FACULDADE DE CIÊNCIAS SOCIAIS E HUMANAS
UNIVERSIDADE NOVA DE LISBOA

My Crohn's disease on real-time information –

User experience improvement through cross-platform applications

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Tese de Doutoramento em Medias Digitais

Junho, 2018

Thesis submitted in accordance with the requirements for the degree of Doctor of Philosophy in Digital Media, under the scientific supervision of Professor Graça Rocha Simões, Ph.D and Professor Teresa Romão, Ph.D.

Tese apresentada para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Media Digitais, realizada sob orientação científica de Professora Doutora Graça Rocha Simões e a Professora Doutora Teresa Romão.

Financial support

FCT
Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, INOVAÇÃO E DO ENSINO SUPERIOR

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INTERNATIONAL COLLABORATORY FOR EMERGING TECHNOLOGIES, COLAB

Collaboration

APD
ASSOCIAÇÃO PORTUGUESA
DA DOENÇA INFLAMATÓRIA
DO INTESTINO

ACKNOWLEDGMENTS

What a journey and challenge, as both designer and a patient.

I would like to give a big thank you to my supervisor, Professor Graça Simões, and co-supervisor, Professor Teresa Romão for believing that it was possible to cross the finish line.

I would also like to thank the APDI, João Machado, Ana Sampaio and Amélia Santos, for their unconditional support. To all IBD patients – associative members of the APDI – that contributed to the study, this research is dedicated to all of you.

To my doctors, David Serra – Hospital da Luz; Tiago Bana and José Neves – Hospital Egas Moniz, for the informal talks about the project and for your care.

To my family and friends. You have always been there for me, thanks for the unconditional support.

ABSTRACT

Reducing hospital institutionalization of citizen with chronic diseases is a major priority of western countries priorities. The more complex the health condition, the harder it is to coordinate clinical care. To improve the disease management and control, most patients need to use mobile applications that are available in online stores or web services because of the difficulty that a personal mobile phone has to get real time access to clinical data outside of a hospital.

In terms of IBD - Inflammatory Bowel Disease - existing mobile phone solutions are very complex, because visually the interfaces communicates with the user through inadequate use of symbols in clinical features, which are inconsistent and have poor legibility. They also presents a lack of visual optimization between multiplatform systems. This increases the user's learning curve in terms of how to interpret and interact with these systems, generating an opportunity for these patients with abilities to innovate through the creation and development of solutions that solve their own problems related to the management and coordination of the disease.

This thesis aims to analysis IBD patients behaviour related to disease management, identify the type of problems, both functional and communication, which occur in existing IBD m-Health and e-Health systems, and introduces two topics – communication and design studies – in the "User Innovator" model of Von Hippel (1976) which consists of users, that are, for example, patients with chronic diseases, and who innovate by creating solutions to solve personal problems because of unfavourable healthcare conditions. To validate in the design process the three perspectives – design, innovation and patient – were considered, and the framework “Human-social Interaction Model for e-Health Interfaces” was created, enabling a sustainable approach to research, with inputs from personal experience being used, introducing relevant feedback for the final goal of the preliminary studies, when creating the interface for mobile phone application particularly for Crohn’s disease, one of the IBD, with a new healthcare user experience.

To reach the objective, a set of studies were conducted that were divided into

two stages. The first, a literature review of the relationship between semiotics and interactive communication; the meaning of symbolic representation in interactive projects; new design research guidelines that define interfaces and features and that are more approachable for users; user perspectives towards technology for health supporting and controlling; the design and communication space on technological projects; the challenge for users/ patients who try to create systems to solve personal problems. The second part, presents the practical research that includes a survey of 279 participants with IBD; the empirical analysis of six case studies – mobile applications and multiplatform: context, features, design principles lifting, and usability testing A/B with the design features and principles of design on two of the six systems being compared.

The results from the thesis challenge the concepts of mobile interface usability in health, providing users with a structured interpretation of medical information design and a guideline for designers with chronic diseases that would like to create solutions to monitor health problems.

KEYWORDS: e-Health, Human-Social Interaction, Interaction Design, Interface Design, m-Health, User Innovator.

RESUMO

Reduzir a institucionalização hospitalar de cidadãos com doenças crónicas é uma das prioridades para os países ocidentais. Quanto maior for a complexidade das condições de saúde, mais difícil se torna a coordenação dos cuidados clínicos. Para melhorar o controle e a gestão da doença, a maioria destes pacientes recorre às aplicações para telemóvel disponíveis em lojas online e aos serviços na web pois, é difícil obter permissão para aceder a dados clínicos em tempo real no telemóvel pessoal a partir do hospital.

No contexto da DII – Doença Inflamatória do Intestino – as soluções existentes apresentam níveis de complexidade visual elevados pois, a interface comunica com o utilizador através de símbolos clínicos inadequados em funcionalidades convencionais – fraca legibilidade e inconsistência; Apresenta também, fraca coerência visual entre sistemas multiplataforma. Estes cenários promovem no utilizador, um aumento da curva de aprendizagem relativamente à forma como estes interagem com os sistemas criando assim, uma abertura para o desenvolvimento de soluções pelos que têm habilidade para inovar através da criação e desenvolvimento de sistemas que resolvem os seus problemas com a gestão e coordenação da doença.

Esta tese tem como objetivo analisar o comportamento dos pacientes com DII relativamente à gestão da sua doença. Identificar que tipo de problemas – funcionais e de comunicação – existem nas soluções atuais para telemóvel e web no contexto da DII, introduzindo novos temas – estudos em comunicação e design – no modelo "User Innovator" de Von Hippel (1976) que consiste em, utilizadores, como por exemplo, pacientes com doenças crónicas, que inovam ao criarem soluções para resolver os problemas pessoais, tais como, condições de saúde adversas. Para validar no processo de design a integração das três áreas – design, inovação e paciente – criamos a framework “Human-social Interaction Model for e-Health Interfaces” que nos permitiu uma abordagem sustentável à investigação, quando foram aplicados inputs provenientes de experiência pessoal das três perspectivas introduzindo feedback relevante para o objetivo final dos estudos preliminares, também quando criada a interface para dispositivos móveis focada na doença de Crohn, uma das DII,

com uma nova experiência de utilizador na área da saúde.

Para atingir o objectivo, realizou-se um conjunto de estudos que se encontram divididos em dois momentos: o primeiro, com revisão de literatura sobre a relação da semiótica com a comunicação interativa; o significado da representação simbólica em projetos interativos; as novas linhas de reflexão do Design que definem interfaces e funcionalidades mais próximas do utilizador; a perspectiva dos utilizadores perante a tecnologia como meio de suporte e controle da saúde; o espaço do design e da comunicação em projetos tecnológicos; o desafio para utilizadores/ pacientes que tentam criar sistemas para solucionar problemas pessoais. A segunda parte apresenta a investigação de campo com, um inquérito a 279 participantes com DII; análise empírica de seis casos de estudo – aplicações para telemóvel e multiplataforma: contexto, funcionalidades, levantamento de princípios do design, e testes de usabilidade A/B onde comparamos em dois dos seis sistemas, a articulação entre as funcionalidades e os princípios do design.

Os resultados obtidos desafiam a usabilidade das interfaces para telemóvel no contexto da saúde, proporcionando aos utilizadores uma interpretação mais coerente do ponto de vista formal do design de informação médica e um caminho para designers com doenças crónicas que pretendem criar soluções para resolver problemas de monotorização da saúde.

PALAVRAS-CHAVE: e-Health, Human-Social Interaction, Interaction Design, Interface Design, m-Health, User Innovator.

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Part I
Presentation

> *The important thing is not to stop questioning. Curiosity has its own reason for existing. One cannot help but be in awe when he contemplates the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if one tries merely to comprehend a little of this mystery every day.*

(Einstein, 1952)

Chapter 1. Introduction

Mmobile devices are nowadays used as tools, especially for routine tasks like managing e-mails or reminders, booking flights or hotels, taking some photographs or recording videos, or used as a remote control for presentations ,among others. Most users are generally trying to reduce the complexity of their daily lives by using different devices like – smartphones, tablets and wearables. This ecosystem, which stands apart from traditional media like radio, newspapers or television, is clearly a form of communication between users and designers, where the mediator being a digital interface.

Nuno Ribeiro (2006, p. 1) states that mobile communication can be considered as a mass medium, but by analyzing the increase of smartphones applications or the growing number of websites and the impact they have on users' daily life, it is clear that these systems are designed to be used as tools with citizens increasingly accepting this as their function. In terms of healthcare, mobile applications can also be very helpful to

monitor patient data and behaviour, to encourage patients to follow best practices and to register and retrieve patient medical history. In 2007, Dan Saffer referred (p. 198) that the "next desktop applications to be developed, would be able to take advantage of the strengths of the internet, as publication and circulation of content in real time access, but many of these services, would not be properly associated to websites". Instead, citizens would be dealing with mobile applications, with data would not "live" in the physical space, but could be located and at any time any place. A few years later, this can now be found in the form of the cloud system[1]. Also Klasnja & Pratt (2012, p. 184) defended that to make monitoring patients easier it was necessary to create sustainable technological paths to help develop applications for collecting real-time health data.

Moreover, design for e-Health (Electronic Health) systems is not abstract or random. Integrated in a pluralist area, it involves different concepts, and when all of them are well applied allows fluent communication between users and systems to be achieved which helps those who use it to understand what kind of message designers want to convey. It is a perceptive space of signs, where users create multiple interpretations about the designer's message, which can be considered as a medium of a communication between users and systems. As Liu et al. (2011, pp. 2022–2023) said, e-Health systems have been widely used in professional healthcare venues and the acceptance in homecare is growing (Ball & Lillis, 2001; Dixon, 2007; Hsu et al., 2005). With the increasing in hardware capacity of the mobile devices, the number of new m-Health (Mobile Health) applications and functionalities have surged, transforming today´s m-Health applications into potentially great tools for monitoring data. However, healthcare systems have been focused on clinical approaches rather than trying to change patients behavior with new user experience perspectives and technological innovation (Pernencar, 2014).

Digital healthcare applications involve a high level of interactivity and design

1 "Computing as a service over the Internet. Cloud computing, often referred to as simply "the cloud," is the delivery of on-demand computing resources—everything from applications to data centers—over the Internet on a pay-for-use basis." ("IBM What Is Cloud Computing – United States," n.d.).

complexity in order to provide appropriate user experiences. User needs and general characteristics, as well as individual differences must be considered in the design. To be adopted by users, technology must adapt to their needs and streamline task performance.

When dissatisfied, some of the more proactive and innovative patients try to create their own mechanisms to support how their personal disease problems are managed. For Baldwin et al. (2006, pp. 2–3) these kind of “Users – both individuals and firms – develop new products to serve their own needs (…). Thus user innovation can greatly influence the rate and direction of innovation in some industries”. This sentence reflects those users who try to implement their own ideas, creating tools that involve diseases communities, and research groups. The Portuguese project "Patient Innovation" (2014) is an example of this, but it is potentially missing an important area, one that involves the contributions of personal experience focused on design, in order to involve different methods and techniques that could influence the development of the main idea.

1.1 MOTIVATION

Inflammatory Bowel Disease (IBD) involves a chronic inflammation of all or part of the digestive tract. It includes Ulcerative Colitis (UC) and Crohn’s disease (CD). Both usually involve severe diarrhea, pain, fatigue and weight loss. IBD can be debilitating and sometimes leads to life-threatening complications, affecting mainly women (Rowe et al., 2015). In Portugal, the IBD prevalence increased from 86 new cases per 100.000 population in 2003 to 146 new cases per 100.000 in 2007[2]. Lisbon and Porto are the

2 Statistical data about the incidence and prevalence of IBD in Portugal was mentioned later in another study (Magalhães, J. et al., 2015). Here the researchers reference the article, Magro et al., 2012 which is the only scientific article discovered that referenced this subject literally. According to Ng, Siew C. et al. (2017), the highest incidence and prevalence of IBD in Europe is situated in Norway, where UC has 505 per 100,000 persons, and CD, 322 per 100,000 persons in Germany. In USA, the UC with 279 per 100,000 persons, and in Canada, the CD with 319 per 100,000 persons.

most affected areas – 173 cases and 163 cases per 100.000 population respectively. In 2007, the age group 40-64 had the highest incidence of UC – 99 cases per 100.000 population – while the age group 17-39 had the highest incidence of CD – 121 cases per 100.000 inhabitants (Magro et al., 2012, pp. 72–73).

Firstly, as a Crohn's patient for thirteen years that has undergone several distinct treatments and gone through innovative hospital innovative care, a surgery, and other disease complications, and secondly, as a designer, with almost 20 years of experience working in areas such as communication design, interaction design and interface design, I feel that mobile applications can have a very welcome and impactful contribution on IBD patients' daily life and this thesis would, from a design perspective, hopefully contribute towards this area, creating ways to improve patient disease management and motivating per behavioural changes.

Several situations may jeopardize patients' health conditions, such as:

Patients need to deal with and keep track of considerable amounts of data that are registered on paper documents. Each uses their own personal methods to manage this information, but keeping paper archives can be inefficient or an error prone; Tracking relevant information like clinical details about the stool, food ingestion, pain or mood is essential to analyse IBD impact and the disease progression, but it also a time consuming and arduous process; Travelling abroad without any clinical information on their disease is not recommended. In the case of an emergency, the patients' ability to remember relevant information about their health conditions could be an issue.

M-health can help to overcome these and other situations faced by IBD patients in their daily life, but the applications need to be designed according to the patients' needs, ensuring streamlined an easy interaction and usable interfaces. Combining a background in design ("User Designer") and long-term experience as an IBD patient ("User Patient"), this research aims to extend the "User Innovator" profile defined by Von Hippel in the seventies (Hippel, 1976) and further developed by Baldwin et al (2006), by adding the design theme.

1.2 CHALLENGES AND CONCERNS

1.2.1 Problem definition

Patients with chronic diseases and complex health conditions represent critical healthcare concerns in any part of the world. Coordinating healthcare outside of hospitals is hard for clinics and patients. M-health applications may help them to manage their diseases, but the currently available IBD m-Health applications are too much challenging for the majority of patients, requiring them to make a considerable effort to successfully interact due to several reasons such as: (1) Misunderstanding of medical non-standard symbols which jeopardize task completion; (2) Use of subjective criteria for data collection which confuses patients or produces inaccurate results instead using clear data correlation; (3) The use of different communication strategies in cross-platform systems that have inconsistent interface design.

Thus, it is necessary to explore new design strategies, that consider users' needs and current attitudes and behaviours, as well as interface design principles, to find out how to create helpful, and easy to use m-Health applications, that could be widely adopted by users.

1.2.2 Research questions

From a pragmatic standpoint and considering the potential output that will emerge from this research – to create an IBD interface user experience focused on patients rather than an experience that users do not, for whatever reason, identify with – two perspectives are considered: (1) From a research point of view, to identify and solve communication and design problems through different approaches of the methodology proposed in section 1.3; (2) From a patient point of view, to achieve practical results, by creating an interactive prototype for IBD, and subsequently, validated the project using end users. The research questions are:

1. **How will m-Health user experience contribute to change the IBD patient's behaviour?**

- Which are the main communication issues of current IBD m-Health interfaces?

- How does a new Inflammatory Bowel Disease user experience empower patients to manage their health condition?

2. **How do "User Innovators" benefit from interdisciplinary work joining three disciplines – communication, design, and technology to improve technological healthcare systems?**

- How do IBD patients use technological systems to manage their disease?

- How does experience as a designer and patient challenge the approaches of traditional research methods in terms of access and management of healthcare information?

3. **How to build a UCD framework based on a personal experience both as a designer and as a patient?**

- What kind of design guidelines should be helpful for creating a digital mobile healthcare digital prototype?

- How to promote IBD patient interaction with current m-health systems?

1.3 METHODOLOGY

The methodological approach of the thesis is divided into three main points. The last two represent a particular issue and are blended with the inputs coming from the experience as a patient, a designer, as well as, an innovator. To understand how these contributions are applied in all of the research, a framework was created, the "Human Social Interaction Model for e-Health interfaces" (Pernencar, 2014). Chapter 4 details this model, the goals usage and the expected benefits.

The first point, which involves the state-of-the-art, chapters 2 and 3 from Part II, includes the literature review. For this a triangulation model outlining three topics,

communication sciences, user experience and user interface (Mackay, 2004; Mackay & Fayard, 1997), is used. The goals are to comprehend how communication, design and technology work together to integrate healthcare systems in daily activities of patients with chronic diseases; what kind of healthcare experience do patients have by using those systems, and how to join different areas of knowledge in a healthcare design project.

The second point, which involves the preliminary studies in Part III, is divided into three chapter, and follows a strategy that uses statistical analyzes (Cresweel, 2009) and combines with User Research techniques (Rohrer, 2014) related to that. Firstly, in chapter 5, a quantitative study is conducted using a patient survey with open and close questions (Creswell, 2009). Secondly, in chapter 6, the design issues like contextual and content analyses, interface design concepts, and navigation, interaction styles and micro-interactions from six selected IBD systems, are studied empirically (Kumar, 2012; Lidwell et al., 2013; Giles, 2010; Mullet & Sano, 2008). After that, usability tests A/B (Anderson et al., 2010; Albert and Tullis, 2013; Nielsen, 2001; Rohrer, 2014) are conducted in the two of the six systems studied previously. The objective is to compare both in how is the user behave in terms of performing the same tasks; to help on identifying patterns of users behaviour related to their disease; to recognize medical information design problems; and to understand what kind of tasks are related to the disease. The main goal of this part is to characterize the IBD environment – patients behaviour, mobile and web applications available on online stores – to guide the iterative design process.

The iterative design process of the “myCrohn” (Pernencar, 2013) project, Part IV, is the third point. As Shneiderman et al. (2009) referred to, it is possible to iterate in a few hours and to continue up to budget constraints. So, following the perspective mentioned above, another author (Roher, 2014) suggested to include three phases in the design process three phases, helping to answer what are the user research methods to understand patients behaviour and their attitudes when they are interacting with digital systems. These three states are: (1) Wireframes sketch to present the first drafts, especially the features, followed by more redesigns (Buxton, 2007); (2) Paper prototype technique in the preliminary design versions, to offer

more iterations within a limited budget and timeline (Snyder, 2003); (3) Gradually, we switching from the sketch phase to a higher-fidelity renderings, including a final digital prototype, with defined visuals and the interactivity.

In the process explained earlier, the "Spiral Model" (Boehm, 1988, pp. 64–69) is also followed, meaning iterations, iterate as much as it is necessary, and possible, to collect real-time participants feedback during different stages of the usability tests. According to this, and after proceeding with the wireframes sketch, a usability evaluation using first click tests is conducted. After that, the features and design are reviewed based on the results (Jones & Marsden, 2005). The aim of this is to detect design and features problems and fix them before starting a new phase, fixed them. The end of the process includes a end user validation, through first click tests of the final digital product.

1.4 DISSERTATION'S CONTRIBUTIONS

The work developed within the scope of this Ph.D. contributes towards: Firstly, a literature review of specific topics like technology, semiotics, design or user innovation — papers 1, 4 and 5. Secondly, a quantitative data study related to Portuguese IBD patients behaviour; the quantitative and qualitative research of IBD case studies — paper 3. Thirdly, the framework "Human-Social Interaction model for e-Health interfaces", which supports the preliminary studies and the iterative design process – paper 2. Fourthly, the interactive prototype for IBD patients, and end user evaluation results. Lastly, in the contribution section, a group of design guidelines for healthcare research is presented. For these two last points, the strategy to disseminate the study is to submit an article, which is a work in progress, to the Design Studies Journal in Elsevier.

The next section presents the publications contribution from 2013 until 2016, and a note on how each article discussion is related to the content of every the chapters of this thesis.

1.4.1 Publications contribution

Papers listed below were published to validate and disseminate the several concepts, ideas and results addressed in this Ph.D to the scientific community:

1. Pernencar, C. and Romão, T. (2016). **Mobile apps for IBD self-management using wearable devices and sensors.** In proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct (MobileHCI '16), Florence, Italy, September, 2016. ACM, New York, NY, USA, pp. 1089-1092. doi: 10.1145/2957265.2965007[3];

The article presents a literature review of the use of wearables devices and biochips to collect patients data and empower patients to manage their own health condition. This is part of the guidelines suggested as the next research phase in the future work section of this thesis.

2. Pernencar, C., Romão, T. and Simões, G. (2016). **The design process of an e-Health project: Applying the HSI framework for interface analysis.** In proceedings of IEEE International Conference on Serious Games and Applications for Health (SeGAH 2016), Orlando, Florida, USA, May 2016, pp. 1-8. doi: 10.1109/SeGAH.2016.7586279;

The paper summarizes three preliminary studies where HSI framework, presented on chapter 4, is applied during the design process: Firstly, an IBD patients survey that corresponds to the results analysed in chapter 5 – a quantitative study. Secondly, the interfaces case studies using qualitative analysis, where selected universal principles of design are applied, with this topic being linked to that which is discussed in chapter 6. Lastly, A/B testing case studies part, with a summary of the most relevant test results included in chapter 7.

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3 The orientation discussed here, using wearable devices and sensors for disease self-management, was cited in an article, on mobile technology that was published recently. The research study the "present and future trends in consumer heath informatics and patient-generated health data" (Lai et al., 2017).

3. Pernencar, C. (2015). **The challenge of designing for digital health environment – e-Health and m-Health.** In proceeding of the 8th International Conference Sense and Sensibility, Lisbon, Portugal, October 2015. ISBN 978-989-8473-18-9;

This article, which is focused on literature review, presents the citizen's perspective of healthcare technology and how they deal with its growth. It is also covers the design space of e-health and m-health projects related to interface design, and at the end, presents a list of methods for designing medical information. Here, the strategy was to disseminate what chapter 3 of this thesis presents, especially the sections 3.1 and 3.2.

4. Pernencar, C. (2014). **Human-Social Interaction Model for e-Health interfaces.** In proceeding of the 5th International Conference on Applied Human Factors and Ergonomics (AHFE Conference 2014), Krakow, Poland, July 2014, vol. 11, pp. 555–566. ISBN: 978-1-4951-2106-7;

This paper discussed in detail the framework of "Human-Social Interaction model for e-health interfaces", presented in chapter 4, is discussed in detail. It also covers a topic from section 3.3 of chapter 3 ("Improving the participatory healthcare – The challenge for a "User Innovator"): the perspective of "User Innovator".

5. Pernencar, C. (2013). **My Crohn's disease on real time information – HCI improvement for e-Health interfaces.** In proceeding of IEEE 2nd International Conference on Serious Games and Applications for Health (SeGAH 2013), Vilamoura, Portugal, May 2013, pp. 1-7,. doi: 10.1109/SeGAH.2013. 6665304

The first article, among other things, explores the relationships that exist between HCI, ID, and UX in the context the thesis theme, healthcare Technology. This literature review also considers aspects like how designers could challenge the Communication and Design theme, working on aspects like for example Semiotics, which is discussed in chapter 2.

1.5 STRUCTURE OF THE DOCUMENT

This thesis is organised into:

- **Part I:** The first chapter introduces 1) the work and its motivations; 2) the challenges and concerns with the problem definition, research questions and methodology; and 3) the dissertation contributions, as well as the structure of the whole document.

- **Part II:** This is divided into two chapters. Chapter two presents theoretical contributions related to Semiotics in interactive communication. Chapter three outlines patient perspectives on healthcare technology.

- **Part III:** Comprised of a total of four chapters. The first, chapter four, defines the framework which supports the studies of the subsequent three chapters. Chapter five includes an IBD patient survey; chapter six presents the case studies features, tasks and interface design analysis; and chapter seven includes A/B testing case studies.

- **Part IV:** With only one chapter, chapter eight, this part presents "myCrohn" project and the stages of the design process: (1) the project insight; (2) a list of the interface design requirements; (3) a low-fidelity prototype followed by usability tests; (4) A colour and icons study; (5) a high-fidelity prototype followed by usability tests.

At the end, conclusions and further research directives are presented.

Part II
State-of-The-Art

This part introduces the main theoretical concepts and methodologies related to the fields of Semiotics, interactive communication environments and HCI (Human Computer Interaction) field. The goal is to provide context coming from different areas to support case study analysis and reflect on project development. Theoretical problems that need to be addressed are also discussed, as well as, detailing the most relevant research and work within related areas.

The last topic describes the patient perspectivs on healthcare technology to contextualize how we could improve the participation of IBD patient could be improved on by improving management of health conditions; the design space of m-Health and e-Health projects to identify if any design process methodology or a particular technique is include to not be included by researchers; the concept of user innovator that supports patients who take it upon themselves to improve how they monitor personal health conditions when there is no other viable option.

> *One of the prime advantages of a semiotic perspective on HCI is to center a researcher's attention on signs. Signs have a concrete objective stance that is produced and interpreted by individuals and groups in a variety of psychological, social, and cultural contexts. They are encoded in natural or artificial signification systems of widely diverse kinds, and they are typically used to communicate attitudes, intents, and contents in a multiplicity of media.*

(De Souza, 2005, p. 5)

Chapter 2. System design

This chapter mainly addresses how aesthetic and functional issues influence the experience of interactive communication, how the semiotic engineering contributes towards the interpretation of the computer signs systems, and lastly, how designers may create a pleasant healthcare experiences for user engagement.

2.1 THE BEAUTY OF USABLE INTERFACES

Over the past few years, beauty related fields have grown such as Human Factors, Ergonomics and Interaction Design, throughout the creation of aesthetics systems that changed the user experience, and also influenced designers on how to create beautiful and usable interfaces.

In terms of the human appreciation of the beauty and how things are sensed, felt and judged, the aesthetics includes areas like philosophy studies that bring users

into the world of both artistic, communication and philosophy of the art (Mullet & Sano, 1995). As it is recognised, the beauty is directly related to our aesthetic and emotional world. Whether aesthetic appreciation is inherent to the function of an object or if the user engagement of artefacts is only guided by form, is as ongoing discussion. Users' emotions and engagement with objects are also related to these factors.

Within the digital interface context, Giles (2010, p. 32) says that the user is driven by an emotional need, which means that for designers it is crucial to understand how to emotionally involve users with systems, not only because of its beauty, but also because they comply with the correct functions.

Don Norman (2002) concluded that what is users consider attractive also makes them feel good, despite the systems being more or less creative from a design perspective. This conclusion comes from the results of Norman Group research projects[4] which tried to understand what kind of relationship exists between affect, behaviour, and cognition. Mullet & Sano (1995) defends that good design preserves a balance between aesthetic and functional goals, because it works with features requirements closer more akin to communication problems that exist in beautiful interfaces. For Lavie & Tractinsky (2004), discussing aesthetics is more like talking about classical aesthetics terms – cleaness, brightness, pleasantness, and symmetry– and expressive aesthetics – originality, sophistication, fascination, unique effects, and creativity. Tractinsky et al. (2000) in their article "What is beautiful is usable" conducted an experiment to test user perceptions of both the aesthetics and usability of a system – an ATM (Automated Teller Machine). The results were similar to those founded by social psychologists related to the effect of physical attractiveness on the recovery from other personal

4 The Carle Foundation; City of Olathe, Kansas; Coca-Cola Enterprises Ltd.; Consumer Financial Protection Bureau (CFPB); FDC Solutions, Inc.; Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.; Fraunhofer Heinrich Hertz Institute; Municipal Design and Survey Unitary Enterprise "Minskinzhproekt"; National Archives and Records Administration (NARA); Northern Arizona University (NAU); Palm Beach County Board of County Commissioners; Persistent Systems Limited Resource Data, Inc.; Think Mutual Bank; Department of Transport (Canada); Yara International ASA (Caya & Pernice, 2014).

attributes. Meanwhile, Hartmann et al. (2007) argued that the aesthetic aspect is much more complicated and deeper than the idea presented by Lavie & Tractinsky, because measuring the beauty of an interface is subjective. It depends on several factors that surround users, like previous experiences. For Jordan (2002), an important design issue is to not create products per se, but to create products that have a significant impact on user experience.

Considering the importance of the aesthetics presented above, in this research tries to understand the relationship between functional and aesthetic goals of an interface, and especially of how the interface design interacts with the assigned functions and its aesthetics.[5]

It is also important to reflect on how, within the context of interactive communication, people through the use of e-mail or mobile phone reduce, the physical and emotional distance from others. Nowadays, the emotional distance due to technological evolution is changing, because users are in a constant contact despite time or place. An example given by Donald Norman (2004, p. 149) is that for e-mail, text messages, and voice mails or distance don't exist. In the context of m-Health, the emotional distance is also changing. An example of this is the article of Zia et al. (2015) presents: the patients compliance towards the use of technology as a support to improve their health conditions is increasing and they are emotionally closer to their disease through the use of technology.

Analysing the emotions context in the design field, Norman's book "Emotional Design" (2004) and Desmet's book "Designing Emotions" (2002) highlighted the same point of view: when people process information they have different levels of experiences in terms of visceral, behavioural and reflective experiences. These three stages of experiences are related to how the perception on aesthetics occur: the visceral one, where a quick judgment is made (i.e. is it good or bad?); the behavioural, where positive emotions come from the understanding of an action; the reflective

5 In chapter 7, two of the six case studies analyzed in chapter 6 tested the following aesthetics dimension referred to.

level, whith conscious thoughts occurs linked to cultural and personal values. Pieter Desmet (2002) presents another important topic about on emotions: it is crucial to consider product emotions as a manageable set of tedium, inspiration and amusement, which are especially relevant for creating design diversity. According to the author, there are seven positive emotions: inspiration, desire, satisfaction, fascination, pleasant, surprise, amusement, and admiration, and seven negative emotions: disgust, indignation, disappointment, dissatisfaction, contempt, boredom, and unpleasant surprise. Considering these emotions within the context of interactive systems, it appears that something that exceeds the "emotional, hedonistic and practical benefits" of user judgment is a pleasurable experience. Patrick Jordan in his book entitled "Designing Pleasurable Products" (Jordan, 2002), argues that designing for pleasure can be important when ensuring that an interactive device is usable. Jordan (2002, p. 12) describes pleasure as "the condition of consciousness or sensation induced by the entertainment or anticipation of what is felt or viewed as useful or desirable; enjoyment, delight, gratification"(considering it an "Oxford English definition").

So, in what concerns the aesthetic topic, it is recognized that beautiful digital interfaces produce positive emotions. But is it possible that functional problems change that route creating unpleasure experiences? Following this idea, Benyon (2005, pp. 103–104) explores Tiger's framework (2000) by presenting four dimensions of pleasure: physio-pleasure, socio-pleasure, psycho-pleasure and ideo-pleasure.

The physio-pleasure concerns the body and the senses. It arises from touching, handling devices or from their smell. This kind of pleasure comes from using devices which fits seamlessly with the human body – although this is common when it fits less than ideal, e.g., the smell of a new car. The socio-pleasure arises from the relationship with other users. The experience with products or devices in our society have a socio-pleasurable aspect, either facilitating or improving social activity. This kind of pleasure delivers status and it is exploited by sellers of successful technology brands, e.g., text messaging that quickly grow in social communication or the use of social networks to keep in touch. The physico-pleasure engage people with technology, as long as user's concern the ergonomic and design approach of the product, e.g., a well-designed keyboard. Ideo-pleasure or ideological pleasure focuses on people's goals and values.

Users enjoy using items that have similar values. An example of this is the loyalty that products from brands like Apple inspire in their users. As it was seen, pleasure related aspect have a profound impact on user emotions. It is also recognized that pleasurable experiences are crucial to catch user's attention.

In terms of emotions caused by beautiful and usable interfaces, authors like Andersen et. al (2010), Bill Buxton (2007), Dan Saffer (2007), Donald Norman (2004) and Jesse Garret (2003), suggest another important concept, the “engagement”. This is well known concept related to human factors and user experience and human factors. It reflects on the pleasurable interaction between users and systems that flows without any functional constraint. However, Nathan Shedroff, in his book “Experience Design 1.1” (2009), presents a contradictory idea on this perspective, with design for user engagement not only being about creating things that are "easy to like", but it also about making things that can be experienced on many levels of enjoyment and pleasure.

