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Future Health Today: Co-design of an electronic chronic disease quality improvement tool for use in general practice

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Title: Future Health Today: Co-design of an electronic chronic disease quality improvement tool for use in general practice

Abbreviated title: Future Health Today: Co-designing QI in general practice

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ABSTRACT (300)

Objective: To co-design an electronic chronic disease quality improvement tool for use in general practice

Method: Co-design sessions with general practice staff, using a service design approach, were conducted to explore key design criteria and functionality of the audit and feedback and clinical decision support tools. Think Aloud interviews were conducted in which participants articulated their thoughts of the resulting Future Health Today (FHT) prototype as they used it. One co-design session was held with patients. Using inductive and deductive coding, content and thematic analyses were conducted to explore the development of a new technological platform and factors influencing implementation.

Results: Eight GPs, five practice nurses and four practice managers, representing general practice in metropolitan Melbourne and regional Victoria, and five patients from metropolitan Melbourne participated in the study. Participants identified that the prototype needed to work within their existing workflow to facilitate automated patient recall and track patients with or at-risk of specific conditions. It needed to be simple, provide visual snapshots of information and easy access to relevant guidelines, and facilitate quality improvement activities. Successful implementation may be supported by accuracy of the algorithms in FHT and data held in the practice; the platform supporting planned and spontaneous interactions with patients; the ability to hide tools; links to Medicare Benefits Schedule; and pre-filled management plans. Participating patients supported the use of the platform in general practice. They suggested the use of the platform demonstrates a high level of patient care and could increase patient confidence in health practitioners.

Conclusion: Study participants were looking for, and worked together to design, a platform that is clear, simple, accurate and useful, and that sits within any given general practice setting. The resulting FHT

platform is currently being piloted in general practices and will continue to be refined based on user feedback.

Strengths and limitations of this study

- Co-design, using a service design approach, was used to inform development of a new chronic disease quality improvement tool.
- General practice staff from regional and metropolitan settings and a broad range in experience in use of technology participated in the study.
- Iterative technical development process was used to validate co-design principles throughout development
- General practice and patient participants may not have been representative of these groups more generally
- Prototype developed through this process requires piloting and further testing to determine fidelity, validity and effectiveness

BACKGROUND

More than four in five Australians visit their GP at least once per year, and two million attend each week.[1, 2] As medical knowledge continues to increase at an exponential rate it is crucial that this knowledge is translated efficiently and effectively into the general practice setting, where the majority of Australians receive their medical care. This is critically important for people at risk of, or with, three common, interrelated conditions which affect more than two million Australians and lead to further health complications, disability and premature death: chronic kidney disease (CKD), cardiovascular disease (CVD) and type 2 diabetes (T2D).[3] These conditions share risk factors and management strategies, which, if put in place early, have the potential to reduce disease progression and the development of complications, improving quality of life and reducing burden on the health care system.[3] As such, there is interest in the development and implementation of quality improvement (QI) programs in general practice targeting these conditions.

Successful QI programs are multifactorial and can include elements such as audit, feedback and clinical decision support. A Cochrane systematic review of the impact of audit and feedback concluded that potentially important changes in professional practice can be achieved, particularly if feedback is: 1) reported more than once; 2) delivered in multiple formats; and 3) includes explicit targets and action plans.[4] A review of systematic reviews found that changes to professional behaviour are more likely with multi-faceted interventions including reminders, audit and feedback that create a set of 'rules' about practice that when enacted become a normal component of everyday practice rather than single interventions.[5] Computerised clinical decision support has the potential to improve health professional performance [6], and is more likely to be effective if the advice is provided automatically, on the screen, with patient-specific suggestions, and combined with other strategies such as the use of key opinion leaders and educational sessions.[7, 8]

Australian general practices were early adopters of electronic medical records (EMRs) in the 1990s, with near universal computerisation by 2006.[9] The data stored within these records can be harnessed to facilitate QI activities and facilitate the translation of research into practice. The Australian government introduced a QI Practice Incentive Payment for general practices in August 2019 (requiring submission of data to Primary Health Networks and participation in QI activities), bringing increased focus on QI activities.[10]

The aim of this study was to co-design with end users an electronic chronic disease QI tool incorporating audit and clinical decision support for use in general practice. This paper describes the outcomes of the development process.

METHOD

Study design

The QI tool was developed using service design methodology.[11] This method involved three co-design engagements with general practice staff, one co-design session with patients and an acceptability and feasibility test of the resulting tool through 'Think Aloud' sessions.

Patient and Public Involvement

Patients were recruited at the beginning of the project to provide input in the development and refinement of the QI tool. They provided meaningful feedback on the acceptability of the tool for patients.

Recruitment

General practice staff (general practitioners (GPs), practice nurses and practice managers) were recruited through VicReN, the practice-based research and education network at the Department of General Practice, University of Melbourne. General practices that are currently participating in the Department's Data for Decisions research program were approached to participate [12]. This population was approached as they have an interest in data-driven general practice research and represent a wide range of general practice, in terms of billing structure, location (metropolitan, regional and rural practices) and structure (community health centres, private general practice). They were invited to participate via newsletter and e-mail.

Patients were recruited using advertisements in practices of participating general practice staff and through networks of the investigator group. Interested participants contacted the researchers for further information and an invitation to participate. All participants gave informed consent to participate.

Data Collection

Co-design sessions

General practice participants

The co-design methodology consisted of an iterative process where participants discussed current QI systems, identified barriers and facilitators that could be addressed by technology and provided feedback into the tool development. In each session, participants were provided with information on the status of the development of the chronic disease quality improvement tool, called 'Future Health Today' (FHT), and were asked to provide comment and feedback. The ideas and improvements were incorporated into the tool, subject to technical requirements. A semi-structured interview schedule was utilised to prompt and guide discussion. Meetings were held face to face at the Department of General Practice, University of Melbourne.

The first engagement (initial design)

Service design methodology using storyboarding to explore the health services journey was utilised to inform development of FHT, using chronic kidney disease as an exemplar.[11] Participants were asked to prioritise elements of the prototype for development (including concepts identified by the research and technology teams and by participants themselves) and reality check the platform and proposed components within it.

These sessions asked participants to apply 'blue sky thinking' with chronic disease management in general practice. They were asked to describe and discuss how they currently identified at-risk groups (opportunistic vs planned); what they do once the at-risk groups are identified and how they make this determination; how they identify and manage risk in relation to chronic disease management and in relation to data management; how they manage, enter and store data; how well their current data management systems (including EMR and third party applications) function; if and how they plan and document QI and audit; and if they utilise or would be interested in benchmarking. Finally, participants were asked about proposed FHT functionality - what they would prefer and what they do not like.

The second engagement (functionality)

These co-design sessions provided participants with a version of the prototype that incorporated many of the features discussed in session 1, described as a 'dashboard'. They focused on deeper discussion of the design aspects of the prototype and specifically on the preferred functionality and priorities for the designers relating to the dashboard. This was a heavily technology focused session that included discussion of categorisation and stratification of clinical information; workshopping appearance and basic functionality; and reflecting on issues and preferences discussed in previous sessions.

The third engagement (refinement)

These co-design sessions provided participants with the next version of the prototype for discussion, and asked them to focus on a clinical decision support component to be primarily used at the 'point of care' in consultation. Changes had been made to the system based on previous discussion and these were reviewed and refined through group discussion.

Zoom videoconference sessions

Separate zoom videoconference sessions were held for participants that were either not able to attend the face-to-face sessions or who were based in regional Victoria and not able to travel to Melbourne. Two sessions were held; the first focussed on initial design and functionality; the second focussed on refinement (was held on two separate occasions with different attendees on each occasion).

Sessions were recorded using a digital audio and video recorder, and field notes and sketches were collected for the face to face sessions.

Patient participants

The co-design session with patients focused on the components patients felt were important in a system designed to help identify and manage chronic health conditions. The group discussed the process of being recalled, seen and managed by a doctor for a chronic health condition. They received a demonstration of the prototype tool and explored ideas of acceptability about using technology platforms for health care and opinions about active participation in recalls for medical appointments.

The session was recorded using a digital audio and video recorder and field notes were collected. All audio recordings were transcribed and de-identified for analysis.

Think Aloud Interviews

Following the co-design sessions, a working prototype was developed, and a sub-set of general practice co-design panel members were invited to participate in a 'Think Aloud' session at the Department of General Practice, University of Melbourne, where they talked through their use of the tool and made suggestions for improvement prior to development of the final prototype.[13] They were recorded using a digital video recorder and screen capture technology and field notes were taken.

Data analysis

General practice co-design sessions

The analytical structure applied to this phase of the project involved a two-pronged approach. As one intention of the phase was to explore the components that were essential to include in a new platform for the identification and management of chronic health conditions, the first stage of analysis involved a content and descriptive analysis of current processes and preferred technological functionality of a new system for identification and management of CKD. A further content analysis of the field notes and interviews reviewed items arising throughout the co-design process to enable a fidelity check at the end of the development phase and throughout the piloting/refinement process to ensure that the final product both met the end user need and remained faithful to the co-design key design features. Using an inductive approach, codes were generated from the data to identify what was currently being used, what was missing and what could go in the new platform. Data was reviewed and coded by two researchers.

A thematic analysis [14] was then conducted to examine what co-design participants felt was most important in development and implementation. A combination of inductive coding and deductive coding was utilised.

Patient co-design session

A thematic analysis was conducted on the data captured in the patient session, examining key issues arising for participants that may influence the development and implementation of the FHT platform.

All analysis was conducted using NVivo qualitative data analysis software (QSR International Pty Ltd. Version 12, 2018).

Think aloud sessions

The Think Aloud sessions were analysed utilising content analysis technique.[15] As sessions were focused specifically on the functionality of the FHT platform, analysis examined issues that arose during the short 'test run' of the software.

Ethics approval

Ethics project approval was granted by the Melbourne Health Human Research Ethics Committee, The Royal Melbourne Hospital (Ethics ID: HREC/47394/MH-2018) and registered with the University of Melbourne Human Ethics Sub-Committee (Ethics ID: 1852972).

RESULTS

We aimed to recruit ten participants (four GPs, two practice nurses and two practice managers) to the general practice co-design sessions, however, due to significant interest, 17 people were recruited to participate (eight GPs, five PNs and four PMs), representing practices across metropolitan Melbourne and regional Victoria. Three face to face and three zoom videoconference sessions were conducted, with variable attendance across sessions (See Table 1). Each face to face meeting ran for 85-120 minutes. Each remote session ran for 40-60 minutes.

Table 1. Practitioner participation in co-design sessions

Role	Initial design (1)	Functionality (2)	Zoom (design and functionality		Refinement (3)	
	F2F	F2F	Session 1	Session 2	F2F	Zoom
GP	3	4	4	2	5	1
PN	4	1	1	0	1	0
PM	3	1	1	0	1	1
Total	**10**	**6**	**6**	**2**	**7**	**2**

Over the six sessions participants shifted their focus from the blue skies possibilities of FHT to the practical reality of what the platform was best suited to do, and how it filled the gaps left by existing electronic record management systems. The evolving discussions refined the intended purpose of FHT, and streamlined the activities that should sit within the FHT platform. Participants were enthusiastic about the possibilities for identifying at risk patients, and for filtering and stratifying large databases of patients into a snapshot review of their health status across chronic conditions. Participants felt that FHT needed to be flexible enough to sit across different visual processing styles, EMR systems, and general practice structures.

Key features that participants wanted FHT to include, together with illustrative quotes are summarized in Table 2.

Table 2. Key requested features of Future Health Today, with illustrative quotes

Key feature	Example quotes

Ability to track number of patients at risk of CKD	*"because people who are likely to have the highest number of risk factors …are the group of patients that we are most likely to be able to do something meaningful for by knowing who they are and capturing who they are. Especially in clinics with small numbers of doctors, yet with too many patients, being able to focus on the patients where we are able to make the most meaningful difference is going to be really helpful" (Session 2, GP, zoom, rural and metropolitan)*
Automated patient recall	*"Reminder and recall systems in practice software is inadequate…people are slipping through" (Session 2, PN, zoom, rural and metropolitan)*
Elements to fit within workflow	*"When you're in this you want to be in action mode. You've got your data, you've got your information, you know what you want to do and all of a sudden your clinical decision making says 'ok, what is my strategy, which do I do next, when do I do it what do I have to do and what order do I need to do it" (Session 3, GP, face to face, metropolitan)*
Ability to filter data through a range of lenses	*"What's really good about that, it came up in the group discussion, a smaller practice with perhaps less enthusiasm for this, you can actually drill down and get quite small numbers to begin with that allows people to get their feet wet with looking at the key issues and looking at trying to change behaviours or introduce medications, and as you grow in confidence you can start softening your filter and capturing a wider group." (Session 5, GP, zoom, rural)*
Incorporation of quality improvement cycles	*"Could you have a print out so that when you have your monthly meetings you can say this is where we started, this is where we are now and of course this is going to help with QI?" (Session 1, PN, face to face, metropolitan)*
Links to information, including national guidelines and patient information	*"If it has the list of identified things and the list of identified assessment, that's what I would use at a glance. We all know what recommended assessment for CKD is, but when we get down the line to people on the orange or red action plan then definitely, you forget how often to check for … so having that list pop up quickly rather than clicking through is probably*

	more efficient" (Session 6, GP, face to face, metropolitan)
Relevant patient pathology results displayed in graphical/visual format to facilitate review	*"… but if you did have BP that was green, ACR which was yellow, and the eGFR was red, and you clicked on it, you would see what the last one was, and a trend came up, it would be really helpful to look at the trend." (Session 1, GP, face to face, metropolitan)*
Ability to focus on conditions relevant to individual practice profiles	*"My initial thought to that is, what I think you've got there for general practice is excellent. Because what you are doing is you're identifying one of four groups you can allocate that patient to. I think that behind that there is an opportunity for people with a particular interest to refine their search, such as HIV, but to your bread and butter general practitioner that would be of less importance" (Session 5, GP, zoom, rural)*
Ability to track their own practice's activities over time, and potentially to review their activity against that of like practices (benchmarking).	*"That's the helpful part of it– seeing your own practice change" (Session 1, PN, face to face, metropolitan)*

Participants also stressed the importance of ease of use, facilitated through clear and agreed language for any terms and tools used on the platform, clear and easy links between their chosen EMR and FHT, and snapshots of information with links to further detail, although the nature of the snapshot was influenced by visual processing preferences.

