

Designing Mobile Health and Well-being Applications: A Value-oriented Approach

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Abstract—Mobile health and well-being applications (MHWBAs) provide a means of enhancing the delivery of health care. Ensuring that value is delivered to health care customers (patients) can be a challenge as health initiatives are often supplier-centered and may not take into account patient expectations. In addition, stakeholders including clinicians, customers and MHWBA designers may be divided in their views about what features, and functionalities are required, and how much control patients should have. A close working collaboration between stakeholders may bring significant benefits. Therefore, service systems such as an MHWBA should provide value co-creation opportunities, and support patient engagement by creating a positive environment in which actors can network and communicate with empathy. This study proposes and validates a value-oriented framework for mobile services that can be used to derive MHWBA design guidelines. The framework is based on a three-dimensional typology of service value co-creation activities which considers the co-creation activity type, the dominant participating actor, and the dominant benefitting actor. The framework can be used to analyze the value co-creation potential of existing or proposed mobile apps in a range of service contexts. In this study, the framework was applied to the case of the Green Prescription (GRx) service and was used to identify a range of concrete value co-creating activities. In further work, these activities will underpin the design requirements for a GRx MHWBA, with relevant features supporting a value co-creation process that brings value to both GRx patients and GRx providers.

Keywords—value co-creation, mobile apps, mobile health, service-dominant logic, app design guidelines, GRx

I. INTRODUCTION

In recent times, the health care industry has adopted mobile health and well-being applications (MHWBAs) as a means to enhance the delivery of health care. Health care and well-being services provided by MHWBAs vary from monitoring one's health conditions and medication control [1-2], to therapeutic treatment [3] to facilitating booking and payment for health services [4]. The number of MHWBAs has grown significantly in the last decade [5-6].

The advances in mobile technology (MT) encourage the development of innovative MHWBAs that enable efficient and effective service offerings [7]. However, MHWBA adoption by end-users is still negatively affected by the perceived lack of everyday value [8-10]. Ensuring that value is delivered specifically to patients as MHWBA customers can be a challenge as health initiatives are often supplier-centred

and may not take into account patient expectation and preferences [11]. In addition, stakeholders including clinicians, patients, and MHWBA designers may be divided in their views about what features, and functionalities are required, and how much control shroud patients have [12-13]. Therefore, there is a need for a better understanding of how to design MHWBAs that are aligned with and meet the value needs of all stakeholders including patients [14-16].

Under the paradigm of service-dominant logic (SD) [17], service value co-creation brings various groups of stakeholders together in order to generate benefits to all participating actors. Applying a service science approach, the study presented in this paper addresses the following key question: *How to ensure that the design of an MHWBA provides opportunities for value co-creation?* The study proposes and applies a framework that can be used to derive MHWBA design guidelines based on the projected value to customers and service providers.

The rest of the paper is organized as follows: Section II provides a brief literature review. The framework is presented in Section III; its application to a specific case is discussed in Section IV. In Section V, we identify the potential features of the proposed GRx MHWBA. The last section highlights the contributions and the limitations of the study and outlines directions for further work and research.

II. VALUE CO-CREATION IN HEALTH CARE

A. Service Value and Value Co-Creation

According to the foundation principles of SDL, service value co-creation occurs when customers accept the service value proposition put forward by service providers and integrate the company's offerings into their personal processes [10][18]. Service value is created by customers using the product or service or when they collaborate with service providers, with interactions facilitated by service providers who create opportunities for value co-creation such as shared platforms and provide customers with the necessary resources (products or services) [18-21]. Importantly, the close working collaboration between customers and service providers may bring significant benefits to all stakeholder groups, and boost service growth [22-23]. Therefore, it is crucial that MHWBA service providers actively promote value co-creation opportunities, and support customer engagement [24-25].

B. Patient Experience and Engagement

Patients are the customers in the MHWB health service ecosystem. Patient experience (co-created in collaboration with other ecosystem actors) has a direct impact on patient perceptions about received health service value [25-26]. Therefore, it is essential that patients are willing participants in the value co-creation activities, and are motivated to collaborate with their service provider [27]. For example, a feeling of being controlled may have a negative impact on experience and thus, on the value co-creation process [28].