Despite of the existing approaches to aesthetics, pleasure and user engagement, John Maeda (2006, p. 71) defends that to create pleasant experiences there is another perspective related to user's emotions. He introduces the ROE (Return on Emotions) reflection which means that the existing user emotional patterns are not considered as a weakness of the users, but something desirable for everyone. Considering how our society lives today, in Maeda's statement a brand requires the user engagement, the attention for a better perception of the system, and satisfaction in using it. Without these requirements, probably there would probably be disappointments would emerge related to the experience of it.

The four dimensions of pleasure presented previously showed that the satisfaction dimension is distinct in each one, depending on people’s physiological or social triggers. As it was seen, the beauty requires interpretation, which means an experience with something. The experience referred to is related to the concept of “user engagement” with a system when users interact with it. To create an experience that “engages” the users, designers should know users behaviour very well: what kind of pleasure they feel when interacting with specific system and if they express emotions about that; if the aesthetic values of the system are important for them; and

if users understand the difference between aestheticz and functionality.

Nowadays, designers face complex decisions on how they should create amazing experiences, needing to consider whether the iterative desin process not only takes into account function but also aesthetics. However, this complexity is not only focused on working the beauty of usable interfaces, but also in understanding how the visual information is represented, particularly the signs used; how communication flows between user and systems, especially cognitive attributes; and what kind of problems must be solved. In this context, semiotics may help deal with some of the referred to issues.

2.2 SEMIOTICS AND INTERACTIVE COMMUNICATION

Living environment are increasingly becoming computerized through the convergence of digital technologies, which has brought computers, TV, video, audio and other multimedia experiences closer to users. This diversity is a part of a world of tasks interpretation that requires distinct awareness about: knowledge of interaction taxonomies; experience in interpreting symbolic communication, as well as direct application of a mental model through the familiar association that come from distinct contexts. The interactive systems that we are talking about have digital interfaces that belong to a set of interpretations which combine in each feature, signs and functions. Also, the design of interactive systems are supported by human factors like cognition, which help to understand how users used their mental process when they are interacting with a system.

Nowadays, interacting with an interface that has a weak design but is at the same time easy to work with doesn't make sense anymore, because "user engagement" with systems bring another important values, as we have seen in the previous section, experience. In m-Health, users are continuously challenged to interpret health signs. But, for those who are not unable to understand the complexity and meaning of signs systems and the connotations that these have for human language, problems with interpretation will emerge and the experience will be negative.

To understand why an interactive experience involves sign interpretation, this section covers the semiotics dimensions in interactive communication presenting traditional perspectives from distinct authors that study the signs systems, which are the views that help to explain signs in interactive communication; and how other authors relate semiotic studies to computer signs systems.

Shaleph O'Neil (2008, p. 27) argued that "there is much more going on in the interpretation of an interactive movie than in a traditional movie." Likewise, interacting with interactive content involves a continuous interpretation of signs according to personal manipulation and social or cultural background. This is because multimedia also provides a vast context of signs distinct from the traditional spaces of interpretation. An example of this is, what is the meaning for a user of a specific symbol applied in a feature which in a context that the user doesn't have any experience of? What kind of mental model will be used to interpret signs in an unknown context? For users who don't have experience in a specific context, will it be easier to interpret signs? To answer these questions, semiotics and linguistics, are a helpful scientific tool.

In semiotics, it is recognized that signs interpretation is organized within different media. According to O' Neil in his book "Interactive Media: The Semiotics of Embodied Interaction" (2008), the traditional media perspectives (Barthes, 1972, 1977; Eco, 1976, 1984; Hjelmslev, 1961; Peirce, 1931; Saussure, 1966) aimed to understand the basics of sign's interpretation and their influence. Considering this idea as in that "signification" as a process establishes communication with users by a particular use in a sign systems. This situation is induced by social and cultural conventions which means that signs are interpreted by users through previous choices or experiences so as to have real meaning. Displayed and organized in table 2.1, the five traditional media perspectives presented in O'Neil book (2008, pp. 67- 76) helps to visually compare how the signification process is defended by each author in terms of interactive communication.[6]

Pierce (1931) focused his perspective about semiotics in phenomenology of

6 The chronological criteria that the authors are presented in the table are as those used by O' Neil.

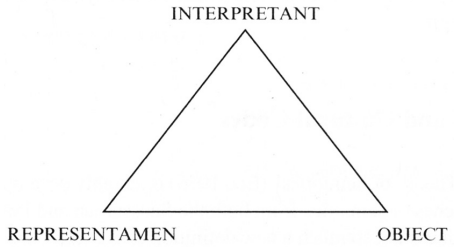
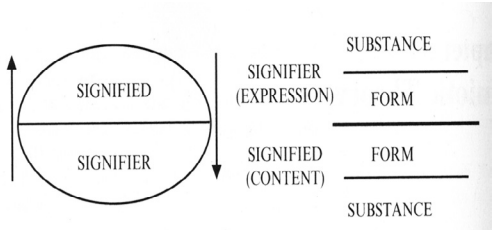
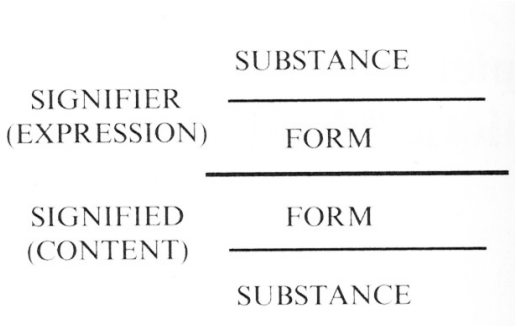
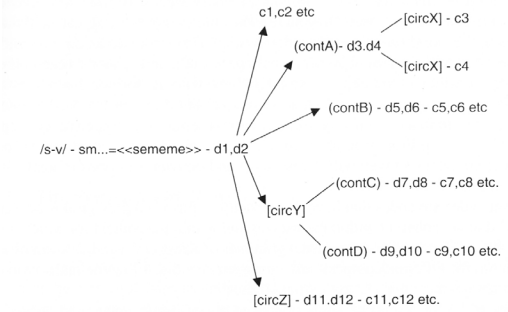
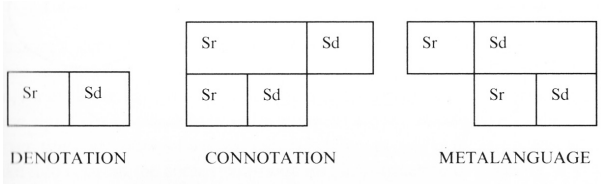
signification, the study of how semiotics is experienced. For example, how a sign – "Object" for Pierce – is comprehended by users – "Interpretant" for Pierce. The result of the interpretation is what the "Representamen" (for Pierce) presents. Another author, Saussure (1966) presents the beginning of the concept related to the signification with two parts: "Signified" related to concerns the meaning, and the "Signifier" which is the representation of that meaning. The Saussure concept of signs referred to here is too straightforward when considering the physical characteristics of a digital screen, because it provides multiple meanings during an interaction. Considering Saussure and Peirce's theories, it is clear that their perspectives don't provide enough tools to correctly interpret the sign meaning on a different signification level, because digital media use signs that include features where functional and aesthetical aspects must be considered on an interactive level. It is possible that by using concepts related to the user's natural languages in the last stage of the understanding – semantic interpretation –, users will interpret symbolic communication using interactivity without any difficulty.

The author Hjelmslev's (1961) presents a definition for the sign structure with two parts, the "Signifier" and the "Signified". Each part has another two components: the "Substance" and the "Form". Perhaps this concept more appropriate for digital objects as it combines the perception of signs that occurs according to a specific environment – e.g., the digital interface which is the "Substance" of the "Signifier" –, and the recognition of signs through interpretation, the "Form" of the "Signified". As seen before, Hjelmslev's two part sign structure is not unique. Sausurre's (1966) perspective of the sign structure has the same particularity, but there is a difference between them. Signification in Hjelmslev's strucure is not as broadly defined Sausurre's structure, because it starts from the recognition of the form and finishes with what that form means in a specific situation. In Sausurre's case, the results of the interaction have diffettent meanings, because the signification can start in "Substance" or in "Form".

On the other hand, Eco's (1976; 1984) theory of semiotics, according to O'Neil (2008, p. 71), didn't present a new definition of the signs but moved what existed to

another context: the use of signs as a coding/ decoding space of a message with sets of specific codes. Eco replaced the sign concept for the content they represent, because the "signs" have ampler meaning than a simple linguistic sign – e.g., a stop sign is not a linguistic sign. So, how signs creates meaning in a interface, refers to who is interacting with the system.[7]

Table 2.1 – Visual comparison between signs definition

Pierce's Sign Definition (Hansen, 2006)	Saussure's Sign Definition (O'Neil 2008, 68)
	
Hjelmslev's Sign Definition (O'Neil 2008, 68)	**Umberto Eco's Sign Definition (O'Neil 2008, 71)**
	
Barthe's Sign Definition (O'Neil 2008, 75)	
	

7 According to Norman (1998, pp. 13-14), for designers to predict the effects of user action they have to follow a conceptual model, which attempts to explain how the real world works. For the author, both designers and users are supposed to work within the same mental model – psychological representation.

For embedding complex structures about signification in interactive media, Barthes (1972; 1977) created three different layers of meanings, according to how users experienced signs in different contexts: “Denotation” which is the literal meaning of the sign; “Connotation” which is how the sign is assimilated according to cultural or emotional association; “Metalanguage” as language (written or visual) used to translate a meaning. Considering O' Neil (2008), the three levels here presented help recognize that Barthes' theory is better matched to the signification created by interactive media, according to the user experience in a specific context and the proximity that the user has to the content.

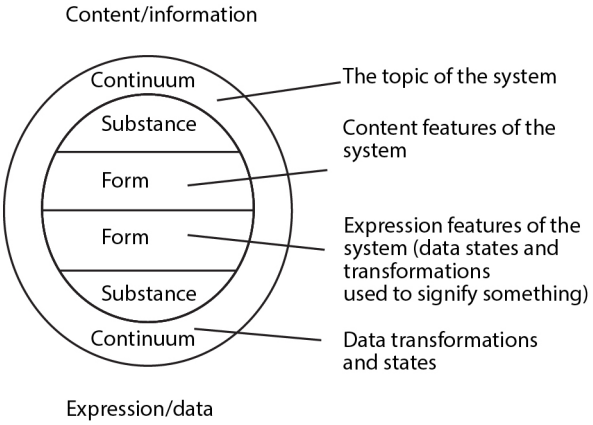


Fig. 2.1 – The structuralist sign concept (Andersen, 1992, p. 12)

In the 90’s, Peter Bøgh Andersen asked one of the first computer science sign related questions “What is a sign and what is a computer-based sign?” (Andersen, 1992, p. 12). The author of the article “Computer Semiotics” presents the European structuralist theory in combination with the American tradition as shown below (figure 2.1). The structuralism defined by Saussure and subsequently reorganized after by Eco and Hjelmslev is a description of a sign type, where the meaning is focused on social and institutional characteristics, and presents two aspects: the “Content” and the “Expression”, also named as “Signified” and “Signifier”. Both have two parts, the “Substance” of a sign, which is the part where the “Continuum” articulates with the “Form” – e.g., the pixels that exist on the computer screens. The pixels are the “Form” that via sign function establish distinct meanings in the content “Continuum”.

When a sign is produced – the “Form”, the information is articulated between

both – “Substance” and ”Form” – and the content is introduced into the expression to mean something, the “Continuum”. Here, according to the author, the European structuralist theory has a problem related to computer systems: the reaction of those that interpret the sign is missing.

In semiotic theory, the meaning of a message is always discussed in signs’ context. A sign is anything that is taken by someone to mean something else. This something else does not necessarily have to exist physically (Eco 1976, pp. 7–8), but it is easy to understand from Eco’s definition that semiotics have strong ties with physical objects like computer systems. In the context of human interaction with computer systems, Clarissa de Souza (2005) argued that semiotics helps to understand the signs system – the visual context of interactive communication. In fact, the author states that “Semiotics is important because HCI involves signification and meaning-related processes that take place in both computer systems and human minds” (2005, p. 4).

Taking into account the above, there is an aspect where semiotics and HCI can work together: the discussion of how human factors influence the user’s interpretation of signs, and what kind of mental model users follow when they have to interpret those signs. For authors like Peter Bøgh Andersen (1992), Jack Carroll (1997), and Clarissa de Souza (2005) “Semiotic Engineering” works with signs interpretation in interactive systems, including the cognitive approach and highlights the communication from designers to users (O’ Neil, 2008, p. 43). Clarissa de Souza argues (2005) that the framework of “Semiotic Engineering” starts from a generic semiotic outlook and consists of what designers create for users and how is their perception of it is moulded in terms of computer-mediated communication, and refers also that the advantages of using semiotic assessment on HCI is “to centre a researcher’s attention on signs” (2005, p. 5). As seen, “Semiotic Engineering” considers the influence of cognition in users interaction with computers as a particular case of computer-mediated human interaction.

To address semiotics dimension in interactive communication, designers, researchers and other professionals should focus their studies on semiotic engineering, because the interaction with a system involves a continued interpretation of the signs system that, requires more than just traditional perspectives (O’ Neil, 2008, p. 27).

The same is argued by Clarissa de Souza (2005) when the author highlights the main advantages of basing semiotic perspective on HCI, “Signs have concrete objective stance that are produced and interpreted by individuals and groups in a variety of psychological, social, and cultural contexts" (2005, p. 5). It is therefore important to incorporate Semiotic studies into HCI in order to improve research about users interpretation and behaviour related to interactive systems and interactive communication.

The complexity that may exist around the interpretating of healthcare sign systems, and the symbols that appear on interfaces, gives an opportunity, for designers, in this field to question how to create healthcare experiences which engage patients, and why some signs are not easy to understand; If the generic approach to the design process is enough for addressing healthcare projects? Which user-centered design methods emphasise the engagement of healthcare users and their experience?

2.3 DESIGNING TO IMPROVE THE HEALTHCARE USER EXPERIENCE

When talking about design, two approaches related to the word “design” emerge: One, related to the use of design as a noun, and the other as a verb. As a process, for Lockwood (2010, p. 49) “Design is about making intent real. There is plenty of unintentional to go around. When you design something new, is brought into the world with purpose”. Also, Moule (2012, p. 7) defines design as a process that helps to solve scenarios where problems emerge through the different levels experienced by users. As a subject, creating a project or solving problems, this includes a workflow that involves principles and methods according to the project context. This workflow is called “Design Process”, and is based on a creative concept embodied by guidelines such as the "Universal Principles of Design" (Lidwell et al., 2003).

Additionally to the existence of “design” as a process, where users experience this is physical object, "design" is also referred to as a noun. Related to that, Donald Norman (1998, p. 142) says "good design" involves solving problems by testing new solutions to create objects with good results in functional and aesthetical aspects which means, design that ais to achieve pleasant experience for “user engagement”.

As seen, design presents two differences in approach. In this section, the word "design" is considered a verb, i.e., a process, with the goal of recognizing what kind of methods exist in the design process that are focused on how to design systems for engaging the user through a pleasant healthcare experience. In the context of designing interactive systems, to involve users in pleasurable healthcare experiences, Anderson et al. (2010, p. 6) defend that “Good UX (User Experience) enhances user engagement (…)”. IBD m-Health design doesn't seem satisfactory[8]. It is therefore crucial to understand what kind of methods or guidelines exist to work within the design process, and if they present a generic work approach of or are more specific in creating systems focused on user behaviour in healthcare context.

As a designer approaching a project, the first question is how design contributes? To help with this issue, Tim Brown (2009, p. 73) presents not methods to follow but a suggestion: “The best ideas emerge when the whole organizational ecosystem – not just its designers and engineers and certainly not just management – has room to experiment.” This opinion seems to be the “right mind frame” to explore and work through existing problems.

Donald Norman (1998, pp. 188–206) suggests six principles "that designers must respect" so as to help find solutions to the problems and transform difficult common tasks into simple ones: (1) Standardize what is well known in the world; (2) Simplify the execution of tasks; (3) Make content accessible; (4) error prediction; (5) Explore the power of technological and user constraints; (6) Make it easy for users to input; (7) when failing, use standards.

According to Dan Saffer (2007, p. 30) after the designer identifies the problem from different angles, he should find solutions according to four approaches: (1) UCD which is focused on users needs and goals; (2) Activity-Centred Design that works on the tasks which have to be completed; (3) Systems Design which set the components of a system; (4) Genius design which works on the source of inspiration. Nevertheless authors like Gulliksen et al. (2003, p. 398), Jakob Nielsen (1993, pp. 73–

8 Chapter 6 and 7 study selected IBD case studies where the results show these in reality.

113) and Shneiderman et al. (2009, pp. 13–15) defend that designing to improve the user experience must be accomplished by following several UCD processes including: planning; user research; task analysis; usability tests; multiple design alternatives using low-fidelity paper prototyping, participatory design technique; extensive UX evaluation during and lastly the development of high-fidelity prototypes.

The goal of the UCD relies on creating experiences that are focused on users (Saffer, 2007, p. 32). Russ Unger & Carolyn Chandler in their book “A project guide to UX Design” (2012) suggest that the UCD methods are divided into four phases: (1) Develop a plan and project statement of the project; (2) Learn about the end-users and analyse the case studies; (3) Define the project requirements, outline the initial ideas, and afterwards develop the prototype; (4) Test the usability of the project creating a test plan for user experience evaluation.

Outlining the design goal of this section – how to improve the healthcare user experience – Anderson et al. (2010, pp. 12–30) say that "good UX" is something that is measured subjectively, because it depends on the individual needs of a product, and on user behaviour when interacting with digital systems. Due to this, it is important to identify the problems and issues according to the goals. The authors present eight topics to help designers improve the quality of the user experience: (1) Measure qualitative and quantitative features and design details using tools that are familiar to tests participants; (2) Provide responsiveness to users building a sense of confidence that allows them to focus on achieving their goals and make sure that they will give correct feedback of the action;(3) Perform tasks that are clear so as to not discourage users; (4) Create intuitive interfaces with features which users can adapt to using their mental models; (5) Define real goals for the systems by improving the overall UX quality and reducing the needs for support; (6) Focus the UX quality product on the purpose of what is essential and relevant to deliver appropriate content; (7) Compare the consistency of visual designs to provide a lower learning curve for when users switch between different systems, helping to ensure that they will have the impression of interacting with a unified interface; (8) Respect user capabilities to grow in the physical operating system through context appropriateness.

To test the usability of a project, Russ Unger & Carolyn Chandler (2012, p. 18) suggest five guidelines: (1) Enable users to interact with a high degree of satisfaction; (2) Help new users with instructions and visual prioritization of critical tasks; (3) Support advanced users by giving them access to shortcut features or deeper features depending on the systems used; (4) Reduce the pressure of making the best use of system resources; (5) Redesign with attention paid to changes required by users. Mahlke (2008) says that the quality of a good user experiences is established by values like utility, usability and visual attractiveness. Still, Rogers et al. (2002, pp. 14–17) also cover the usability theme by suggesting having three goals in the design process three goals: (1) Efficiency/ Safety/ Utility – Which together allow the system to support users in the execution of their tasks. (2) Learnability – It is necessary to prevent the user from making serious mistakes, reducing the risk of using wrong keys or buttons. It is also important to provide users with different means of recovery, helping to avoid making errors. (3) Memorability – It means that after learning to use the system, how easy it is for a user to remember functional aspects. This is an important detail for interactive systems that are used periodically. If users haven't practiced a system for a few months, they should be able to remember, or at least be reminded how to use it. They shouldn't have to relearn how to carry out their tasks.

In terms of suggestions in order to work on the design process, Lidwell et al. (2003) in the book "Universal Principles of Design" presents one hundred and twenty-five principles to work with. They are divided into five categories: (1) Recognizing how a design is perceived; (2) Boost learning through design; (3) Enabling improvement of usability; (4) Strictly following design foundations; (5) Create conditions to make good design decisions.

As previously seen, the suggestions, topics, and guidelines presented, as it was seen, belong to the user-centred design process. They are a relatively generic approach to what methods should be used when designing improvements in the healthcare user system, which means, creating pleasurable healthcare experiences in the digital world.

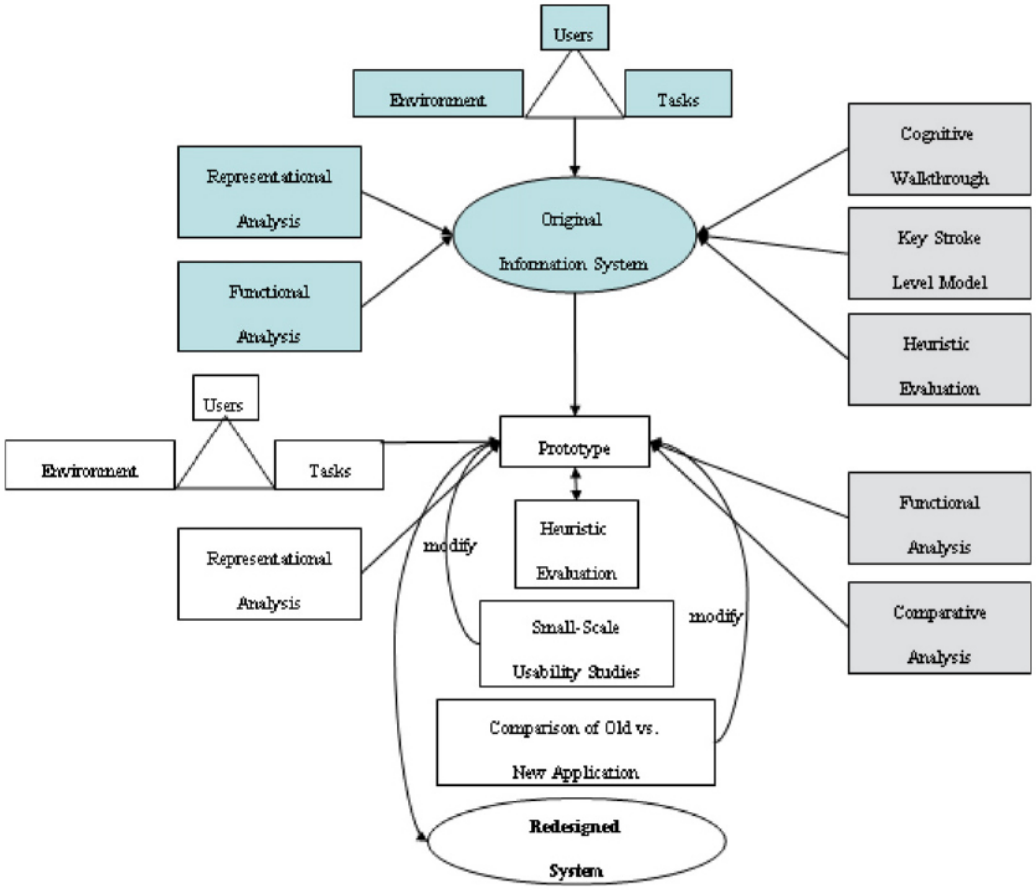


Fig. 2.2 – The redesign lifecycle framework (Johnson et al., 2005, p. 85)

In the context of healthcare, Johnson et al. (2005) present in the article "A user-centred framework for redesigning health care interfaces" an interesting workflow to guide the process of redesigning for healthcare, with several methods that combines scientific areas like computer science, cognitive science, psychology, and HCI. The authors suggest that "once a software product has been designed and users identified, the next step is to conduct the following analysis: User/ environment analysis; task analysis; representational analysis; functional analysis". In order to explain how these analysis phases work together, they created a framework (2005, p. 85) based on their experience of redesigning healthcare systems, matching several design guidelines with evaluation methods in different design stages – figure 2.2.

The "Redesign lifecycle framework" (2005, p. 85) contributions – figure 2.2 – are shown in three colours: The grey areas represent the additional methods to use in

the redesign process; blue, the original system, and white, all the items added to the process. It presents ten steps that guides the design process of creating a healthcare system.

The first step is to conduct an empirical study of the original system using methods from user research to compare task conceptualization of the tasks between users and designers. After, through a heuristic evaluation, understand what kind of components must be changed in systems; Second, redesign the original system using paper prototyping, and including a demographic study with a survey for user analysis; Third, study the features that connect each changed interface element. The goal is to analyse how the user interacts with that element; Fourth, promote a comparative analysis of the user interface between paper prototyping and the original version. After that, validate functional aspects, and taxonomy types; Fifth, present to end users the interface with the direct manipulation, and at the end, ask for them to fill in a survey of task analysis; Sixth, redesign using paper prototype technique after analysing the results; Seventh, validate the design using small-scale usability tests. If necessary, test visual versions but, before conducting the tests, apply an iterative heuristic evaluation with well-established usability guidelines and principles; Eighth, adjust the prototype according to the tests results, which will allow to identify the functionalities that need to be changed, added or removed; Ninth, after solving the problems, compare the new design with the original version using a controlled experiment to determine if the redesign decreased error rate or increased the user satisfaction; At last, adjust as necessary based on the tests results from the last step.

It is understandable that the design process presented is iterative with a focus on how to evaluate healthcare experiences patterns but, unfortunately, even if this framework is relatively interesting, it is too general for designers. It can be helful to understand which prototype evaluation methods should be followed in this research project, although information on what kind of design principles or methodologies designers should follow is missing.

Designers who don't have experience in the field of disease, may feel difficulties with their own ideas and the innovation process may not be as successful

as desired. Here, a new issue arises. How to innovate in healthcare experience design if the methodologies from the design process that designers follow are generic? It can be helpful if there is innovation in the design process. For that topic, Kumar (2012) in his book “101 Design Methods – A structured approach for driving innovation in your organization” (2012) suggests methods to use during the design process that are inherent to innovation. The author divided the one hundred and one methods into seven different categories: (1) Sense intent; (2) Knowing the context; (3) Knowing the people; (4) Frame insights; (5) Explore concepts; (6) Frame solutions; (7) Realize offerings.

2.4 CHAPTER OVERVIEW

As discussed in the literature it is possible to accomplish beautiful design and usable systems is something possible to design through the use of specific methodologies from UCD. Pleasant experiences are what users are expecting to have when they interact with digital systems. Within this topic, several questions have emerged like:

How does the aesthetics and HCI fields work together?

The interface is the space of that relationship where symbolic communication, and the user experience converges side by side. In this context, semiotic engineering has an important role in how designers decide which signs systems are suitable for each type of visual language, because the interface "communicates" with users about designer intentions. The interface expresses all the emotions that designers impart on the users, affecting the results and expected user behaviour, creating a “virtual conversation” with users (De Souza, 2005, p. 4). It is in this “virtual conversation” that designers, through the correct application of signs systems, engage the user. For this situation to happen, the semiotics perspective must involve HCI, or vice-versa.

How to decide which are the best signs systems to use in healthcare projects?

To design signs for healthcare, firstly it is crucial to thoroughly study its users,

the environment, and the tasks, considering that designing for healthcare software or redesigning interfaces will be more productive for those who wants to create pleasant experiences. Secondly, as reviewed in the literature, following UCD methods during the design process may not have the desired effects, as there is only a global perspective of how to conduct the process and which methods should be used in each phase. Nonetheless, the issue is which to choose. Except for the “Redesign lifecycle framework” (Johnson et al., 2005, p. 85) applied in the healthcare context, all the methods reviewed in this chapter (Anderson et al., 2010; Rogers et al., 2002), are not related to healthcare.

Did the design methods studied offer sufficient support to those who want to create pleasurable healthcare experience in m-Health?

This study does not consider these to be enough. As seen from the literature reviewed in this chapter, there is a huge amount of contributions, guidelines and methods, but the topic discussed in the thesis, creating a new IBD m-Health user experience, involves such complexity, that doesn't seem to be sufficient targeted support. The difficulty referred to is related to what kind of specific sign systems should designers should create, as each disease is visually specific. Most studies do, however, seem to explore well-known methods to measure the usability of the systems, and match the "Universal Principles of Design" (Lidwell, 2003) with semiotic engineering to create standard signs that users recognize, but this may not be enough.

The next chapter will study how to improve this issue in the design process.

> *Our lifestyles are increasingly out of balance and we are placing our health at risk through unhealthy habits. We are ageing as a population and more likely to suffer from chronic diseases, as we get older. As a result, our healthcare systems are under increasing demand for costly and complicated care. Yet, with their limited resources and traditional models, they are already struggling to meet existing demand. In short, the healthcare industry is in crisis and facing paradigm change. However, there are plenty of opportunities for innovation within this crisis.*

(Parameswaran & Raijmakers, 2011)

Chapter 3. The treatment guide – Clinics and patients

This chapter presents how citizens deal with healthcare technology, mainly to understand if IBD patients are encouraged to change the participation in their disease management. It also reviews m-Health projects that tried to include in their research stages, design process methodology and techniques. Lastly, it deals with how patients that didn't found in solutions for their problems in the market improved their healthcare monitoring by themselves – thus becoming "User Innovators".

3.1 PATIENT PERSPECTIVE OF HEALTHCARE TECHNOLOGY

One of western countries priorities in healthcare is to reduce institutionalization of patients with chronic diseases. For better control of patients diseases, involving patients by providing them with access to personal data is a balanced solution (Boulos et al., 2011), but in a few countries this scenario can

be extremely complicated in some countries because of medical confidentiality. Still, healthcare technology for patients is a small piece of the puzzle thet is their everyday routines, and, currently, those with chronic diseases download from online stores applications that help with disease management.

If the patient's perspective on the use of technology as a tool for supporting the management of their disease is important, it doesn't make sense to not study the clinical perspective about what kind of improvements in technology could be of use to these professionals, especially within their work environment. The quality of medical services is getting better and are becoming more active in evaluating hospitals and patient disease management, but there are issues which have not entirely been resolved and which several authors (Ballegaard et al., 2008; Boulos et al., 2011; Elf et al., 2015; Zia et al., 2015) consider can be improbed upon: participatory healthcare. This means, for example, that synchronizing clinic data between personal smartphones and hospitals systems is not working as desired; based on the type of care, there are many considerations about how an electronic appointment should take place[9]; a large percentage of patients still keep the notes on paper, appointment books or rudimentary electronic systems such as spread sheets and online calendars (Trotter & Uhlman, 2011, p. 15). Why does this scenario occur when mobile technology could simplify the task for both sides, patients and clinics?

Over the years, technology for computing-in-place has become common place and most of these systems are now ubiquitous. Unfortunately, most systems are still working independently from each others[10], so it is still hard for patients and clinics to manage the diseases in an integrated way. For Ballegaard et al. (2008, p. 1809) healthcare technology should be successfully integrated in patient's lives. For this to happen, it is crucial to recognize what kind of behaviour patient's present related to their disease and what kind of difficulties do they feel managing their disease.

9 Annexes 6, 7, 8 and 9 give an example on the topic referred to above. Four different hospital documents for only one procedure, a daily hospital treatment after collecting hemoglobin and ferritin values during an appointment;

10 Section 3.2 presents a review of e-Health and m-Health projects where similar scenarios were found.

For the authors of the article "Healthcare in Everyday Life - Designing Healthcare Services for Daily Life" (Ballegaard et al., 2008) patients are citizens, so they created the concept “citizens perspective” which reflects how healthcare technology should be integrated into an individual's life when the patient's condition is weak. According to the Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs & American Medical Association (1999), the user's ability or inability to perform tasks through digital interfaces can reflect an individual's lack of healthcare knowledge. It is also necessary to keep in mind the difficulty that users have interpreting medical signs in mobile applications, because in most cases it seems that semiotics were not used in the user behaviour studies of these systems. This means that there are interfaces where sign systems are applied without using the right requirements.

According to the above, it is crucial to create a set of visual literacy related to healthcare interface design, experience and skills of basic terms to recognize specific symbols, enabling citizens to conduct complex tasks in an interactive context. But it is likely that some patients with chronic disease still prefer to only use face-to-face contact in a clinical environment and feel difficulty trusting technology as a tool to control their disease. In these cases, where patients are more likely to have low health literacy, the literature (Alepis & Lambrinidis, 2013; Bickmore et al., 2009; Morris & Halperin, 1979) shows that using design redundant modalities is a good solution for interactive communication, which means standardizing visual symbols in user mental models as much as possible.