The Prototype

Following the co-design sessions with general practice staff, a prototype was developed. This prototype comprised a 'dashboard' designed to assist general practices to identify and manage patients with chronic health conditions and to manage quality improvement activities. The 'Dashboard' prototype enabled a global view of patient health status (as it relates to chronic kidney disease) across a general practice. Through an initial navigation page users were able to filter the patient group by one of five designated areas for improvement and further facilitate recall (see Table 3).

Table 3. The FHT 'dashboard'

The five CKD QI areas as seen on the 'dashboard'
1. Patient has risk factors for CKD and may benefit from a kidney health check
2. Patient has abnormal pathology results and requires confirmatory testing as they may have CKD
3. Test results indicate CKD is present but this is not coded in the electronic medical record as a diagnosis

4.	Patient has diagnosed CKD and their blood pressure requires optimisation
5.	Patient has diagnosed CKD and cholesterol medication initiation or management is recommended
Functions within the FHT 'dashboard'	
	Generate a list of patients to review through their preferred approach (for example, as they attend a usual appointment, or with a specific recall)
	Elect to suspend ('Defer') FHT review for individual patients, either for a given period of time or indefinitely
	Process of 'recall authorisation' to ensure that a patient's usual doctor agrees with and authorises the recall of that patient
	Identify areas where a practice's data capture/management may need improvement
	Links to relevant clinical guidelines and resources.

The FHT prototype also included a decision support tool that links with the patients' electronic medical record (EMR) at the point of care. This clinical decision support tool is activated on opening of a patient file where the criteria within the evidence-based algorithms used by the FHT platform is met. The 'pop-up' in the corner of the computer screen advises the GP of the patient's CKD status and recommendations for CKD management. This links to a summary and graphs of the patient's recent blood pressure and pathology relevant to CKD and links directly back to the dashboard, relevant clinical guidelines and resources. From this 'pop-up', the GP can action or defer the recommendations, as appropriate.

Think aloud – prototype testing

Four participants (two GPs, one practice nurse, one practice manager) from the general practice co-design sessions participated in the 'think aloud' prototype testing of the FHT dashboard. Participants each brought a different perspective to the testing, depending on how they would be using the platform. They each provided detailed comments on usability and preferences within the dashboard. The point of care clinical decision support tool was not tested with this group.

Overall, whilst participants thought FHT looked accessible and provided ample information (both for themselves and for patients), they felt that it was overwhelming and difficult to review and would be challenging for less tech savvy individuals. Many of their concerns were similar to the concerns raised in the general practice co-design sessions and were issues that the technical development team were actively working to improve for the final version for clinical testing. Identified issues surrounded streamlining the dashboard for increased ease of use, simplifying and clarifying language used, and provision of clear instruction and training to best utilise all the features of FHT.

Barriers and enablers to implementation

Co-design session participants discussed factors that could facilitate or impede the implementation of FHT. Some factors were similarly applicable to any new initiative employed at a practice and have been identified in previous research, including clearly defined roles and responsibilities, an understanding of

the intention and functionality of the initiative, good fit or integration with existing systems/protocols and sufficient time/resources. [16-24]

> *"I think that each person, as we were just talking about, needs to know their role. And they need to be trained in their role and they need to stay within their role. And that will prevent the wrong information getting into the wrong arena. Otherwise you'll end up with the thing going wrong, completely wrong…" (Session 1, GP, face to face, metropolitan)*

> *"And don't forget that if it's a ten minute consult and that pops up but it's got nothing to do with what the patient has come in for, then it's just going to be a 'close that'" (Session 1, PN, face to face, metropolitan)*

Others could be applied to the implementation of other new technology: the need for the platform to be engaging (and not annoying), intuitive (or familiar), useful and easy to use; the need for the platform to be accurate and free from bugs; and, the need to be flexible and allow for some individualisation or adaptation to different contexts.

> *"As with any of these things there will be a need for education and you'll have early adopters and you'll have the laggards. I think just keep it simple and to have as much or as little as you want." (Session 5, GP, zoom, rural)*

Factors specific to FHT included: the need for the algorithms sitting within FHT to be accurate; the data drawn from the EMR to be accurate and complete; the ability to use the platform for planned and spontaneous interactions; the ability of the program to be hidden when not required; the ability to link to the MBS; and interactive links and pre-filled tools.

> *"I think you've got things there that prioritise by risk, that allow you to manage your cohort if you want to start small and grow, it's got a feature that allows you to opt the patient out for a period of time, or indefinitely, and discussing there the follow up operation of how you get patients in front of you and do that in a manageable way either me fixing with planned visits to the doctor or support enough that they are coming in before." (Session 5, GP, zoom, rural)*

> *"…and user friendly also, in the respect that when it is done it vanishes, we don't want to see it keep coming up because as you say when people see too many prompts they say I'm not even looking" (Session 1, PN, face to face, metropolitan)*

> *"…cut out the things you don't need to see, so we only have the risks that we have automatically identified" (Session 6, GP, face to face, metropolitan)*

Perceived barriers to implementation included clear ownership, technological complexity and competing priorities. Perceived enablers to implementation included the familiarity of the system functionality, the flexibility of the tool, the simplicity of the technology and the potential to gain from use of the tool.

Participants identified potential ethical/legal concerns relating to the use of technology to assist with quality improvement activities, including the consequences of identifying a patient as having risk factors and not acting on it, of using auto-filled forms (e.g. management plans) without sufficient oversight, privacy concerns regarding communication methods with patients (e.g., email, fax), and appropriate

allocation of responsibility and venue for discussion of risk factors and recall. However, participants felt that these risks, primarily surrounding practice management of recall and chronic health discussions with patients, were sufficiently mitigated with strategies currently in place in their own practices.

Participants felt that some contexts were more suited to the implementation of FHT, namely practices with more doctors, with practice nurses, and with more time available for patient review and building recall lists. They also felt that FHT could only be used when the patient agenda or need was not urgent, or where time was left at the end of a consultation.

Participants in the co-design process had self-selected to participate in the project, and as such demonstrated an openness to new technology and new ways of managing clinical processes. Whilst they indicated variable technological skill and confidence, they expressed confidence that they would be able to use FHT. For some, the more complex functionalities were accessible because of their similarity to existing programs. Participants were enthusiastic about the possibilities for clinical performance enhancement provided by FHT, seeing their current ad hoc approaches being strengthened by the platform.

A patient perspective

The patient co-design group was convened to review the prototype and concept with patients who had attended general practices for chronic health conditions. Five people attended these sessions, with four aged over 60 years and one aged 40-49 years. Three participants were female and two were male. All lived in metropolitan Melbourne. The session ran for approximately 60 minutes.

Participants acknowledged that their preferences may be influenced by their age, and that younger people may have different preferences. They speculated that younger people may be more connected to their mobile devices and prefer communication that was not as 'personal'. However, participants felt that it was important not to make assumptions about the way people use technology

Participants were well versed in their own health and had extensive experience attending a GP for their health conditions (conditions including type 1 diabetes, COPD and hypertension). All had a continuous relationship with one practice/practitioner (including one participant who had visited the same clinic for 50 years). They had experience with being recalled by their GP for a health issue, but only after visiting or having planned tests done.

Participants were comfortable with the use of computers in face to face consultations, had no objections to the inclusion of FHT on the screen and no concerns with the traffic light approach, however, one participant felt strongly that the language used on the clinical decision support at the point of care should be clearer and simpler so that patients would understand exactly what the flag was conveying:

> *"…why wouldn't you just put chronic kidney disease… why wouldn't you put the whole diagnosis there?... When you see all the abbreviations, which I don't know, it leads to other conversations that then the GP has to say 'this is to do with looking into your kidney function'. Why not just say investigate kidney function?" (Female)*

Participants in the general practice co-design sessions were adamant that patients would benefit from the provision of graphs to understand how their health indicators were progressing over time, and that this method would enable greater conversation about why a given treatment plan or course of action was needed. However, participants were concerned that graphs could be manipulated to exaggerate difference or change, and felt that the doctor would tell them if something needed to be addressed.

> *"I know where I'm at. If it's outside the range then we talk about it. If it's not then we don't. So I don't need that." (Male)*

The discussion about the inclusion of information or links to guidelines indicated that participants were very happy with their own doctors. Patients believed their own doctors would not need to reference guidelines but conceded that less experienced doctors may benefit from guideline access at POC. Patients suggested that they would have greater confidence in a doctor that isn't their usual doctor if they accessed the additional information on FHT.

DISCUSSION

De Lusignana et al identified that regular audit and feedback has the potential to increase physician awareness of CKD and improve clinical outcomes for patients. [25] Co-design participants requested (and co-designed) a system that included features in keeping with this best practice approach to quality improvement [4, 25, 26], including audit, feedback and clinical decision support, and wanted to see guideline concordant recommendations for care while in consultation. In keeping with previous research, participants identified that the prototype needed to work within their existing workflow to facilitate automated patient recall and track patients with/at-risk of specific conditions [5]. It needed to be simple, provide visual snapshots of information and easy access to relevant guidelines, and facilitate quality improvement activities. This combination of features should work to alleviate the barriers to implementation of guideline concordant care, as identified by Vest et al and others, including knowledge of the chronic condition, engagement with patients/specialists, time demands and access to/ability to use data [16-24, 27]. The challenge for the FHT technical development team was to operationalise this to find a balance between comprehensive information provision and too much information, between appropriately timed alert and recurrent annoyance, and between succinct and coherent delivery of complex information and over simplification.

Co-design has been utilised effectively in a broad range of health care settings to improve physician engagement with quality improvement activities. [28, 29] The inclusion of the 'think aloud' sessions enhanced this co-design process and enabled the developers to test run their concepts, to determine where the design was not complying with the user requirements and to revise the prototype to resolve these concerns.

The breadth of experience and knowledge contributed by the general practice participants, patients, and the research and development team has enriched the design process, enabling the conceptualisation of a flexible platform designed to improve patient health outcomes. Over the co-design journey it was clear that participants were visualising how they could utilise FHT in their own daily work to set goals and targets in relation to CKD. In contrast to 'top down' approaches to QI intervention design, this design

process enabled the researchers to identify and resolve possible barriers to implementation specific to this particular group of end users before implementing FHT.

In recognition of the central role patients play in their own health journeys, [30] patients were consulted about the acceptability of FHT in primary care. Participating patients also supported the use of the platform in general practice. They felt that use of the platform demonstrated a high level of patient care and could increase patient confidence in health practitioners. Further consultation with patients who have been identified using the FHT platform will provide additional insight on patient experience. Similarly, further piloting and evaluation will provide insight into the usefulness of FHT for quality improvement activities across a range of different general practice settings.

Participants in the co-design process were drawn from a diverse range of contexts, with varying access to resources, vastly different staffing arrangements, patient lists and capacity for new interventions. However, participants may not have been representative of these groups more generally and broader consultation needs to be undertaken to determine the acceptability and usefulness of FHT to a broader general practice and patient audience. Piloting of FHT in general practice settings will determine the specific impact of contextual factors on implementation and ongoing use of FHT.

CONCLUSION

The number of people keen to participate in this co-design process exceeded the expectations of the project team. Those who participated wanted to develop and test the proposed Future Health Today platform, and find new ways to improve their responses to chronic health care. The process itself generated useful ideas for technological development and reflections on the ways the technology would be used in practice, particularly in conjunction with existing technologies, tools and work practices. Issues and challenges identified by participants were reflective of issues common to the introduction of new technology and new programs (as discussed briefly in the background section of this report), as were the described facilitators of success. Ultimately, participants were looking for, and worked together to design, a platform that is clear, simple, accurate and useful, and that sits within any given general practice setting. The resulting Version 1 of FHT will now be tested in general practice pilot sites to determine fidelity to design intentions, acceptability and usefulness of the tool and factors influencing implementation.

The FHT platform is currently being piloted in a general practice clinic to determine if the FHT platform performs as expected to facilitate effective quality improvement within general practice. To ensure that further development of the FHT platform continues to be informed by real world need an advisory group compromising GPs, practices nurses and practice managers will be established. This group will sit alongside a consumer (people with/who care for people with a chronic condition) advisory group and both will provide advice and guidance on future testing and development of the FHT platform.

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Competing interest statement

No competing interests

Author contributions

JMN, an experienced researcher and academic GP, developed the study design, which was refined following feedback by RB (PhD and mixed methods researcher), NL (PhD and QI researcher), and CN (nephrologist). RB and AW (experienced researcher) undertook recruitment of participants. JMN conducted the co-design sessions with support of RB and JJ (nephrologist), and RB conducted the Think Aloud interviews. BH (PhD and experienced qualitative researcher) and RM (academic GP and qualitative researcher) performed the analysis of the data. BH drafted the manuscript. All authors revised all drafts and approved the final version of the manuscript.

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Data sharing statement

Data may be made available on reasonable request.