Patients integrate the resources provided to them by the use of engaging activities and in interaction with the rest of health service ecosystem [25] [29-31]. Creating a connected and positive environment in which actors can network and communicate with empathy may serve as a strong motivator of stakeholder, and in particular, patient engagement [32-33]. Therefore, all actors in the health care service ecosystem need to be aware of the need to engage patients and help them realize the value of their engagement in order to generate benefits for all ecosystem actors [33-35].

III. VALUE FRAMEWORK FOR MOBILE SERVICES

The value framework for mobile services proposed in this study draws on prior research in the area of mobile service adoption and use [36-39] and in particular, on the evaluation framework for mobile service development proposed in [40] and on the concept of value fusion advanced in [41]. The framework is based on a three-dimensional typology of service value which considers the dominant participating and benefitting actor, the value brought to each, and the specific value generating activities (Table I).

The first framework dimension represents the spectrum of value co-creation process domains and the roles of the dominant actors [40]. Each value co-creation process domain offers specific opportunities for stakeholder collaboration and value co-creation:

- **Co-production:** requires customer engagement. Customers participate by choice or as a requirement to use the service, using the tools made available by the service provider.
- **Content co-development:** content creation, publication and distribution using digital platforms.
- **Co-innovation:** generating new ideas related to the development of new services or the upgrading of current services.
- **Co-design:** choosing service features; service providers may re-evaluate and modify current service offerings.
- **Integration:** adapting services to changes in the mobile service and technology space.

The second framework dimension comprises the typical service provider-oriented and customer-oriented value co-creation activities and interactions that occur across each of the five value co-creation domains (Table II). Finally, the third framework dimension considers the value-fusion process that generates benefits for each participating actor (stakeholder-specific value) through the fusion of the key MT characteristics [41]. The main types of service provider-specific value and customer-specific value are described in Table III.

TABLE I. VALUE FRAMEWORK FOR MOBILE SERVICES

Main Actor / Value Beneficiary	Value to Service Provider	Value to Customer
Service provider	Domain-specific & service provider-oriented value co-creation activities for the benefit of the service provider.	Domain-specific & service provider-oriented value co-creation activities for the benefit of the customer.
Customer	Domain-specific & customer-oriented value co-creation activities for the benefit of the service provider.	Domain-specific & customer-oriented value co-creation activities for the benefit of the customer.

TABLE II. VALUE CO-CREATION DOMAINS AND ACTIVITIES

Domain	Value Co-creation Activities	
	Service provider-oriented	Customer-oriented
Co-production	<i>Self-service:</i> the service design and conditions of use prescribed by the service provider.	<i>Do-it-yourself:</i> customers participate by using resources provided by the service provider.
Content co-creation	<i>Feedback:</i> customers provide unstructured feedback based on experience. <i>Inquiry:</i> service providers respond to specific customer requests.	<i>Feedback:</i> customers respond service providers' questions. <i>Content development and sharing:</i> customers provide input into the creation, publication and distribution of content.
Co-innovation	<i>New service development:</i> customers participate in testing and evaluation activities such as testing, based on service providers' guidelines.	<i>Idea generation:</i> customers provide ideas about new services or about improving existing ones using platforms made available by the supplier.
Co-design	<i>Customization:</i> customers can make minor modifications to certain features within limits set up by the service provider.	<i>Personalization:</i> customers can modify key service or product features using the frameworks supplied by the service provider.
Integration	<i>Packaging:</i> the service provider combines services to create a range of package solutions targeting particular customer segments.	<i>Self-acting integration:</i> customers designs package solutions according to their needs, possibly involving more than one service provider.

The framework was first tested using three existing mobile applications (AliExpress, Spotify, and BNZ) in order to establish its robustness as an evaluation tool. Next, it was applied in a specific health and well-being service context in order to derive design guidelines for a proposed MHWBA.