Healthcare professionals, patients, families and community leaders still struggle to understand the interaction between health and patients to improve the health status of populations (Gravenhorst et al., 2015). Currently, some nation’s healthcare systems still ignore the environment, the processes, and the capabilities to ensure that these services are safe, effective, patient-centred, timely efficient, and equitable (Elf et al., 2015).This studies' perspective is that “traditional clinical perspective is no longer confined to hospitals, thanks to the development of new systems that are closer to patient needs, involving the impact in their daily life. With an increasing number of chronic patients, there is a life to be enjoyed and common health problems to be solved” (Pernencar 2013, p. 5). So, for most patients, health

and disease is just a part of their lives, which includes, for instance, spending time with family and friends, having an interesting job or exciting hobbies.

Given the situation described above, patients should improve their understanding of how crucial their involvement in healthcare is. Nevertheless, it is not enough to merely encourage citizens to participate in healthcare. It's also important to understand the other side of the process: the perspectives of clinics and designers on healthcare technology, with these professionals trying to facilitate patient life. Kulkarni & Öztürk (2007) predicted that the next generation of pervasive and ubiquitous healthcare systems would be a challenge for designers and would involve complex structures by using multiple multimedia devices. In the same year, Ahern (2007) defended that the contributions for fast growth in e-Health would emerge from advances in internet, information and communication technologies. One year later, Ballegaard et al. (2008, p. 1807) argued that designing healthcare technology would be driven only by technological company considerations and healthcare advisors. In 2011, Jones et al. (2011, p. 359) wrote that "with an ever growing community of designers and researchers working in healthcare sectors, participants and investigators of current special interest groups have organized around urgent questions, with direct effect on policy, systems and information technology, medical education and care procedures, and the patient experience of healthcare". Recently, Bardram & Frost (2016, p. 70) reported in the article "The personal health technology design space" that using mobile platforms to improve well-being and health increased interest in scientific and commercial fields, in particularly tracking physical activity, managing chronic illness, and mental illness or sleep patterns.

Returning to patient perspective and IBD, Zia et al. (2015, p. 3-5) present a qualitative study conducted in the US with gastroenterology patients on the importance – value, usability, credibility, and intrusiveness – in using different health-related applications for self-tracking clinical characteristics. The goal of this research is to understand if empowering patients to actively participate in their health increases their autonomy by facilitating self-management. 51% of participants, mostly middle-aged, agreed that using m-Health systems could help them track disease indicators and clinical characteristics. 73% answered that they disagree with the difficulty of learning

how to use the health-related applications (all participants owned a Smartphone). The article showed another interesting result, 80% of participants felt comfortable using health-related applications.

The advent of the internet and the WWW (World Wide Web) helped change citizen healthcare perspectives, and online services and mobile applications became cheaper more accessible (Gravenhorst et al., 2015). Accordingly, patient communities increased the potential of globalization and citizen proximity, reaching facilities in connecting stakeholders, clinics from different areas and citizens with severe or chronic disease all over the world. The growing of these relationships promote access to more information which changes patient behaviour related to their healthcare. An example of such progress is the impact of IBD online communities, such as APDI[11] or EFCCA[12] , and their awareness-raising which leads to better collaboration between patients and health professionals. Grimes et al. (2010) claim that these sort of groups compete with the idea of "face-to-face" environment that is widespread in psychology and psychiatry for the treatment of psychological illnesses, like depressive disorders.

Still, it is important not to forget that nowadays medical work involves the use of a wide range of documents, charts, whiteboards, among others, all structured according to specific workspace settings in which they are implemented. An example of this is the project presented in the article "Activity-based computing for medical work in hospitals" (Bardram 2009, p. 1574) where the content written on whiteboards is adapted to the settings of the local medical environment. Another significant characteristic referred to is the role of expertise in writing diagnosis and adjusting prescribed treatments by doctors. The technological scenarios of these clinical characteristics are also changing inside hospitals. Instead of using paper, a few departments are only using digital content. The problem is how to provide clinical information in patient's digital devices.

In e-Health and m-Health, three important working directives seem clear:

11 APDI – Associação Portuguesa da Doença Inflamatória do Intestino – http://www.apdi.org.pt;

12 EFCCA – European Federation of Crohn's & Ulcerative Colitis Associations – http://www.efcca.org.

firstly, devices will continue to create new kinds of output/input data for citizens to use at a high level of digital sophistication (Bardram & Frost, 2016); secondly, cross-platform communication will increase and improve ways to manage chronic diseases; finally, citizen confidence in technology will change through inclusive and innovative experiences, especially for patients with chronic diseases. Citizens will follow the circumstances related to each disease, shaping their participatory healthcare behaviour accordingly. The research conducted by Zia et al. (2015) shows this exact direction. What will be different in the near future is, potentially the way citizens will use new technology to improve their health; the accuracy of clinical data collected using personal devices; the appropriate integration of that information with collected hospital data.

3.2 DESIGN SPACE OF E-HEALTH AND M-HEALTH

This section presents a review of e-Health and m-Health projects, identifying if they incorporate any specific design process methodology and techniques; if so, how researchers conducted the studies and which sort of methods they chose. During this process, difficulties in finding IBD specific studies emerged, especially scientific articles concerning healthcare interaction/interface design and technology information, particularly those focused on mobile applications.

Oliver & Flores-Mangas' research (2005, pp. 1–2) presents a wearable real-time system for monitoring, visualizing and analysing physiological signals that is wirelessly connected to a mobile phone via Bluetooth technology; a validation of the complete system (hardware and software). The core of the article is the hardware content and as such is too vague to contribute much to this paper. Watson (2006, pp. 1–2) has a project related to the use of a mobile system in a clinical treatment workflow that occurs between the oncological hospital and the physician's environment. MAVAAN (Mobile Ad Hoc Vicinity Area Application Network) is the name of the system that provides a method for delivering health records into the mobile system of a physician coming from the oncologist doctor at the cancer treatment centre. The article is not clear on how a native application from the mobile device of a

physician is incorporated into the hospital system. It seems to be a relevant project, but, again, design study is not a priority.

Ahmad et al. (2008, p. 39) in the article “Future mobile health systems: Designing personal mobile applications to assist self diagnosis” wrote a study focused on design, describing the UCD methods used for prototyping, designing and evaluation. The content presented in the article helps understand how the authors moved from theory to practice: (1) Investigate how older adults with Presbyopia monitor their health; (2) Identify if patients are more likely to use mobile technology to track their health data (providing interface requirements), rather than using traditional methods like analogical systems. Furthermore, in order to reduce project costs, they presented the advantages over using paper-prototyping technique. The goal was to study how older adults with declining eyesight with ages between 40- 55 reply to a self-diagnosis system on a personal mobile phone. This study helps identify, in a specific healthcare context, the methodologies adopted by the authors in each phase of the design process.

Rahbar's article (2010, p. 1269), related to the worldwide ambulatory disease control context through the use of mobile phone and, with the introduction of a new healthcare mobile network architecture, provides an electronic ambulatory support in any part of the world. The proposed research gives an opportunity to patients across personal devices to be visited by a physician or to be contacted directly by a clinic which will instantaneously have access to full medical information, whenever and wherever patients will need a medical appointment in a time efficient and secure manner. Although divergent from the main objective of this study, this research is an interesting contribution, because it offers technical information about how to cross clinical data outside the hospital environment.

The demo’s framework is based on the mobile phone system called AA-Heart (Activity-aware heart) which consists of two parts: (1) Front-end mobile platform to collect user's heart data; (2) Back-end web server to display visual data, screened, analysed, and shared with user’s permission. Using the mobile phone system with the AA- Heart application, it is possible to monitor the heart continuously and, simultaneously send the information in real-time to medical staff. This research is an

example of how the authors apply the word "design" without any direct association to the methods or processes used in design. Related to mobile phone technology for healthcare scenarios, Puma et al. (2012, p. 39) reviewed the use of NFC (Near Field Communication) and listed the potential benefits and barriers inside/outside hospitals using this technology and explained how NFC could be used to deploy resource control, manage data acquisition or remote data delivery.

Klasnja & Pratt (2012, p. 184) mention in their article that mobile devices are a good opportunity to provide health data, because of widespread adoption of this technology. Meanwhile Jung et al. (2014, pp. 871-872) present a detailed structure of a system that use EMR (Electronic Medical Records) data synchronization. It is a tool to manage diabetes, weight, cardio-cerebrum vascular risk, stress and depression evaluation. The application synchronizes data with hospital EMR databases to provide accurate data, decreasing the input process. Therefore, this study also reveals that mobile devices may be used as a tool for self health management. Synchronizing data with a mobile application is just a possible additional layer. Ferreira et al. (2014, p.111) describe an interesting research on how many people living alone need special care and how that number has significantly increased in recent years. The authors present a software called Alert implemented in Android systems which detects, using sensors, when users fall. The goal of this research project is to improve health conditions for those who need special care and are living without any family support. It shows how an ubiquitous system can at any time be relevant for end users. This research contributes to help understand user healthcare activities.

Faber et al. article (2016) describes the MoCHA (Monitoring Cognitive Health using Apps) project, which is a tablet-based application. This was created to provide convenient, low-stress, and affordable cognitive health monitoring for elderly at risk of developing Alzheimer's disease. The study presents several interesting details: an overview of the system explaining how it works, how it tracks the user's cognitive health over time, and provides a warning if the users start to show signs of decline; the design challenges that the researchers faced, like for example, how to design for Psychometrics, and how to engage specific user thinking on issues like accessibility. At

the end they explain how design helped with system management, with the visuals considering users with common types of colour blindness or limited visual acuity.

A relevant direction related to design is what Aruanno et al. (2017) presents in the article "HoloLens-based Mixed Reality Experiences for Subjects with Alzheimer's Disease". The researchers use HoloLens technology, as a tool for therapeutic activities in Alzheimer's. In the article it is mentioned that they followed design guidelines for a specific feature, "targeting cursor always visible", and also to "avoids users to feel lost and provide visual feedback" (Aruanno et al., 2017, p. 4). So, it is believed that what surrounds this project is very much connected with technological issues but, it is interesting in how to work on design issues, and it seems that the researchers believed that to successfully conclude a task, the user experience should be measured.

To conclude this section, Sing et al. (2017, pp. 1323-1324) article, despite not presenting a project, refers to a relevant topic for discussion, and argues that the clinical environment is still often an unfamiliar landscape for the HCI community, and also defend that conducting efficient research driven by holistic potential teams, responsibility in the field of digital health has to grow. They also say that there are difficulties in establishing a common research language between health researchers or medical practitioners and technologists. They have created a special interest group which includes interdisciplinary researchers and they present workshops in the field of healthcare (CHI'2013 and CHI'2014) where the focus is challenging the organising, performing, evaluating, publishing and funding of multidisciplinary studies in healthcare.

3.3 IMPROVING THE PARTICIPATORY HEALTHCARE – THE CHALLENGE FOR A "USER INNOVATOR"

"Being a hospital patient is one of the most crippling situation one can experience in modern society, and very little research has been done on data systems to provide information to patients while they are in their hospital beds. Hospital discharge represents a significant transition that, lasts normally less than eight

minutes, but it is intended to transform patients from completely passive recipients of care, to beings completely responsible for all aspects of their healthcare" (Bickmore et al., 2009, p. 1265).

The first step to change the quality of patient clinical assistance involves providing them with access to medical data (Banks, 1998, p. 163). But, as Bardram (2009, p.2) argued, a medical environment inside hospitals is full of details like, a high level of specific communication; a huge amount of cross data coming from distinct departments; and continuous interruptions, which are a challenge for those who assist patients. For these reasons, the integration that Banks referred to is hard to establish. To Trotter and Uhlman (2011, p. 3), "reducing the costs and improving the quality of healthcare is a weak description concerning IT (Information Technology) health ambition" especially when it is necessary to have a holistic perspective of how to improve patient behaviour related to their health conditions. Volk et al. (2015) discussed how the mobile health industry will change patient perspectives between 2015 and 2018, especially the implications of sharing large volumes of sensitive data; the challenge of designing an application in the context of medical device regulations; and the interpretation of legislative framework. They argued (2015, p. 1) that "This is a massive opportunity for a next generation of better and more sustainable healthcare, which was recognized also by the European Commission in a green paper published in 2014", but involves concerns and challenges on data privacy and information transparency.

Some of the work presented in the previous section was about the importance of new technology to improve patient's quality of life and how citizens will be able to monitor symptoms with the growth of the internet and the increase of mobile applications for healthcare. At the same time, over the last decades, citizens have shown some insecurity about assistive technologies and interventions that aim to control patient's living environment with more efficiency (Vergados, 2010, p. 575).

The use of the internet to help gather health information from an individual's EMR through email and other sources is becoming increasingly popular (Watson, 2006,

p. 1). This scenario encourages healthcare organizations to find efficient methods to provide cost saving high-quality care services. An example of this is what researchers have been studying in recent years: how to use mobile phones as a tool focused on physical activity and healthy diets; how to track symptoms in asthma, heart disease or diabetes; how to send reminders about upcoming appointments to patients; how to support quitting smoking, to name a few (Klasnja & Pratt, 2012, p. 184).

The recent work of authors like Gravenhorst et al., 2015; Lewy, 2015; Zia et al., 2015 concluded that, confidence in using healthcare technology is growing among patients. A few years ago, Butler (2011, p. 452) discussed a relevant issue of healthcare focused on citizens with a chronic disease condition: the perception that an "active and informed patient" changes their behaviour in terms of how they deal with disease treatment and management of health, playing an important role in self-managing health conditions.

Some years ago patients used virtual communities as part of their treatment, improving their quality of life through sharing experiences between patients and families, promoting socialization and clinical orientation and, also, exchanging information about new medical treatments. Nowadays, these communities have grown and are simultaneously exploring the advantages of mobile technology and ubiquitous computing (Mendoza-González et al., 2012, p. 4).

As sections 3.1 and 3.2 showed, most of the systems using technology to improve healthcare issues have a relevant constraint: an isolated technological background rather than combining an integrated approach including healthcare user experience and iterative design process from the initial idea of system creativity and through development to the final implementation phase. This approach may explain why patients with chronic disease sometimes don't find answers to solve their own healthcare problems, and start creating suitable solutions themselves, thus becoming what Von Hippel considered a "User Innovator". This concept was created in 1976 by this author and describes the behaviour of those users who create solutions for themselves to solve personal problems, including healthcare. For Von Hippel, this special kind of users influence the direction and rate of innovation in specific industries

(Hippel, 1976; 1988; 1990; 2001; 2005).

Typically, user innovators are considered to be end-consumers of goods, services, and designs or more broadly, those who provide in the case of intermediary companies input for further production (Bogers et al., 2010). During forty years, academic work validated the importance of user innovators exploring the conditions where they created a solution and how the process occurred (Bogers et al., 2010; Hippel, 2010). These users modified the traditional processes of creating systems by adopting existing solutions to their own context, changing the existing design and technology contexts to new ones (Baldwin & Clark, 2000; Baldwin et al., 2006; Hippel, 1976, pp. 225–227; Hippel, 1988; 2005).

Consequently, a patient who is a "User innovator" increases their participation in healthcare management, improves health conditions of others, but start with their own. In Portugal, there is a good example of promoting the “User Innovator” concept in healthcare, the online platform “Patient Innovation” (Patient Innovation, 2014). Patients with different disorders share useful solutions online. With a board of medical and research community members, “Patient Innovation” is a research project that aims to become an incubator of patient ideas and solutions. This format – mostly home-made – does not appear to involve a quality based design process.

The interesting projects presented online on the “Patient Innovation” platform are mainly projects with medical validation, but without design or communication concerns. This project appears to open a space for patients who are entrepreneurs and who gather a set of skills to be able to enhance their ideas. However, it should be possible to include in a few projects correct procedures for designing and developing these systems.

In IBD, the platform "Patient Innovation" (2014) presents the Ostom-i Altert, a sensor-based device that notifies the patient with a message via Bluetooth to a mobile application when the ostomy bag is full. The solution comes from a patient diagnosed with Crohn's disease almost 20 years ago. After an ileostomy in 2011, this patient lives with a hole located in the abdomen (surgical procedure), and uses a small bag – ostomy

bag – for receive his bowel movements.

3.4 CHAPTER OVERVIEW

Health isolation in contemporary healthcare organizations does not make sense anymore. Likewise, patients are left highly anxious concerning their lack of knowledge and misunderstanding their illness. Therefore, promoting changes in patients behaviour can improve their healthcare and management of the information on their disease, improving their ability to act upon issues and becoming participatory agents in personal healthcare.

To improve all of these aspects it is possible to take advantage of the ubiquity environment, providing access to data anytime and anywhere. As seen, one of the major problems in several projects is to exchange data from hospitals to patient's mobile phone. Moreover, the projects presented in section 3.2 were crucial to recognize if any design process was adopted or interactive communication topics were considered. The conclusion was that they offer a sophisticated technological approach, and in the most recent research, integration in healthcare technology of topics like user experience and user interface design does exist. It is believed that the approach is changing from a technological point, but Sing et al. (2017, p. 1323-1324) referred that the clinical environment is still often an unfamiliar landscape for the HCI community, meaning that there is still space for improvement.

The Ostom-i Alert project in the "Patient Innovation" (2014) platform is an excellent example of the innovative behaviour of a Crohn's patient/user. To solve a personal health problem, such as how to control when the ostomy bag is full from a bowel movement, this patient proposed a solution on the online platform. This attitude is a way of improving participatory behaviour in all IBD patient communities. The platform gives the opportunity to patients to be entrepreneurs. This could be a good way to recognize multidisciplinary work as well as have space to implement good design contributions.

The behaviour of this patient somewhat reflects the issues of a patient with a chronic disease has when facing difficulties in managing relevant personal IBD data. The difference is that, instead of proposing the project to "Patient Innovation" (2014) platform, this thesis is being used to conduct the studies and create a prototype. The goal is to create space in healthcare for an important field, the design perspective.

Part III
Preliminary studies

This is the beginning of the practical part of this thesis. It covers three stages: (1) Chapter 5, with a survey of IBD patients to analyse their routines related to information about the disease such as, paper exams, record of treatment dates, and medical appointments; and also to identify if they use analogue or digital equipment to manage their medical information; (2) Chapter 6, with an interface analysis of six IBD mobile applications found in online stores and web versions when they exist – "Crohn Al Dia" (Abbott, 2011), "Diario de Crohn" ("Diario de Crohn," 2011), "GI Monitor" (Medivo Inc, 2013), "myIBD" (SickKids, 2011), "GI Buddy" (GI Buddy, n.d.) and "My Crohn's Diary" (My Crohn's Diary, n.d.); (3) Finally, chapter 7 where two from the six case studies are studied, "myIBD" (SickKids, 2011) and "GI Buddy" (GI Buddy, n.d.), and A/B usability tests are performed.

Chapter four presents the framework "Human Social Interaction Model for e-Health Interfaces" (Pernencar, 2014). This framework was created to scientifically support and integrate personal experiences related to three main roles or perspectives: Patient; Designer; Innovator. Personal input coming from personal experience are detailed in this chapter. This framework will be applied from the preliminary studies in chapter 5 up to the "myCrohn" project in chapter 8.

> *The philosophy behind user-centered design is simply this: users know best. The people who will be using a product or service know what their needs, goals, and preferences are, and it is up to designer to find out those things and design for them.*

(Saffer, 2007, p. 31)

Chapter 4. HSI Model for e-Health interfaces

This chapter addresses the first steps of preliminary studies, presenting a framework which combines input from personal experience, as well as including a grid with the expected benefits related to the application of this framework.

4.1 HSI MODEL FOR E-HEALTH INTERFACES – FRAMEWORK GOALS USAGE

In 2014, the "Patient Innovation" (2014) had its official launch in Portugal and, at its core came an interesting feature: innovative behaviour coming from patients with chronic or rare diseases who had been trying to solve illness problems using new solutions with or without the support of technology, which has ties to the concept of “User Innovator” (Baldwin et al., 2006; Riggs & Hippel, 1994; Hippel, 1976), presented in section 3.3 from chapter 3.

After studying the concept and exploring the project "Patient Innovation" (2014) in detail, it was clear how personal experience could be of an important input to the “myCrohn” (Pernencar, 2013) project and how these contributions could help

to improve the design process of this kind of project, with a personal total of thirteen years as a Crohn's disease patient together with seven years working as an interface designer.

After concluding Part II, the question was how to connect theory from multiple fields that present well defined design methodologies and techniques with personal and practical experience? The answer to this question may be found in Kumar's statement (2012, p. 5) “A traditional approach to designing a healthcare- related product would be to focus on product performance. By placing the product in the context of overall healthcare systems, we can develop a greater understanding of the product’s value in relation to all components of the system, such as the patient, doctor, hospital.”

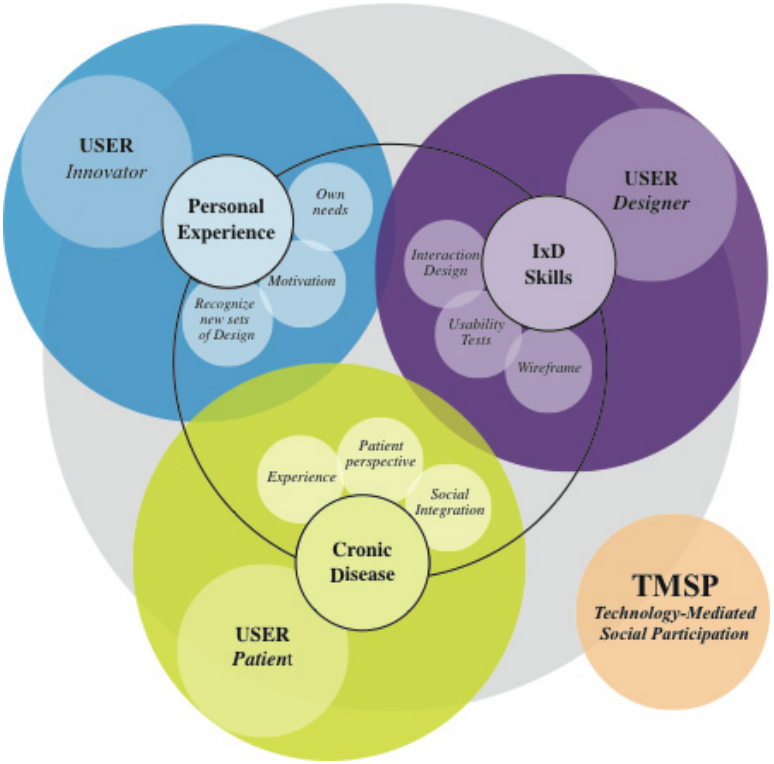


Fig. 4.1 – Human-Social Interaction Model for e-Health Interfaces (Pernencar, 2014, p. 560)

With Kumar’s sentence in mind, innovating in the design process starts with the understanding of the tangible factors from the real world in order to create and develop an assertive healthcare project. The solution may be to reframe Von

Hippel's (1976) concept of “User Innovator” by adding a third perspective, the “User Designer”, and emphasising the “User Patient”. This means changing the healthcare design paradigm by increments from a designer with a chronic disease. According to the concepts referred to above, the framework “Human-Social Interaction model for e-Health interfaces” (Pernencar, 2014)[13] was created, and figure 4.1 shows a UCD model that includes standard methodologies (and was discussed in section 2.3 in chapter 2), combined with personal experience as a designer and a patient.

The framework is divided into three viewpoints and will help those who wants to scientifically validate the use of personal experience as a designer, a patient and a innovator. It includes from a design perspective with background, vision and techniques; The patient's perspective with knowledge and experience of the disease; And the innovator's perspective with identifying some of the innovative healthcare scenarios and new sets for healthcare design.

4.2 HSI MODEL FOR E-HEALTH INTERFACES – EXPECTED BENEFITS

The framework “Human-Social Interaction model for e-Health interfaces” (Pernencar, 2014, p. 560) provides a grid where contributions from personal inputs may applied. To detail the contributions of each perspective – “User Designer”, “User Patient”, and “User Innovator”– to the preliminary studies and the iterative design process of “myCrohn” (Pernencar, 2013) project presented in this thesis, table 4.1 specifies the expected inputs and where each will be applied: In chapter 5, experience as a “User Designer” and a “User Patient" during the preliminary studies. Afterwards, in chapter 6, the scenarios, questions and tasks of an online survey to IBD patients will be based on personal experience as a “User Designer” and a “User Patient” . Here, the main goal is to identify patients routines related to their IBD disease, such as paper format exams, recording treatment data, or medical

13 The framework title mentions e-Health, but the project environment where it will be applied is mobile, which means that the electronic processes and communication of healthcare information is related to m-Health.

appointments; and whether patients are using analogue or digital equipment for these tasks. Lastly, in chapter 7, personal experience as a “User Designer” will guide A/B testing.

In Part IV, "myCrohn" (Pernencar, 2013) project. The three perspectives will have a global influence on all of the design process, helping to understand which are the best design practices to apply in IBD, revealing new opportunities for IBD systems, and, equally important, define directives in medical information design.

Table 4.1 – Personal inputs and expected benefits in each chapter

Part/ Chapter		Framework perspective	Personal inputs for the preliminary studies and project	Expected benefits
Part III – Preliminary Studies	5	User Patient	The scenarios used in patient survey will be based on Crohn disease emergencies that happened personally as a Crohn's patient.	– Help in understanding the research context; – Promotes shared experience in the IBD community.
		User Designer		– Manage research resources; – Guide the preliminary studies in healthcare context.
	6	User Patient	The case studies will be analysed through a personal perspective as a patient, and as a professional experience as an interface designer.	– Identify opportunities and challenges in healthcare design.
		User Designer		– Work as a medical information design translator; – Bring new perspectives to IBD systems.
	7	User Patient	The case studies will be analysed through a personal perspective as a patient and professional experience as an interface designer.	– Help in translating cross-platform systems.
		User Designer		– Find in case studies new opportunities for healthcare design.

Part IV – "myCrohn" project	8	User Patient	The project approach will be focused on the personal inputs explained in chapter IV, and will incorporate a new interaction and interface design approach.	– Release new IBD insight related to m-Health.
		User Innovator		– Reveal opportunities in IBD systems.
		User Designer		– Project Design; – Define directives for medical information design; – Helps understanding which are the best practices for interface design.

4.3 CHAPTER OVERVIEW

The daily life of a patient with a chronic disease like IBD is a challenge in itself. But, this thesis encompasses another challenge, to scientifically integrate the use of personal contributions as a “User Designer", a “User Patient" and a “User Innovator” to help to improve the design process of digital healthcare projects.

To summarize, the next four chapters and conclusions will provide two distinct sets of feedback: (1) the results of quantitative and qualitative analysis: a survey, empirical studies, and usability tests; (2) the validation of a low and high fidelity "myCrohn" (Pernencar, 2013) prototype: project insight, interface requirements, and validation. At the end of the thesis, in the contribution section, research design guidelines for healthcare projects.

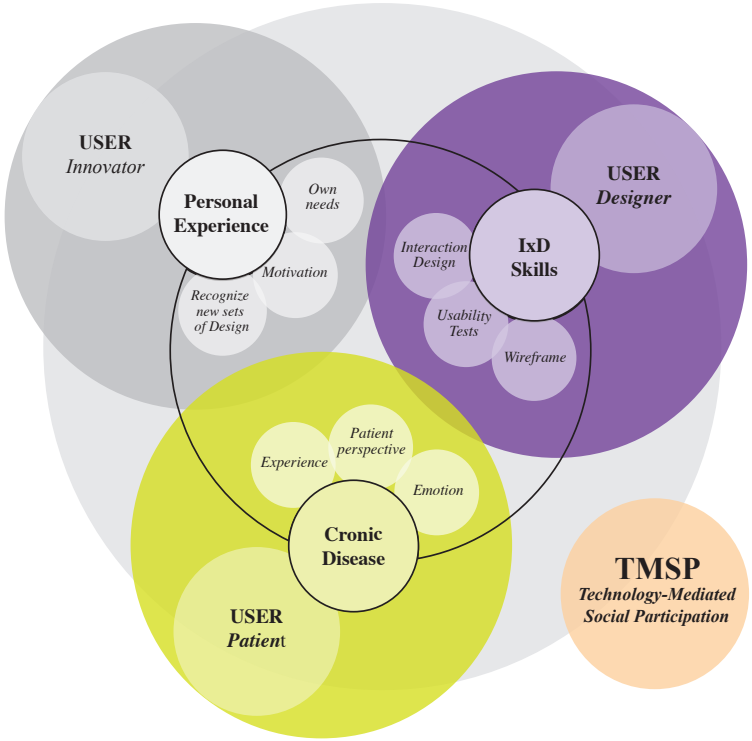


Fig. 5.1 – Human-Social Interaction Model for e-Health Interfaces –

"User Patient" and "User Designer" (Pernencar, 2014, p. 560)

Chapter 5. 1st stage – IBD patients survey

This chapter introduces a user study to understand patient behaviour related to: (1) how they manage information on their disease like register appointments, tracking symptoms, filing documents, among others.

5.1 PATIENT'S BEHAVIOUR ANALYSIS

As a preliminary study was conducted in online survey[14] with the support of the APDI ("APDI," 2012), which provided us access to a pool of anonymous patients. The main objective was to identify the patient's routines when managing

14 Copy of the online survey sent to APDI members available in Annexes (annex 12).

information regarding their IBD disease. The survey scenarios and tasks, were based on personal circumstances as a "User Patient" and experience as a "User Designer" (Pernencar, 2014) – figure 5.1. This study had 279 participants: 37% male and 63% female from 6 age groups, 10-20, 21-30, 31-40, 41-50, 51-60 and +60 (figure 5.2).

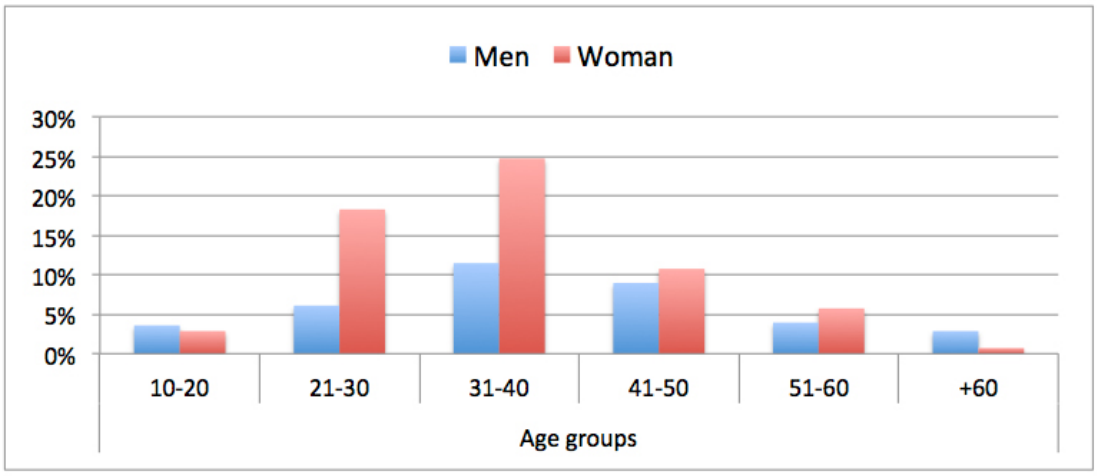


Fig. 5.2 – Numbers of IBD participants in the survey

Starting by identifying how many participants, from the 279 total, took medication daily to understand activity in the available sample. 90% of the participants said they took medication related to their IBD disease on daily basis.

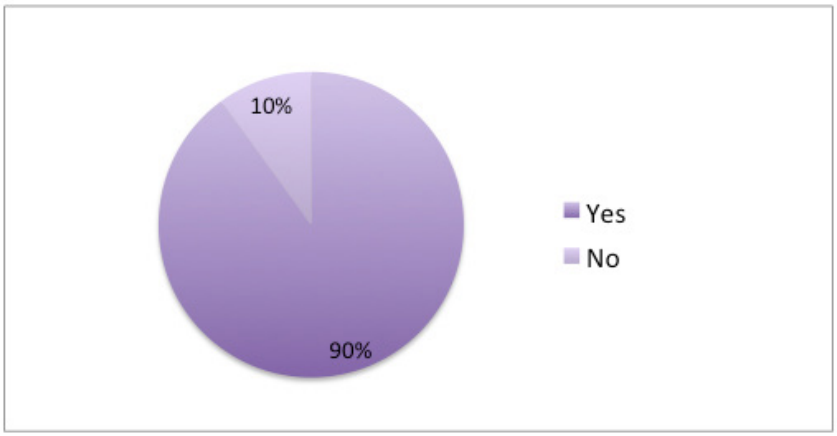


Fig. 5.3 – Participants who are enrolled with medication

Subsequently, the aim was to identify, out of the participants who took medication daily, how long they had the disease. Figure 5.4 shows that this group mostly had IBD experience for less than five years.

