control?', listing legal, funding and health fund issues as specific barriers to implementation.

2.2. Co-design Outcome Opinions

Secondly, 48 data points represented team members reflections on the design outcomes. Participant responses were almost all positive with participants surprised the design outcomes were achieved. This was demonstrated by the comments: '[I'm] surprised the app came to life…all that was discussed in the focus/planning groups came true' (clinician 4) and 'congratulations to where you've got to in the development' (patient).

Ten of 11 participants interviewed would recommend or use the app. Clinicians would recommend the app for the 'younger generation' of patients and carers 'depending

on IT skills' specifically regarding their ability to use mobile technologies. Patients would use and recommend the app but recognised they would need 'a few days to be at ease with it' and it would take 'a while to get used to doing it [self-management] this way'. One clinician said they *might* recommend the app if the exercise section was reviewed and updated. None said they would not use/recommend the app.

The app was considered a supportive tool for meaningful self-monitoring for all stakeholders. Clinician 5 communicated how the app may be used 'I see it will be a wonderful tool to support heart failure patients and their family and clinicians'. Positive features were ease to 'self track', using 'meaningful, timely data' specifically through 'self-reflection of symptoms and how it ties to behaviour'. The user interface was considered simple, easy-to-use, particularly favouring the modular design with a customised home screen to address patient preferences. Generally, the information within the app was considered comprehensive, however one clinician suggested it may be 'too much' information to manage for the target patient group.

Patients believed the app would be relevant to their situations. The main reasons were the convenience of having data 'all stored together' especially for 'things I don't remember like blood pressure – it's all documented' and to mitigate using a paper diary. Clinicians believed having the data in one system would improve clinicians' time management and communication, stating the app is like an electronic health record.

3. Discussion

The in-hospital co-design process was overwhelmingly positive for those involved. Two key lessons were learned from this evaluation.

Key learning 1: Using a structured approach to innovation, local app design and development can be achieved by clinicians and patients. Participants reported success applying the Design Thinking process to the development but similar, highly-structured co-design approaches also exist. A notable approach is Experience Based Co-design [3]. A free-to-access toolkit for the Australian healthcare sector [1] and an 'accelerated' version [3] to achieve a quicker, lower cost result, are now available. Adopting the 'monitor and maintain' component of this approach [1] may have addressed the concerns around the implementation of the app. Regardless of the chosen approach, clinicians can lead co-design processes, successfully partner with consumers, and make embedded innovation and quality improvement a reality.

Key learning 2: Executing a co-design project is about stakeholder management. The format of co-design often involves a renegotiation of roles and expectations of stakeholders, particularly around power dynamics between provider and consumer [3]. The findings suggest this dynamic of stakeholder interaction resulted in positive experiences, similar to other healthcare co-design projects [2]. However, the relative lack of documented evaluations of co-design projects is likely reflective of the stage of adoption in the health sector [4] and raises recommendations for future research. Of particular significance is stakeholder selection. Our evaluation reported that 'involving many stakeholders' was a success but 'inadequately diverse stakeholders' was a failure. This signifies the importance of building meaningful, appropriately-sized co-design teams. Donetto and colleagues suggest 'as many stakeholders as possible have input' [3[p234]], however in health research - at least in this project - participation was limited by ethical approvals, access to volunteer consumers and competing priorities of clinicians and organisations. Our findings also suggest those involved in co-design are loyal to the

design outcomes and may be less likely to identify barriers to sustainability of design outcomes. Consequently, involving a new subset of patients to test the designs would be needed to capture the app's true usability for an uninitiated user.

In interpreting the findings, it is necessary to highlight the study's limitations. First, few patient and family participants were involved to the project's completion, so the findings were weighted towards clinician perspectives. Second, the clinician researcher in the co-design project conducted the interviews rather than a non-biased third party.

4. Conclusion

Analysis of stakeholders' accounts of the co-design process has enabled a deeper understanding of the strengths and weaknesses in operationalising co-design. These understandings have supported our initial impressions that co-design can be achieved with a sincere partnership between staff and consumers. However, 'inadequately diverse stakeholders' was a failure, signifying the importance of selecting a meaningful, appropriately-sized co-design team. The findings have suggested that managing stakeholders throughout the design is key to the project's success.

Acknowledgements

This project is supported by a St Vincent's Clinic Foundation Grant and the University of Tasmania's Elite Research Scholarship funded by The District Nurses.

References

[1] P. Dawda, A. Knight, *Experience based co-design; a toolkit for Australia* (2017). Accessed March 3, 2018 from the Australian Healthcare & Hospitals Association website https://ahha.asn.au/experience-based-co-design-toolkit

[2] G. Robert, J. Cornwell, L. Locock, A. Purushotham, G. Sturmey, M. Gager, Patients and staff as codesigners of healthcare services, *BMJ* **350** (2015), g7714.

[3] S. Donetto, P. Pierri, V. Tsianakas, G. Robert, Experience-based co-design and healthcare improvement: realizing participatory design in the public sector, *The Design Journal* **18**:2 (2015), 227-248.

[4] D. Clarke, F. Jones, R. Harris, G. Robert, What outcomes are associated with developing and implementing co-produced interventions in acute healthcare settings? A rapid evidence synthesis, *BMJ Open* **7** (2017), e014650.

[5] Hasso Plattner Institute of Design at Stanford University, *A Virtual Crash Course in Design Thinking* (2017). Accessed March 17, 2017 from https://dschool.stanford.edu/resources-collections/a-virtual-crash-course-in-design-thinking

[6] L. Woods, E. Cummings, J. Duff, K. Walker, Conceptual design and iterative development of a mHealth app by clinicians, patients and their families, *Studies in Health Technology and Informatics* **252** (2018), 170-175.

[7] L. Woods, E. Cummings, J. Duff, K. Walker, Design Thinking for mHealth application co-design to support heart failure self-management, *Studies in Health Technology and Informatics* **241** (2017), 97.

[8] L. Woods, E. Cummings, J. Duff, K. Walker, Partnering in digital health design: Engaging the multidisciplinary team in a needs analysis, *Studies in Health Technology and Informatics* **252** (2018), 176-181.

[9] Innovating for People: Handbook of Human-centered Design Methods. LUMA Institute. Pittsburgh, PA, USA, 2012.

[10] M. Weprin, *Design Thinking Methods: Affinity Diagrams* (2016). Medium post by UXDICT.IO, accessed November 19, 2018 from https://uxdict.io/design-thinking-methods-affinity-diagrams-357bd8671ad4