IV. DESIGNING AN MHWBA: THE CASE OF GRX

Obesity is a serious health risk. A New Zealand based health care service (Green Prescription, or GRx) is freely available to patients with obesity who want to change their life style. GRx promotes physical activity and a dietary regime.

New value co-creation opportunities involving the development of an GRx MHWBA were suggested recently in [11]. Using the customer and service provider processes, and customer experiences (i.e., behaviour, emotion, cognition) identified in [11], we applied the framework in order to understand how a GRx MHWBA can provide value to its stakeholders. This stage is a key part of an MHWBA development process because it prevents designing the 'wrong' software.

TABLE III. SERVICE PROVIDER- AND CUSTOMER-SPECIFIC VALUE

Service Provider-specific Value		
Reducing cost	Service providers reduce marketing costs, staffing costs. Service providers use customer	
Customer co-creation	Feedback for promoting goods and services.	
Market insight & customer knowledge	Service providers gain insights into customer acceptance of goods and services.	
Real time tracking & control	Service providers can control the service channel based on real time usage data.	
Customer influence	Service providers can benefit from customer reviews and recommendations.	
Customer-specific Value		
Informational value	Customers using MT to search for information to support decision making.	
Identity value	Customers using MT to express and identify themselves in the public space.	
Social value	Customers using MT to interact with others, obtain social approval.	
Entertainment & emotional value	Customers using MT as an entertainment channel, engage in an enjoyable experience.	
Monetary value	Customers use MT select a cost-effective service offer depending on context and location.	
Convenience value	Personalization	Customers able to set up MT devices according to personal preferences.
	Multitasking	Customers use MT device carrying out tasks simultaneously.

A. Customer Perspective

First, we identified what the GRx patient (GRx customer) considers valuable, according to the customer-specific value types (Table III). Then we identified the domain-specific value co-creation activities required (Table IV).

1) Informational value

GRx patients value health-related information for activities, such as “learning about the right physical activity” and “understanding [the] why and how behind healthy living” [11]. To reach their health goals, patients can participate in Do-it- Yourself activities, to co-produce relevant content.







Testimonials have been used to encourage others to join the GRx programme by “providing the success stories to help others out” [11] and strengthen the reputation of service offering. Patient input into the creation of content can facilitate customer processes such as “collecting information about healthy living” and “encouraging others in similar situations to follow the GRx programme” [11].

Customer value can be destroyed because the patient is “not understanding how the community programme operates” [11]. Patients can co-design content to meet the informational needs, supported by their current knowledge of GRx.

2) Identity value

Currently, GRx patients can express their views through the annual GRx patient survey [42], and by providing testimonials to GRx providers. The proposed GRx MHWBA should allow them to freely express their thoughts and comments and share their health and well-being progress. would contribute to “providing the success stories to help others out” [11].

TABLE IV. VALUE CO-CREATING ACTIVITIES TO BENEFIT GRx CUSTOMERS

Value Co-creation Activities	Informational Value 	Identity 	Social Value 	Entertainment & Emotional Value 	Convenience Value 	Monetary Value 
Do-it Yourself						
Feedback						
Content Development and sharing						
Idea generation						
Personalization						
Self-Acting Integration						

3) Social value

Using social media can facilitate searching for information about health and well-being practices and interventions. This can foster a meaningful dialogue extending beyond the ecosystem: “encouraging others in similar situations to follow the GRx programme”, “encouraging others for healthier lifestyle” and “interacting with others (e.g., family members and friends) for getting support or exercising together” [11].

Recently, the GRx team in Rotorua faced a challenge in providing proper patient support during the New Zealand COVID-19 lockdown period [41]. Patients missed the regular face-to-face interactions in their physical activity groups. To remedy the situation, the GRx team created a Facebook group with the purpose “to share daily and weekly activity and well-being challenges for the members of the group.” [43]. The virtual space shows the social value of a social networking tool for patients.

4) Entertainment and emotional value

A physical activity can be inherently enjoyable to a person (intrinsic engagement) if sufficient extrinsic motivation is provided. Patients can obtain emotional value from interacting with the MHWBA if it facilitates the following customer processes: “interacting with others (e.g., family members and friends) for getting support or exercising together” and “participation in and communicating sporting events” [11]. Content development and sharing and feedback can be used for emotional value co-creation.