Exclusive Licence

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A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the inter view or focus group?	
Duration	21	What was the duration of the inter views or focus group?	
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or	

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	
Description of the coding tree	25	Did authors provide a description of the coding tree?	
Derivation of themes	26	Were themes identified in advance or derived from the data?	
Software	27	What software, if applicable, was used to manage the data?	
Participant checking	28	Did participants provide feedback on the findings?	
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	
Data and findings consistent	30	Was there consistency between the data presented and the findings?	
Clarity of major themes	31	Were major themes clearly presented in the findings?	
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Future Health Today: Co-design of an electronic chronic disease quality improvement tool for use in general practice using a service design approach

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Title: Future Health Today: Co-design of an electronic chronic disease quality improvement tool for use in general practice using a service design approach

Abbreviated title: Future Health Today: Co-designing QI in general practice

Authors: Hunter B*[1], Biezen R[1], Alexander K[1], Lumsden N[1,2], Hallinan C[1], Wood, A[1], McMorrow, R[1], Jones J[1,2], Nelson C[2], Manski-Nankervis J[1] on behalf of the Future Health Today Group

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ABSTRACT (300)

Objective: To co-design an electronic chronic disease quality improvement tool for use in general practice.

Design: Service design employing co-design strategies.

Setting: General practice.

Participants: Seventeen staff (GPs, nurses and practice managers) from general practice in metropolitan Melbourne and regional Victoria, and five patients from metropolitan Melbourne.

Interventions: Co-design sessions with general practice staff, using a service design approach, were conducted to explore key design criteria and functionality of the audit and feedback and clinical decision support tools. Think Aloud interviews were conducted in which participants articulated their thoughts of the resulting Future Health Today (FHT) prototype as they used it. One co-design session was held with patients. Using inductive and deductive coding, content and thematic analyses explored the development of a new technological platform and factors influencing implementation of the platform.

Results: Participants identified that the prototype needed to work within their existing workflow to facilitate automated patient recall and track patients with or at-risk of specific conditions. It needed to be simple, provide visual snapshots of information and easy access to relevant guidelines, and facilitate quality improvement activities. Successful implementation may be supported by: accuracy of the algorithms in FHT and data held in the practice; the platform supporting planned and spontaneous interactions with patients; the ability to hide tools; links to Medicare Benefits Schedule; and pre-filled management plans. Participating patients supported the use of the platform in general practice. They

suggested that use of the platform demonstrates a high level of patient care and could increase patient confidence in health practitioners.

Conclusion: Study participants worked together to design a platform that is clear, simple, accurate and useful, and that sits within any given general practice setting. The resulting FHT platform is currently being piloted in general practices and will continue to be refined based on user feedback.

Strengths and limitations of this study

- Co-design, using a service design approach, was used to inform development of a new chronic disease quality improvement tool.
- General practice staff from regional and metropolitan settings with a broad range of experience in the use of technology participated in the study.
- Iterative technical development process was used to validate co-design principles throughout development.
- General practice and patient participants may not have been representative of these groups more generally.
- Prototype developed through this process requires piloting and further testing to determine fidelity, validity and effectiveness.

BACKGROUND

More than four in five Australians visit their GP at least once per year, and two million attend each week.[1, 2] As medical knowledge continues to increase at an exponential rate it is crucial that this knowledge is translated efficiently and effectively into the general practice setting, where the majority of Australians receive their medical care. This is critically important for people at risk of, or with, three common, interrelated conditions which affect more than two million Australians and lead to further health complications, disability and premature death: chronic kidney disease (CKD), cardiovascular disease (CVD) and type 2 diabetes (T2D).[3] These conditions share risk factors and management strategies, which, if put in place early, have the potential to reduce disease progression and the development of complications, improving quality of life and reducing burden on the health care system.[3] As such, there is interest in the development and implementation of quality improvement (QI) programs in general practice targeting these conditions.

Successful QI programs are multifactorial and can include elements such as audit, feedback and clinical decision support. A Cochrane systematic review of the impact of audit and feedback concluded that potentially important changes in professional practice can be achieved, particularly if feedback is: 1) reported more than once; 2) delivered in multiple formats; and 3) includes explicit targets and action plans.[4] A review of systematic reviews found that changes to professional behaviour are more likely with multi-faceted interventions including reminders, audit and feedback that create a set of 'rules' about practice that when enacted become a normal component of everyday practice.[5] Computerised clinical decision support, combined with other strategies such as the use of key opinion leaders and educational sessions, has the potential to improve health professional performance [6], and is more likely to be

effective if the advice is provided automatically, on the screen, with patient-specific suggestions.[7, 8] A systematic review and meta-analysis examining the systems of effectively delivering feedback for QI identified development components that were critical for the successful implementation of audit and feedback mechanisms: the method of feedback delivery, the attitude and comprehension of the healthcare professional, and the context in which the feedback is delivered all need to align.[9]

Research from Canada and the UK has identified that algorithms developed using data from electronic medical records (EMRs) can accurately identify patients at risk of chronic health conditions in primary care, and support QI through audit and feedback. [10, 11] These have been delivered to primary healthcare physicians through both paper-based and computerised QI programs (e.g., PINGR), and have been tailored to the specific data-capture structures (e.g. EMR systems used) and health system quirks (including the integration of health services) of the given settings. [12-14] Challenges associated with implementation of these QI systems include user engagement and ongoing use. Further, successful implementation is influenced by factors such as: ensuring staff QI roles and responsibilities are clearly defined and allocated; the intention and functionality of the initiative are understood and agreed upon; the new initiative fits or integrates well with existing systems/protocols; and, that sufficient time/resources have been allocated to complete the QI activity. [15-23] QI systems designed with end-users that provide actionable options are most likely to succeed and be sustained over time.[24]

Australian general practices were early adopters of EMRs in the 1990s, with near universal computerisation by 2006.[25] The data stored within these records can be harnessed to facilitate QI activities and facilitate the translation of research into practice. The Australian government introduced a QI Practice Incentive Payment for general practices in August 2019 (requiring submission of data to Primary Health Networks and participation in QI activities), bringing increased focus on QI activities.[26] The challenge remains to develop a tool for Australian general practice that provides effective systematic QI functionality to improve guideline concordant care for patients at risk of or diagnosed with chronic disease.

The aim of this study was to co-design with end users an electronic chronic disease QI tool incorporating audit and clinical decision support for use by general practice staff. The tool was not intended to replace existing EMR systems. This paper describes the outcomes of the development process.

METHOD

Study design

The QI tool was developed using service design methodology that promotes user-centred development strategy.[27] This method involved three co-design engagements with general practice staff, one co-design session with patients and an acceptability and feasibility test of the resulting tool through 'Think Aloud' sessions.

Service design using co-design is a methodology increasingly utilised in the development of health services technology. It endeavours to include the end-user or primary customer in both the initial and ongoing development of the tool, to ensure that what is developed meets consumer needs.[28, 29] A strength of the co-design process is that it explicitly aims to develop a process or product in partnership

with a variety of end users, and then to test or pilot the 'result' further with a wider range of end-users. Strategies employed in the co-design process included visualisation and mapping of system gaps, potential tool components and opportunities for system integration, and observation of user interaction with the resulting prototype.[28]

Patient and Public Involvement

Patients were recruited at the beginning of the project to provide input in the development and refinement of the QI tool (see 'Recruitment' below). They provided meaningful feedback on the acceptability of the tool for patients and on features specifically related to patient recall, through participation in the co-design focus group.

Recruitment

General practice staff (general practitioners (GPs), practice nurses and practice managers) were recruited through VicReN, the practice-based research and education network at the Department of General Practice, University of Melbourne.[30] General practices that are currently participating in the Department's Data for Decisions research program [31] were approached to participate as they have an interest in data-driven general practice research and represent a wide range of general practice, in terms of billing structure, location (metropolitan, regional and rural practices) and structure (community health centres, private general practice). They were invited to participate via newsletter and e-mail.

Patients were recruited by participating GPs using a direct approach. Interested participants contacted the researchers for further information and an invitation to participate, if they met the inclusion criteria. Inclusion criteria comprised patients with one or more chronic disease, or their carer, who have visited a GP at least three times in the last two years. This population was approached as they have experienced recall and management for chronic health conditions in general practice.

All participants gave informed consent to participate.

Data Collection

Co-design sessions

General practice participants

The co-design methodology consisted of an iterative process where participants discussed the QI systems they use, identified barriers and facilitators to QI in chronic disease management that could be addressed by technology and provided feedback into the tool development (see Appendix A). In each session, participants were provided with information on the status of the development of the QI tool, called 'Future Health Today' (FHT), and were asked to provide comment and feedback. The clear intention, as provided to participants, was to understand the variety of opinions and perceptions they had regarding each stage of development, not to arrive at consensus. The ideas and improvements were incorporated into the tool, subject to technical requirements. A semi-structured interview schedule was utilised to prompt and guide discussion (see Appendix B). Meetings were held face to face at the Department of General Practice, University of Melbourne.

The first engagement (initial design)

Service design methodology, using storyboarding to explore the health services journey, was utilised to inform development of FHT, using CKD as an exemplar.[27] Participants were asked to prioritise elements of the prototype for development (including concepts identified by the research and technology teams and by participants themselves) and reality check the platform and proposed components within it.

These sessions provided participants with current statistics on the prevalence of chronic disease (including CKD, CVD and T2D) in Australia and asked participants to apply 'blue sky thinking' to QI for chronic disease management in general practice. They were asked to use CKD to describe and discuss how they currently identified at-risk groups (opportunistic vs planned); what they do once the at-risk groups are identified and how they make this determination; how they identify and manage risk in relation to chronic disease management and in relation to data management; how they manage, enter and store data; how well their current data management systems (including EMR and third party applications) function; if and how they plan and document QI and audit; and if they utilise or would be interested in benchmarking. Finally, participants were asked about proposed FHT functionality - what they would prefer and what they do not like.

The second engagement (functionality)

These co-design sessions provided participants with a version of the prototype that incorporated many of the features discussed in session 1, described as a 'dashboard'. They focused on deeper discussion of the design aspects of the prototype and specifically on the preferred functionality and priorities for the designers relating to the dashboard. This session included discussions of categorisation and stratification of clinical information; workshopping appearance and basic functionality; and reflecting on issues and preferences discussed in previous sessions.

The third engagement (refinement)

These co-design sessions provided participants with the next version of the prototype for discussion, and asked them to focus on a clinical decision support component to be primarily used at the 'point of care' in consultation. Changes had been made to the system based on previous discussion and these were reviewed and refined through group discussion.

Zoom videoconference sessions

Separate zoom videoconference sessions were held for participants that were either not able to attend the face-to-face sessions or who were based in regional Victoria and not able to travel to Melbourne. Two sessions were held; the first focussed on initial design and functionality; the second focussed on refinement (was held on two separate occasions with different attendees on each occasion).

Sessions were recorded using a digital audio and video recorder, and field notes and sketches were collected for the face to face sessions.

Patient participants

The co-design session with patients focused on the components patients felt were important in a system designed to help identify and manage chronic health conditions from the patient perspective. The group

were asked questions about and discussed the process of being recalled, seen and managed by a doctor for a chronic health condition (see Appendix B). They received a demonstration of the prototype tool and explored patient opinions and acceptance of using technology platforms for health care and opinions about active participation in recalls for medical appointments.

The session was recorded using a digital audio and video recorder and field notes were collected. All audio recordings were transcribed and de-identified for analysis.

Think Aloud Interviews

Following the co-design sessions, a working prototype was developed, and a sub-set of general practice co-design panel members were invited to participate in a 'Think Aloud' session at the Department of General Practice, University of Melbourne, where they talked through their use of the tool and made suggestions for improvement prior to development of the final prototype.[32] They were recorded using a digital video recorder and screen capture technology and field notes were taken.

Data analysis

General practice co-design sessions

The analytical structure applied to this phase of the project involved a two-pronged approach. The first stage of analysis involved a content and descriptive analysis of current processes and preferred technological functionality of a new system for identification and management of CKD. A further content analysis of the field notes and interviews reviewed items arising throughout the co-design process to enable a fidelity check at the end of the development phase and throughout the piloting/refinement process to ensure that the final product both met the end user need and remained faithful to the co-design key design features. Using an inductive approach, codes were generated from the data to identify what was currently being used, what was missing and what could go in the new platform. Data was reviewed and coded by two researchers.

A thematic analysis [33] was then conducted to examine what co-design participants felt was most important in development and implementation. A combination of inductive coding and deductive coding was utilised.

Patient co-design session

A thematic analysis was conducted on the data captured in the patient session, examining key issues arising for participants that may influence the development and implementation of the FHT platform.

All analysis was conducted using NVivo qualitative data analysis software (QSR International Pty Ltd. Version 12, 2018).

Think aloud sessions

The Think Aloud sessions were analysed utilising content analysis technique.[34] As sessions were focused specifically on the functionality of the FHT platform, analysis examined issues that arose during the short 'test run' of the software.

Ethics approval

Ethics project approval was granted by the Melbourne Health Human Research Ethics Committee, The Royal Melbourne Hospital (Ethics ID: HREC/47394/MH-2018) and registered with the University of Melbourne Human Ethics Sub-Committee (Ethics ID: 1852972).

RESULTS

We aimed to recruit ten participants (four GPs, two practice nurses and two practice managers) to the general practice co-design sessions, however, due to significant interest, 17 people were recruited to participate (eight GPs, five PNs and four PMs), representative of practices across metropolitan Melbourne and regional Victoria. Three face to face and three zoom videoconference sessions were conducted, with variable attendance across sessions (See Table 1). Six participants attended all three co-design sessions, four attended two sessions and the remaining seven attended a single session (initial design=6, functionality=1). Each face to face meeting ran for 85-120 minutes. Each remote session ran for 40-60 minutes.