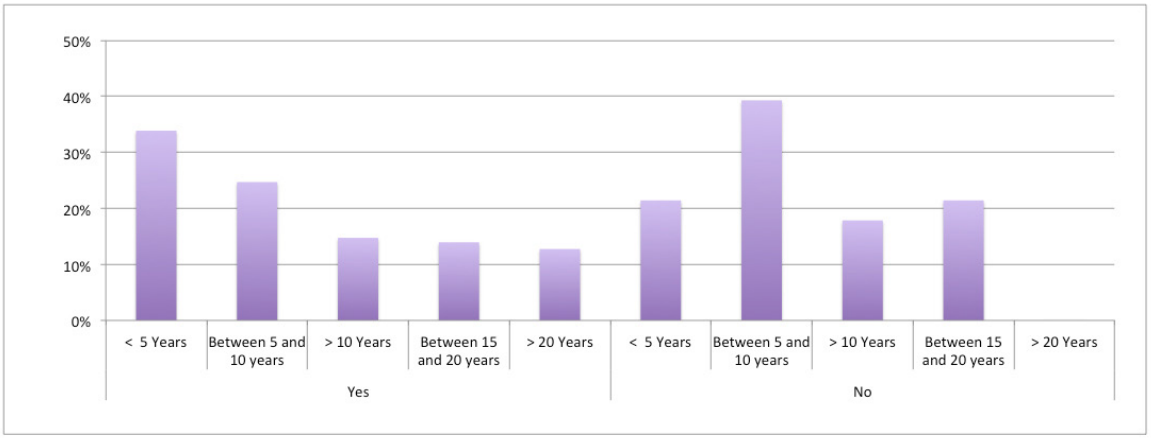


Fig. 5.4 – Disease time related for “Yes” answer from figure 5.3

With 90% of the participants taking medication, it was important to understand what habits they had related to recording their use of medication, the date time they took them.

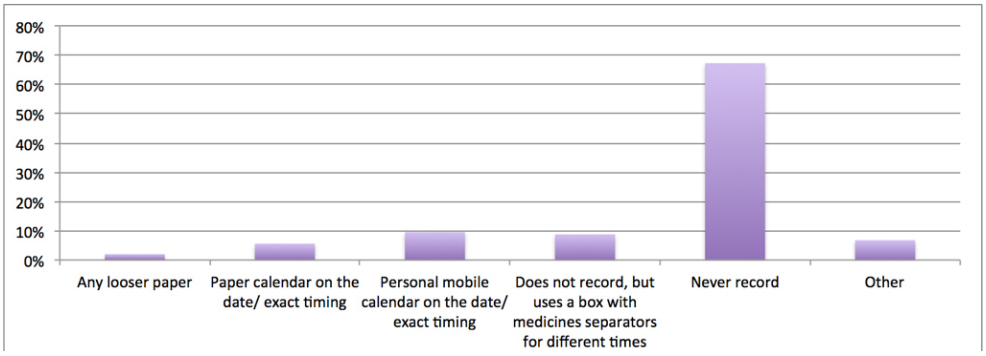


Fig. 5.5 – Participants record of their medication on the date/ exact time (the 90% of "Yes" in figure 5.3)

68% of all age groups answered "do not record anything, anywhere"– (“Never record” – figure 5.5). The number of participants that chose the option “Any loose paper” – as a way to record information of the medication, had the lowest percentage, 2%. In this scenario, it is questionable how possible it is for IBD patients to remember disease information from previous years and provide it correctly when they need to talk with clinics outside their traditional medical environment. Another interesting result in the analysis was related to the way patients record their medical information. 6% still register their medication schedule on a paper calendar – “Paper calendar on

the date/exact timing" (figure 5.5).

Continuing with the registration methods, the following step was to analyse the patient usage of digital reminders, in for example, a calendar set up on a mobile phone or on a personal computer, as an alert for disease routines like taking medication, remembering appointments or treatments. From the 279 participants only 15% acknowledged to have used this method (figure 5.6).

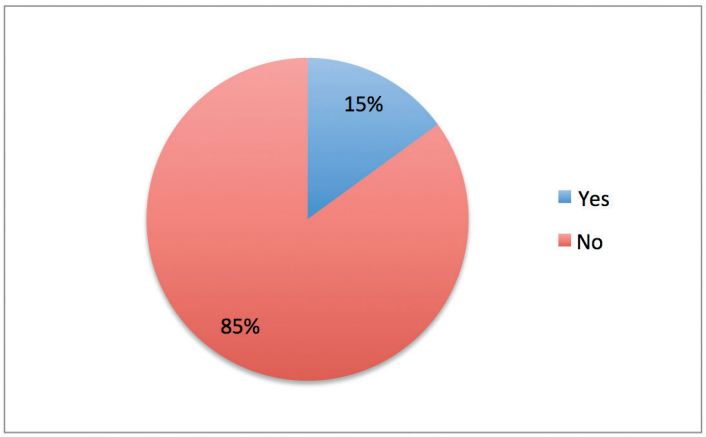


Fig. 5.6 – Use of reminders on mobile phones / computers an alert method to take medication, and remember appointments or treatments – "Yes" and "No" answer.

Of the 15% of participants who said they use reminders on mobile phones/ computers as an alert to take medication, most of them belong to the age group: 21-30, 31-40 and 41-50 with 31%, and the lowest, 10-20 with 0% – in terms of the "No" answer ("Don't use this method" item), the highest value was achieved by the age group 31-40 with 37% and the lowest in the age group +60 with 4% (figure 5.7).

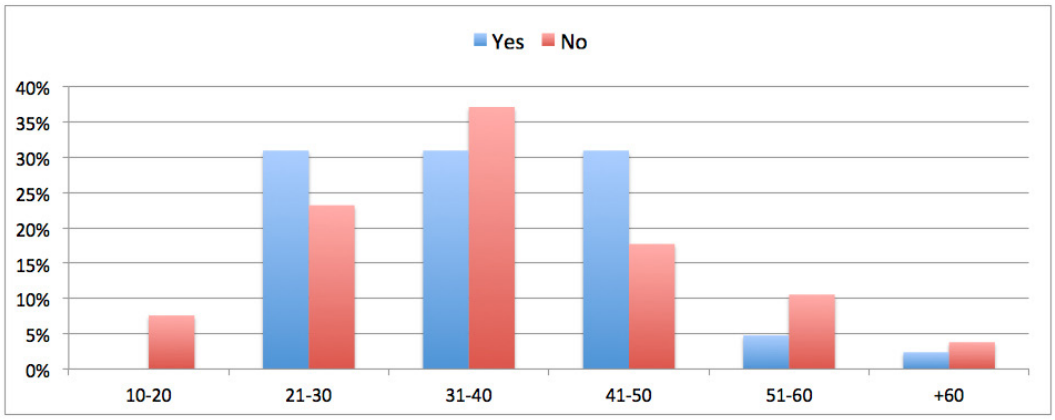


Fig. 5.7 – Use of reminders on mobile phones / computers an alert method to take medication, remember appointments or treatments – "Yes" and "No" answer per age group.

In the sample of participants that answered that they did not "use reminders on mobile phones/ computers as an alert to take medication and remember appointments or treatments", the 85% from figure 5.6, the highest incidence about how long participants had the disease was with those that had the IBD less than five years, 68%. As can be seen in figure 5.8, in all criteria, "Never record" is the highest compared to other items like for example "Any loose paper".

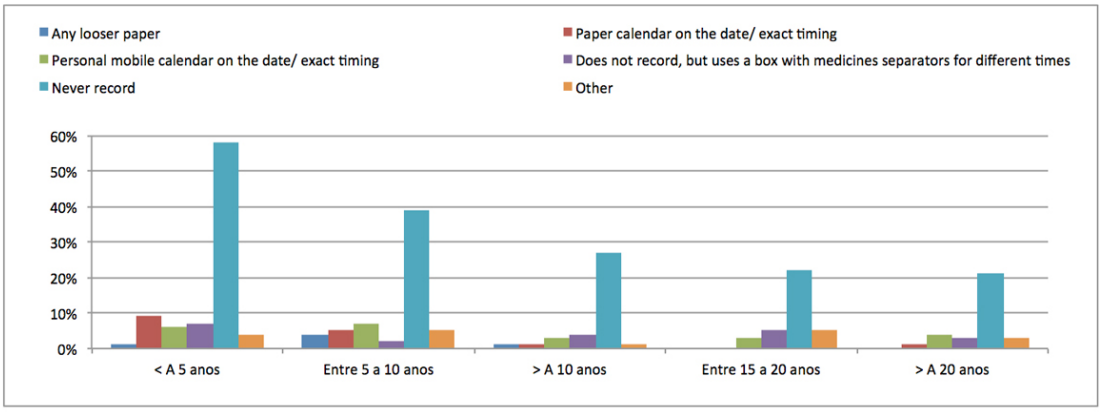


Fig. 5.8 – Information recorded by participants who answered “No” in figure 5.6

In terms of patient routines, it was also interesting to understand behaviour related to recording of information. Figure 5.9 presents the results for the survey question “Do you record on your mobile phone the information received on paper related to treatment scheduling or appointments?” From the 279 participants, 39% answered “Yes”, 60% “No” and 1% “Do not know". More than 50% said that they did not have this habit, and it is important to understand why this happens.

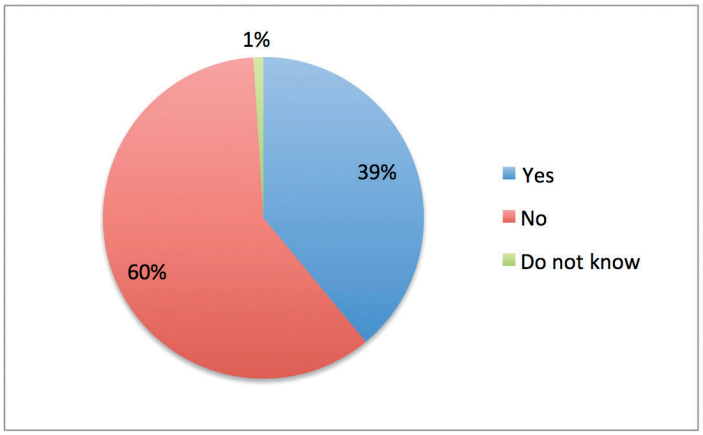


Fig. 5.9 – Participants record of their routines – “Yes”, “No and “Do not know” answers

Another relevant issue to evaluate with this survey was the category of routines related to different procedures involving individual medical appointments (figure 5.10). From experience as a “User Patient”, there is always a set of information, usually on paper, such as new exams.[15]

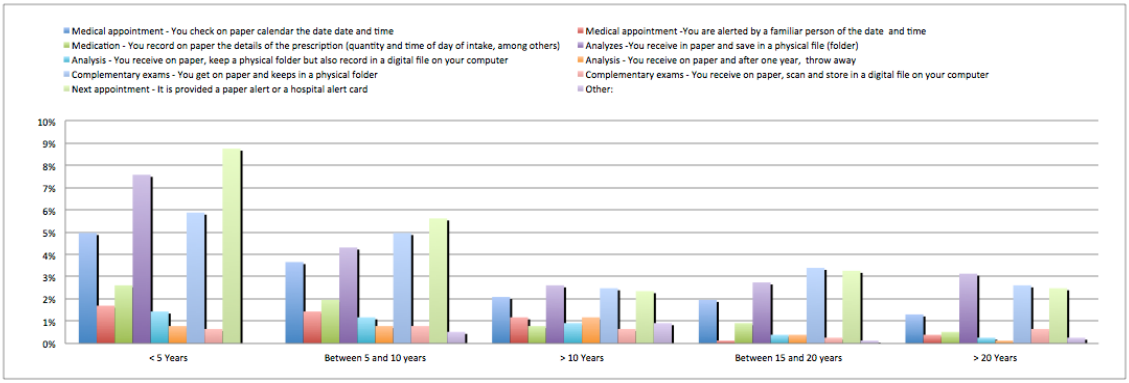


Fig. 5.10 – Participants record of routines involving medical appointment

Regarding how patients record different routines after an appointment, the groups which have less than 5 years of IBD have the highest results, particularly in items like "Medical appointment - You check on paper calendar the date and time", 5%; "Analyses -You receive on paper and save in a physical file (folder)", 8%; “Complementary exams - You get on paper and keep in a physical folder, 6%; “Next appointment - provided a paper alert or a hospital alert card”, 9%.

Analyzing from another point of view, a routine which directly involves computers, like for example, “Complementary exams - You get on paper and keeps in a physical folder”, the highest percentage is six percent, and for the patient groups that have the disease for less than ten years.

15 An example of a common procedure related to a personal appointment with paper documents for each stage: (1) An hemogram to check for disorders like anaemia; (2) Hospital treatment appointment; (3) Acceptance treatment with patient signature; (4) Following appointment document (Annexes 6, 7, 8, and 9).

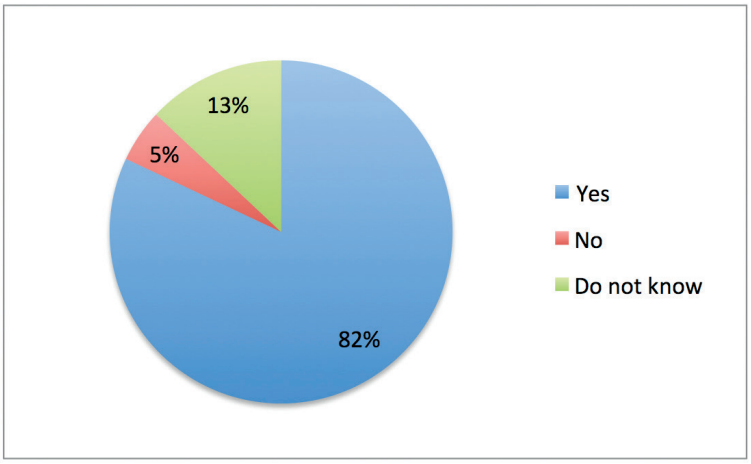


Fig. 5.11 – Patient openness to use free cross-platform applications

Finally, it was relevant to know if participants were open to manage their disease in the future through the use of a free cross-platform application (using a mobile phone or a desktop computer). From the 279 patients surveyed, 82% responded "Yes", 5% "No" and 13% "Do not know", as showed in figure 5.11. It is possible that participants of the survey do not comprehend the potential and the benefits of using health- related Smartphone apps to manage personal disease, as presented in a US study by Zia et al. (2015) – gastroenterology patients' perspectives about m-Health.

5.2 CHAPTER OVERVIEW

The survey results showed that the majority of IBD patients (68% said "Never record" – figure 5.5) do not record medication in digital environments. The reason for this may be due to the fact that for most participants, the task of medicating is a daily routine, so the probability of forgetting is lower. Figure 5.3 shows that 90% of participants answered "Yes" to the question of how many patients are medicating. So, most of them have to follow routines like daily treatment. On the other hand, 85% said they do not use reminders on mobile phone or computers as alerts to take medication or remember appointments or treatments – figure 5.6. This result shows that when patients have daily routines with a fixed schedule, using any kind of reminder on a mobile phone (or even on paper) is not a priority. From personal experience, it is crucial with fortnightly treatment to have an alert in a digital or analogue environment

to take medication because this solution is one of the best ways to avoid forgetfulness.

After a medical appointment, it is common to receive clinical reports on paper, like for example, treatment scheduling or appointments. In this scenario, the objective was to understand if participants use mobile phones as a tool to manage this type of information. Here, the results were different. 39% of participants said that to manage this information they use digital devices – figure 5.9. Related to receiving medical information on paper after a medical appointment, those participants who said to record on a mobile phone "Date/ time of the next appointment", are those who have the disease for less than five years – figure 5.10. Considering the use of these devices as a tool to manage alerts, like for example, reminders to take medication, or not to forget appointments and treatments, participant behaviour change. Figure 5.6 shows a lower indicator. Only 15% of participants use mobile phone as a tool.

In the study presented in chapter 5, two IBD user behaviours are clear: First, those patients that do not have any digital habit like using mobile phone as a tool to help managing illness tasks. Second, those participants that don't take care of their own IBD information, meaning they completely trust their mental capacities. The survey results reflect low literacy of the Portuguese population or, perhaps the patients are not rigorous enough, regardless of the frequency that they take medication.

The results of chapter 5 will help define different feature settings in the dashboard.

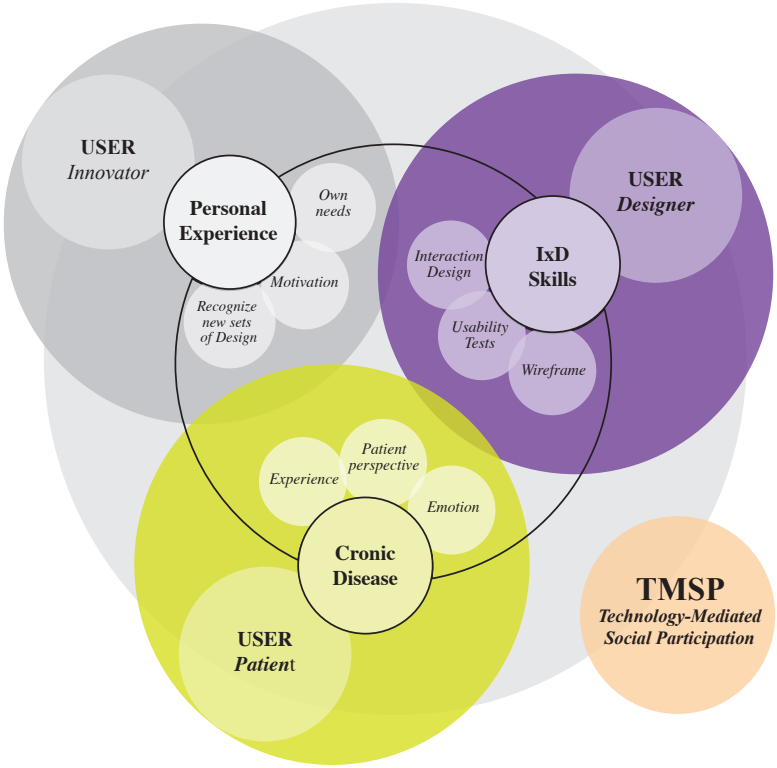


Fig. 6.1 – Human-Social Interaction Model for e-Health Interfaces

– "User Patient" and "User Designer" (Pernencar, 2014, p. 560)

Chapter 6. 2nd stage – Case study analysis

This chapter shows a qualitative study regarding six IBD m-Health applications where subjects like graphic design, interface and interaction design, are explored empirically. The contribution of this part will help decide how to create mobile and desktop healthcare experiences that reduce the abandon rates of these systems; how to change patient behaviours related to the disease; and how to provide them with confidence that those systems are created to empower them.

6.1 UNDERSTANDING THE ECOSYSTEM

Chapter 6 presents an empirical analysis of six commercial IBD applications. In 2011, at the beginning of this research, only four IBD mobile applications were found in both Apple and Android stores: "Crohn Al Dia" (Abbott, 2011) – figure

6.2, “Diario de Crohn” (“Diario de Crohn,” 2011) – figure 6.3, “GI Monitor” (Medivo Inc, 2013) – figure 6.4 and “myIBD” (SickKids, 2011) – figure 6.5. In the meantime more have emerged, including, “GI Buddy” (GI Buddy, 2014) – figure 6.6, and “My Crohn’s Diary” (My Crohn’s Diary, n.d.) – figure 6.7. The criteria adopted to select the six applications as the thesis case studies are divided into three parts: (1) Availability on online stores; (2) Integration of design principles – Understanding the hierarchy of the content; Visual coherence; Iconic representation; Consistency in the related interactions; (3) Association of the “User Patient” and “User Designer” perspectives (figure 6.1) – with, as much as possible, performed tasks being related to episodes, medication and exam registration; Ease or difficulty in understanding the dynamics of the interactions; Visual interpretation.

Other systems were found in both stores, which although not related with IBD, still offer patients the opportunity to record some symptoms and medical appointments.

Below, the applications which will be analysed in further detail later on are briefly described.

Fig. 6.2 – Mobile app icon "Crohn Al Día”

Fig. 6.3 – Mobile app icon “Diario de Crohn”

Fig. 6.4 – Mobile app icon “GI Monitor”

Fig. 6.5 – Mobile app icon “myIBD”

Fig. 6.6 – Mobile app icon “GI Buddy”

Fig. 6.7 – Mobile app icon “MyCrohn’s Diary

- **Crohn Al dia** (Abbott, 2011) – figure 6.2 – this free cross-platform application requires registration and permission from clinics to work with the available health services – figure 6.8. This hinders continued the analysis because the Group Español de Trabajo en Enfermedad de Crohn’s y Ulcerative Colitis

("GETECCU," n.d.) didn't answer our requests asking for authorization to test the application. Even without permission, it was possible to understand a few visual interface details like icons, colours, shapes and typography used (figures 6.9 and 6.10), because the screenshots are available on the store homepage. The information available on the online store allowed for some empirical idea.

Fig. 6.8 – "Crohn Al Día" mobile app – Registration

Fig. 6.9 – "Crohn Al Día" mobile app – Launchpad

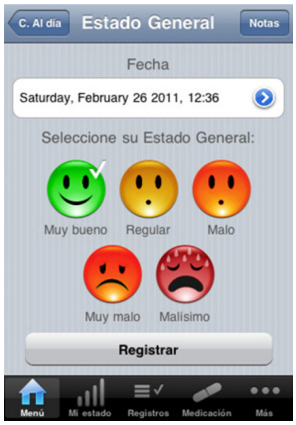


Fig. 6.10 – "Crohn Al Día" mobile app – Estado general item

- **Diario de Crohn** – figure 6.3 – another free cross-platform application with the same restriction as "Crohn Al dia" (figures 6.11 and 6.12). The screenshots available on the online store gave us an idea of the visual interface style used and what kind of features the dashboard provides (figure 6.13).

Fig. 6.11 – "Diario de Crohn" mobile app – Registration

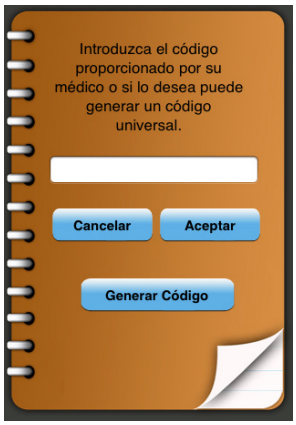


Fig. 6.12 – "Diario de Crohn" mobile app – Registration

Fig. 6.13 – "Diario de Crohn" mobile app – Launchpad

- **GI Monitor** (Medivo Inc, 2013) – figure 6.4 – it is a logging cross-platform

application, available for mobile phones – figures 6.14 and 6.15 and desktop (Medivo Inc, 2009) – figure 6.16, that synchronize data between each other. The dashboard structure is similar to the "Cronh Al Dia" application, which provides different types of logs, like BM (Bowel Movement), stress and pain levels, meals, weight and other data. The areas are organized into two pages using a carousel with horizontal navigation to switch between them. This structure is completely different to those that exist in the desktop. In the desktop version, figure 6.16, there is a menu list called "Log Events" with fewer items than the mobile application – figures 6.14 and 6.15.

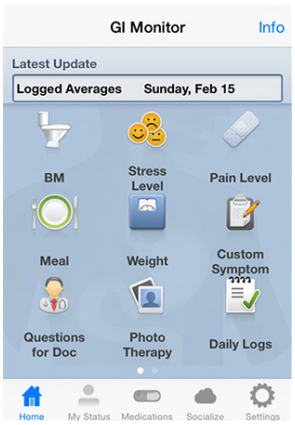


Fig. 6.14 – "GI Monitor" mobile app – Launchpad of first page and navigation

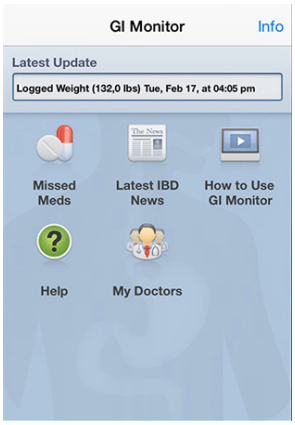


Fig. 6.15 – "GI Monitor" mobile app – Launchpad of second page and navigation

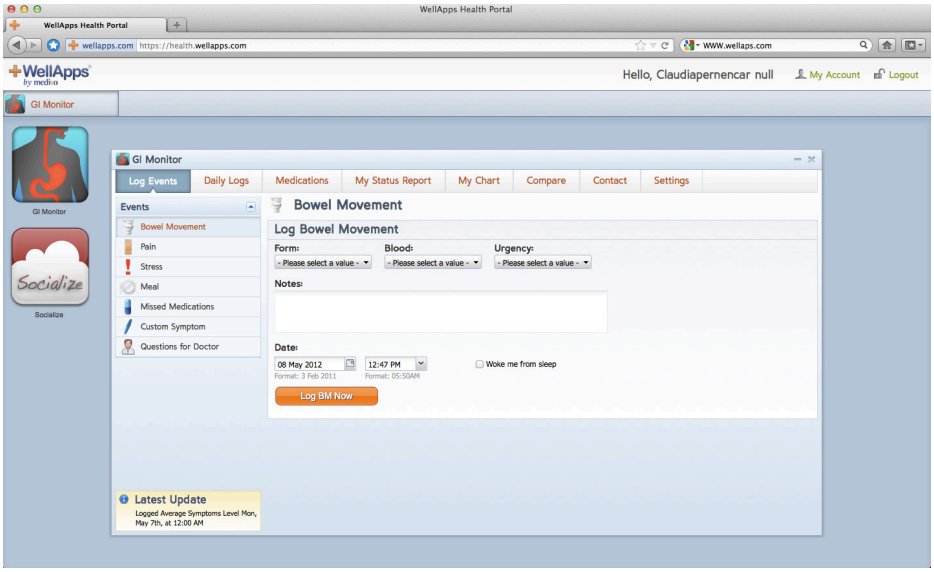


Fig. 6.16 – "GI Monitor" website homepage

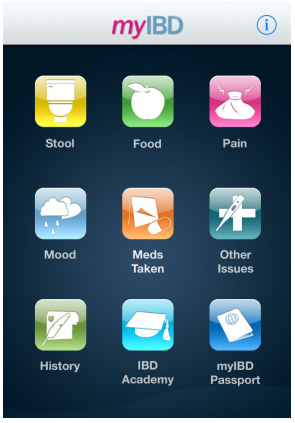


Fig. 6.17 – "myIBD" mobile app – Launchpad

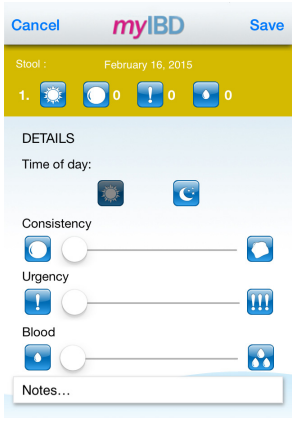


Fig. 6.18 – "myIBD" mobile app – Stool item

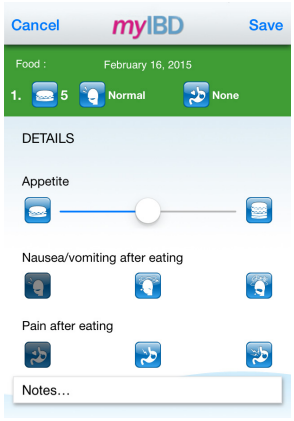


Fig. 6.19 – "myIBD" mobile app – Food item

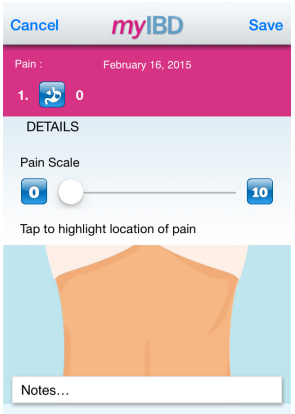


Fig. 6.20 – "myIBD" mobile app – Pain item

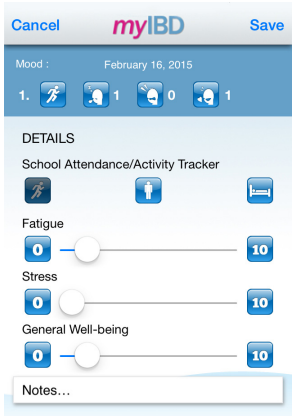


Fig. 6.21 – "myIBD" mobile app – Mood item

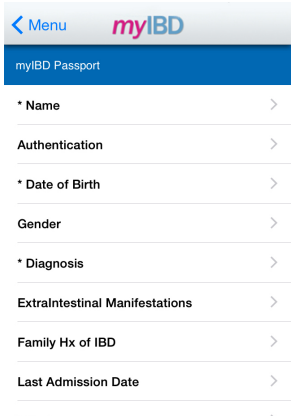


Fig. 6.22 – "myIBD" mobile app – Passport item

- **myIBD** (SickKids, 2011) – figure 6.5 – is a free mobile application. This system presents a single launch pad with items like "Stool", "Food", "Pain", "Mood" among others – figure 6.17. Comparing the interface design of "myIBD" (SickKids, 2011) with the others studied in this thesis, this is the only system with its second and the third navigation screen still presenting icon demonstrating features – figures 6.18, 6.19, 6.20 and 6.21. The "myIBD" application allows two interaction styles: Drag or tap. E.g., "Pain scale" where to change the values in the scroll bar, it is necessary to drag the button, and the "Tap to highlight location of pain" feature, to identify in the image where it is painful (figure 6.20). Another interesting feature that we can find in this system is "myIBD Passport" – figure 6.22 – where each patient can record personal and clinical information: Through a list menu, users fill in a form with required information like "Name", "Data of Birth",

"Diagnosis" and "Meds". Additional information is also requested, "Extra Intestinal Manifestations", "Immunization Status", "Bone Status" to create a record of personal information.

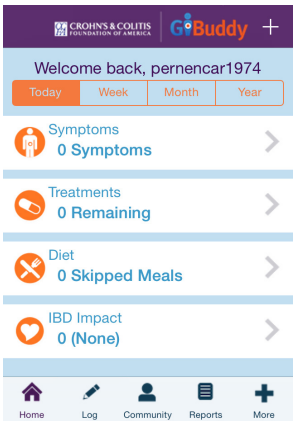


Fig. 6.23 – "GI Buddy" mobile app – Launchpad

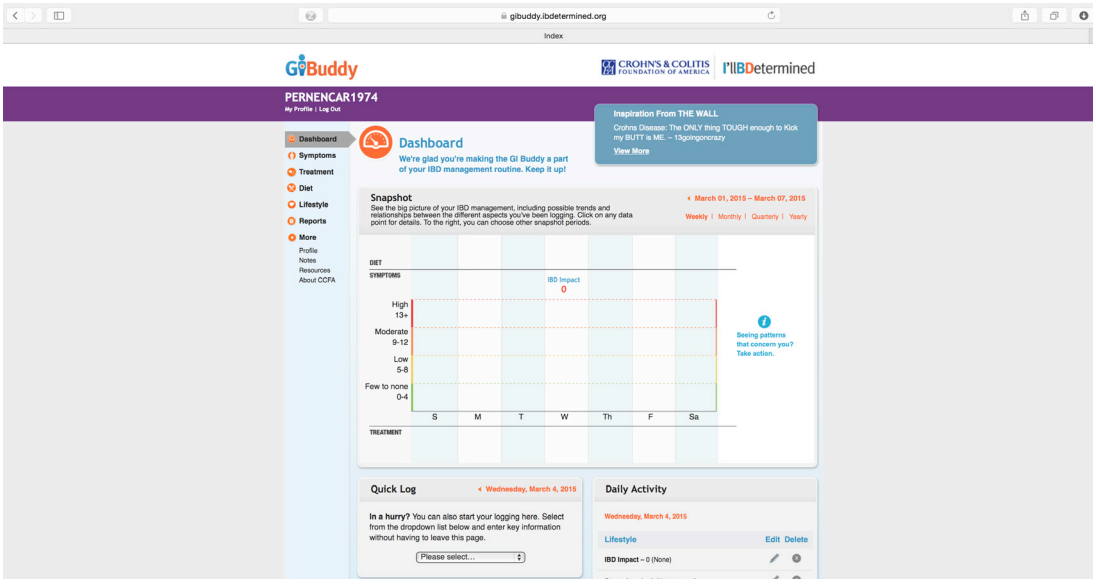


Fig. 6.24 – "GI Buddy" website homepage

- **GI Buddy** (GI Buddy, 2014) – figure 6.6 – this is a free tracker tool to manage Crohn's Disease or Ulcerative Colitis and is available as a desktop tool, and as an iPhone® or Android™ mobile application. Figure 6.23 presents the mobile application's homepage with a menu list, and a navigation menu at the bottom. Through the features available, users track their symptoms, monitor overall well-being, control treatments, log eaten food and generate reports to help them detect IBD trends. Figure 6.24 shows the desktop

application homepage with a main dashboard. The corresponding content and the interface design concepts will be compared for both systems in sections 6.1.2 and 6.2.1.