5) Convenience value

Trough meaningful feedback and content sharing, the GRx MHWBA could support the following customer processes identified in [11]: “giving feedback”, “organizing future support from health advisor or personal trainer”, “collecting information about healthy living”, “reading about the GRx programme”.

B. Service Provider Perspective

Table V shows the results of applying the framework from a GRx provider perspective. What the GRx provider considered value was categorised according to service provider-specific value types in Table III. We identified the required value co-creation activities across the five co-creation domains described earlier (Table II).

TABLE V. VALUE CO-CREATING ACTIVITIES TO BENEFIT GRX PROVIDERS

Value Co-creation Activities	Reducing Cost 	Customer Co-creation 	Market Insight & Customer Knowledge 	Real time tracking & control 	Customer Influence 
Self-service					
Feedback					
Inquiry					
New service development					
Customisation					
Packaging					

1) *Customer Co-creation value*

GRx providers use traditional socio-technical channels to support value co-creation (phone, SMS texting, face-to-face meetings, and email communication). They may not be always efficiently used: it was found in [11] that 38% of the patients who were dissatisfied with the GRx service, mentioned “insufficient follow-up/communication” as one of the reasons for their disappointment.

The GRx provider may use the GRx MHWBA to increase the level of interaction with patients. The app can act as resource integrator for the system’s actors (e.g., exercise providers and patients) to allow them to collaborate, customise, and create value. Patients posting feedback or reviews about the GRx programme may help improve the service and engage others.

2) *Market insight and customer knowledge*

The following negative patient experiences were identified in [11]: “feeling that activities prescribed are inappropriate”, “annoying but someone talking by the phone about to be motivate and more active”, and “feeling embarrassed by the health advisor”. The GRx provider would benefit from MHWBA features that allow the provider to gain in depth knowledge and insight about patients based on patient feedback and inquiries.

3) *Real time tracking and control*

Currently, patients’ progress is recorded by the GRx support person. The information is reported back to the referring health practitioner who decides whether the patient should continue or should be discharged at the end of the programme. Real time tracking and control may be valuable both to the GRx provider, and the referring health practitioner.

4) *Customer influence*

GRx providers can receive value from patient feedback and use inquiry activities to influence patients’ behaviour towards achieving their health and well-being goals. GRx providers can exploit the relevant features of an MHWBA for extended interactions with patients and to disseminate new health and well-being support ideas to help patients get more insights into how to reach their goals.

The findings of the analyses above can be used to identify functionalities and capabilities that may enhance the value creation and co-creation potential of an GRx MHWBA. A set of desired features are described in the next section.

V. EXPLORING THE POTENTIAL FEATURES OF THE GRX MHWBA

Drawing on [44-47] where a range of potential features of mobile applications for promoting physical activity are suggested and based on the analyses in Section IV, we identified a set of mobile application features that specifically supported the value co-creation activities highlighted in Tables IV and V. The features, and their expected value for GRx patients and GRx providers are presented in Table VI. The features can be used to provide high level specifications for the design and implementation of MHWBA, as explained below.

1) *Patient Education* [44]: The MHWBA needs to offer reliable and helpful information, to increase patient awareness and confidence.

2) *Exercise Library* [44]: The MHWBA needs to comprise sets of physical activities that can be performed by patients.

3) *Social Support* [45]: The MHWBA needs to support interaction features that allow the patient to connect with other patients, helping each other remain motivated.

4) *Positive feedback system* [44]: The MHWBA needs to offer virtual rewards for reaching health and well-being goals and objectives.

5) *Reviews* [44]: The MHWBA needs to provide means for patients to check their progress towards pre-set goals, to assist them to stay motivated.

6) *Goal setting* [45]: The MHWBA needs to provide means for patients to set up their goals for the day, to support motivation.

7) *Motivational messages* [46-47]: The MHWBA needs to display motivational messages as the patient progresses toward achieving their goals for each physical activity.