Table 1. Practitioner participation in co-design sessions

Role	Initial design (1)	Functionality (2)	Zoom (design and functionality)		Refinement (3)	
	F2F	F2F	Session 1	Session 2	F2F	Zoom
GP	3	4	4	2	5	1
PN	4	1	1	0	1	0
PM	3	1	1	0	1	1
Total	**10**	**6**	**6**	**2**	**7**	**2**

Over the six sessions participants shifted their focus from the blue skies possibilities of FHT to the practical reality of what the platform was best suited to do, using CKD as an example, and how it filled the gaps left by existing QI systems. The evolving discussions refined the intended purpose of FHT and streamlined the activities that should sit within the FHT platform. Participants were enthusiastic about the possibilities for identifying at-risk patients, and for filtering and stratifying large databases of patients into a snapshot review of their health status across chronic conditions. Participants felt that FHT needed to be flexible enough to sit across different visual processing styles, EMR systems (participants used three different systems), and general practice structures.

The variability of attendance across the sessions ensured that the co-design process did not develop a dominant participant dynamic, and provided opportunity for participants to challenge and refine concepts over the period of co-design. The semi-structured interview structure provided prompts for discussion around the given design components and enabled facilitators to explore issues identified by the research team and those raised by participants. Participants were not asked or encouraged to reach consensus and engaged in respectful discussion with each other, sharing and challenging ideas. Common themes emerged, however, from the multiple discussions.

Key features that participants wanted FHT to include, together with illustrative quotes are summarized in Table 2.

Table 2. Key requested features of FHT, with illustrative quotes

Key feature	Example quotes
Ability to track number of patients at risk of CKD	*"because people who are likely to have the highest number of risk factors …are the group of patients that we are most likely to be able to do something meaningful for by knowing who they are and capturing who they are. Especially in clinics with small numbers of doctors, yet with too many patients, being able to focus on the patients where we are able to make the most meaningful difference is going to be really helpful" (Session 2, GP, zoom, rural and metropolitan)*
Automated patient recall	*"Reminder and recall systems in practice software is inadequate…people are slipping through" (Session 2, PN, zoom, rural and metropolitan)*
Elements to fit within workflow	*"When you're in this you want to be in action mode. You've got your data, you've got your information, you know what you want to do and all of a sudden your clinical decision making says 'ok, what is my strategy, which do I do next, when do I do it what do I have to do and what order do I need to do it" (Session 3, GP, face to face, metropolitan)*
Ability to filter data through a range of lenses	*"What's really good about that, it came up in the group discussion, a smaller practice with perhaps less enthusiasm for this, you can actually drill down and get quite small numbers to begin with that allows people to get their feet wet with looking at the key issues and looking at trying to change behaviours or introduce medications, and as you grow in confidence you can start softening your filter and capturing a wider group." (Session 5, GP, zoom, rural)*
Incorporation of QI cycles	*"Could you have a print out so that when you have your monthly meetings you can say this is where we started, this is where we are now and of course this is going to help with QI?" (Session 1, PN, face to face, metropolitan)*
Links to information, including national guidelines and patient information	*"If it has the list of identified things and the list of identified assessment, that's what I would use at a glance. We all know what recommended assessment for CKD is, but when we get down the line to people on the orange or red action plan then definitely, you*

	forget how often to check for … so having that list pop up quickly rather than clicking through is probably more efficient" (Session 6, GP, face to face, metropolitan)
Relevant patient pathology results displayed in graphical/visual format to facilitate review	*"… but if you did have BP that was green, ACR which was yellow, and the eGFR was red, and you clicked on it, you would see what the last one was, and a trend came up, it would be really helpful to look at the trend." (Session 1, GP, face to face, metropolitan)*
Ability to focus on conditions relevant to individual practice profiles	*"My initial thought to that is, what I think you've got there for general practice is excellent. Because what you are doing is you're identifying one of four groups you can allocate that patient to. I think that behind that there is an opportunity for people with a particular interest to refine their search, such as HIV, but to your bread and butter general practitioner that would be of less importance" (Session 5, GP, zoom, rural)*
Ability to track their own practice's activities over time, and potentially to review their activity against that of like practices (benchmarking).	*"That's the helpful part of it– seeing your own practice change" (Session 1, PN, face to face, metropolitan)*

Participants also stressed the importance of ease of use, facilitated through clear and agreed language for any terms and tools used on the platform, clear and easy links between their chosen EMR and FHT, and snapshots of information with links to further detail, although the nature of the snapshot was influenced by visual processing preferences.

The Prototype

Following the co-design sessions with general practice staff, a prototype was developed. This prototype comprised a 'dashboard' designed to assist general practices to identify and manage patients with chronic health conditions and to manage QI activities. The 'Dashboard' prototype enabled a global view of patient health status (as it related to CKD) across a general practice. Through an initial navigation page users were able to filter the patient group by one of five designated areas for improvement and further facilitate recall (see Table 3).

Table 3. The FHT 'dashboard'

The five CKD QI areas as seen on the 'dashboard'
1. Patient has risk factors for CKD and may benefit from a kidney health check
2. Patient has abnormal pathology results and requires confirmatory testing as they may have CKD

3.	Test results indicate CKD is present but this is not coded in the electronic medical record as a diagnosis
4.	Patient has diagnosed CKD and their blood pressure requires optimisation
5.	Patient has diagnosed CKD and cholesterol medication initiation or management is recommended
Functions within the FHT 'dashboard'	
	Generate a list of patients to review through their preferred approach (e.g., as they attend a usual appointment, or with a specific recall)
	Elect to suspend ('Defer') FHT review for individual patients, either for a given period of time or indefinitely
	Process of 'recall authorisation' to ensure that a patient's usual doctor agrees with and authorises the recall of that patient
	Identify areas where a practice's data capture/management may need improvement
	Links to relevant clinical guidelines and resources.

The FHT prototype also included a decision support tool that linked with the patients' EMR at the point of care. This clinical decision support tool is activated when a patient file is opened and where the criteria within the evidence-based algorithms used by the FHT platform are met. The 'pop-up' in the corner of the computer screen advises the GP of the patient's CKD status and recommendations for CKD management. This links to a summary and graphs of the patient's recent blood pressure and pathology relevant to CKD and links directly back to the dashboard, relevant clinical guidelines and resources. From this 'pop-up', the GP can action or defer the recommendations, as appropriate.

Think aloud – prototype testing

Four participants (two GPs, one practice nurse, one practice manager) from the general practice co-design sessions participated in the 'think aloud' prototype testing of the FHT dashboard. Participants each brought a different perspective to the testing, depending on how they would be using the platform. They each provided detailed comments on usability and preferences within the dashboard. The point of care clinical decision support tool was not tested with this group.

Overall, whilst participants thought FHT looked accessible and provided ample information (both for themselves and for patients), they felt that it was overwhelming and difficult to review and would be challenging for less tech savvy individuals. Many of their concerns were similar to the concerns raised in the general practice co-design sessions and were issues that the technical development team were actively working to improve for the final version for clinical testing. Identified issues surrounded streamlining the dashboard for increased ease of use, simplifying and clarifying language used, and provision of clear instruction and training to best utilise all the features of FHT.

Barriers and enablers to implementation

Co-design session participants discussed factors that could facilitate or impede the implementation of FHT. Some factors were similarly applicable to any new initiative employed at a practice and have been identified in previous research, including clearly defined roles and responsibilities, an understanding of the intention and functionality of the initiative, good fit or integration with existing systems/protocols and sufficient time/resources. [15-23]

> *"I think that each person, as we were just talking about, needs to know their role. And they need to be trained in their role and they need to stay within their role. And that will prevent the wrong information getting into the wrong arena. Otherwise you'll end up with the thing going wrong, completely wrong…" (Session 1, GP, face to face, metropolitan)*

> *"And don't forget that if it's a ten minute consult and that pops up but it's got nothing to do with what the patient has come in for, then it's just going to be a 'close that'" (Session 1, PN, face to face, metropolitan)*

Others could be applied to the implementation of other new technology: the need for the platform to be engaging (and not annoying), intuitive (or familiar), useful and easy to use; the need for the platform to be accurate and free from bugs; and, the need to be flexible and allow for some individualisation or adaptation to different contexts.

> *"As with any of these things there will be a need for education and you'll have early adopters and you'll have the laggards. I think just keep it simple and to have as much or as little as you want." (Session 5, GP, zoom, rural)*

Factors specific to FHT included: the need for the algorithms sitting within FHT to be accurate; the data drawn from the EMR to be accurate and complete; the ability to use the platform for planned and spontaneous interactions; the ability of the program to be hidden when not required; the ability to link to the MBS; and interactive links and pre-filled tools.

> *"I think you've got things there that prioritise by risk, that allow you to manage your cohort if you want to start small and grow, it's got a feature that allows you to opt the patient out for a period of time, or indefinitely, and discussing there the follow up operation of how you get patients in front of you and do that in a manageable way either me fixing with planned visits to the doctor or support enough that they are coming in before." (Session 5, GP, zoom, rural)*

> *"…and user friendly also, in the respect that when it is done it vanishes, we don't want to see it keep coming up because as you say when people see too many prompts they say I'm not even looking" (Session 1, PN, face to face, metropolitan)*

> *"…cut out the things you don't need to see, so we only have the risks that we have automatically identified" (Session 6, GP, face to face, metropolitan)*

Perceived barriers to implementation included clear ownership, technological complexity and competing priorities. Perceived enablers to implementation included the familiarity of the system functionality, the flexibility of the tool, the simplicity of the technology and the potential to gain from use of the tool.

Participants identified potential ethical/legal concerns relating to the use of technology to assist with QI activities, including the consequences of identifying a patient as having risk factors but not acting on them, of using auto-filled forms (e.g. management plans) without sufficient oversight, privacy concerns regarding communication methods with patients (e.g., email, fax), and appropriate allocation of responsibility and venue for discussion of risk factors and recall. However, participants felt that these risks, primarily surrounding practice management of recall and chronic health discussions with patients, were sufficiently mitigated with strategies currently in place in their own practices.

Participants felt that some contexts were more suited to the implementation of FHT, namely practices with more doctors, with practice nurses, and with more time available for patient review and building recall lists. They also felt that FHT could only be used when the patient agenda or need was not urgent, or where time was left at the end of a consultation.

Participants self-selected to participate in the project, and as such demonstrated an openness to new technology and new ways of managing clinical processes. Whilst they indicated variable technological skill and confidence, they expressed confidence that they would be able to use FHT. For some, the more complex functionalities were accessible because of their similarity to existing programs. Participants were enthusiastic about the possibilities for clinical performance enhancement provided by FHT, seeing their current ad hoc approaches being strengthened by the platform.

A patient perspective

The patient co-design group was convened to review the prototype and concept with patients who had attended general practices for chronic health conditions. Five people attended these sessions, with four aged over 60 years and one aged 40-49 years. Three participants were female and two were male. All lived in metropolitan Melbourne. The session ran for approximately 60 minutes.

Participants acknowledged that their preferences may be influenced by their age, and that younger people may have different preferences. They speculated that younger people may be more connected to their mobile devices and prefer communication that was not as 'personal'. However, participants felt that it was important not to make assumptions about the way people use technology

Participants were well versed in their own health and had extensive experience attending a GP for their health conditions (conditions including type 1 diabetes, COPD and hypertension). All had a continuous relationship with one practice/practitioner (including one participant who had visited the same clinic for 50 years). They had experience with being recalled by their GP for a health issue, but only after visiting or having planned tests done.

Participants were comfortable with the use of computers in face to face consultations, had no objections to the inclusion of FHT on the screen and no concerns with the traffic light approach, however, one participant felt strongly that the language used on the clinical decision support at the point of care should be clearer and simpler so that patients would understand exactly what the flag was conveying:

> *"…why wouldn't you just put chronic kidney disease… why wouldn't you put the whole diagnosis there?... When you see all the abbreviations, which I don't know, it leads to other*

conversations that then the GP has to say 'this is to do with looking into your kidney function'. Why not just say investigate kidney function?" (Female)

Participants in the general practice co-design sessions were adamant that patients would benefit from the provision of graphs to understand how their health indicators were progressing over time, and that this method would enable greater conversation about why a given treatment plan or course of action was needed. However, participants were concerned that graphs could be manipulated to exaggerate difference or change, and felt that the doctor would tell them if something needed to be addressed.

"I know where I'm at. If it's outside the range then we talk about it. If it's not then we don't. So I don't need that." (Male)

The discussion about the inclusion of information or links to guidelines indicated that participants were very happy with their own doctors. Patients believed their own doctors would not need to reference guidelines but conceded that less experienced doctors may benefit from guideline access at POC. Patients suggested that they would have greater confidence in a doctor that isn't their usual doctor if they accessed the additional information on FHT.

DISCUSSION

Regular audit and feedback has the potential to increase physician awareness of CKD and improve clinical outcomes for patients. [35] This awareness, coupled with the experience of members of the research team in CKD (clinical and QI), informed the decision to use CKD as the 'test condition' in the development process. Using this exemplar as a handle to focus their thoughts, co-design participants requested (and co-designed) a system that included features in keeping with this best practice approach to QI [4, 12, 35], including audit, feedback and clinical decision support, and wanted to see guideline concordant recommendations for care while in consultation. In keeping with previous research, participants identified that the prototype needed to work within their existing workflow to facilitate automated patient recall and track patients with/at-risk of specific conditions [5]. It needed to be simple, provide visual snapshots of information and easy access to relevant guidelines, and facilitate QI activities. This combination of features should work to alleviate the barriers to implementation of guideline concordant care, as identified by Vest et al and others, including knowledge of the chronic condition, engagement with patients/specialists, time demands and access to/ability to use data [15-23, 36]. The challenge for the FHT technical development team was to operationalise this to find a balance between comprehensive information provision and too much information, between appropriately timed alert and recurrent annoyance, and between succinct and coherent delivery of complex information and over simplification. Evaluation of the implementation of the prototype in multiple general practice settings will provide greater understanding of whether these features are effective in supporting QI.