- **My Crohn's Diary** (My Crohn's Diary, n.d.) – figure 6.7 – from the six case studies analysed this application is the only one that is not freely available. My Crohn's Diary is used to monitor food and beverage intake when symptoms arise – figure 6.25. With a menu list on the main page, this system gives an opportunity to the users to create a report in "My History" section, and after be reviewed and analysed by the patient or a doctor.

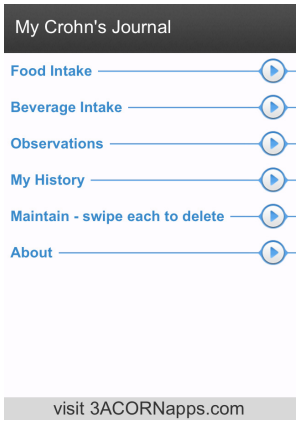


Fig. 6.25 – "My Crohn's Diary" mobile app – Launchpad

6.1.1 Contextual analysis

This part presents an overall analysis regarding details of the different applications such as, the date when they were available for download on online stores, and in which operating system; if the user needs any external permission, like a user code, for registration[16], and the main areas available. Table 6.1 shows the first four online systems studied, and table 6.2, the other two.

16 On the webpages related to the applications researched, we understood that the request type referred to was directly connected to a specific healthcare service (public or private).

Table 6.1 – Cronh Al Dia & Diario de Crohn mobile app – General analyse based on (Pernencar, 2013, p. 2)

		CrohnAlDia	Diário de Crohn
Language		Spanish	Spanish
Release date		March 15, 2011	February 18, 2012
Users registration		Required	Required
Users permissions		Restricted information	Without access to this information
Platforms	Desktop	-	-
	Mobile	IOS	IOS
Disease tracking		Crohn	Crohn
Areas		Como te encuentras	Estado geral
		Dolor de estómago	Dolor abdominal
		Mi medicacíon	Alimentación
		Cuantas deposiciones	Medicacíon perdida
		Y de ânimo	Síntomas personalizados
Navigation bar			Menú
			Mi estado
			Registos
			Medicacíon
			More
		GIMonitor	**MyIBD**
Language		English, French, German, Italian, Spanish	English
Release date		October 19, 2011	July 19, 2011
Users registration		Required	Not required
Users permissions		Do not have any requirements	Do not have any requirements
Platforms	Desktop	Website	-
	Mobile	IOS + Android	IOS + Android + Windows Phone 7
Disease tracking		Crohn and Colitis	Crohn and Colitis

Areas	BM	Stool
	Stress Level	Food
	Pain Level	Pain
	Meal	Mood
	Weight	Meds taken
	Custom Symptom	History
	Questions for Doc	IBD Academy
Areas	Photo Therapy	myIBD Passport
	Daily logs	
	Missed Meds	
	Latest IBD News	
	How to use GI Monitor	
	Help	
	My Doctors	
Navigation bar	Home	
	My Status	
	Medications	
	Socialize	
	Settings	

Table 6.2 – GI Buddy and My Crohn's Diary mobile app – General analyse

		GI Buddy	My Crohn's Diary
Language		English	English
Release date		May 28, 2015	September, 2012
Users registration		Required	Not required
Users permissions		Do not have	Do not have
Platforms	Desktop	Website	-
	Mobile	IOS + Android	IOS
Disease tracking		Crohn and Colitis	Crohn

Areas	Symptoms	Food Intake
	Treatments	Beverage Intake
	Diet	Observations
	IBD Impact	My History
		Maintain – Swipe each to delete
		About
Navigation bar	Home	
	Log	
	Community	
	Reports	
	More	

Tables 6.1 and 6.2 show that three of the six applications track Crohn disease ("Crohn All Dia", "Diario de Crohn", "Gy Buddy"), and the others both Crohn and Colitis ("Gi Monitor", "myIBD", "My Crohn's Diary"). Only two do not require user registration, My Crohn's Diary and "Diario de Crohn", where the users receive a username and a password coming from an external service for login procedures. "myIBD" is the only one that provides a system for IOS (iPhone Operating System), Android and WP7 (Windows Phone). "Gi Monitor" and "Gy Buddy" are the applications that also run a website version with a launchpad as a homepage, as well as a navigation bar. The areas and navigation bar features will be explained in the following section.

6.1.2 Content analysis

Annexes 1, 2, 3, 4, 5 present detailed tables with the content strategy adopted by each system. They also give the opportunity to know how the information architecture is organized even without a navigation map. Each table lists the titles of the main areas, and afterward, the titles of each launchpad and navigation bar, exchaning information between primary and secondary pages.

In general, it is recognized that all systems help patients to monitor daily tasks related to the disease, like recording symptoms, medication registration, meals

or sharing information with clinics through personal devices. Only two systems, “GI Monitor” (Medivo Inc, 2013) and “GI Buddy” (GI Buddy, 2015), are cross-platform, and they also include a chart where patients have information related to the evolution of some signs, using cross data methods of selected criteria like symptoms, meals or medication track. “myIBD” (SickKids, 2011) is the only system that offers a “Digital Passport”. Here, each patient records important personal information like “Family HX of IBD” (Family history of IBD), “Immunization Status”, the “Last Colonoscopy Date” among others.

On primary screens, the options available are similar. E.g.,: “BM” (Bowel Movement), "GI Monitor" and “Stool”, "myIBD". For patients, this means performing the same task – Logging what happened during bowel movement. Another common feature on the primary screen or on the navigation bar, is the medication area, also presenting different names according to each system. E.g., “Medicación Perdida”, "Diário de Crohn"; “Missed meds”, "GIMonitor"; “Meds taken”, "myIBD". Related to the mood, there are also different names to similar features: “Mi estado”, "Diário de Crohn" and "Crohn All Dia"; “My Status”, "GIMonitor"; “Mood”, "myIBD". Related to the titles presented, some of them appear to be too abstract. e.g., “Mood” which seems to refer to how the patients are feeling.

In the systems studied, there are other common details, like for example “GI Buddy” has in the menu list: the item “Treatments” which contains a list of medications, and an “Open Field” to add new ones if necessary. Still, “Gi Monitor” divides this feature, the logging of a treatment, into two areas, but a small detail can be what makes the difference between them: In the tab area, the “Medications” item lets users add medication through a selection in the available alphabetical list, and it is also possible to consult the tracked history. On the main page there is a carousel navigation with the option “Missed Meds”. The second launchpad of “Missed Meds” asks the users “Which medication did you miss?”, and according to the previous list, the patients have to confirm this information.

To reduce the distance between patients and clinics, five of the presented systems show different ways of connecting these two worlds. E.g., “GI Monitor”

has areas like “Question for Doc” and “My Doctors”; “myIBD” presents “In case of emergency” which allows patients to send a message to a nurse; “Care team” is inside the patient’s profile (specialty, name, phone number is required) in the “GI Buddy” system. “My Crohn’s Diary” is the only application that does not present any connection with clinics. “Diário de Crohn”, as the screenshots available in the stores show, contains a tab “Consultas”.

Considering these aspects as a “User Patient” and a “User Designer” (Pernencar, 2014), “myIBD” and “GI Buddy” are the systems that present the best approach in terms of features, closer to what could be a relevant healthcare experience for patients, because out of the six, these two have features that are more focused on patient needs, even presenting design problems that will be explained in the following sections. The strategy for content adopted in these two systems shows that there is a connection between the daily tasks related to user needs, like for example, tracking general symptoms such as, bowel movement, pain and stress levels, and food intake, among others. The area titles with different names for patients, have the same meaning when they have to perform a task in this kind of system. However, this situation only occurs on the first page. After that, both applications present a lot of constraints that will also be analysed in the following sections.[17]

6.2 OUTLINING THE INTERACTION DESIGN

Looking at particular design fields like industrial design, communication design and UxD, all of them should include in their workflow a creative process and work on “concept” on different levels. Changes in design practice (Bártolo, 2010), where disruptive narratives generate in the interfaces different characteristics to decode. The idea of creating a “concept” when designing a digital interface belongs to a new set of strategies that, considered as a “User Designer”, simultaneously interacts with fields like communication, design and technology.It is a hybrid space where designers are constantly challenged to overlap distinct knowledge in order to create a digital

17 The tables only contains main pages informations like the contents and the features. In the following section, the remaining pages will be discussed.

project. To help in this situation, the "Universal Principles of Design" (Lidwell et al., 2003) brought to those who work in the digital world a deeper understanding of how a “concept” should be involved in design studies. E.g., Suggestions for studying colour, icon representation, alignment, consistency, and visibility, as well as underlying symbols like icons, interactions standards, among others, allowing designers to follow sustainable strategies in order to create their projects. Like Lidwell et al. (2003, p. 11) said “It gives designer the ability to calculate the product design’s capability to resonate with people”.

Following the experience as a “User Designer”, and as previously discussed, six core principles were chosen from the one hundred and twenty five "Universal Principles of Design" (Lidwell et al., 2003, pp. 24, 32, 48, 56, 92, 146, 154, 250) which, considering the subject of Medical Information Design are: (1) colour; (2) Iconic representation; (3) Alignment; (4) Consistency; (5) Visibility. The goal of selecting these specific guidelines is to outline the design concepts that better suit creating a new user experience for mobile healthcare, and by the end of this thesis, be able to define guidelines for designers that have the same framework, as well as the potential to solve personal healthcare problems and be able to follow a structured design process, with specific methods that have been tested in a chronic disease environment.

6.2.1 Design concepts analysis

- **Colour** – Not all colours have universal symbolism, depending on how different cultures give a symbol meaning. Nonetheless, red, orange and green have universally established rules: dangerous, not so dangerous and not dangerous. Table 6.3 shows several well used examples of how to combine colour meaning with visual and functional representation. E.g., Figure 6.26 “Estado general” green is used for “Muy bueno”. In this example, the facial expression helps patients to recognize “well being” by matching the visual representation of "happiness" with green, which means “feeling good” or “without any urgency”. The opposite of this scenario in the IBD for a high pain level, is the red.

Table 6.3 – Visual representation of design principle colours that are well used from a design perspective

Fig. 6.26 – "Crohn Al día" mobile app – Estado General

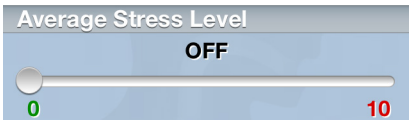


Fig. 6.27 – "GI Monitor" mobile app – Average Stress Level

Fig. 6.28 – "GI Monitor" website – My Status Report

Fig. 6.29 – "GI Monitor" mobile app – Log BM

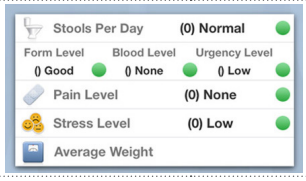


Fig. 6.30 – "GI Monitor" mobile app – My Status

Fig. 6.31 – "GI Monitor" mobile app– Add Meal

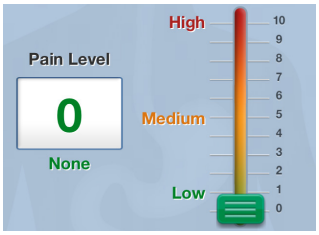


Fig. 6.32 – "GI Monitor" mobile app – Log Pain Level – Low

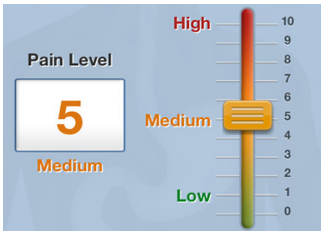


Fig. 6.33 – "GI Monitor" mobile app – Log Pain Level – Medium

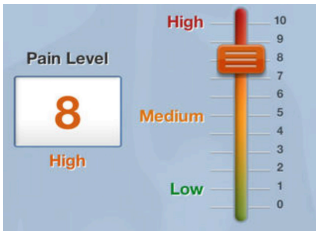


Fig. 6.34 – "GI Monitor" mobile app – Log Pain Level – High

IIn "GI Monitor" (Medivo Inc, 2013), items like "Pain level" enable users to record values using a subjective method for tracking criteria, because the patients select a value between 0 and 10 in a symptom that diverges from person to person according to tolerance. As a "User Patient" (Pernencar, 2014) this common strategy is adopted by clinics in hospital environment to evaluate a few symptoms but, when the patient uses mobile applications to collect this information, it can be difficult for doctors to understand exactly, and in real time the patients mood.Still, as a "User Designer", the suggestion is for another kind of visual more clearer for the user, for example, what figure 6.29 shows. When a patient needs to show what is happening to them,

it is better recognized using colour patterns that are well known and titles directly related to the symptom stages.

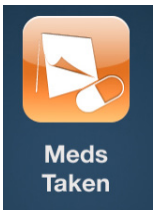
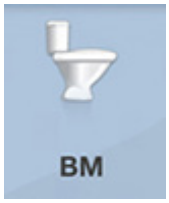
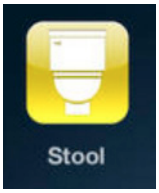
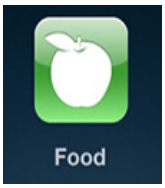
As a "User Patient" (Pernencar, 2014), it is easy to recognize what "Solid" or "Loose" stools means. In the first case, if correlated with colour, like green, represents a scenario where there isn't any critical situation in terms of bowel movement. The second case is the opposite and represents a dangerous situation for the patient's condition. It is therefore easy to recognize the meaning of each colour. An example of this is shown in figure 6.30. "My Status" presents a global overview for disease status where all items are marked in green, meaning that the patient is not in a critical situation.

Considering all six IBD case studies, only two, "Crohn Al dia" (Abbott, 2011) and " GI Monitor" (Medivo Inc, 2013), follow the colour rules explained above. The other four systems, , did not apply in similar features these rules. E.g. the pain item in "myIBD" uses a pain scale from 0 to 10, and an image where the patient taps to highlight the location of their pain – Figure 6.20. The results of the tracking appear in a menu bar followed by a small icon that changes the values, considering what the user selects. By adopting the colour pattern mentioned above, it is more likely that it would be clearer for users to better understand their level of pain.

- **Iconic representation** – Table 6.4 gives some examples of how it is essential to create an icon accompanied with a label. The correct use of symbols, especially standards, is the best way to improve recognition, learning, and the memorizing of features. This means that they can work as an efficient alternative to catch the attention of those who interact with the systems (Lidwell et al., 2003, p. 132). Figures 6.35, 6.36 and 6.37 present the pictogram pill. For all cultures, this visual representation means medications or related treatments, , and patients recognize this meaning without any constraint. Experience as a "User Designer" (Pernencar, 2014) indicated that it is sometimes difficult for users to understand what kind of tasks are related to the symbol, because it is occasionally used to represent medication or treatment area, but using a

label can help users deal with the issue. An example of this is shown in figures 6.35 and 6.36. The additional information used, titles “Missed Meds” and “Meds Taken”, clarifies what kind of tasks the user should perform, bearing in mind that both systems use similar icons for different purposes. This detail enables those who interact with the system to better comprehend what they have to do. Figures 6.38, 6.39 and 6.40 are more good examples. E.g., they present different titles, “Deposiciones, “BM” and “Stool”, but for patients the feature means the same, tracking bowel movement. This acknowledgment is possible because of clear iconic representation, even if they follow different visual perspectives.

Table 6.4 – Visual representation of design principle iconic

		
Fig. 6.35 – GI Monitor” mobile app – Missed Meds Log	Fig. 6.36 – “myIBD” app mobile – Meds Taken Log	Fig. 6.37 – “GI Buddy” app mobile – Treatments Log
		
Fig. 6.38 – “Crohn Al Día” app mobile – Deposiciones Log	Fig. 6.39 – “GI Monitor” mobile app – BM Log	Fig. 6.40 – “myIBD” app mobile – Stool Log
		
Fig. 6.41 – “Crohn Al Día” mobile app – Alimentación Log	Fig. 6.42 – “GI Monitor” mobile app – Meal Log	Fig. 6.43 – “GI Monitor” mobile app – Food Log
		
Fig. 6.44 – “GI Buddy” mobile app – Diet Log	Fig. 6.45 – “Diario de Crohn” mobile app – Food Intake Log	

In the feed, three different uses of adopted symbols were identified. Table 6.4: (1) Figures 6.41, 6.42, and 6.44, present icons of a meal showing a plate and cutlery; (2) Figure 6.43 – a healthy way to represent tracking what is eaten with a white apple inside a green shape; (3) Figure 6.45 – the only application that does not use any icon representation. In this case, the feature is not clear enough. The doubt therefore becomes whether this feature will track what patients are eating or the food or diet that they should follow. The patients know exactly what they have to do after the first screen which may cause confusion in the beginning of the task.

- **Alignment** – Generally, an alignment rule is defined in terms of following a grid divided by rows and columns to organize content. This kind of structure creates a sense of unity and structure, which contributes to the overall design (Lidwell et al., 2003). In the case studies there are several examples of well aligned content – figures 6.29, 6.31, 6.47, 6.49, among others. in the case studies launchpad two different interface design scenarios were found: (1) icons distributed in a grid – figures 6.14 and 6.15 – or (2) features left aligned – figure 6.23 – plus a navigation menu bar positioned at the bottom. When the interfaces present text blocks aligned on the left in the launchpad, there usually isn't a secondary screen, e.g., figures 6.25 and 6.48. In all case studies no critical use of alignment as a Universal Principle of Design was found (Lidwell, 2013).

Table 6.5 – Visual representation of well implemented design alignment

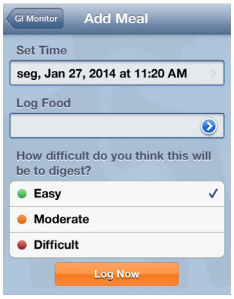
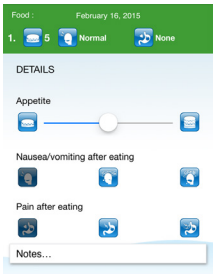
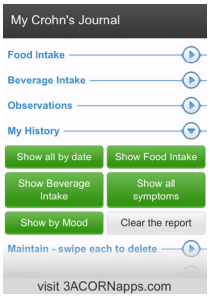
		

Fig. 6.46 – "GI Monitor" mobile app	Fig. 6.47 – "myIBD" mobile app	Fig. 6.48 – " My Crohn's Diary" mobile app

- **Consistency** – According to this principle, the systems are more usable and easier to learn when related content is represented in different contexts and follow the same visual rules. This principle enables users to exchange experience and knowledge between systems, learn quickly, and focus attention on relevant aspects of the features. Lidwell et al. (2003) present four categories to describe consistency: aesthetic, functional, internal, and external. Related to the interface layouts of the case studies, aesthetic consistency was analysed, and well implemented examples shown– figures 6.18-6.21. They follow the same layout structure in all secondary screens, which allow users to recognize the content structure, although they may not understand the features because of possible symbol misunderstanding. Another interesting point related to consistency is the colour of each menu bar that matches a specific area in the launchpad – figure 6.17. "myIBD" (SickKids, 2011) is the system where there are good examples of improving both system usability and learnability.

  This design guideline allows people to transfer knowledge from different contexts and quickly learn new things. In this situation, functional consistency is also important, because similar controls that work in the same way allow users to feel comfortable with the task. As a "User Designer", it is much better for healthcare mobile systems to adopt a colour scheme because it strengthens understanding of the feature. E.g., figures 6.32-6.34 – the colour applied to the number changed according to the value selected in the slide bar, and the colour title of the box also follows this adjustment.

  Good internal consistency does not always exist in systems that have cross-platform applications, i.e. mobile and desktop. An example of this is the poor internal consistency that both figures 6.49 and 6.50, from table 6.6, present: the icon representation of "Symptoms", "Treatments" and "Diet" areas. In the desktop version, the main page presents two parts with different approaches. This can cause users to misunderstand. E.g., the "Dashboard" area, in the web system, and is related to features like "Quick Log" or "Daily Activity", but in the mobile version, the icon that represents the log "Daily

Activity", is a pencil – available at the bottom of the interface. This means two ways of representing the same task were used. This situation also happens with the "Lifestyle" item. In the desktop version, there isn't the item "IBD Impact", just a "Lifestyle Log" where patients can manage their Inflammatory Bowel Disease Impact. This situation may be confusing for the patients when they use both systems.

Table 6.6 – Visual representation of poorly implemented design consistency

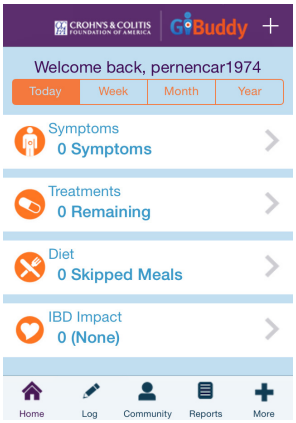


Fig. 6.49 – "GI Buddy" mobile app

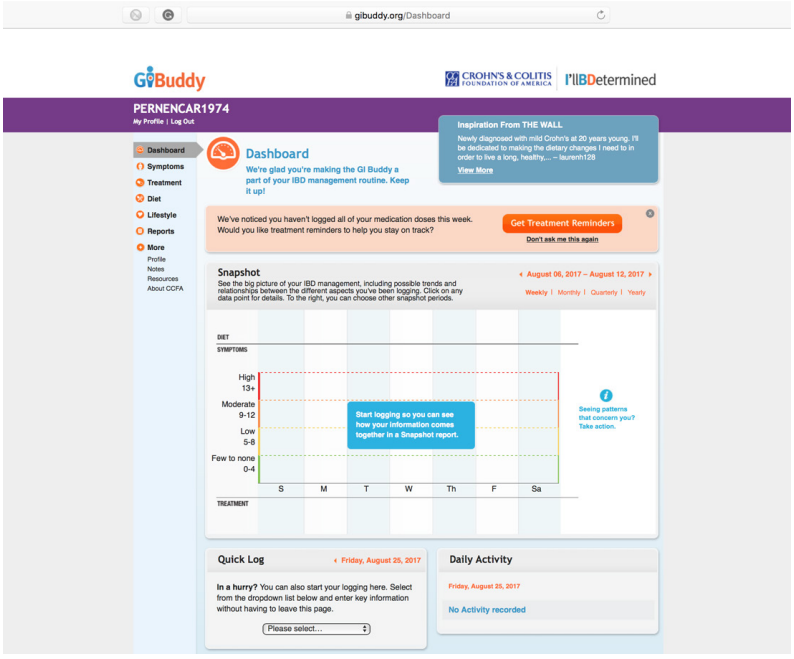


Fig. 6.50 – "GI Buddy" website

The "Bowel Movement" item in both the desktop and mobile application presents aesthetic consistency which sometimes does not follow design

principles. An example of this is shown in table 6.7. Figures 6.51-6.53 present the same features that have visually different icons and labels in different systems. So, graphically the mobile application and the desktop version seem graphically inconsistent. The situation is similar for items like "Pain", "Stress", "Meal", "Missed Medications" and "Custom Symptom". This situation could be worse for users who don't have experience in dealing with healthcare systems, and the learning curve is higher. E.g., "Pain Level" – figure 6.51 and "Pain" figure 6.53.

Table 6.7 – Visual representation of poorly implemented design consistency

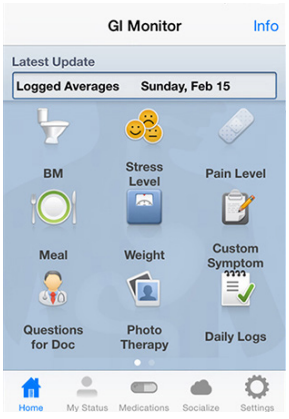


Fig. 6.51 – "GI Monitor" mobile app – Primary navigation launchpad

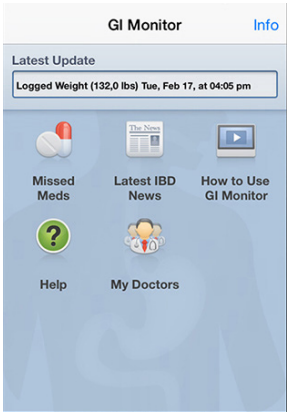


Fig. 6.52 – "GI Monitor" mobile app – Secundary navigation launchpad

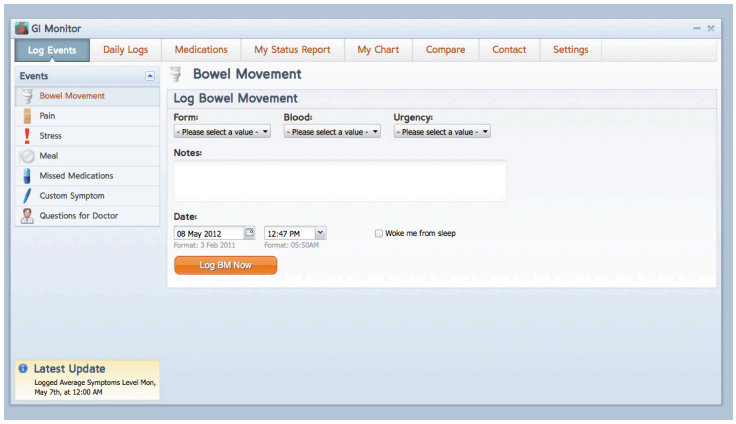


Fig. 6.53 – "GI Monitor" website

- **Visibility** – The usability of a system is improved when designers use methods that are clearly understandable. Considering the complexity of designing healthcare interface layouts, the principle "visibility" is perhaps one of the most important in design because it is related to comprehension through

visual elements. To work with these complex systems, designers must consider which are the best design decisions to avoid visibility difficulties (Lidwell et al., 2003).

Table 6.8 – Visual representation of poorly implemented design visibility

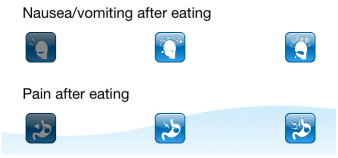


Fig. 6.54 – "myIBD" mobile app – "Food" tracking

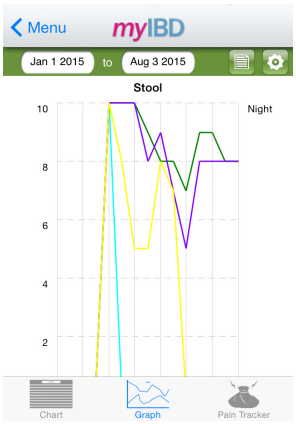


Fig. 6.55 – "myIBD" mobile app – "History" item > Show graph

Figures 6.54 and 6.55, from table 6.8, represent different examples where the principle "Visibility" is not well applied. In the first figure, 6.54, the small shape sizes don't contribute towards a clearer understanding of the meaning, and even the symbols present visual complexity. The second one, figure 6.55, shows a different problem. The users may not understand if there is a relationship between each coloured line and the scaled values available on the left, because at the bottom of the graph there is no orientation about what information is supposed to be there. Here the principle visibility is related to the influence of the results.

Figures 6.56 and 6.57, from table 6.9, show an interesting gap in terms of this principle. The first figure presents a list of the daily logs dated "Aug 3, 2015". If the user clicks on the calendar symbol on the right side, it will expand the calendar feature but, what appears is the information about the day after, "Aug 4, 2015", instead of the selected day – figure 6.57. Nevertheless, the previously shown action is not clear in the second figure. In the scenario described above, it is hard for users to understand which days they logged data.

Table 6.9 – Visual representation of poorly implemented design visibility

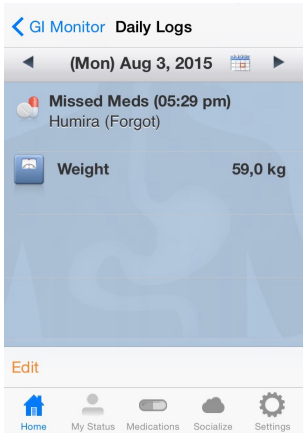


Fig. 6.56 – "GI Monitor" mobile app – "Daily Logs"

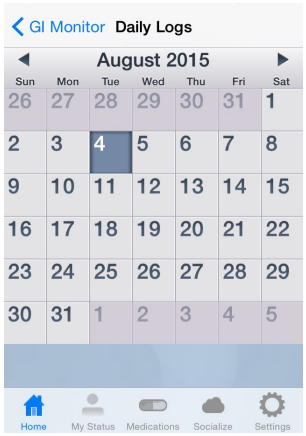


Fig. 6.57 – "GI Monitor" mobile app – Calendar on "Daily Logs"

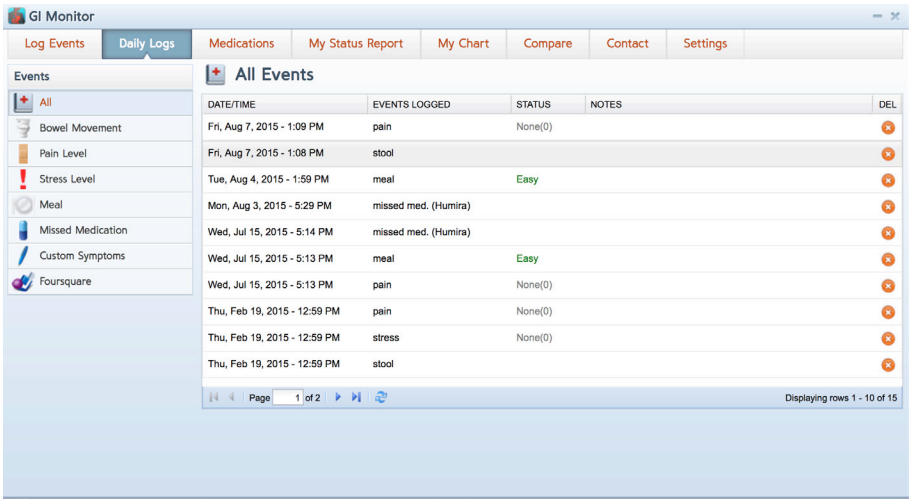


Fig. 6.58 – "GI Monitor" website – "Daily Logs"

Comparing the "Daily Log" feature from the website with those on mobile phone applications, both present distinct designs. Figure 6.58, from the website, shows a list of all logs. As a "User Designer" this method of organizing all the recorded events is the best way to display this kind of information. With this solution, the user only needs to click the button "Next", available at the bottom of the screen, to go to the next page. This cross-platform system, the "GI Monitor", is a good example of development conducted by two different companies, because several dissimilarities between them can be seen. E.g., Icons and titles, content structure and a few functionalities.

6.2.2 Navigation, interaction styles and micro interactions

Mobile and desktop navigation have different interface design approaches and interaction patterns. It is sometimes complex to create cross-platform systems that are well standardized because of existing constrains. First, the difference in screen size between desktops and mobile devices. Second, mobile devices have touch screens that allow the use of touch based interfaces. Users currently switch between different cross-platform systems sequentially, and at the same time (Saffer 2013; Volk et al., 2015). Because of this, it is essential for designers and companies to think about cross-device interaction.

The mobile systems studied for this thesis present interfaces that have two types of primary navigation patterns:

- **Dashboard –** "Crohn Al Dia" (figure 6.9), "Diário de Crohn" (figure 6.13), "GI Monitor" (figures 6.14 and 6.15), "myIBD" (figure 6.17);
- **List –** "GI Buddy" (figure 6.23) and "My Crohn's Journal" (figure 6.25).