8) *Activity tracking* [44]: The MHWBA needs to be able to record metrics such as a step counter and heart rate.

9) *Support and feedback* [47]: The MHWBA needs to provide advice and recommendations on physical activity in textual, visual and auditory format.

10) *Data collection* [47]: The MHWBA needs to provide means for patients to input data related to workouts to be analysed, summarised, and displayed.

11) *Generating progress graphs* [47]: The MHWBA needs to display data on progress in graphical form.

VI. DISCUSSION AND CONCLUDING REMARKS

Value based design is extremely important for health and well-being services [18] [31] [33-34]. However, at the core of the current GRx service is a physical activity scheme where patients have limited customisation options. Co-production activities are dominated by the GRx provider who creates the programme as a one-for-all service, with limited opportunities for new service development based on patient input. The current design therefore provides limited value to its customers, the patients. Following the design guidelines synthesised above, a mobile service based on a MHWBA can facilitate creating benefits for patients (informational identity, social, entertainment / emotional, and convenience value), and benefits to the GRx provider (customer co-creation, market insight/ customer knowledge, real time tracking/ control, and customer influence).

TABLE VI. GRx MHWBA FEATURES SUPPORTING VALUE GENERATION

Value for GRx Patients	GRx MHWBA Features	Value for GRx Providers	GRx MHWBA Features
Informational value	(i)Patient education (ii)Exercise library	Customer co-creation	(i)Support and feedback
Identity value	(i)Social support	Market insight & customer knowledge	(i)Data collection (ii)Generating progress graphs
Social value	(i)Social support	Real time tracking & control	(i)Activity racking
Entertainment & emotional value	(i)Positive feedback system (ii)Reviews (iv)Goal setting (v)Motivational messages	Customer influence	(i)Support and feedback
Convenience value	(i)Activity tracking (ii)Exercise library		

Thus, the MHWBA can act as a resource integrator for patients, GRx providers and support teams, as well as for actors outside the immediate MHWBA ecosystem (for example, facilitating the sharing of new health and well-being support ideas with friends and family members.) The increased level of ecosystem participant interactions leads to increased service efficiency and a higher service adoption rate, and to generating benefits for all participants [19][32].

A. Contribution

This study contributes a mobile service value framework that synthesises concepts and constructs proposed in prior research [40-41]. The use of the framework as a tool to support value-oriented mobile application design was demonstrated by applying the framework to the analysis of the value co-creation aspects of a proposed MHWBA to complement the currently active health and well-being programme GRx, and deriving the guidelines for the design of the MHWBA.

While the customer and service supplier processes and customer experiences related to GRx reported in a previous study [11] were used as input to the analysis, the proposed mobile service value framework can be applied in other specific service contexts either for evaluation or for design purposes. It can also guide the development of relevant data gathering instruments.

B. Limitations

One of the limitations of the analysis is that customer monetary value was not considered relevant as patients referred to the GRx support team do not need to pay for the service (even though additional paid fitness activities may be offered to GRx patients at a discounted rate) . Similarly, cost reduction benefits to GRx providers were not considered as the GRx programme is government funded. Another limitation is that only one empirical study ([11]) provided findings that could be considered in the analyses. .

C. Directions for Further Research

Co-creation opens the opportunity for customers and service providers to engage in the invention of new ideas, in

the development of new services, or in the upgrading of the current services. In the future, we want to explore new ways to engage patients in physical and well-being activities employing some value co-creation practices, also taking into consideration GRx customers and providers' views and opinions. The results can be used to enhance the design of the proposed MHWBA by improving both user experience and the outcomes of the GRx programme.

In addition, further research may identify additional value co-creation activities that may need to be incorporated in the design of the MHWBA. For example, a GRx provider can use the app in order to reduce costs associated with running the service, if the government subsidy is reduced.

Another research avenue is to apply the mobile value framework in different contexts: as a tool for deriving mobile service design recommendations that facilitate value co-creation, and also, to evaluate existing mobile services with the view of improving their value co-creation potential to the benefit of the stakeholders.

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