Co-design has been utilised effectively in a broad range of health care settings to improve physician engagement with QI activities. [37, 38] The inclusion of the 'think aloud' sessions enhanced this co-design process and enabled the developers to test run their concepts, to determine where the design was not complying with the user requirements and to revise the prototype to resolve these concerns.

A key component of successful QI is the level and nature of involvement of the end-users, in this case the health care professionals.[9] Those who participated in this project wanted to develop and test the proposed FHT platform, and find new ways to improve their responses to chronic health care. The process itself generated useful ideas for technological development and reflections on the ways the technology would be used in practice, particularly in conjunction with existing technologies, tools and work practices. Issues and challenges identified by participants were reflective of issues common to the introduction of new technology and new programs (as discussed briefly in the background section of this report), as were the described facilitators of success.

Participants in the co-design process were drawn from a diverse range of contexts, with varying access to resources, vastly different staffing arrangements, patient lists and capacity for new interventions. The breadth of experience and knowledge contributed by the general practice participants, patients, and the research and development team has enriched the design process, enabling the conceptualisation of a flexible platform designed to improve patient health outcomes. Over the co-design journey it was clear that participants were visualising how they could utilise FHT in their own daily work to set goals and targets in relation to CKD. In contrast to 'top down' approaches to QI intervention design, this design process enabled the researchers to identify and resolve possible barriers to implementation specific to this particular group of end users before implementing FHT. However, participants may not have been representative of these groups more generally and broader consultation needs to be undertaken to determine the acceptability and usefulness of FHT to a broader general practice and patient audience.

In recognition of the central role patients play in their own health journeys, [39] patients were consulted about the acceptability of FHT in primary care. Participating patients also supported the use of the platform in general practice. They felt that use of the platform demonstrated a high level of patient care and could increase patient confidence in health practitioners. Further consultation with patients who have been identified using the FHT platform will provide additional insight on patient experience. Similarly, further piloting and evaluation will provide insight into the usefulness of FHT for QI activities across a range of different general practice settings.

The next step for the FHT project was to pilot the prototype in two different general practice settings, and undertake an evaluation of the implementation process (completed in early 2020, results as yet unpublished) using the framework for effective audit and feedback developed by Brown et al, Clinical Performance Feedback Intervention Theory (CP-FIT).[9] Further refinement and piloting of FHT in additional general practice settings in 2020-21 will determine the specific impact of contextual factors on implementation and ongoing use of FHT, and the usefulness and acceptability of the platform to GPs, nurses and practice managers. Further development of the tool is underway to include multiple chronic health conditions (including CKD, CVD, T2D and prostate cancer). A pragmatic cluster randomised control trial is planned to commence in late 2021 to further test the usefulness of FHT in improving outcomes for patients.

CONCLUSION

The aim of this study was to co-design with end users an electronic QI tool incorporating audit and clinical decision support for use by Australian general practice staff to support chronic disease management. This

approach has been a practical and acceptable method for bringing together ideas, concepts and end user needs to develop a platform that can be integrated into the general practice clinical workload. Challenges with QI applications remain an ongoing challenge. However, the resulting FHT version 1 platform is being tested in the general practice pilot sites to determine fidelity to design intentions, acceptability and usefulness of the tool and factors influencing implementation.

To ensure that future development of the FHT platform continues to be informed by real world need an advisory group compromising GPs, practices nurses and practice managers will be established. This group will sit alongside a consumer (people with/who care for people with a chronic condition) advisory group and both will provide advice and guidance on future testing and development of the FHT platform.

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Competing interest statement

No competing interests. We are not involved in any sponsorship arrangements with health or technology industries, however we are fee-paying members of the Best Practice Partner program which allows FHT to integrate with that product.

Supplementary materials

Appendix A provides a snapshot of the initial design through to the prototype product and provides a summary of the platform and its components. Copies of the schedules that guided discussion in the co-design sessions are included in Appendix B.

Author contributions

JMN, an experienced researcher and academic GP, developed the study design, which was refined following feedback by RB (PhD and mixed methods researcher), NL (PhD and QI researcher), and CN (nephrologist). RB and AW (experienced researcher) undertook recruitment of participants. JMN conducted the co-design sessions with support of RB and JJ (nephrologist), and RB conducted the Think Aloud interviews. BH (PhD and experienced qualitative researcher) and RM (academic GP and qualitative researcher) performed the analysis of the data. BH drafted the manuscript. All authors revised all drafts and approved the final version of the manuscript.

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Data sharing statement

Data may be made available on reasonable request.

Exclusive Licence

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Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the inter view or focus group?	
Duration	21	What was the duration of the inter views or focus group?	
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or	

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	
Description of the coding tree	25	Did authors provide a description of the coding tree?	
Derivation of themes	26	Were themes identified in advance or derived from the data?	
Software	27	What software, if applicable, was used to manage the data?	
Participant checking	28	Did participants provide feedback on the findings?	
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	
Data and findings consistent	30	Was there consistency between the data presented and the findings?	
Clarity of major themes	31	Were major themes clearly presented in the findings?	
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

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Title: Future Health Today: Co-design of an electronic chronic disease quality improvement tool for use in general practice using a service design approach

Abbreviated title: Future Health Today: Co-designing QI in general practice

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ABSTRACT (300)

Objective: To co-design an electronic chronic disease quality improvement tool for use in general practice.

Design: Service design employing co-design strategies.

Setting: General practice.

Participants: Seventeen staff (GPs, nurses and practice managers) from general practice in metropolitan Melbourne and regional Victoria, and five patients from metropolitan Melbourne.

Interventions: Co-design sessions with general practice staff, using a service design approach, were conducted to explore key design criteria and functionality of the audit and feedback and clinical decision support tools. Think Aloud interviews were conducted in which participants articulated their thoughts of the resulting Future Health Today (FHT) prototype as they used it. One co-design session was held with patients. Using inductive and deductive coding, content and thematic analyses explored the development of a new technological platform and factors influencing implementation of the platform.

Results: Participants identified that the prototype needed to work within their existing workflow to facilitate automated patient recall and track patients with or at-risk of specific conditions. It needed to be simple, provide visual snapshots of information and easy access to relevant guidelines, and facilitate quality improvement activities. Successful implementation may be supported by: accuracy of the algorithms in FHT and data held in the practice; the platform supporting planned and spontaneous interactions with patients; the ability to hide tools; links to Medicare Benefits Schedule; and pre-filled management plans. Participating patients supported the use of the platform in general practice. They

suggested that use of the platform demonstrates a high level of patient care and could increase patient confidence in health practitioners.

Conclusion: Study participants worked together to design a platform that is clear, simple, accurate and useful, and that sits within any given general practice setting. The resulting FHT platform is currently being piloted in general practices and will continue to be refined based on user feedback.

Strengths and limitations of this study

- Co-design, using a service design approach, was used to inform development of a new chronic disease quality improvement tool.
- General practice staff from regional and metropolitan settings with a broad range of experience in the use of technology participated in the study.
- Iterative technical development process was used to validate co-design principles throughout development.
- General practice and patient participants may not have been representative of these groups more generally.
- Prototype developed through this process requires piloting and further testing to determine fidelity, validity and effectiveness.

BACKGROUND

More than four in five Australians visit their GP at least once per year, and two million attend each week.[1, 2] As medical knowledge continues to increase at an exponential rate it is crucial that this knowledge is translated efficiently and effectively into the general practice setting, where the majority of Australians receive their medical care. This is critically important for people at risk of, or with, three common, interrelated conditions which affect more than two million Australians and lead to further health complications, disability and premature death: chronic kidney disease (CKD), cardiovascular disease (CVD) and type 2 diabetes (T2D).[3] These conditions share risk factors and management strategies, which, if put in place early, have the potential to reduce disease progression and the development of complications, improving quality of life and reducing burden on the health care system.[3] As such, there is interest in the development and implementation of quality improvement (QI) programs in general practice targeting these conditions.

Successful QI programs are multifactorial and can include elements such as audit, feedback and clinical decision support. A Cochrane systematic review of the impact of audit and feedback concluded that potentially important changes in professional practice can be achieved, particularly if feedback is: 1) reported more than once; 2) delivered in multiple formats; and 3) includes explicit targets and action plans.[4] A review of systematic reviews found that changes to professional behaviour are more likely with multi-faceted interventions including reminders, audit and feedback that create a set of 'rules' about practice that when enacted become a normal component of everyday practice.[5] Computerised clinical decision support, combined with other strategies such as the use of key opinion leaders and educational sessions, has the potential to improve health professional performance [6], and is more likely to be

effective if the advice is provided automatically, on the screen, with patient-specific suggestions.[7, 8] A systematic review and meta-analysis examining the systems of effectively delivering feedback for QI identified development components that were critical for the successful implementation of audit and feedback mechanisms: the method of feedback delivery, the attitude and comprehension of the healthcare professional, and the context in which the feedback is delivered all need to align.[9]

Research from Canada and the UK has identified that algorithms developed using data from electronic medical records (EMRs) can accurately identify patients at risk of chronic health conditions in primary care, and support QI through audit and feedback. [10, 11] These have been delivered to primary healthcare physicians through both paper-based and computerised QI programs (e.g., PINGR), and have been tailored to the specific data-capture structures (e.g. EMR systems used) and health system quirks (including the integration of health services) of the given settings. [12-14] Challenges associated with implementation of these QI systems include user engagement and ongoing use. Further, successful implementation is influenced by factors such as: ensuring staff QI roles and responsibilities are clearly defined and allocated; the intention and functionality of the initiative are understood and agreed upon; the new initiative fits or integrates well with existing systems/protocols; and, that sufficient time/resources have been allocated to complete the QI activity. [15-23] QI systems designed with end-users that provide actionable options are most likely to succeed and be sustained over time.[24]

Australian general practices were early adopters of EMRs in the 1990s, with near universal computerisation by 2006.[25] The data stored within these records can be harnessed to facilitate QI activities and facilitate the translation of research into practice. The Australian government introduced a QI Practice Incentive Payment for general practices in August 2019 (requiring submission of data to Primary Health Networks and participation in QI activities), bringing increased focus on QI activities.[26] The challenge remains to develop a tool for Australian general practice that provides effective systematic QI functionality to improve guideline concordant care for patients at risk of or diagnosed with chronic disease.

The aim of this study was to co-design with end users an electronic chronic disease QI tool incorporating audit and clinical decision support for use by general practice staff. The tool was not intended to replace existing EMR systems. This paper describes the outcomes of the development process.

METHOD

Study design

The QI tool was developed using service design methodology that promotes user-centred development strategy.[27] This method involved three co-design engagements with general practice staff, one co-design session with patients and an acceptability and feasibility test of the resulting tool through 'Think Aloud' sessions.

Service design using co-design is a methodology increasingly utilised in the development of health services technology. It endeavours to include the end-user or primary customer in both the initial and ongoing development of the tool, to ensure that what is developed meets consumer needs.[28, 29] A strength of the co-design process is that it explicitly aims to develop a process or product in partnership

with a variety of end users, and then to test or pilot the 'result' further with a wider range of end-users. Strategies employed in the co-design process included visualisation and mapping of system gaps, potential tool components and opportunities for system integration, and observation of user interaction with the resulting prototype.[28]

Patient and Public Involvement

Patients were recruited at the beginning of the project to provide input in the development and refinement of the QI tool (see 'Recruitment' below). They provided meaningful feedback on the acceptability of the tool for patients and on features specifically related to patient recall, through participation in the co-design focus group.

Recruitment

General practice staff (general practitioners (GPs), practice nurses and practice managers) were recruited through VicReN, the practice-based research and education network at the Department of General Practice, University of Melbourne.[30] General practices that are currently participating in the Department's Data for Decisions research program [31] were approached to participate as they have an interest in data-driven general practice research and represent a wide range of general practice, in terms of billing structure, location (metropolitan, regional and rural practices) and structure (community health centres, private general practice). They were invited to participate via newsletter and e-mail.

Patients were recruited by participating GPs using a direct approach. Interested participants contacted the researchers for further information and an invitation to participate, if they met the inclusion criteria. Inclusion criteria comprised patients with one or more chronic disease, or their carer, who have visited a GP at least three times in the last two years. This population was approached as they have experienced recall and management for chronic health conditions in general practice.

All participants gave informed consent to participate.

Data Collection

Co-design sessions

General practice participants

The co-design methodology consisted of an iterative process where participants discussed the QI systems they use, identified barriers and facilitators to QI in chronic disease management that could be addressed by technology and provided feedback into the tool development (see Appendix A). In each session, participants were provided with information on the status of the development of the QI tool, called 'Future Health Today' (FHT), and were asked to provide comment and feedback. The clear intention, as provided to participants, was to understand the variety of opinions and perceptions they had regarding each stage of development, not to arrive at consensus. The ideas and improvements were incorporated into the tool, subject to technical requirements. A semi-structured interview schedule was utilised to prompt and guide discussion (see Appendix B). Meetings were held face to face at the Department of General Practice, University of Melbourne.

The first engagement (initial design)

Service design methodology, using storyboarding to explore the health services journey, was utilised to inform development of FHT, using CKD as an exemplar.[27] Participants were asked to prioritise elements of the prototype for development (including concepts identified by the research and technology teams and by participants themselves) and reality check the platform and proposed components within it.

These sessions provided participants with current statistics on the prevalence of chronic disease (including CKD, CVD and T2D) in Australia and asked participants to apply 'blue sky thinking' to QI for chronic disease management in general practice. They were asked to use CKD to describe and discuss how they currently identified at-risk groups (opportunistic vs planned); what they do once the at-risk groups are identified and how they make this determination; how they identify and manage risk in relation to chronic disease management and in relation to data management; how they manage, enter and store data; how well their current data management systems (including EMR and third party applications) function; if and how they plan and document QI and audit; and if they utilise or would be interested in benchmarking. Finally, participants were asked about proposed FHT functionality - what they would prefer and what they do not like.