Some systems like "Crohn Al Dia", "GI Monitor", "Diário de Crohn" and "GI Buddy" add further navigation tabs on the bottom. This is a traditional primary navigation pattern that doesn't have any interactive innovation, so the users are quite familiar with it.

Luke Wroblewski (2011) wrote in his book "Mobile first" that there are four interaction styles on mobile phones: (1) Look up/Find: When users need an answer for something they are looking for; (2) Explore/Play: This is when users have time and just want to play; (3) Check In/Status (Repeat/Micro-tasking): Something important that keeps them updated about changes; (4) Edit/Create (Urgent change/ micro-tasking): An urgent subject that needs immediate attention. Moreover, Shneiderman et al. (2009) explain, using examples in Part 3 of their book "Designing the user Interface – strategies for effective Human-Computer Interaction", how interactions styles can influence the conclusion of several tasks.

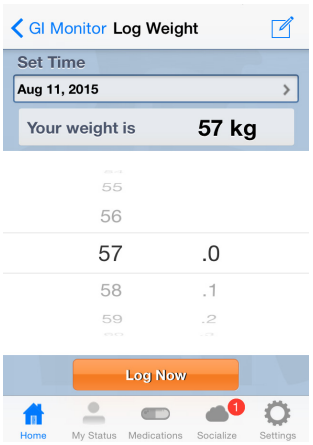


Fig. 6.59 – "GI Monitor" mobile app – Select weight – Weight log

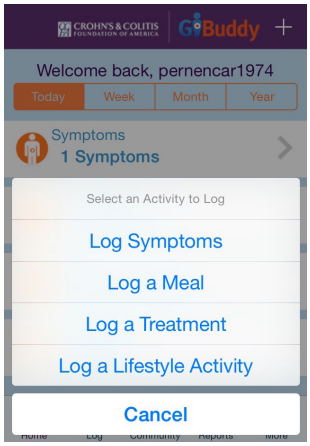


Fig. 6.60 – "GI Buddy" mobile app – Select an activity – Daily Activity log

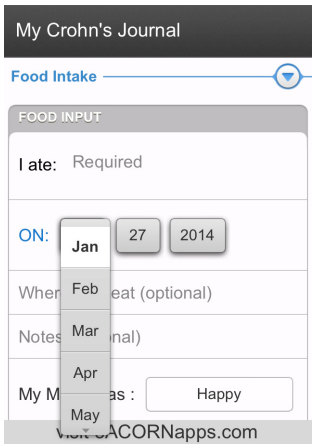


Fig. 6.61 – "My Crohn's Journal" mobile app – Select month – Food input log

As a "User Designer" it is believed that following design patterns as a strategy when planning interface mobiles for healthcare helps users easily identify where they have to click, or what they have to select, to continue a task. An example of this, and following what Shneiderman et al. (2009) talk about interaction styles, with figures 6.59, 6.60 and 6.61 showing three distinctive examples of direct manipulation, one of the interaction styles described by the authors, with users dealing with features which use design patterns created for that purpose. An example of this is presented in figure 6.59, An IOS design pattern related to scroll selection of numeric values. This design option doesn't compromise interpretation and focuses on the definition of "Rapid, incremental, reversible actions which effects on the objects of interest are visible immediately" (Shneiderman et al., 2009).

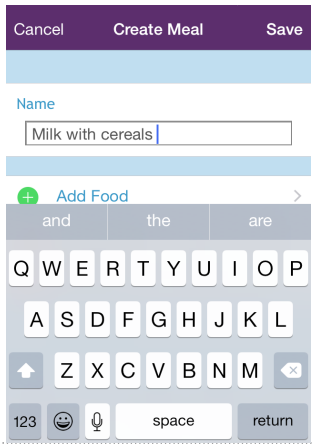


Fig. 6.62 – "GI Buddy" mobile app – Fill-in dialogue box – Create Meal

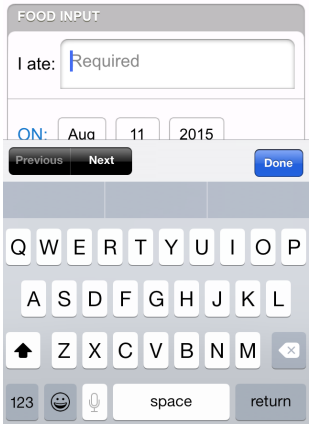


Fig. 6.63 – "My Crohn's Journal" mobile app– Fill-in dialogue box Food Input

Other patterns suggested by the authors are very common in mobile interfaces. E.g., The form fill-in of figure 6.62, 6.63 and 6.64 allows users to write down information. The word “Required” appears as a requirement to write something, as shown in figure 6.63. In the six case studies, another type of a form that requested for something to be filled-in, but with an open text field was "My Crohn's Journal" system, figure 6.63, which presents a space to write the name of a meal without using a predefined list. Experience as a “User Designer” indicates that this method of collecting data increases the difficulty for patients to understand information standardization. Moreover, “GI Buddy” systems, figure 6.62, provides a list of default foods and meals with well defined content. The last solution referred to helps users avoid writing unnecessary information or having doubts related to information they have to add.

Most users of mobile devices are accustomed to interacting with virtual keyboards. these are typically automatically displayed on the screen when users tap them to fill in text fields – figures 6.62, 6.63 and 6.64. The feature scenario for mobile interface is similar to the desktop version, , but instead of the user interacting through a “Pointing Task" – figure 6.64, they use a gesture to touch the screen. As referred to before, the systems that present lists from where users can choose correct data instead relying on the input of non-standardized information is a better solution to prevent errors. Another interesting example of what was addressed as open writing, is what happens on the website “GI Monitor” with its first item – figure 6.64. Here it is necessary to fill-in, using numeric data, the average number of bowel movements per day. As a “User Patient” (Pernencar, 2014) this requirement is suitable choice because it’s possible to know exactly how many times a patient went through this process.

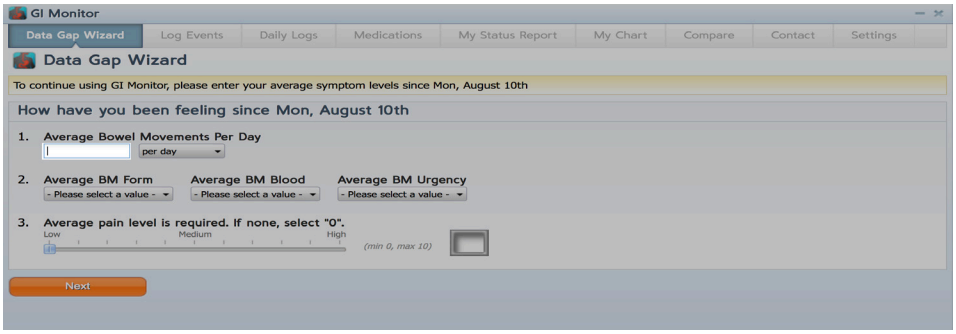


Fig. 6.64 – “GI Monitor” website – Pointing tasks for typing Text

Interaction styles are principles which all users deal with when interacting with interfaces. In some cases, when certain actions have implications like fast perception, action loop or reversibility (Shneiderman et al., 2009), micro interactions can help users understand the meaning of a task that they have to perform, because there is functional feedback (Dan Saffer, 2003), in other words, the positive or negative answer received by users when interacting, and if the task is completed successfully or not.

Steve Krug (2006, p. 34), in his book "Don't Make Me Think! A Common Sense Approach to Web Usability" cites evidence that following conventions and formats when designing websites or mobile applications, makes user lives easier, which means that it is likely that if designers combine interaction styles with micro interactions, they will maybe answer a few doubts and make it easier to understand how to create features, in the huge and complex world of healthcare content. As a "User Designer" (Pernencar, 2014) it is recognized that the meaning of a micro user experience mentioned by Saffer and Krug respects common interaction conventions. Additionally, the use of small visual elements, written or not, provides users with experience that is focused entirely on single tasks where there isn't complexity or an excess of number of steps to conclude tasks.

According to Dan Saffer (2013, p. 14), micro interactions are divided into four components: (1) Trigger, which is the first visual detail identified in a interface by users when they initiate interaction; (2) Rules, that are what determine how micro interactions work in systems; (3) Feedback, which explains established interaction rules; (4) Loops and modes, which are meta-rules performed based on how micro interactions are designed.

1. **Trigger –** E.g., Fig 6.65 with the "GI Buddy" system, presents feedback "Sync in progress" telling users that both mobile application and website are synchronizing data between them in real-time. This situation occurs on mobile interfaces after an automatic login. The scenario here is an example of one of the three components that Dan Saffer presents for manual triggers, the name and its control. This means that the system status goes through feedback, keeping the users informed.

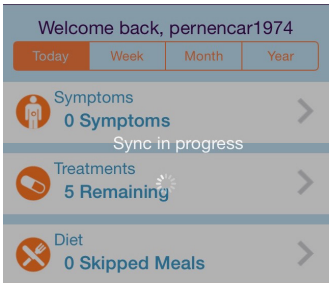


Fig. 6.65 – "GI Buddy" mobile app – Automatically login

2. **Rules –** This is a simple and nontechnical way to show how micro interaction works. For example, most existing user interface design procedures respect established guidelines. Sometimes, each operating system follows rules for similar features, in terms of strategies adopted for different brands. Figure 6.66 is an example where there is a rule defined by "IOS Human Interface Guidelines" (Developer, 2015) guidelines, the green bottom part is the visual feedback for the unlock function. The switch between "off", in grey, and "on", with green, is an existing rule that designers must apply in visuals, and users will clearly understand its meaning. In this case, the micro interaction rule is applied to colour change and to the trigger being initiated

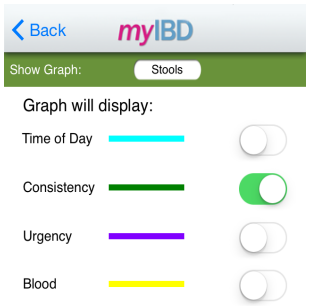


Fig. 6.66 – "myIBD" mobile app – Graph display settings

3. **Feedback –** Dan Saffer says that this micro interaction component "illuminates the rules". (2013, p. 86). As a "User Designer", this design approach is also frequently used by other designers because by highlighting a rule during a task users will recognize what they have to subsequently do. Micro interactions such as "Trigger" or "Rules" combined with "Feedback" can be considered to be good design choice, helping users to be aware of what is going on, and the following task they have to do with less difficulty.

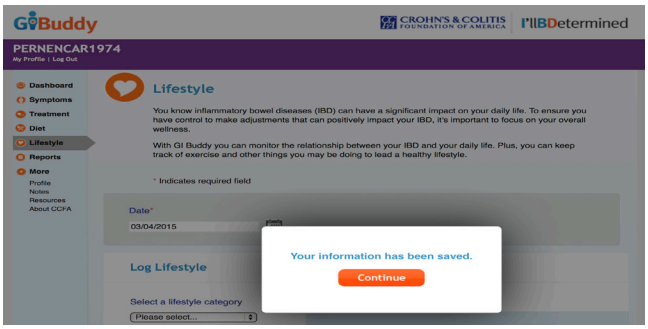


Fig. 6.67 – "GI Buddy" website – Lifestyle – Saved report feed

Figure 6.67 shows exactly what was explained above. The "Trigger" – "Your information has been saved" is followed by the "Rule" – "Continue", which is in orange and is supporting by the visible "Feedback".

4. **Loops and modes –** Out of the two topics, the discussion will be focused on "Modes". This has more interesting and relevant issues that are important to understand how they were used in some case studies so as to create good solutions . Healthcare mobile applications are full of non-standardised layouts that display complex content, and use common interaction styles. E.g., In figure 6.68, "GI Monitor" mobile application, it is hard to understand where the button that displays criteria for users to select is located, figure 6.69, in order for them to see these displayed in a chart, figure 6.70.

   On the other hand, the existing info button at the top right of the screen, figure 6.68, presents this information, but only after clicking on the items. Traditionally, Micro UX "Modes" means a complex system with non-standard layout where small design details help users to interact without complications. The info button example explained earlier, is a design detail where, for example, a standard icon is used for the "Settings" feature related to the chart, and this is where users select the criteria. However, its uses seems difficult enough that only expert users can recognize it, and clicking the button "info" will open a dialogue box with a message explaining the meaning of that feature, figure 6.70.

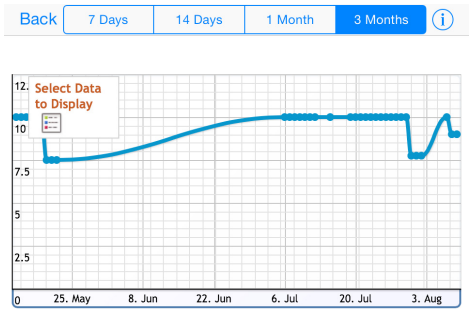


Fig. 6.68 – "GI Monitor" mobile app – Create a chart with data range (View chart)

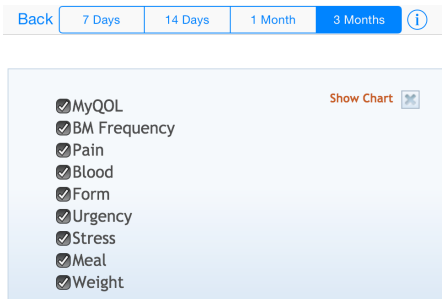


Fig. 6.69 – "GI Monitor" mobile app – Create a chart with data range (Select data to display)

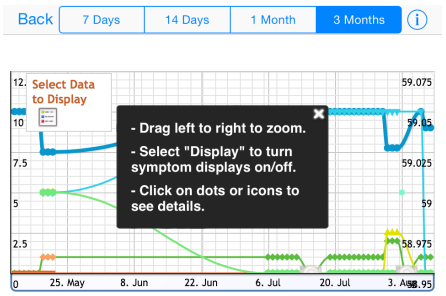


Fig. 6.70 – "GI Monitor" mobile app – Create a chart with data range (View Info)

For the issue discussed above, "myIBD" system tries to solve the complexity issue by using standard icons for similar features. There are two buttons in the top right hand corner of the menu bar , one "Document", and the other, "Settings" – figure 6.71. The first is where users click to create the document report using external software as shown in figures 6.72 and 6.73, and the second, the criteria list, where users select the items to display in the chart, figure 6.66.

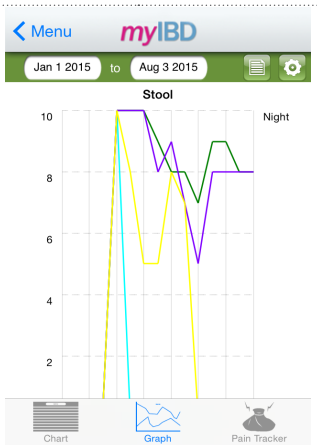


Fig. 6.71 – "myIBD" mobile app –"History" item > Show graph

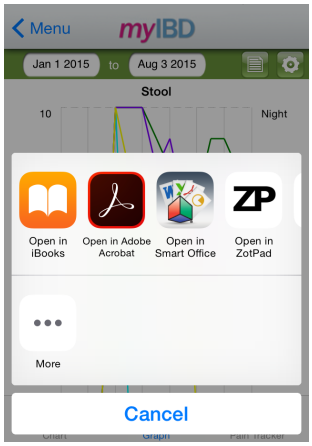


Fig. 6.72 – "myIBD" mobile app – "History" item > Open graph with

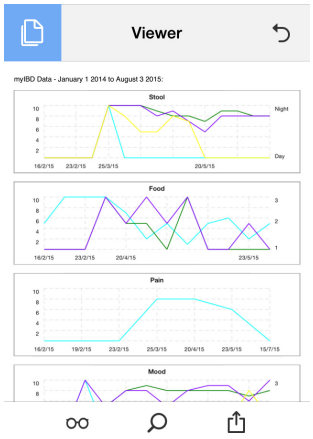


Fig. 6.73 – "myIBD" mobile app – "History" item > Portrait PDF (Graph preview)

Continuing the discussion on designing complex layouts using small visual elements to simplify the understanding of features, "GI Buddy" for example, and comparing with the other systems studied earlier, avoids visual complexity when presenting the same content by adopting a standard layout. Figures 6.74, 6.75, 6.76 show a task sequence that allows users access to the report through a click of a button, represented using an icon of a common list. There, the users select from the list what items they wish to see displayed in the graph. As a "User Designer" this visual solution probably provides a better experience, especially in healthcare, because it's hard to standardize complex information when dealing with data of specific chronic diseases.

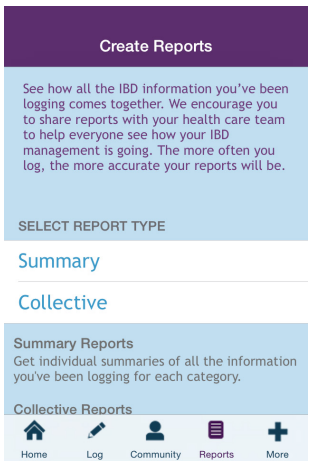


Fig. 6.74 – "GI Buddy" mobile app – Create a report

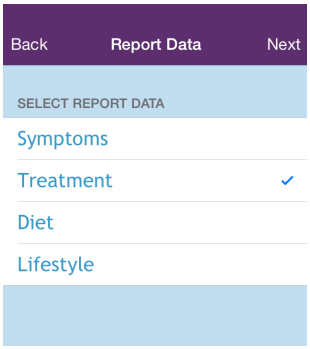


Fig. 6.75 – "GI Buddy" mobile app – Create a report – Select report data

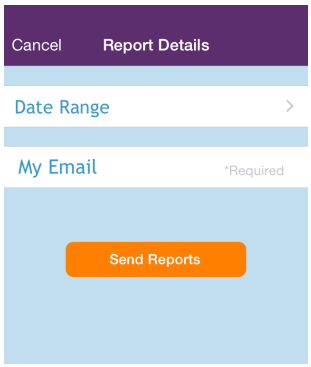


Fig. 6.76 – "GI Buddy" mobile app – Create a report – Report details

6.3 CHAPTER OVERVIEW

The empirical study in chapter 6 shows that IBD m-Health applications still require several tasks that involve user data input, and in most cases, manual actions with the data to fill-in step-by-step or to select using manual settings, e.g., figures 6.18, 6,20, 6.62. Chronic diseases always involve extensive information, so it is usually harder for users when they have, for example, to track data without any clinical filter, e.g., figures 6.47, 6.48, 6.62, 6.63, or when they waste unnecessary time interpreting non-standard symbols that do not have a label to help understand what users have to do. E.g., "myIBD" system in figure 6.47.

After analysing different issues in the six case studies, there are numerous common design errors like incorrect text alignment, missing feedback after an action (or even weird feedback), strange icons used in specific healthcare features, fields to fill in without following a content list, tracking of abstract values that are commonly used in medical environment, but through a mobile or desktop interface the clinics don't have the opportunity, in real-time, to understand what is going on with their patients. So, most of the interface design problems presented are related to bad graphic design decisions in specific healthcare functions, i.e. existing guidelines and design principles, for example like Lidwell et al. (2003) referred to in their book, these are for generic applications and not to be directly applied to the design of healthcare interfaces.

It appears to be clear that designers would be able to create a healthcare experience that was more appropriate for users needs (and without any additional constraints) by reducing the complexity of medical information design, and introducing features such as those used to collect data, and basic design elements like colour patterns. This, will help users to understand what designers have created through common knowledge and meaning. Perhaps, by removing abstract icons and changing them to something that communicates better like text, the studied features, especially those in figures 6.18, 6.19, 6.21, would be more clear.

Standardizing visual elements is not the only solution. To avoid situations like those studied in topic 6.2 in this chapter, designers should use details like micro interactions (Dan Saffer, 2013), because, as seen, they help users during different stages of a task understand, using small details, what they have to do, and whether users are proceeding correctly or not

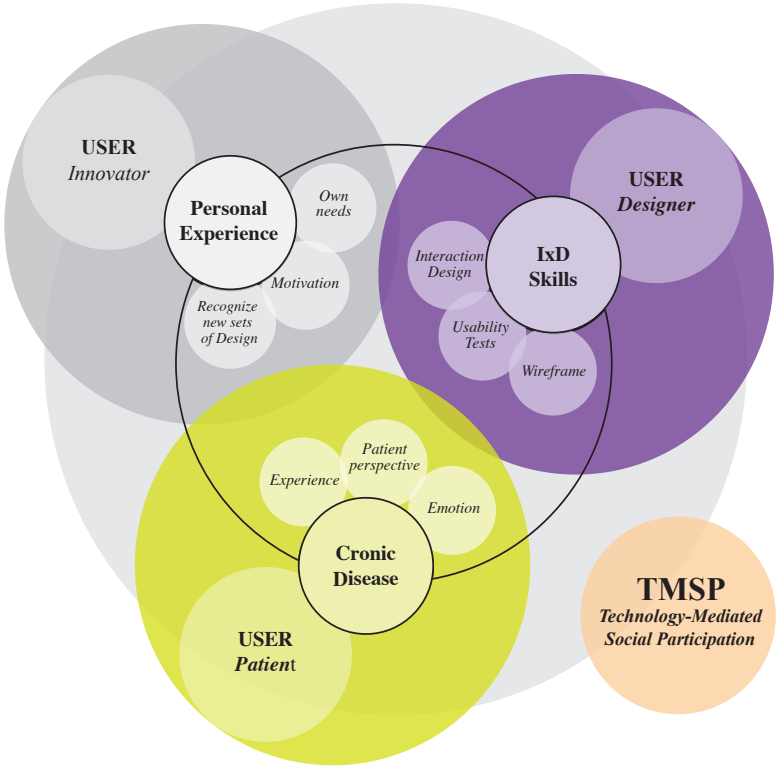


Fig. 7.1 – Human-Social Interaction Model for e-Health Interfaces –

"User Patient" and "User Designer" (Pernencar, 2014, p. 560)

Chapter 7. 3rd stage – A/B testing case studies

This chapter presents an analysis with video screenshots of the results from A/B usability tests, which include three different scenarios and related tasks, using two systems from the six case studies previously studied in chapter 6.

7.1 PRELIMINARY USABILITY TESTS

After presenting the empirical analysis of the six IBD case studies, now it is now essential to detect which are the most relevant interface problems, both visual and functional, and understand what kind of difficulties IBD patients felt in real disease scenarios. The goal is to compare related tasks in two different applications.

Thus, from the systems studied earlier in chapter 6, two were selected: “myIBD” (SickKids, 2011) and “GI Buddy” (GI Buddy, 2014). The criteria for selecting these were based on several aspects related to what were considered good design decisions. For example, the main page of the system is divided into three areas. At the top, a space with an add button to directly add related activities such as “Symptoms”, “Meal”, “Treatment”, or “Lifestyle activity” (figure 6.60). After that, the patient can find a list of features focused on IBD impact, and at the bottom, a navigation bar including secondary features like “Log”, “Community”, “Report” and "More" (figure 6.49). The goal of selecting this mobile application for tests reflects the problem that it may cause difficulties for patients to conclude some tasks. An example of this is “Log Symptoms”, an open field where patients are free to write about how they feel overall. This field may not be very useful for those who don’t know exactly how to describe what they feel, and it would probably be better to use a list of common symptoms. Curiously, in another area, “Food”, there is a list of typical meals. It is therefore important to understand how patients deal with these scenarios, whether they give up because they do not know what to write, or if they write random information.

Considering both perspectives, “User Designer” and “User Patient” (Pernencar, 2014), the aim is to study which "Universal Principles of Design" (Lidwell et al., 2003; Mullet & Sano, 1995) correspond to: (1) User expectations about the experience with IBD digital systems; (2) How selected micro interactions (Saffer, 2013) are applied to help IBD patients understand the complexity of existing solutions.

Eight IBD patients from Lisbon and Oporto participated in the study: four men in three different age groups (20-30/ 2; 31-40/ 1; 51-60/ 1), and four women, divided into four different age groups (20-30/ 1; 31-40/ 1; 41-50/ 1; 51-60/ 1). The decision on only using eight users follows the concepts presented in both Jakob Nielsen articles “Why You Only Need to Test with 5 Users“ (2000) and “How Many Test Users in a Usability Study?” (2002), where he defended that 5 users should be enough for small usability tests, and it would be better to do this as an iterative design process, with several test phases, than using a larger sample with only one test phase. So, in Part IV – "myCrohn" project, two phases of design and feature validation will be presented with a low-fidelity and high-fidelity prototype.

An appropriate method of evaluation to compare related tasks in two different applications is an A / B test, in other words, conduct the same task in two different systems using equivalent scenarios (Nielsen, 1993; Moule, 2012; Tullis & Albert, 2013).

According to what Jakob Nielson referred to in the article "Putting A/B Testing in Its Place" (2005), A/B testing offers huge benefits when compared to other methods, because it analyses participant behaviour in real-work conditions; It can estimate small differences in user performance with high statistical reliability; It can also solve conflicts between guidelines and qualitative usability findings because it defines which carries the most weight in a specific circumstances; and it is also affordable.

The scenarios and tasks presented to participants were based on IBD situations that the "User Patient" has experienced: (1) Recording of symptoms during an episode of the illness getting worse, (2) a routine treatment change, and (3) generate a report in an emergency hospital episode choosing the chart button, figures 7.2-7.5.

Participants were requested to fill in an online survey to systematize their findings enabling them to also contribute with opinions that will help define the best design strategies for "myCrohn" project.

To be able to later analyse and better understand in detail participant behaviour, such as where they hesitated clicking, the usability tests were all recorded using a video camera. Before starting, participants were briefed regarding the purpose and the procedures of the tests.

A/B Testing – Mobile Applications

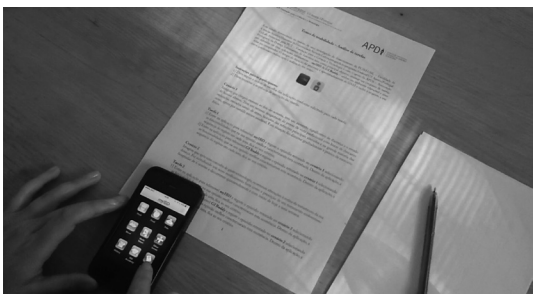


Fig. 7.2 – "myIBD" mobile app – Video screenshot A1

Fig. 7.3 – "GI Buddy" mobile app – Video screenshot B1

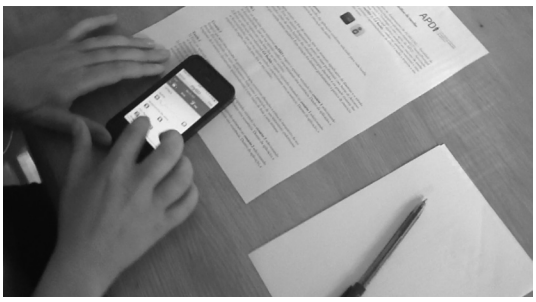


Fig. 7.4 – "myIBD" mobile app
– Video screenshot A2

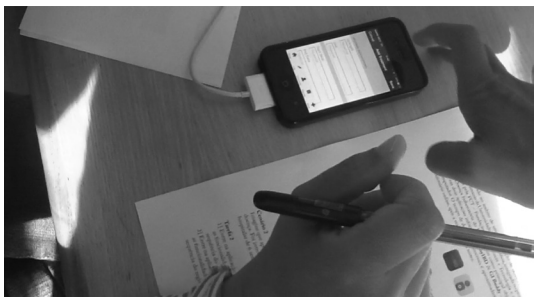


Fig. 7.5 – "GI Buddy" mobile app
– Video screenshot B2

The scenarios that were used are described below:

- **1st scenario** —"Imagine that you arrived exhausted at the end-of-week with a significant increase of diarrhoea and mood change. You had an exhausting professional week without resting enough hours, with high levels of stress, changing meal schedules and in most cases, eating fast food. This situation gradually decreased your week exercise routine."

  For this scenario, only one task was defined: use both applications to record the episode described above. The sequence for task procedure was left up to them to see if different patients followed the same path .

  All participants felt difficulty in completing the proposed task. Five from the eight reported that both applications were complex, both visually and functionally. Out of the two systems, "GI Buddy" ("GI Buddy," 2014) was beyond doubt the one with which participants had more difficulty, because it is graphically full of textual information – figures 6.62, 6.74, 6.75. Compared with "myIBD" (SickKids, 2011), where there are more graphical elements, it is hard to record information with so many fields to fill in. Only one participant easily concluded the task in both applications.

  Most of the issues were related to understanding of non-standard symbols, especially in "myIBD", where the names of each function didn't help clarify their meaning. Most participants considered the "GI Buddy" application graphically unclear, affecting its interpretation negatively: "The application does not have the features that I need to complete the task"; "The

application GI Buddy had features that were too complex and I was not be able to complete the task".

- **2nd scenario** – "Imagine that after a gastroenterology medical appointment, your routine treatment changed and a new drug was introduced. You have a prescription of six sessions, including once a fortnight intravenous treatment in the hospital, and it will start in a week."

  Here, the eight participants were asked to record the treatment schedule. They had to choose the features which in their opinion were better to record the information that was needed. Again, the sequence for task completion was left to their criteria to see if different patients followed the same logic.

  In this scenario, the results were clearer. Six of the eight users had some difficulty while the other two didn´t. For the first group, "myIBD" (SickKids, 2011) was visually unclear and had graphical problems. Some pictograms were too small and visually were not well contextualized – figures 6.47, 6.55, so participants didn't understand where to record the information. From observation, it is important two highlight this feedback: "The application did not have enough features that I needed to complete the task"; "Both are too complex which led me to not be able to complete the task."

  Completing the task in "GI Buddy" ("GI Buddy," 2014), the participants said that the systems were very complex. They didn´t know where to add the required data and the oldest users were those who had greater trouble with the interpretation of the functionalities related to what was asked for in this scenario. The type of strain was the same in a graphically unclear application. Another problem was related to content overlap on the screen – figure 6.73.

- **3rd scenario** – The last scenario was: "Imagine that you are travelling in Eastern Europe. After an unusual but tasty meal, you feel ill. Fever reaching 39ºC, you go to the local hospital, but you have difficulties in explaining the symptoms in English, as well as your disease history. However, you've been

recording several IBD episodes in a mobile application for a while."

Participants were asked to automatically create a report in the chart button of each system, choosing from the available filters those which best matched the requested task, to summarize personal history since January 1st, 2015 until the date of the usability test.

The results were elucidatory of different perspectives. Five participants felt more difficulties in accomplishing the task in "GI Buddy" ("GI Buddy," 2014), while three mentioned it to be easier to conclude in "myIBD" (SickKids, 2011). It is believed that the main reason for this was the fact that, in both systems, participants couldn't find the correct feature located on the primary screen to start the proposed task. Achievement of the requested task was put at risk on the first screen, even though there was a specific area to accomplish that task, but the symbol used in the icon wasn't clear enough. Also, without a label which could help, participants felt completely lost. They didn't know where the feature was. It was necessary to help them, telling them where to click. Furthermore, six of the eight participants stated that "GI Buddy" was graphically unclear and used complex features, explaining why it was harder to complete the requested task.

7.2 CHAPTER OVERVIEW

As observed during the tests, and especially in the first scenario that used non-standard signs systems, misunderstandings happen frequently, even when there are icons supported by labels. This situation occurred in several secondary screens of "myIBD" (SickKids, 2011) like, "Stool", "Consistency" and "Urgency" features (figure 6.18); "Mood" with "School Attendance/Activity Tracker" (figure 6.21), among others. This system presents symbols for tracking IBD symptoms which the tests showed may cause doubts related to the symptoms users are tracking, e.g., figures 6.47 and 6.71. It is difficult to understand whether these features were tested or not during the design process because the symbols used don't suggest any common symptom.

The results of the tests also demonstrated that even when systems are using micro interactions such as “Feedback” (figure 6.47), they still have difficulty with interpretation. As a “User Designer” the problem isn't due to the micro interactions per se, but the design adopted which wasn’t clear enough, as well as their location on the interface. An example of this is what happened during the tests with the “Food” area of “myIBD” system. After the second screen, where participants should track their symptoms, they didn’t recognize that the system was giving them feedback through a number (figure 6.47). This situation was tested, and the results of the symptoms appeared in a menu at the top near symbols that changed according to the situation that the user was in. These scenarios also occurred in areas like "Stool", “Mood” where the problem was similar.