The second engagement (functionality)

These co-design sessions provided participants with a version of the prototype that incorporated many of the features discussed in session 1, described as a 'dashboard'. They focused on deeper discussion of the design aspects of the prototype and specifically on the preferred functionality and priorities for the designers relating to the dashboard. This session included discussions of categorisation and stratification of clinical information; workshopping appearance and basic functionality; and reflecting on issues and preferences discussed in previous sessions.

The third engagement (refinement)

These co-design sessions provided participants with the next version of the prototype for discussion, and asked them to focus on a clinical decision support component to be primarily used at the 'point of care' in consultation. Changes had been made to the system based on previous discussion and these were reviewed and refined through group discussion.

Zoom videoconference sessions

Separate zoom videoconference sessions were held for participants that were either not able to attend the face-to-face sessions or who were based in regional Victoria and not able to travel to Melbourne. Two sessions were held; the first focussed on initial design and functionality; the second focussed on refinement (was held on two separate occasions with different attendees on each occasion).

Sessions were recorded using a digital audio and video recorder, and field notes and sketches were collected for the face to face sessions.

Patient participants

The co-design session with patients focused on the components patients felt were important in a system designed to help identify and manage chronic health conditions from the patient perspective. The group

were asked questions about and discussed the process of being recalled, seen and managed by a doctor for a chronic health condition (see Appendix B). They received a demonstration of the prototype tool and explored patient opinions and acceptance of using technology platforms for health care and opinions about active participation in recalls for medical appointments.

The session was recorded using a digital audio and video recorder and field notes were collected. All audio recordings were transcribed and de-identified for analysis.

Think Aloud Interviews

Following the co-design sessions, a working prototype was developed, and a sub-set of general practice co-design panel members were invited to participate in a 'Think Aloud' session at the Department of General Practice, University of Melbourne, where they talked through their use of the tool and made suggestions for improvement prior to development of the final prototype.[32] They were recorded using a digital video recorder and screen capture technology and field notes were taken.

Data analysis

General practice co-design sessions

The analytical structure applied to this phase of the project involved a two-pronged approach. The first stage of analysis involved a content and descriptive analysis of current processes and preferred technological functionality of a new system for identification and management of CKD. A further content analysis of the field notes and interviews reviewed items arising throughout the co-design process to enable a fidelity check at the end of the development phase and throughout the piloting/refinement process to ensure that the final product both met the end user need and remained faithful to the co-design key design features. Using an inductive approach, codes were generated from the data to identify what was currently being used, what was missing and what could go in the new platform. Data was reviewed and coded by two researchers.

A thematic analysis [33] was then conducted to examine what co-design participants felt was most important in development and implementation. A combination of inductive coding and deductive coding was utilised.

Patient co-design session

A thematic analysis was conducted on the data captured in the patient session, examining key issues arising for participants that may influence the development and implementation of the FHT platform.

All analysis was conducted using NVivo qualitative data analysis software (QSR International Pty Ltd. Version 12, 2018).

Think aloud sessions

The Think Aloud sessions were analysed utilising content analysis technique.[34] As sessions were focused specifically on the functionality of the FHT platform, analysis examined issues that arose during the short 'test run' of the software.

Ethics approval

Ethics project approval was granted by the Melbourne Health Human Research Ethics Committee, The Royal Melbourne Hospital (Ethics ID: HREC/47394/MH-2018) and registered with the University of Melbourne Human Ethics Sub-Committee (Ethics ID: 1852972).

RESULTS

We aimed to recruit ten participants (four GPs, two practice nurses and two practice managers) to the general practice co-design sessions, however, due to significant interest, 17 people were recruited to participate (eight GPs, five PNs and four PMs), representative of practices across metropolitan Melbourne and regional Victoria. Three face to face and three zoom videoconference sessions were conducted, with variable attendance across sessions (See Table 1). Six participants attended all three co-design sessions, four attended two sessions and the remaining seven attended a single session (initial design=6, functionality=1). Each face to face meeting ran for 85-120 minutes. Each remote session ran for 40-60 minutes.

Table 1. Practitioner participation in co-design sessions

Role	Initial design (1)	Functionality (2)	Zoom (design and functionality)		Refinement (3)	
	F2F	F2F	Session 1	Session 2	F2F	Zoom
GP	3	4	4	2	5	1
PN	4	1	1	0	1	0
PM	3	1	1	0	1	1
Total	**10**	**6**	**6**	**2**	**7**	**2**

Over the six sessions participants shifted their focus from the blue skies possibilities of FHT to the practical reality of what the platform was best suited to do, using CKD as an example, and how it filled the gaps left by existing QI systems. The evolving discussions refined the intended purpose of FHT and streamlined the activities that should sit within the FHT platform. Participants were enthusiastic about the possibilities for identifying at-risk patients, and for filtering and stratifying large databases of patients into a snapshot review of their health status across chronic conditions. Participants felt that FHT needed to be flexible enough to sit across different visual processing styles, EMR systems (participants used three different systems), and general practice structures.

The variability of attendance across the sessions ensured that the co-design process did not develop a dominant participant dynamic, and provided opportunity for participants to challenge and refine concepts over the period of co-design. The semi-structured interview structure provided prompts for discussion around the given design components and enabled facilitators to explore issues identified by the research team and those raised by participants. Participants were not asked or encouraged to reach consensus and engaged in respectful discussion with each other, sharing and challenging ideas. Common themes emerged, however, from the multiple discussions.

Key features that participants wanted FHT to include, together with illustrative quotes are summarized in Table 2.

Table 2. Key requested features of FHT, with illustrative quotes

Key feature	Example quotes
Ability to track number of patients at risk of CKD	*"because people who are likely to have the highest number of risk factors …are the group of patients that we are most likely to be able to do something meaningful for by knowing who they are and capturing who they are. Especially in clinics with small numbers of doctors, yet with too many patients, being able to focus on the patients where we are able to make the most meaningful difference is going to be really helpful" (Session 2, GP, zoom, rural and metropolitan)*
Automated patient recall	*"Reminder and recall systems in practice software is inadequate…people are slipping through" (Session 2, PN, zoom, rural and metropolitan)*
Elements to fit within workflow	*"When you're in this you want to be in action mode. You've got your data, you've got your information, you know what you want to do and all of a sudden your clinical decision making says 'ok, what is my strategy, which do I do next, when do I do it what do I have to do and what order do I need to do it" (Session 3, GP, face to face, metropolitan)*
Ability to filter data through a range of lenses	*"What's really good about that, it came up in the group discussion, a smaller practice with perhaps less enthusiasm for this, you can actually drill down and get quite small numbers to begin with that allows people to get their feet wet with looking at the key issues and looking at trying to change behaviours or introduce medications, and as you grow in confidence you can start softening your filter and capturing a wider group." (Session 5, GP, zoom, rural)*
Incorporation of QI cycles	*"Could you have a print out so that when you have your monthly meetings you can say this is where we started, this is where we are now and of course this is going to help with QI?" (Session 1, PN, face to face, metropolitan)*
Links to information, including national guidelines and patient information	*"If it has the list of identified things and the list of identified assessment, that's what I would use at a glance. We all know what recommended assessment for CKD is, but when we get down the line to people on the orange or red action plan then definitely, you*

	forget how often to check for … so having that list pop up quickly rather than clicking through is probably more efficient" (Session 6, GP, face to face, metropolitan)
Relevant patient pathology results displayed in graphical/visual format to facilitate review	*"… but if you did have BP that was green, ACR which was yellow, and the eGFR was red, and you clicked on it, you would see what the last one was, and a trend came up, it would be really helpful to look at the trend." (Session 1, GP, face to face, metropolitan)*
Ability to focus on conditions relevant to individual practice profiles	*"My initial thought to that is, what I think you've got there for general practice is excellent. Because what you are doing is you're identifying one of four groups you can allocate that patient to. I think that behind that there is an opportunity for people with a particular interest to refine their search, such as HIV, but to your bread and butter general practitioner that would be of less importance" (Session 5, GP, zoom, rural)*
Ability to track their own practice's activities over time, and potentially to review their activity against that of like practices (benchmarking).	*"That's the helpful part of it– seeing your own practice change" (Session 1, PN, face to face, metropolitan)*

Participants also stressed the importance of ease of use, facilitated through clear and agreed language for any terms and tools used on the platform, clear and easy links between their chosen EMR and FHT, and snapshots of information with links to further detail, although the nature of the snapshot was influenced by visual processing preferences.

The Prototype

Following the co-design sessions with general practice staff, a prototype was developed. This prototype comprised a 'dashboard' designed to assist general practices to identify and manage patients with chronic health conditions and to manage QI activities. The 'Dashboard' prototype enabled a global view of patient health status (as it related to CKD) across a general practice. Through an initial navigation page users were able to filter the patient group by one of five designated areas for improvement and further facilitate recall (see Table 3).

Table 3. The FHT 'dashboard'

The five CKD QI areas as seen on the 'dashboard'
1. Patient has risk factors for CKD and may benefit from a kidney health check
2. Patient has abnormal pathology results and requires confirmatory testing as they may have CKD

3.	Test results indicate CKD is present but this is not coded in the electronic medical record as a diagnosis
4.	Patient has diagnosed CKD and their blood pressure requires optimisation
5.	Patient has diagnosed CKD and cholesterol medication initiation or management is recommended
Functions within the FHT 'dashboard'	
	Generate a list of patients to review through their preferred approach (e.g., as they attend a usual appointment, or with a specific recall)
	Elect to suspend ('Defer') FHT review for individual patients, either for a given period of time or indefinitely
	Process of 'recall authorisation' to ensure that a patient's usual doctor agrees with and authorises the recall of that patient
	Identify areas where a practice's data capture/management may need improvement
	Links to relevant clinical guidelines and resources.

The FHT prototype also included a decision support tool that linked with the patients' EMR at the point of care. This clinical decision support tool is activated when a patient file is opened and where the criteria within the evidence-based algorithms used by the FHT platform are met. The 'pop-up' in the corner of the computer screen advises the GP of the patient's CKD status and recommendations for CKD management. This links to a summary and graphs of the patient's recent blood pressure and pathology relevant to CKD and links directly back to the dashboard, relevant clinical guidelines and resources. From this 'pop-up', the GP can action or defer the recommendations, as appropriate.

Think aloud – prototype testing

Four participants (two GPs, one practice nurse, one practice manager) from the general practice co-design sessions participated in the 'think aloud' prototype testing of the FHT dashboard. Participants each brought a different perspective to the testing, depending on how they would be using the platform. They each provided detailed comments on usability and preferences within the dashboard. The point of care clinical decision support tool was not tested with this group.

Overall, whilst participants thought FHT looked accessible and provided ample information (both for themselves and for patients), they felt that it was overwhelming and difficult to review and would be challenging for less tech savvy individuals. Many of their concerns were similar to the concerns raised in the general practice co-design sessions and were issues that the technical development team were actively working to improve for the final version for clinical testing. Identified issues surrounded streamlining the dashboard for increased ease of use, simplifying and clarifying language used, and provision of clear instruction and training to best utilise all the features of FHT.

Barriers and enablers to implementation

Co-design session participants discussed factors that could facilitate or impede the implementation of FHT. Some factors were similarly applicable to any new initiative employed at a practice and have been identified in previous research, including clearly defined roles and responsibilities, an understanding of the intention and functionality of the initiative, good fit or integration with existing systems/protocols and sufficient time/resources. [15-23]

> *"I think that each person, as we were just talking about, needs to know their role. And they need to be trained in their role and they need to stay within their role. And that will prevent the wrong information getting into the wrong arena. Otherwise you'll end up with the thing going wrong, completely wrong…" (Session 1, GP, face to face, metropolitan)*

> *"And don't forget that if it's a ten minute consult and that pops up but it's got nothing to do with what the patient has come in for, then it's just going to be a 'close that'" (Session 1, PN, face to face, metropolitan)*

Others could be applied to the implementation of other new technology: the need for the platform to be engaging (and not annoying), intuitive (or familiar), useful and easy to use; the need for the platform to be accurate and free from bugs; and, the need to be flexible and allow for some individualisation or adaptation to different contexts.

> *"As with any of these things there will be a need for education and you'll have early adopters and you'll have the laggards. I think just keep it simple and to have as much or as little as you want." (Session 5, GP, zoom, rural)*

Factors specific to FHT included: the need for the algorithms sitting within FHT to be accurate; the data drawn from the EMR to be accurate and complete; the ability to use the platform for planned and spontaneous interactions; the ability of the program to be hidden when not required; the ability to link to the MBS; and interactive links and pre-filled tools.

> *"I think you've got things there that prioritise by risk, that allow you to manage your cohort if you want to start small and grow, it's got a feature that allows you to opt the patient out for a period of time, or indefinitely, and discussing there the follow up operation of how you get patients in front of you and do that in a manageable way either me fixing with planned visits to the doctor or support enough that they are coming in before." (Session 5, GP, zoom, rural)*

> *"…and user friendly also, in the respect that when it is done it vanishes, we don't want to see it keep coming up because as you say when people see too many prompts they say I'm not even looking" (Session 1, PN, face to face, metropolitan)*

> *"…cut out the things you don't need to see, so we only have the risks that we have automatically identified" (Session 6, GP, face to face, metropolitan)*

Perceived barriers to implementation included clear ownership, technological complexity and competing priorities. Perceived enablers to implementation included the familiarity of the system functionality, the flexibility of the tool, the simplicity of the technology and the potential to gain from use of the tool.

Participants identified potential ethical/legal concerns relating to the use of technology to assist with QI activities, including the consequences of identifying a patient as having risk factors but not acting on them, of using auto-filled forms (e.g. management plans) without sufficient oversight, privacy concerns regarding communication methods with patients (e.g., email, fax), and appropriate allocation of responsibility and venue for discussion of risk factors and recall. However, participants felt that these risks, primarily surrounding practice management of recall and chronic health discussions with patients, were sufficiently mitigated with strategies currently in place in their own practices.

Participants felt that some contexts were more suited to the implementation of FHT, namely practices with more doctors, with practice nurses, and with more time available for patient review and building recall lists. They also felt that FHT could only be used when the patient agenda or need was not urgent, or where time was left at the end of a consultation.

Participants self-selected to participate in the project, and as such demonstrated an openness to new technology and new ways of managing clinical processes. Whilst they indicated variable technological skill and confidence, they expressed confidence that they would be able to use FHT. For some, the more complex functionalities were accessible because of their similarity to existing programs. Participants were enthusiastic about the possibilities for clinical performance enhancement provided by FHT, seeing their current ad hoc approaches being strengthened by the platform.

A patient perspective

The patient co-design group was convened to review the prototype and concept with patients who had attended general practices for chronic health conditions. Five people attended these sessions, with four aged over 60 years and one aged 40-49 years. Three participants were female and two were male. All lived in metropolitan Melbourne. The session ran for approximately 60 minutes.

Participants acknowledged that their preferences may be influenced by their age, and that younger people may have different preferences. They speculated that younger people may be more connected to their mobile devices and prefer communication that was not as 'personal'. However, participants felt that it was important not to make assumptions about the way people use technology

Participants were well versed in their own health and had extensive experience attending a GP for their health conditions (conditions including type 1 diabetes, COPD and hypertension). All had a continuous relationship with one practice/practitioner (including one participant who had visited the same clinic for 50 years). They had experience with being recalled by their GP for a health issue, but only after visiting or having planned tests done.

Participants were comfortable with the use of computers in face to face consultations, had no objections to the inclusion of FHT on the screen and no concerns with the traffic light approach, however, one participant felt strongly that the language used on the clinical decision support at the point of care should be clearer and simpler so that patients would understand exactly what the flag was conveying:

> *"…why wouldn't you just put chronic kidney disease… why wouldn't you put the whole diagnosis there?... When you see all the abbreviations, which I don't know, it leads to other*

conversations that then the GP has to say 'this is to do with looking into your kidney function'. Why not just say investigate kidney function?" (Female)

Participants in the general practice co-design sessions were adamant that patients would benefit from the provision of graphs to understand how their health indicators were progressing over time, and that this method would enable greater conversation about why a given treatment plan or course of action was needed. However, participants were concerned that graphs could be manipulated to exaggerate difference or change, and felt that the doctor would tell them if something needed to be addressed.

"I know where I'm at. If it's outside the range then we talk about it. If it's not then we don't. So I don't need that." (Male)

The discussion about the inclusion of information or links to guidelines indicated that participants were very happy with their own doctors. Patients believed their own doctors would not need to reference guidelines but conceded that less experienced doctors may benefit from guideline access at POC. Patients suggested that they would have greater confidence in a doctor that isn't their usual doctor if they accessed the additional information on FHT.

Unresolved challenges

The complexity of patients' non-clinical characteristics and situations (including homelessness, cultural background, socio-economic status, age) were discussed in both general practice and patient sessions, both in relation to how best to capture this information and use it in the alerts to practitioners, and in relation to how best recall patients for further screening or management. Whilst participants were in agreement that a diverse range of factors influence whether and when a patient will visit their GP, the way they interact with their GP, and the complexity of providing care to patients, there was uncertainty as to how a technological platform could identify and incorporate these influencing factors, particularly when many factors are not recorded in the patient's EMR (where FHT will draw its information from), nor are EMR programs set up to capture the full breadth of information in a systematic and consistent manner. General practice participants also described the complexity of establishing a single technological solution or system for recalling patients to the practice given the diversity of non-clinical characteristics of patients. For example, one participant described the shortcomings of traditional mail-out systems where patients were homeless or between addresses, opting instead for a hybrid phone/email approach. Others, including patients, described the presumed preferences of different age groups in receiving contact from a general practice. The discussions indicated that these issues required additional consideration to determine which features could be embedded in the FHT technology, and which would form part of the broader implementation of FHT within a quality improvement framework.

A final issue that was very briefly touched upon, but not resolved, was how to display recommendations relating to co-morbidity and multi-morbidity. The group considered options for a prioritization process, a time-limited condition specific focus, and a broader display of all conditions. These discussions did not resolve with a single solution, and indicated to the research and development team that a multi-pronged approach may be required. Development was to focus on the prototype with a single condition to test if the concept was both possible and useful.

DISCUSSION

Regular audit and feedback has the potential to increase physician awareness of CKD and improve clinical outcomes for patients. [35] This awareness, coupled with the experience of members of the research team in CKD (clinical and QI), informed the decision to use CKD as the 'test condition' in the development process. Using this exemplar as a handle to focus their thoughts, co-design participants requested (and co-designed) a system that included features in keeping with this best practice approach to QI [4, 12, 35], including audit, feedback and clinical decision support, and wanted to see guideline concordant recommendations for care while in consultation. In keeping with previous research, participants identified that the prototype needed to work within their existing workflow to facilitate automated patient recall and track patients with/at-risk of specific conditions [5]. It needed to be simple, provide visual snapshots of information and easy access to relevant guidelines, and facilitate QI activities. This combination of features should work to alleviate the barriers to implementation of guideline concordant care, as identified by Vest et al and others, including knowledge of the chronic condition, engagement with patients/specialists, time demands and access to/ability to use data [15-23, 36]. The challenge for the FHT technical development team was to operationalise this to find a balance between comprehensive information provision and too much information, between appropriately timed alert and recurrent annoyance, and between succinct and coherent delivery of complex information and over simplification. Evaluation of the implementation of the prototype in multiple general practice settings will provide greater understanding of whether these features are effective in supporting QI.

Co-design has been utilised effectively in a broad range of health care settings to improve physician engagement with QI activities. [37, 38] The inclusion of the 'think aloud' sessions enhanced this co-design process and enabled the developers to test run their concepts, to determine where the design was not complying with the user requirements and to revise the prototype to resolve these concerns.

A key component of successful QI is the level and nature of involvement of the end-users, in this case the health care professionals.[9] Those who participated in this project wanted to develop and test the proposed FHT platform, and find new ways to improve their responses to chronic health care. The process itself generated useful ideas for technological development and reflections on the ways the technology would be used in practice, particularly in conjunction with existing technologies, tools and work practices. Issues and challenges identified by participants were reflective of issues common to the introduction of new technology and new programs (as discussed briefly in the background section of this report), as were the described facilitators of success.

Participants in the co-design process were drawn from a diverse range of contexts, with varying access to resources, vastly different staffing arrangements, patient lists and capacity for new interventions. The breadth of experience and knowledge contributed by the general practice participants, patients, and the research and development team has enriched the design process, enabling the conceptualisation of a flexible platform designed to improve patient health outcomes. Over the co-design journey it was clear that participants were visualising how they could utilise FHT in their own daily work to set goals and targets in relation to CKD. In contrast to 'top down' approaches to QI intervention design, this design process enabled the researchers to identify and resolve possible barriers to implementation specific to this particular group of end users before implementing FHT. However, participants may not have been

representative of these groups more generally and broader consultation needs to be undertaken to determine the acceptability and usefulness of FHT to a broader general practice and patient audience.

In recognition of the central role patients play in their own health journeys, [39] patients were consulted about the acceptability of FHT in primary care. Participating patients also supported the use of the platform in general practice. They felt that use of the platform demonstrated a high level of patient care and could increase patient confidence in health practitioners. Further consultation with patients who have been identified using the FHT platform will provide additional insight on patient experience. Similarly, further piloting and evaluation will provide insight into the usefulness of FHT for QI activities across a range of different general practice settings.

The next step for the FHT project was to pilot the prototype in two different general practice settings, and undertake an evaluation of the implementation process (completed in early 2020, results as yet unpublished) using the framework for effective audit and feedback developed by Brown et al, Clinical Performance Feedback Intervention Theory (CP-FIT).[9] Further refinement and piloting of FHT in additional general practice settings in 2020-21 will determine the specific impact of contextual factors on implementation and ongoing use of FHT, and the usefulness and acceptability of the platform to GPs, nurses and practice managers. Further development of the tool is underway to include multiple chronic health conditions (including CKD, CVD, T2D and prostate cancer). A pragmatic cluster randomised control trial is planned to commence in late 2021 to further test the usefulness of FHT in improving outcomes for patients.

CONCLUSION

The aim of this study was to co-design with end users an electronic QI tool incorporating audit and clinical decision support for use by Australian general practice staff to support chronic disease management. This approach has been a practical and acceptable method for bringing together ideas, concepts and end user needs to develop a platform that can be integrated into the general practice clinical workload. Challenges with QI applications remain an ongoing challenge. However, the resulting FHT version 1 platform is being tested in the general practice pilot sites to determine fidelity to design intentions, acceptability and usefulness of the tool and factors influencing implementation.

To ensure that future development of the FHT platform continues to be informed by real world need an advisory group compromising GPs, practices nurses and practice managers will be established. This group will sit alongside a consumer (people with/who care for people with a chronic condition) advisory group and both will provide advice and guidance on future testing and development of the FHT platform.

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Competing interest statement

No competing interests. We are not involved in any sponsorship arrangements with health or technology industries, however we are fee-paying members of the Best Practice Partner program which allows FHT to integrate with that product.

Supplementary materials

Appendix A provides a snapshot of the initial design through to the prototype product and provides a summary of the platform and its components. Copies of the schedules that guided discussion in the co-design sessions are included in Appendix B.

Author contributions

JMN, an experienced researcher and academic GP, developed the study design, which was refined following feedback by RB (PhD and mixed methods researcher), NL (PhD and QI researcher), and CN (nephrologist). RB and AW (experienced researcher) undertook recruitment of participants. JMN conducted the co-design sessions with support of RB and JJ (nephrologist), and RB conducted the Think Aloud interviews. KA was a participant in the co-design sessions. BH (PhD and experienced qualitative researcher) and RM (academic GP and qualitative researcher) performed the analysis of the data. BH drafted the manuscript with support from CH (PhD and experienced researcher) and KA (PhD, GP and experienced researcher). All authors revised all drafts and approved the final version of the manuscript.

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Data sharing statement

Data may be made available on reasonable request.

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Appendices

Appendix A – The Future Health Today (FHT) Platform

Initial design sessions started scribbled on paper and pin boards, and then progressed to a mock-up on screen (see Figure 1 below).

Figure 1. Initial design

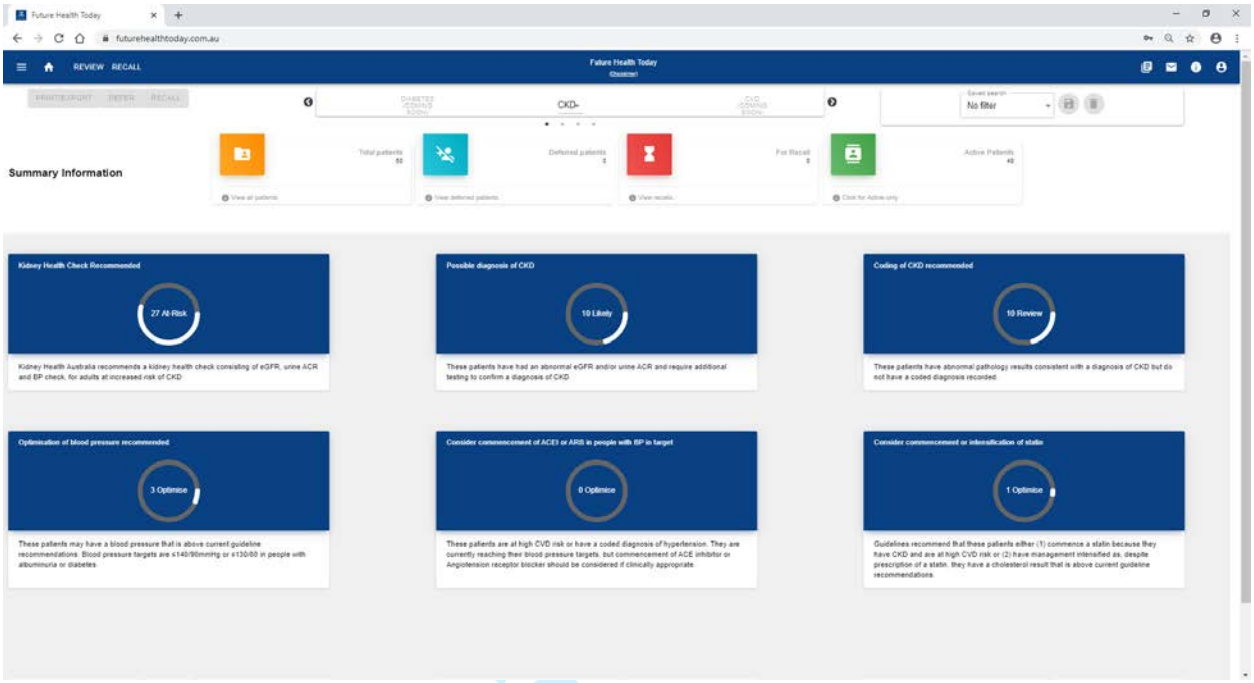
From these sessions, the FHT platform was developed. It incorporates a 'dashboard' (see Figure 2) to assist with triage, audit and recall; a 'point of care' to assist with in-consultation opportunistic identification and management; and a benchmarking component to assist practices to evaluate their performance and enable quality improvement activities (under development). It also includes information and resources to support clinical decision making (including relevant clinical practice guidelines) and to assist with patient understanding of chronic disease.