In “GI Buddy”, participants felt less difficulty to register the symptoms asked for in the first scenario because the system only presents symbols on the first screen, and after that, on the secondary screen, the design choice was a list menu to track related content (Figures 6.49 and 6.74-6.76).

The results of this chapter help understand more about which design strategies should be adopted in the project: (1) Avoid using fields to fill in with open text. If necessary, adopt a list with content located on a database; (2) Assume standard symbols for common IBD features always followed by labels without using clinical expressions that are too complex; (3) On the second screen, avoid using systems where the tracking of IBD symptoms is too abstract.

Part IV
"myCrohn" project

In Part II, a review of issues related to how aesthetic and functional topics influence the experience of interactive communication was made; how semiotic engineering contributes towards the interpretation of computer sign systems; how designers may create a pleasant healthcare experience for user engagement; how citizens deal with healthcare technology, especially when IBD patients are encouraged to change participation in the disease; what kind of e-Health and m-Health projects tried to include in their research some stages of the design process; how patients that didn't find solutions for their problems in the market improved their own healthcare monitoring.

In Part III, the practical phase of the thesis covered three stages: collect quantitative data of IBD patient behaviours related to the disease; case study analysis in interface design and interaction design; and task validation with A/B tests that allowed the comparison of features in two mobile applications from the six case studies.

In Part IV, “myCrohn” project, incorporates the project insight, a list with interface design requirements, and low-fidelity and high-fidelity prototype, both followed by usability tests. The aim is to apply the UCD framework created in chapter 4, and understand if the benefits listed in section 4.2 are as expected.

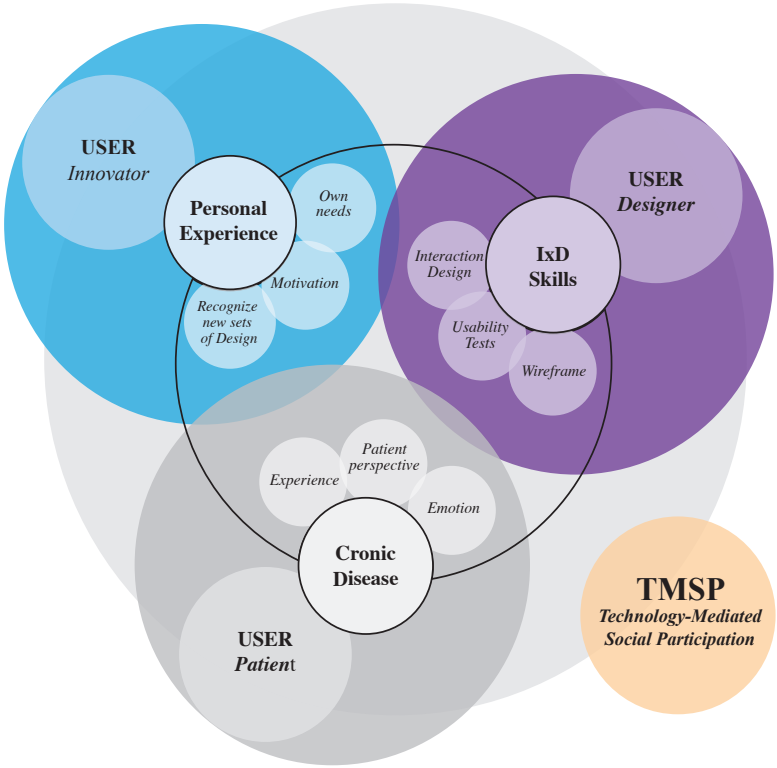


Fig. 8.1 – Human-Social Interaction Model for e-Health Interfaces – "User Innovator" and "User Designer" (Pernencar, 2014, p. 560)

Chapter 8. The design process of "myCrohn" m-Health

This chapter presents the project "myCrohn", namely the different stages of the design process, such as the definition of the concept – project insight, a list with the interface design requirements, and a low and a high-fidelity prototype. For each of the prototypes, usability tests to validate design issues were performed and are also presented.

8.1 PROJECT INSIGHT

Defining the insight of a project, which means to describe the creative concept, is the first goal designers aim to achieve. Only after that can there

be a clearer path to create the visuals around the defined concept. The infographic in the figure 8.2 is an example of this process. It explains in detail the insight of the "myCrohn" project: the headline "Empower IBD patients" matches three areas of knowledge, communication, design and technology. This vision is also influenced by the fact that, as a Crohn's patient since 2004, several issues related to the IBD disease were detected, like verbal communication problems between patients and clinics; the passive attitude of most patients; how easily they forget to take medications, and other issues. It is believed that using digital media tools, like for example healthcare mobile applications, is the key to motivate patients with chronic conditions and successfully change their behaviour. In the project, the aim is to define strategies (the interface requirements from section 8.2) that will help accomplishing the goals for the "myCrohn" (Pernencar, 2013) project, a mobile healthcare application where IBD patients can take advantage of features according to their needs.

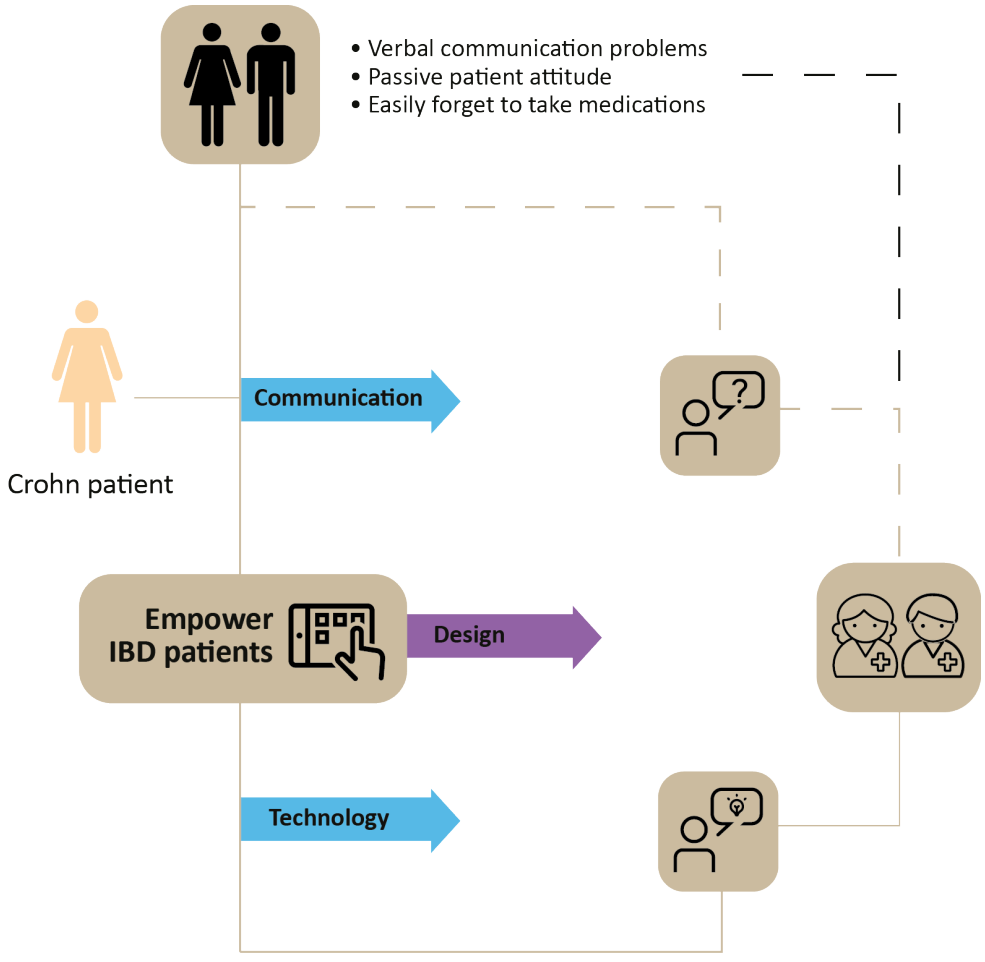


Fig. 8.2 – Project insight

Kumar said (2012) “reframing problems are framing-up challenges differently based on the associated trends and conditions and finding opportunities where the organization could create high-value innovation.” This appears to be particularly true, as the project emerged from specific problems which were part of the personal experience as a “User Patient” (Pernencar, 2014). “myCrohn” (Pernencar, 2013). This is an opportunity to frame the challenges from a user perspective, as a patient, a designer and a innovator, so as to encourage other patients with chronic conditions to proceed in the same way.

8.2 INTERFACE REQUIREMENTS

The three studies from Part III, the IBD patients survey, the empirical case study analysis and the task validation with the A/B usability test, helps understand situations like user requests for a new IBD system to manage their disease, and what interface design requirements should be matched to specific needs. Table 8.1 presents the requirements that should be followed during the creative process of the “myCrohn” interface design, according to previous studies.

Table 8.1– List of requirements for the project

Requirements
Create a custom interface, with areas according to the disease specifications;
Provide two types of content structure, a grid and a list (adaptable interface);
On the first screen, avoid using nonstandard symbols to identify each area. Instead, adopt symbolic communication that is always followed by labels;
Simplify data input collected by patients through the use of standards design details on how they record IBD information;
Adopt universal colour patterns to let patients easily recognise the meaning of the features;
Select the micro interaction “Feedback”, through the use of text or even colour, to keep the patients informed of the next action;
Whenever possible, avoid using symbols that are difficult to understand;

According to the list from table 8.1, the following sections will present the

iterative design process including: a low and high fidelity prototype; colour study of the dashboard areas; designing the interface launchpad icons; designing the interface layout, and during the process conduct usability tests validation using participatory design technique, and after finishing the high fidelity prototype, first click usability tests followed by a survey.

8.3 LOW-FIDELITY PROTOTYPE

This section presents the design, development, and evaluation of a paper based prototype of "my Crohn" project.

8.3.1 Sketching the initial ideas using paper prototype

"Sketching is testing, not refining, so your next step is to put your ideas on paper, so you can work through your alternatives and establish where to go from here. Finally, remember to test your ideas again with potential users" (Moule, 2012, pp. 117–118).

Fig. 8.3 – Sketch – Colour pattern defined for each user

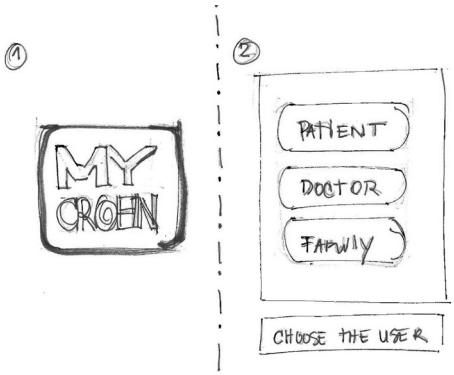


Fig. 8.4 – Sketch – Users Login

In this topic, sketches from figure 8.3 to 8.15 address an initial proposal especially focused on the features "myCrohn" will include and how the navigation should be done in terms of planning interface flow. This phase starts by outlining four points; (1) Analyse the best choice for colour criteria that visually represents the meaning of each type of user login; (2) Understand which are the available areas that in the dashboard,

and what kind of symbols and labels should be used to represent each feature; (3) Comprehend how navigation could be organized according to each profile; (4) Sketch potential well known tasks in IBD according to the defined areas.

Related to the first point, the initial idea for the user login, figures 8.3 and 8.4, was to create three different user profiles (Patient, Doctor, Family), each with different restrictions to access and manipulate data. The idea is that each profile should be represented by a specific colour: (1) Patient with green ; (2) Doctor with Bordeaux; (3) Family with blue. Taking into account theories of colour psychology, it's possible to associate colours to established meanings like, for example, green, which means hope and is related to sacredness. It is a secondary colour and also represents life (Heller, 2014), thus matching patient specification. For a doctor user, the decision was to use Bordeaux . This colour is associated to blood and healthcare (Heller, 2014), and is very suitable for a doctor's medical area. Its cognitive impact is directly related to medical fields in almost countries. Blue is related to sympathy, harmony, friendship and trust. It gives the sense of eternal feeling (Heller, 2014). In most cases of chronic diseases, family is the patient's support structure. So, for the family profile blue was used, because the goal is to give an idea of a strong connection between patients and family, through the good and bad moments.

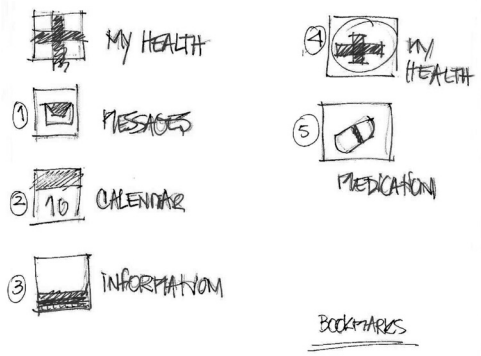


Fig. 8.5 – Sketch – Areas available in the dashboard

In the second point, figure 8.5 presents the areas available in the dashboard. The analysis from chapter 6 showed that it would make sense for the "myCrohn" project to repeat some of the existing case study features, restructure others, and and even

create some new ones. In the first case, repeat “Medication” and “My Health”. Both are related to self control of clinical story with items like IBD symptoms, medication tracking and treatment. As a “User Patient”, it is crucial to maintain patients informed about their IBD. The second case, areas which were restructured like “Message”. Here, the goal is to think about an area where it’s possible to gather all messages between patients and clinics. In this phase of the creative process the financial cost of this idea is not clear. The last case, new features, the decision was to create a “Calendar” but using a different approach, registering data added by patients and doctors from different users. It is undecided whether creating different types of logins has any advantage, and this decision will be made later in the iterative design process.

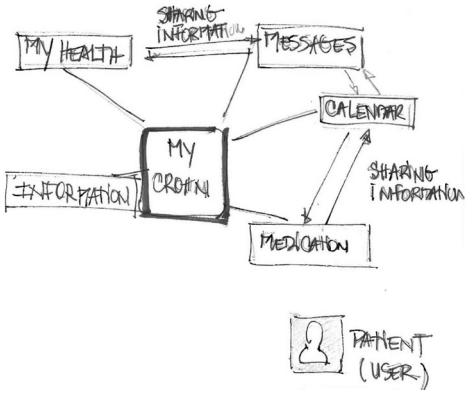


Fig. 8.6 – Sketch – System navigation (User Patient)

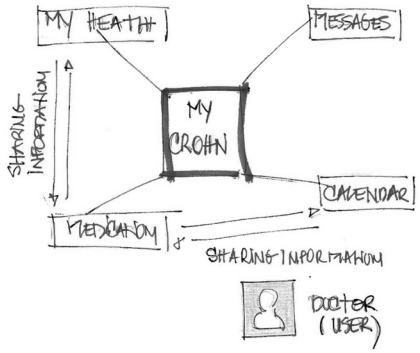


Fig. 8.7 – Sketch – System navigation (User Doctor)

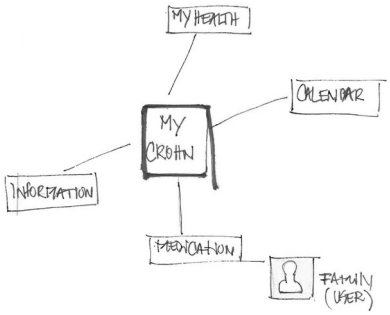


Fig. 8.8 – Sketch – System navigation (User Family)

For the third point, the navigation analysis according to a specific type of user (figures 8.6-8.8), the proposal focuses on systematizing how the content should be structured according to each area and type of user. Figure 8.6 presents an example of user data which synchronizes with other data, "Medication”, “Calendar”, “Messages”, "Information" and “My Health” which means that the user "Patient", for example, can

receive a message from the user "Doctor" with the prescription as simultaneously, the medication is scheduled by the same user in the calendar. Another scenario could be that the user “Patient” registers their medication in “Medication”, and it appears automatically in “Calendar”, because all the information is synchronized, and an alert message in “Messages” is subsequently created automatically. All this process is automatically recorded in the “My Health” area. In figure 8.7, which represents the “Doctor” login, there is a similar task. The difference here is that the user "Doctor" doesn't receive the same options as the user "Patients" because the user should focus on managing medical prescriptions, medication, exams, and appointments.

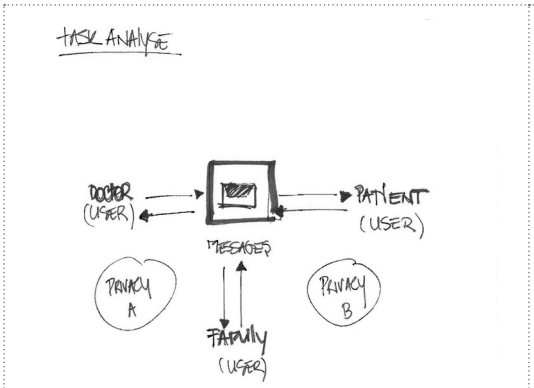


Fig. 8.9 – Sketch – Feature analysed – Message (Users Patient and Family)

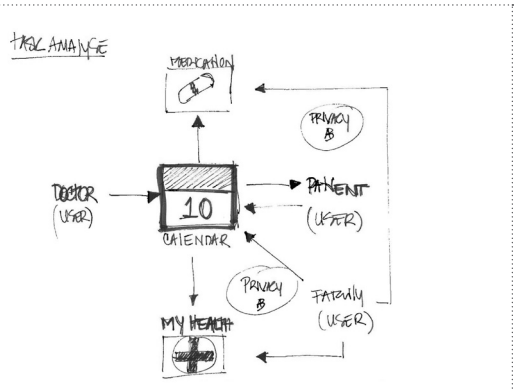


Fig. 8.10 – Sketch – Feature analysed – Calendar (User Doctor)

Lastly, in area and task analysis (figures 8.9-8.12) the aim was to understand a bit more about the relationship between the adopted features and related tasks. For this a visual simulation of a task for each area was created. Figure 8.9 presents a message between two users, the “Doctor” and the “Patient”, and as can be seen, both logins have the same features which allow them to communicate between each other. For patients that are under the age of 18, the process for interacting with the content is to involve another user, the family, which will be the go-between the doctor and the patient. So, in the scenarios shown in figures 8.9 and 8.10 both users "Patient" and "Family" received a message but, the last image shows another scenario, a calendar record of medication and treatment used only in the “Doctor” login. When this user records the data in their profile, the information is automatically shared in the calendar of the users “Patient” and "Family". This task is complemented after both received an alert. AAfter this, an alert is sent by e-mail using the automatic messaging system.

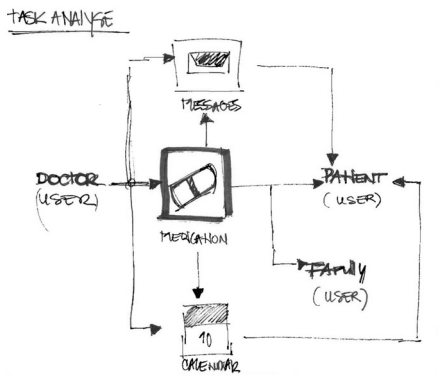


Fig. 8.11 – Sketch – Feature analysed – Medication (User Doctor)

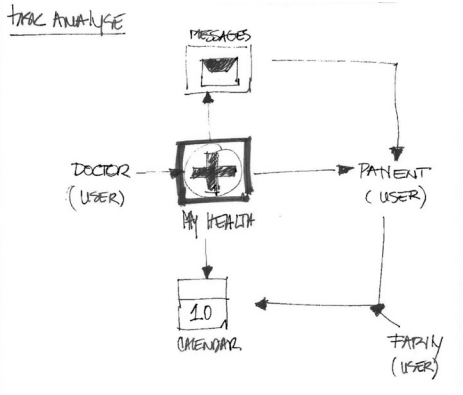


Fig. 8.12 – Sketch – Feature analysed – My Health (User Doctor)

Figures 8.11 and 8.12, show in the “Doctor” login the task procedure of a medication log: First, in figure 8.11, the doctor must select what kind of medication or treatment patients need; Second, after saving all related details of that log in the “Medication” area, schedule the prescription in the “Calendar” area, the goal is for the system to send a message to the user “Patient”, which will be in the “Message” area. Another potential solution is shown in figure 8.12. The user "Doctor" registers the medication in "My Health", complementing others like “Calendar” and “Message” to complete the task.

The tasks sketched in figures 8.13-8.15 are a complement of the previous analysis, focusing on the content instead on the users. In the "My Health" area – figure 8.13 – three topics were adopted: Medical Appointment, Exams, and History Disease. Even knowing that each type of user will perform a task according to the related settings, the idea for the first two is that after registration in the “Calendar” area, an automatic message will be sent by e-mail to the user “Patient”. Figure 8.14 showing the the "Calendar" area illustrates the task of scheduling an appointment or treatment which could be available for both users, “Doctor” or “Patient”; Figure 8.15 presents the "Medication" area with three features: Schedule, Typology and Pharmacy. The first two synchronize the data recorded in the “Calendar”, and after sends an alert of that procedure using an e-mail notification. Lastly, pharmacies were considered for a future scenario.

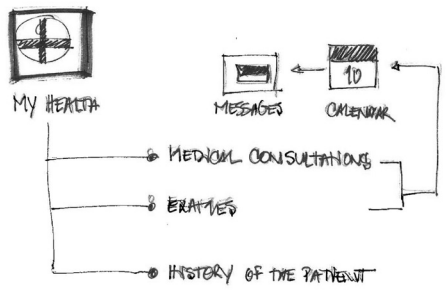


Fig. 8.13 – Sketch – Task to register medication in the "My Health" area (User Patient)

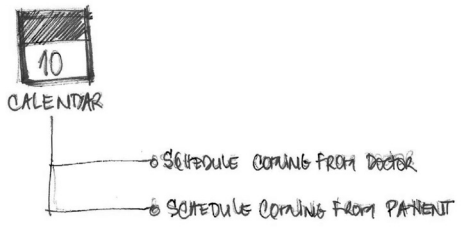


Fig. 8.14 – Sketch – Task to schedule medication in the "Calendar" area (User Patient)

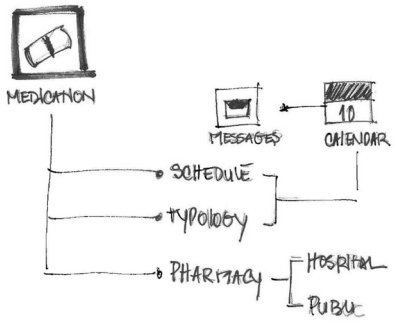


Fig. 8.15 – Sketch – Task to register a prescription in the "Medication" area (User Patient)

In summary, the areas presented in this section show common medical tasks similar to the case studies from chapter 6. The decisions incorporated in the “myCrohn” dashboard come from the results of the preliminary studies, especially from the feature analysis done during the A/B tests (Pernencar et al., 2016).

8.3.2 Mock-up validation with participatory design technique

After sketching the initial idea, user tests were conducted. Participants were a group of e male students[18], three without IBD were chosen within the age group of 21-30. The main goal was to collect balanced feedback on the preliminary studies.

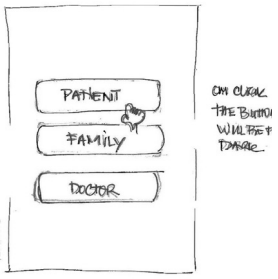
Each participant tested three distinct tasks for three different scenarios. These tests were recorded using a video camera. Video screenshots from the test are shown in: figures 8.16-8.20 for the 1st scenario; figures 8.21-8.24 for the 2nd scenario; figures

18 Participants came from a degree of computer science and it was expected that they would have technical skills rather than IBD experiences.

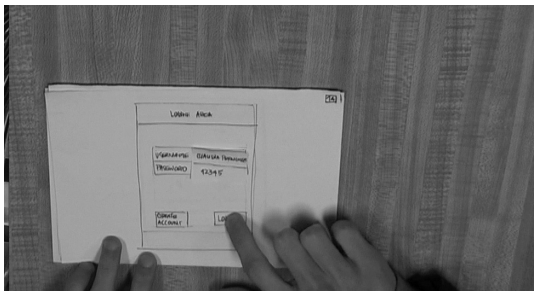
8.25-8.30 for the 3rd scenario[19]. Before the usability tests, participants were asked to read a document explaining the context of the scenarios they would be part of, as well as the requested tasks. As the goal for this phase was to collect qualitative data, participants were not asked to fill in a survey, and only more general doubts and suggestions that emerged were noted.

Table 8.2 – Scenario 1 – Mobile app usability tests

1st Scenario – Mobile Application
After finishing the login in the mobile application "myCrohn", the user has to find the medical report in the health history area, and after that send this information to the doctor using the e-mail.

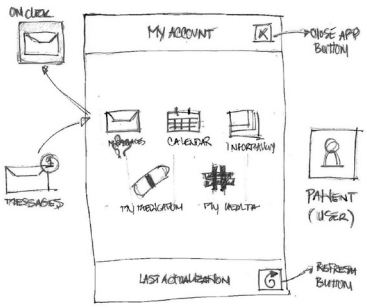


(a)

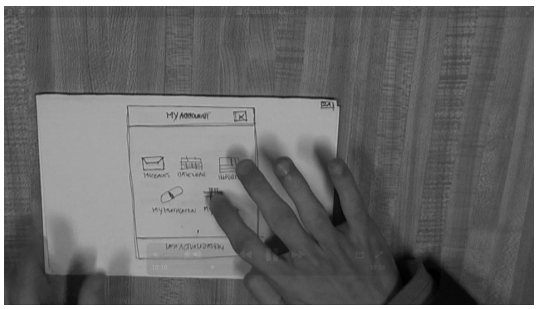


(b)

Fig. 8.16 – Mobile app paper prototype – User profile/ Login area: (a) Sketch; (b) Usability test



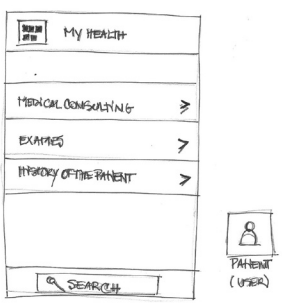
(a)

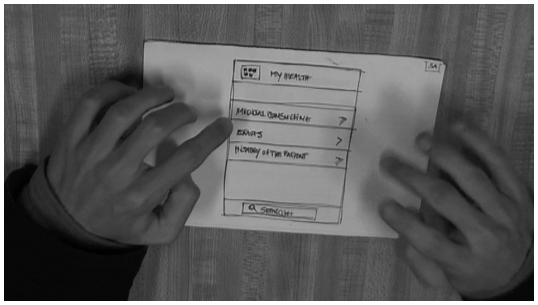


(b)

Fig. 8.17 – Mobile app paper prototype – Looking for an event in the calendar
(a) Sketch; (b) Usability test

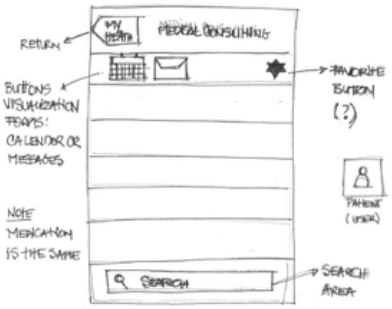
19 See the following pages.

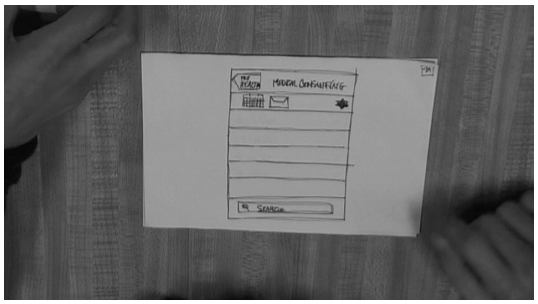




(a) (b)

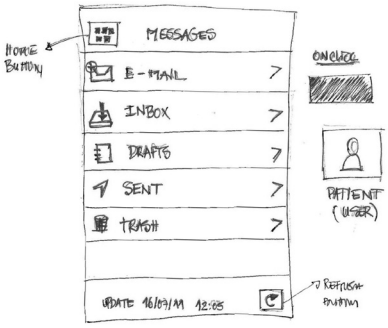
Fig. 8.18 – Mobile app paper prototype – Send a medical report by e-mail through the "My Health" area: (a) Sketch; (b) Usability test

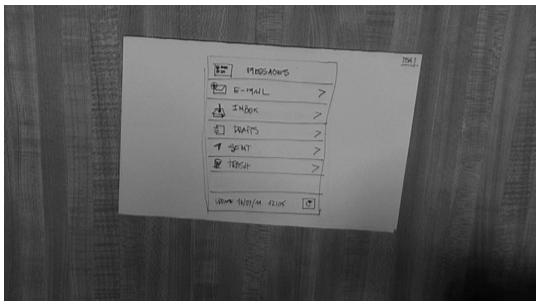




(a) (b)

Fig. 8.19 – Mobile app paper prototype – Send a medical report by e-mail through the "Medical Consulting" feature of the "My Health" area: (a) Sketch; (b) Usability test





(a) (b)

Fig. 8.20 – Mobile app paper prototype – Send a medical report through the "Message" area: (a) Sketch; (b) Usability test

Test results	
User A	Correctly Identify the names in the submenus; Return directly to the initial menu; It makes sense to have solution – information on the list combined with the calendar and messages; Add favourites features.

Tip from user A	Use the idea of the “iCal” application.
User B	Doubts about the difference between submenus “Medical Consulting” and “History of the patient”; Button “Home to return to the main menu” is not user-friendly; It is useful to have a list of doctors.
Tip from user B	Suggestion to change the name “My Health” to something clearer.
User C	Doubts related to the choice of menu – a task chosen by the calendar; Doubts in choosing the correct submenu: “Medical Consulting” or “History of the patient”; Button “Home to return to the main menu” seems strange.
Tip from user C	Suggestion to change the name of the submenu “History of the patient”; Add the “My Medication” area to “My Health”.

Table 8.3 – Scenario 2 – Mobile app usability tests

2nd Scenario – Mobile Application	
After login of the mobile application “myCrohn”, the user has to send a message to the Doctor using the e-mail, asking if the medication “Mesalazine” is compatible with another, “Benuron”.	

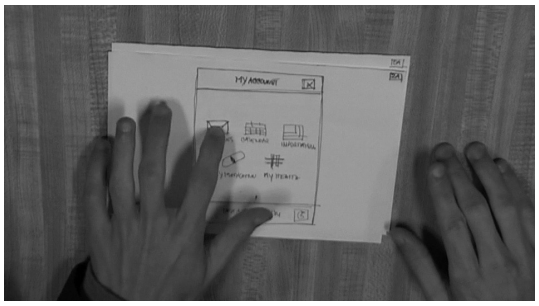
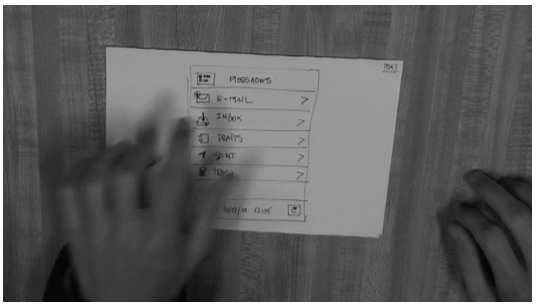

	

Fig. 8.21 – Mobile app sketch – Usability test: Send a message to the Doctor – Click on the e-mail icon	Fig. 8.22 – Mobile app sketch – Usability test: Send a message to the Doctor – Select an e-mail area

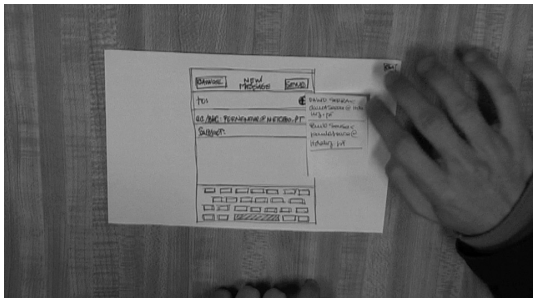
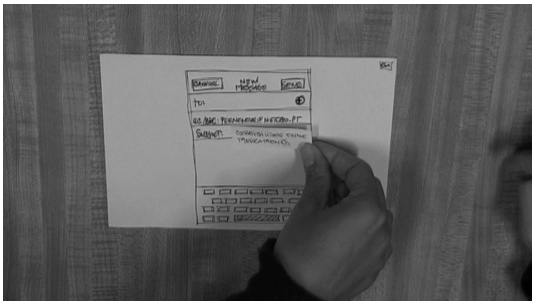

	

Fig. 8.23 – Mobile app sketch – Usability test: Send a message to the Doctor – Select a contact	Fig. 8.24 – Mobile app sketch – Usability test: Send a message to the Doctor – Write the subject

Test results	
User A	The e-mails structure actions are correct.
User B	The labels of the med areas are not clear enough: “My health” and “My Medication” seem the same.
User C	The validation of clinic information s clear in terms of their thought proces.