The dashboard enables practices to:

- Identify patients who may benefit from a Kidney Health Check
- Identify patients with possible CKD requiring further investigations
- Generate lists of patients who have pathology results consistent with CKD, but no coded diagnosis
- List patients who may benefit from review of their blood pressure management
- List patients who may benefit from commencement of a statin
- Manage patient recalls, including deferral of patients
- Access guidelines and consumer resources for chronic disease management
- Access quality improvement activity documentation

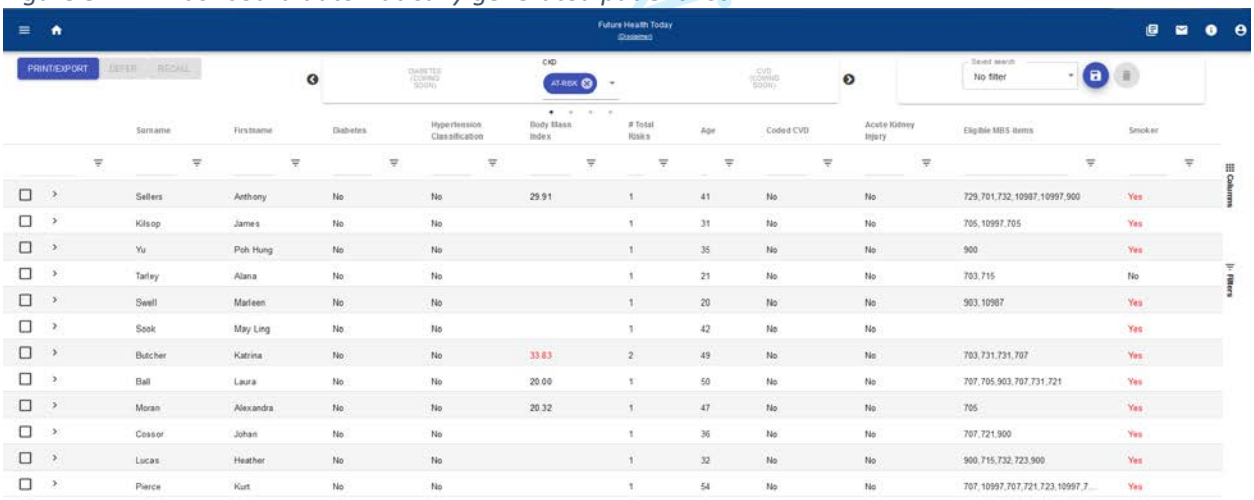
Appendices

Figure 2. FHT Dashboard entry page



Clicking on one of the quality improvement areas will generate a patient list for review (see Figure 3).

Figure 3. FHT Dashboard automatically generated patient list

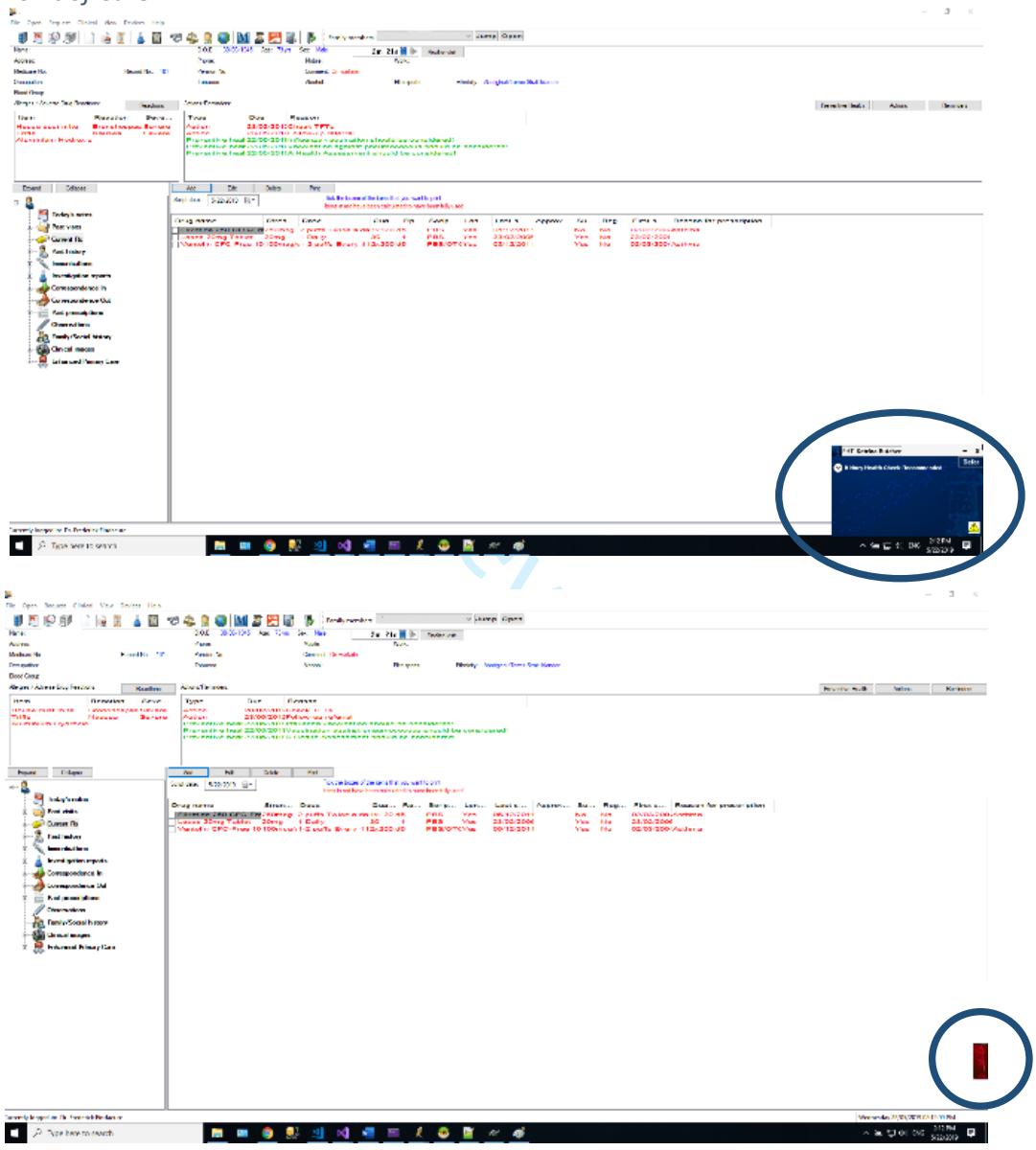


The point of care (POC) tool deploys for all patients that meet quality improvement criteria and provides a prompt for the GP, nurse or health assistant to discuss the patient's risk factors or condition. It displays a recommended action according to best practice guidelines, assisting the health professionals to better manage patients and their condition, and provides consumer resources and instructions for further investigation and management if required.

Appendices

The POC tool sits in the bottom right corner of the screen, either as a small box with detailed recommendations or minimised to a traffic light coloured icon (including red for urgent attention, orange for review required and green for no recommendation), hugging the edge of the EMR (see Figure 4). When minimised the POC can be moved to a different location on the screen. It is designed to be as unobtrusive as practicable (following feedback from the co-design sessions), and as such does not flash or actively attempt to alert the user to its presence.

Figure 4. Point of Care



Both components of FHT reside within the practice that they are used, with no data leaving the site. The dashboard can be accessed by any staff at the practice with a link and a login. The POC must be installed on individual machines.

Resources and guidance can be found both on the dashboard and on the POC. This includes links to evidence based clinical management guidelines and peak body information for patients.

Appendix B - Focus group interview guides

General Practice Co-Design Sessions

Introduction	Thanks for coming to the first co-design focus group. As you know, we are designing a new technology called Future Health today. We are envisaging that this will have three main components – an audit and benchmark component, a patient recall system and a clinical decision support component embedded within the electronic medical record. Before we start, I'd just like to remind everyone that we are video and/or audio recording this session, but that the recordings will be stored securely and only used by the researchers. **We will make sure that we remove identifying details as much as we can as well.** Does anyone have any questions before we start?
To start off with, I'd like each of you to write two key features you would like to be incorporated in each of these components, and two things that we should <u>not</u> include in the design	Post it notes to be used to write comments and stick on butcher's paper. Facilitator to then summarise and clarify any features.
Next, I would like to show you the current prototype. **Facilitator to step through current prototype; use screens and multiple A3/A4 sheets showing each component** **Focus 1: Key components and workflow**	Its design has been informed by previous qualitative work with GPs, practice nurses and practice managers. I would like to hear your thoughts about this prototype, and to get your ideas for improvements to the tool. Please think about clinical workflow and how you might use this tool in practice. We will use your ideas to improve the prototype. We also have some screen shots of the prototype. Feel free to write or draw on these – we will use these to inform further development of the tool. Prompt: 1. Audit, benchmarking tool • Can you tell me what you think of the information provided by the tool? • Would you like any other information included? • How would you like to do the search? • How could this inform quality improvement in your practice i.e. how would you use this? 2. Patient recall system

	• How would you like to link audit and patient recall? • Does it need to integrate with other systems? How? ▪ Pathology, appointments, EMR 3. The clinical decision support (CDS) tool is triggered by xxx. How would this work in your practice? • Can you think of a different trigger for the tool? • The CDS extracts information on x, y, z patient factors to inform which guideline information is shown. o Is this too restrictive? o Are there other important factors that haven't been incorporated? • Where would you like the tool to deploy on the screen? o E.g. link to patient information sheet, additional prescribing information, Health pathways link • Can you tell me if there is any important information that is not covered in CDS? • Is there any information that we have presented that you don't think is important to include?
Focus 2: Design and navigation	Prompt: • Can you tell me what you think about the appearance of Future Health Today? o Audit o Recall o CDS • Is there anything about the appearance that would make you less likely to use the tool? More likely? • Can you tell me how the appearance of the tool might impact on your patients? Would you show them the tool? Why/why not?
Any other comments?	

Note – prototypes will be developed as part of this project.
It is expected that most of the information covered by the prompts will be covered as the general practice staff provide their feedback. It is not anticipated that all of the questions (which are used as prompts) will be asked but are provided as examples.
A second set of prototypes will be developed in response to the feedback from the general practice, consumer and specialist physician groups and presented using a similar structure to above. An electronic prototype, if available, may also be utilised in the second round of focus groups.

Appendices

Patient Co-Design Session

Introduction	Thanks for coming to the first co-design focus group. As you know, we are designing a new technology called Future Health today. We are envisaging that this will have three main components – an audit and benchmark component, a patient recall system and a clinical decision support component embedded within the electronic medical record. As a person attending general practice, you might receive a recall to attend the practice or your GP might use a CDS tool with you whilst you are at an appointment, so we are going to focus on those two components. Before we start, I'd just like to remind everyone that we are video and/or audio recording this session, but that the recordings will be stored securely and only used by the researchers. **We will make sure that we remove identifying details as much as we can as well** Does anyone have any questions before we start?
To start off with, I'd like you to think about whether you have ever been recalled to a general practice for example, for a health check or to receive results. This might have been by phone, sms, letter, or e-mail. I'd like each of you to write two key features that would be included in the best recall system you could imagine, and two things that we should <u>not</u> include in the design	Post it notes to be used to write comments and stick on butcher's paper. Facilitator to then summarise and clarify any features.

Appendices

Next, I would like to show you the current prototype. **Facilitator to step through current prototype; use screens and multiple A3/A4 sheets showing each component** **Focus 1: Key components**	Its design has been informed by previous qualitative work with GPs, practice nurses and practice managers but we need your input. I would like to hear your thoughts about this prototype, and to get your ideas for improvements to the tool. Please think about how this tool might help you be contacted by your general practice as well as how you might like to use this tool together with your practice nurse or GP when you visit a general practice. We will use your ideas to improve the prototype. We also have some screen shots of the prototype. Feel free to write or draw on these – we will use these to inform further development of the tool. Prompt: 1. Patient recall system a. How would you like to receive information? b. How much information should it contain? c. How would you like it delivered? d. Is there anything we need to be aware of? E.g. privacy e. Does it need to integrate with other systems? How? i. Electronic calendars, My Health Record, pathology companies 2. The clinical decision support (CDS) tool is triggered by xxx. • The CDS extracts information on x, y, z patient factors to inform which guideline information is shown. • Is this too restrictive? • Are there other important factors that haven't been incorporated? • What information would you like the tool to deploy on the screen? • Would you want to see this information or just the GP? ▪ E.g. link to patient information sheet, additional prescribing information, Healthpathways link ▪ How would you like to receive this information? Web portal, e-mail, print out • Can you tell me if there is any important information that is not covered in CDS? • Is there any information that we have presented that you don't think is important to include?
Focus 2: Design and navigation	Prompt: • Can you tell me what you think about the appearance of Future Health Today? o Recall

Appendices

	o CDS • Is there anything about the appearance that would make you less likely to use the tool? More likely? • Can you tell me how the appearance of the tool might impact on whether you want to see it/use it with your GP?
Any other comments?	

Note – prototypes will be developed as part of this project.
It is expected that most of the information covered by the prompts will be covered as the general practice staff provide their feedback. It is not anticipated that all of the questions (which are used as prompts) will be asked but are provided as examples.
A second set of prototypes will be developed in response to the feedback from the general practice and consumer groups and presented using a similar structure to above. An electronic prototype, if available, may also be utilised in the second round of focus groups.

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the inter view or focus group?	
Duration	21	What was the duration of the inter views or focus group?	
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or	

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	
Description of the coding tree	25	Did authors provide a description of the coding tree?	
Derivation of themes	26	Were themes identified in advance or derived from the data?	
Software	27	What software, if applicable, was used to manage the data?	
Participant checking	28	Did participants provide feedback on the findings?	
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	
Data and findings consistent	30	Was there consistency between the data presented and the findings?	
Clarity of major themes	31	Were major themes clearly presented in the findings?	
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.