As referred to in section 1.2.1, problem definition, cross-platform systems use inconsistent interfaces due to different communication strategies. As seen earlier, during the case study analysis in chapter 6, some cases have a website. Related to the “myCrohn” (Pernencar, 2013) project, it was important to understand, through the initial phase of the design process, a low fidelity prototype, if suggesting a website that used the same user experience strategies in mobile applications, like for example three distinct profiles, would be of benefit to the patients.

Consequently only one scenario was sketched, shown in figures 8.25-8.30 from table 8.4, and the landing page, adding specific quantities of a selected antibiotic using an alphabetic list. To validate the conducted task, the same group of participants from the mobile application usability tests were used. The goal of this working process was to use a navigation map related to a common task for IBD patients, and register medication with settings. Related to the features of the website proposal, areas from mobile applications such as “Calendar”, “Information”, “My Medication”, “My Health”, “Messages”, were used. The main difference between both systems is the interface's primary screen. Instead of using a dashboard divided in to a grid like used in mobile applications, the website system adopted a menu list on the left side which includes all areas.

From an early stage of the design process, as a designer and patient, a few doubts about the challenges of creating a doctor profile appeared. After several informal talks with gastroenterologists, the conclusion was that connecting a mobile system focused on IBD patients with internal clinic software systems could be problematical. IBD data works with different clinical specialities, and huge amounts of data that uses different software.

Table 8.4 – Scenario 3 – Desktop application usability tests

3rd Scenario – Desktop Application	
cnrio – the user "Doctor" on the desktop cmputer has to run the "myCrohn" application. After that, choose the correc rea to add "Ciprofloxacin 500mg" medication, in quntities of three.	

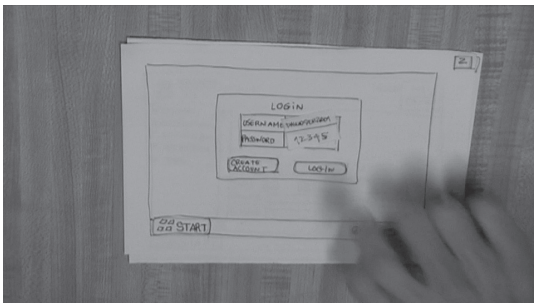
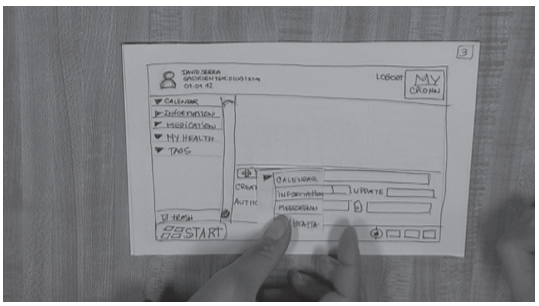

	

Fig. 8.25 – Website sketch: Usability test – Login	Fig. 8.26 – Website sketch: Usability test – Landing page: Click on the add button

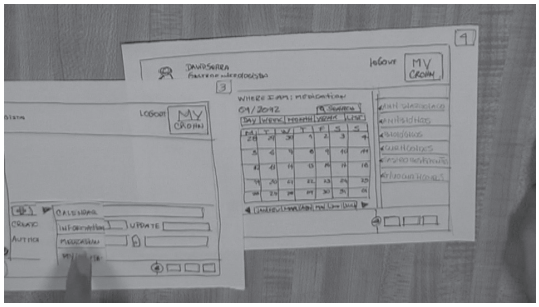



Fig. 8.27 – Website sketch: Usability test – Select medication	Fig. 8.28 – Website sketch: Usability test – From the list select Ciprofloxacin 500mg

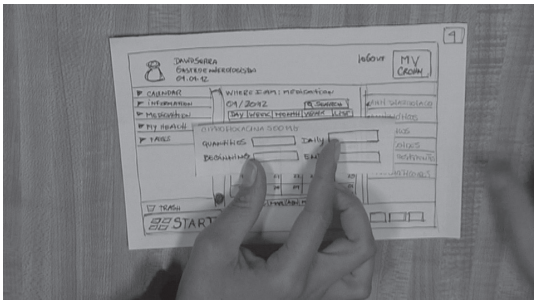
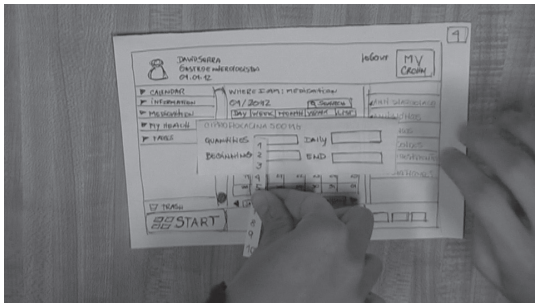

	

Fig. 8.29 – Website sketch: Usability test – Ciprofloxacin 500mg menu	Fig. 8.30 – Website sketch: Usability test – Add quantities on Ciprofloxacin 500mg menu

Results of the tests	
User A	How to find "Add product"?; "Header" insertion of a new medication – Task.
Tip	Add this task automatically to "iCal" and "GoogleCal".
User B	It is confusing to understand where to insert the new medication – Difficulty in finding medication areas.
Tip	Remove the menu below. Use only one on the right and there create a list of medication.

User C	How to find where “Add product”; “Header” say to insert a new medication – Task.
Note	I was not expecting a timetable.
Tip	Hint of “iCal” or “GoogleCal”.

8.4 COLOUR AND ICONS STUDIES

This section presents two study phases related to the Mobile App Icon location: the creative concept behind the symbol designed and the other, a few sketches showing the representation of the shape of the icon; a colour study on the interface buttons and the launchpad areas, and their relationship with the colour in different phases of IBD disease. Lastly, brainstorming using sketches of symbols that represent each area, and their connection to the colour adopted for each icon.

8.4.1 Outlining the mobile app icon location

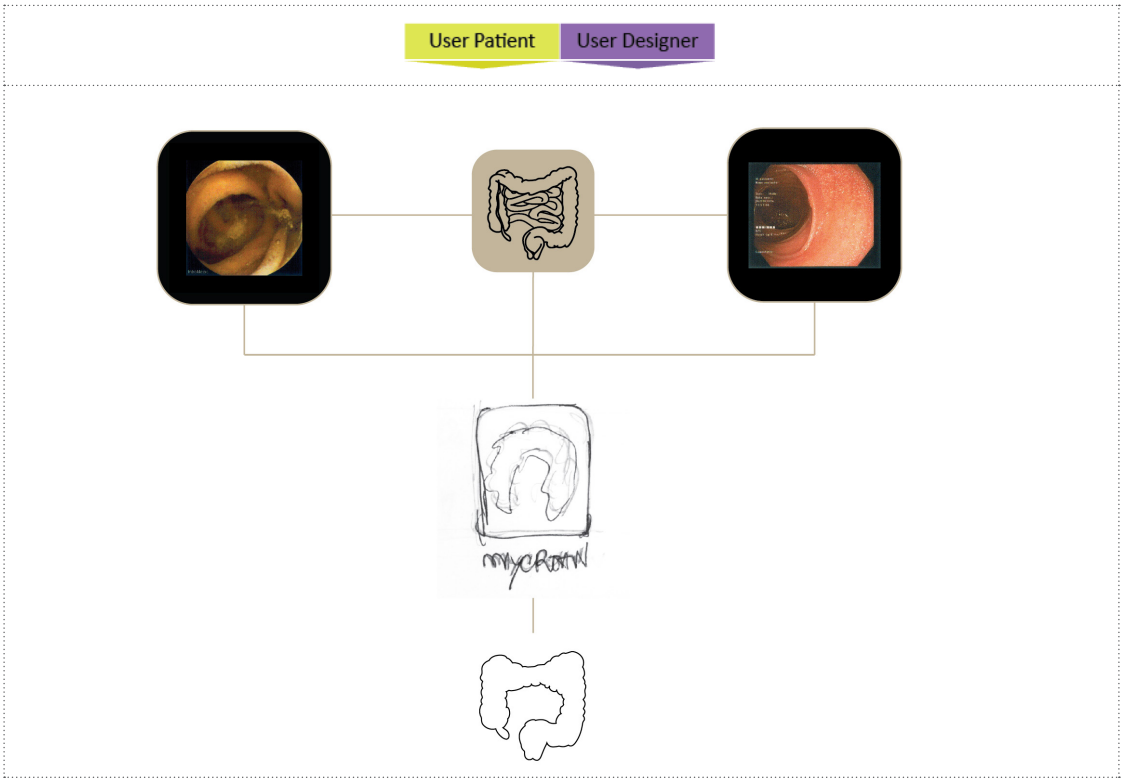


Fig. 8.31 – Mobile icon representation

The aesthetic concept of the symbol created for the “myCrohn” project (Pernencar, 2013) was born from two stages of the inflammatory bowel disease: sickness and health. Figure 8.36 presents two images that served as inspiration for

the creative process, which shows the disease stage: The image that appears on the left represents a sick bowel, and on the right, an example of a healthy bowel. As a "User Patient" (Pernencar, 2014) it is believed that patients will easily recognize the formal language of the symbol because the visual representation is closer to the shape of a bowel.

The creative suggestion to adopt this symbol is based on what Mullet & Sano (2008, pp. 37-44) defend "design should be reduced to its essence". So, as a "User Designer", the traditional creative process was followed, starting by drawing a small sketch that visually communicates the concept, a bowel. After that, by using a software tool, an outline symbol detailing the bowel's visual elements was drawn. However, once finished, it became clear that the symbol was confusing because of its considerable detail. So, the complexity was reduced, with only the outline of the main shape being adopted.

8.4.2 Colour meaning study

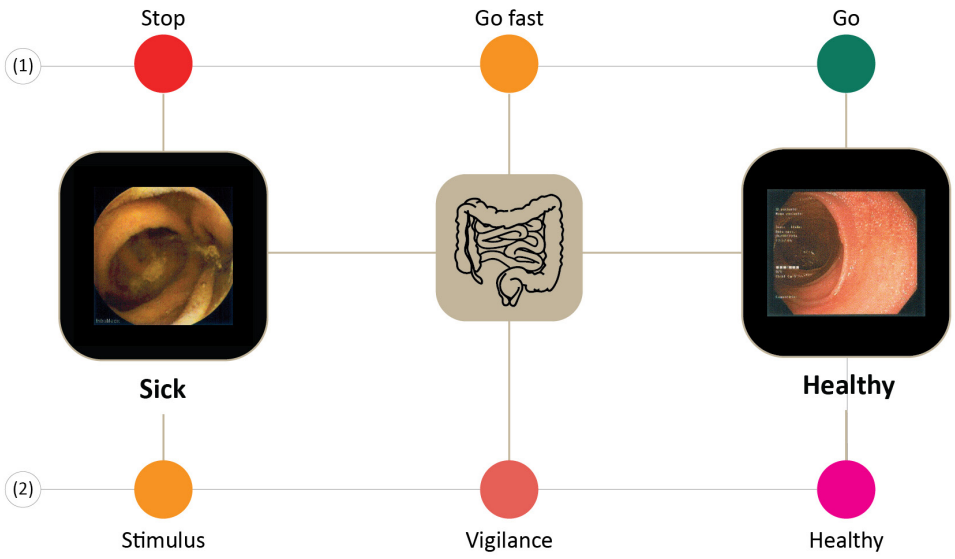


Fig. 8.32 – Colour meaning (1) for interface buttons and (2) launchpad areas

The meaning of each colour is in some cases is influenced by cultural interpretations and circumstances, but there are a few examples that, even when

changing the context, the meaning of a colour is universal and standard (Lidwell et al., 2003, pp. 48-49). This means that, when the colour is applied in a distinct scenario it always has the same connotation. An example of this is what figure 8.32 shows: (1) Red means energy, passion, action, ambition, and determination. Following this assumption, the design strategy for “myCrohn” project is to apply red to features which, for IBD patients, represent dangerous health scenarios. E.g., when their bowel is affected by diarrhoea or blood loss; Orange radiates warmth and happiness, combining the physical energy and stimulation of red with the cheerfulness of yellow. It offers emotional strength in difficult times. It helps recover from disappointments and despair, assisting recovering from grief (Heller, 2014, pp. 179–189).

In IBD, patients always have intermittent stages where bowel movement is not stable and needs vigilance, but these are not extremely unhealthy situations; Green represents balance and growth, which means both self-reliance as being positive, and possessiveness as being negative (Heller, 2014, pp. 103–107). It will also represent in IBD scenarios and features positive feedback related to the disease, which means the patients are feeling well and healthy.

In the dashboard, for the sick condition, “myCrohn” project (Pernencar, 2013) will present areas in orange that are decisive to manage the disease in illness scenarios, and the features related to the same condition will be visually represented in red. In healthy situations, the areas displayed in the dashboard will use magenta, and the features, green.

8.4.3 Mapping the interface launch pad icons

After deciding what colour criteria to follow, this section presents brainstorming using the sketch method, followed by the decisions on which areas to include in the launchpad, and the corresponding icons. For this, two issues from previous studies were considered: (1) The decision of which sections the “myCrohn” interface should adopt, as well as what standard icons should be designed for selected areas like the ones analysed in the empirical studies in section 6.2 from chapter 6; (2) Analysing the

non-standard icons that participants felt were difficult to understand during the A/B tests (Pernencar et al., 2016).

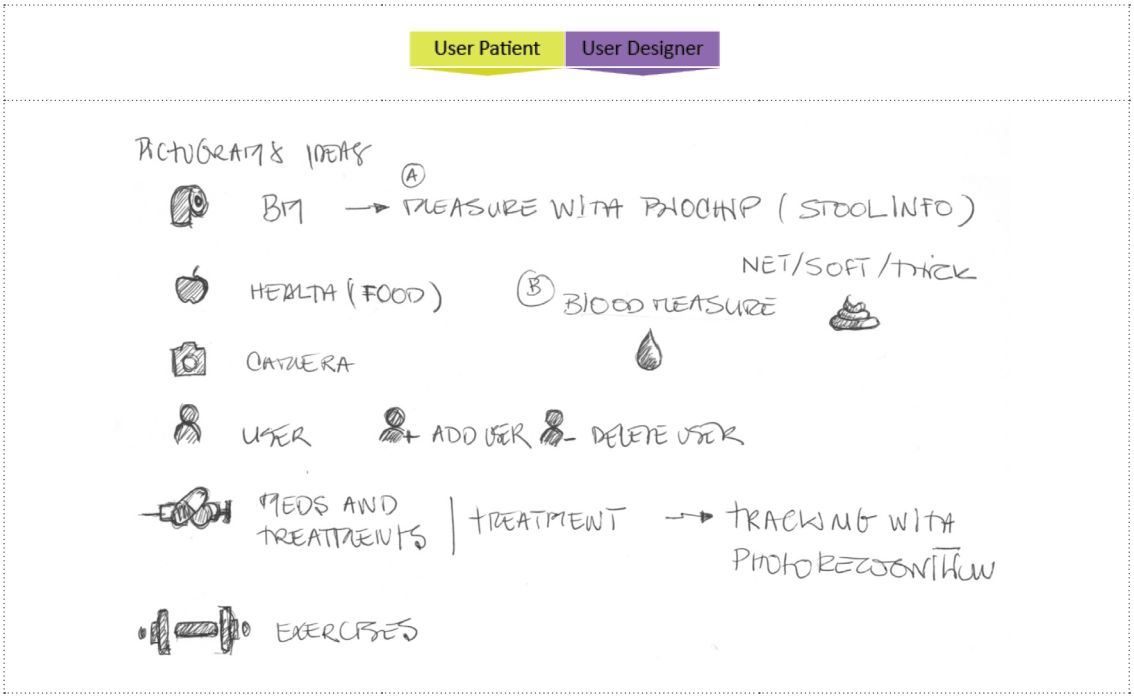


Fig. 8.33 – "myCrohn" Mobile app – Sketch launchpad icons

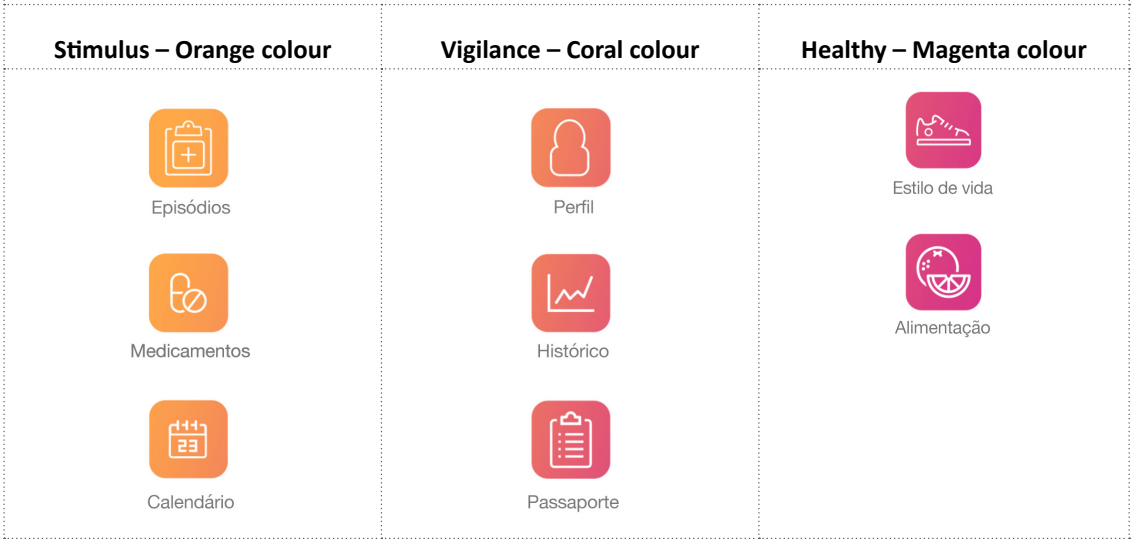


Fig. 8.34 – "myCrohn" Mobile app – Colour application in launchpad areas

As discussed in section 8.4.2, the selected colours are connected to two stages of the disease. Accordingly, the launchpad icons are organized in grids and each column matches a colour – figure 8.34: (1) Orange chosen for "Stimulus" and is applied to areas like "Episódios", "Medicamentos" and "Calendário"; (2) Coral

selected for “Vigilance” applied to areas like “Perfil”, “Histórico” and “Passaporte”; (3) Magenta colour correspond to “Healthy”, meaning that it is applied in “Estilo de vida” and “Alimentação”. The selected structure will help users to understand how to pair each area with related disease symptoms, instead of having to randomly interpret the meaning.

8.5 HIGH-FIDELITY PROTOTYPE

This section initiates another stage of the project: The high-fidelity prototype. As usual, the first step was to sketch the visuals and after redefine the layout using software to create interactive features (without coding). The following sections will show screenshots of the mobile application, as well as inputs coming from participant contributions from the same group that was used in A/B tests (chapter 7), during the "myCrohn" interface validation. For these usability tests, the participatory design technique was used (Gulliksen et al., 2003; Nielsen, J. 1993 and Shneiderman et al., 2009), followed by a survey with closed questions (Annexes 24 and 25).

8.5.1 Building the visuals with participatory design technique

Considering the concept defined for the project, “To Empower the patient on their disease”, collaboration with the IBD Portuguese patients association, APDI (“APDI,” 2012), was thought to be able bring more users. APDI supported this research, enabling contact with IBD patients, and to represent this partnership a credit page was created. The reference to APDI only appears on the initial screen before login, as shown in figures 8.35 and 8.36.

The first task conducted (figure 8.37), customization of the launchpad, included common IBD occurrence described below, and gave the opportunity to understand several issues like bad design decisions. From all participant's feedback, the selection to present here those could help improve the experience by changing design issues. In this first task it was necessary to choose from the dashboard which areas characterize the scenario. The high-fidelity prototype presented to participants didn't show all areas.

They were hidden. The goal here was to understand if users recognized that, and asked others or identified where to add, choosing the menu list (figure 8.38).

User Innovator | User Patient | User Designer

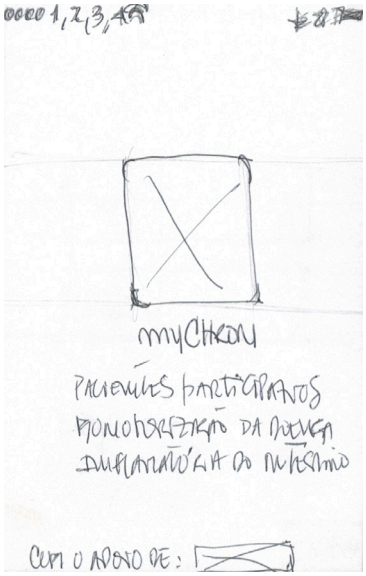


Fig. 8.35 – "myCrohn" sketch – Credits page

Fig. 8.36 – Screenshot of "myCrohn" high-fidelity prototype – Credits page

User Patient | User Designer

1st scenario – User tests

"Imagine that you arrived exhausted at the end of the week with a significant increase of diarrhoea and change. You had an exhausting professional week without resting the necessary number of hours, with high levels of stress, changing meal schedules and in most cases, eating fast food. These situations gradually decreased your week's exercise routine."

1st scenario – 1st Task

Imagine that the scenario referred to above is a common IBD situation in your daily life. You want to customize the dashboard of the "myCrohn" mobile application. Open it and choose from the menu list the available areas that better characterized the occurrence described in the 1st scenario.

1st scenario – Participant feedback

During the evaluation, several participants had difficulty in recognizing the location of menu list – figure 8.38. After we helping them overcome beyond this obstacle, and one participant suggested that it would be helpful for users to create an alert menu that would be available only in the 1st login, and change the icon of the menu list to a different one – figure 8.41.

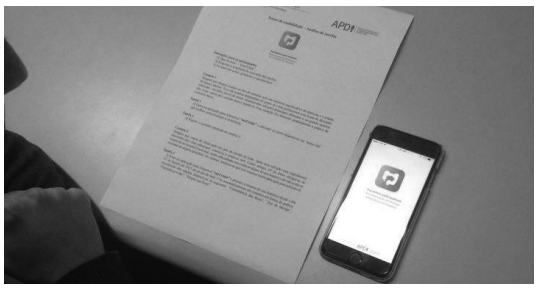


Fig. 8.37 – "myCrohn" first click test – 1st task

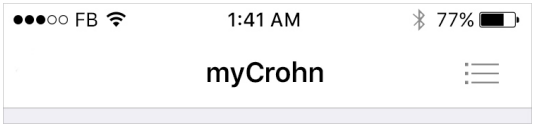


Fig. 8.38 – Screenshot of "myCrohn" high-fidelity prototype – Customization page icon before feedback

Figure 8.38 shows the icon before the validation, while figure 8.40, the final visual solution. The formal structure of this icon helps users recognize where to click, because they recognized the menu icon as being visually similar to the grid in the dashboard. This top right button enables users to customize the mobile application dashboard, deleting or adding selected areas, figures 8.45, 8.46, 8.47 and 8.48.

User Innovator | User Patient | User Designer

1st scenario – User tests

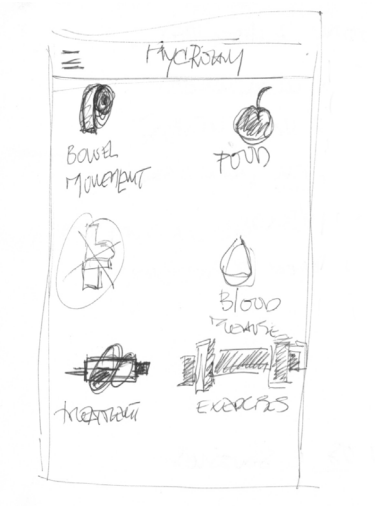


Fig. 8.39 – "myCrohn" sketch – Launchpad

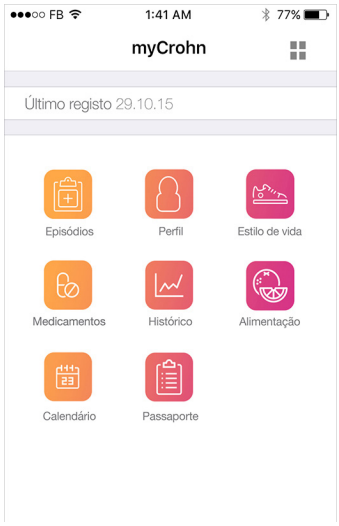


Fig. 8.40 – Screenshot of "myCrohn" high-fidelity prototype – Launchpad with participant suggestion

Fig. 8.41 – Screenshot of "myCrohn" high-fidelity prototype – Alert page

In the task presented earlier, features with a few design issues were validated simultaneously, as figures 8.42, 8.43, 8.44 show, from sketching the idea until the high-fidelity prototype. For the customization dashboard, one design solution was tested, a grey background with white areas organized into one column, figure 8.44. One participant suggested to create the same visual structure as the main dashboard, figure 8.43, and the decision to keep the colours.

User Innovator | User Patient | User Designer

1st scenario – User tests

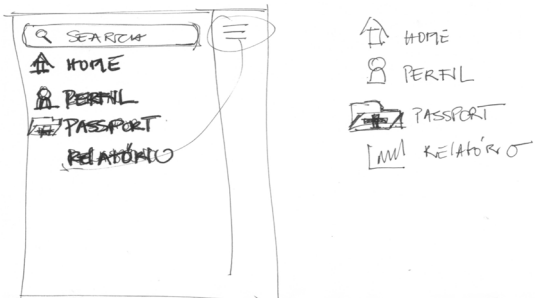


Fig. 8.42 – "myCrohn" sketch – Customization page > Select area

Fig. 8.43 – Screenshot of "myCrohn" high-fidelity prototype – Customization page > participant suggestion

1st scenario – Participant feedback

The structure created to organize the areas in the customization dashboard, one column with a scroll feature, was hard to understand for most participants. One of them suggested to create a visual area near the main dashboard, following the same hierarchy for displaying each area.

Fig. 8.44 – "myCrohn" first click test – 1st Task

After concluding the validation of the first scenario, both features and design issues related to those pointed out by participants were worked on. Figures 8.45, 8.46, 8.47 and 8.48 show another case. After participants suggested to structure the customization page similar to the main dashboard, figure 8.48, the decision was to adopt the suggestion but change colours. Visually, the same colours as the dashboard were kept for each area, figure 8.45. Related to functionality, a common feature such as, "press and hold" the buttons was used, following the iOS Human Interface Guidelines from Apple Developer (2015).

User Innovator | User Patient | User Designer

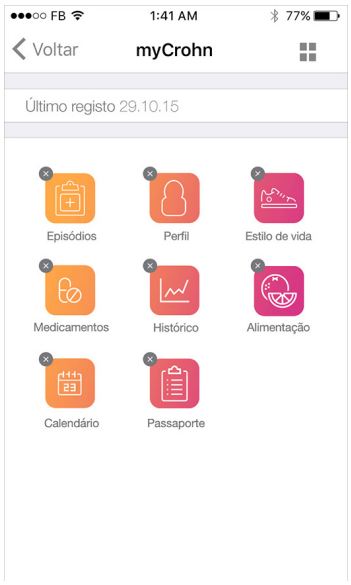


Fig. 8.45 – Screenshot of "myCrohn high-fidelity prototype – Launchpad > Customization_1

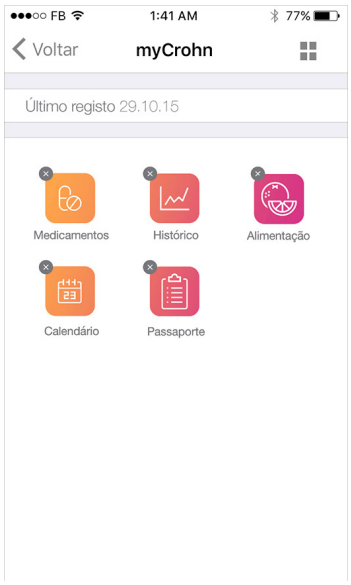


Fig. 8.46 – Screenshot of "myCrohn" high-fidelity prototype – Launchpad page > Customization_2

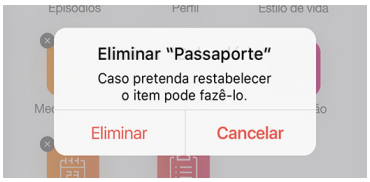


Fig. 8.47 – Screenshot of "myCrohn" high-fidelity prototype – "Passporte" alert

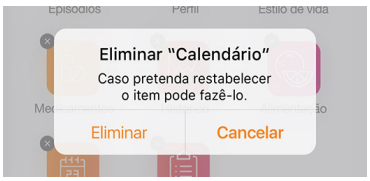


Fig. 8.48 – Screenshot – "myCrohn" high-fidelity prototype – "Calendário" alert

As both figures 8.45 and 8.46 show, if the users press and hold one button, after a few seconds visual feedback will appear, a small grey circle which is the close button. By clicking this button, an alert message will appear asking if the user wants to delete or cancel the task. Both figures 8.47 and 8.48 are examples of this.

After considering the first scenario, the results from the second task are shown (figure 8.49), following the same criteria of how present the design process by sketching the interface design ideas first (figures 8.50 and 8.51) and after, showing screenshots of the high-fidelity prototype. Here, participants were requested to record the IBD episode described in the scenario. The goal was to check if they concluded the task successfully, and also to understand whether the subjects discussed earlier in the colour meaning study, section 8.4.2, specifically red, orange and green colours, would match what was decided for these features: a different colour for each stage of an IBD condition (figures 8.52, 8.53, 8.54 and 8.55). E.g., in the "Consistência das fezes" feature, according to personal experience as a "User Patient", it is possible to divide this into three scenarios: "Sólidas" which means that the patient with the IBD disease has stable symptoms; "Moles" is when IBD patients must pay attention to signs related to the disease; "Líquidas" represents the worst case.

User Patient / User Designer
1st scenario – User tests
"Imagine that you arrived exhausted at the end of a week with a significant increase of diarrhoea and mood changing. You had an exhausting professional week without resting enough hours, with high levels of stress, changing meal schedules and in most cases, eating fast food. These situations gradually decreased your week's exercise routine."
1st scenario – 2nd Task
Record the episode described in first scenario

1st scenario – Participant feedback

During the tests, two participants had difficulty in identifying if the buttons in the "Episódios" area were selected or not, and they did not understand the visual feedback. Initially, the buttons were filled with colour, and the feedback buttons had a small bevel with a shadow (figure 8.49). The decision was to change the button instances: (1) A shape outlined before users press the button, and (2) a shape filled in with the same outline colour after pressing, from figures 8.52 until 8.55.

Fig. 8.49 – "myCrohn" first click test – 2nd Task

Fig. 8.50 – "myCrohn" sketch – "Episódios area"

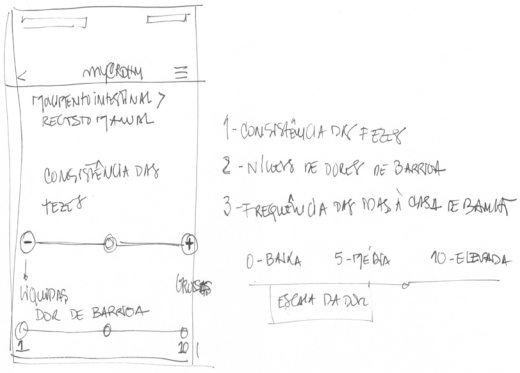


Fig. 8.51 – "myCrohn" sketch – "Episódios area" > "Movimento intestinal" data recording

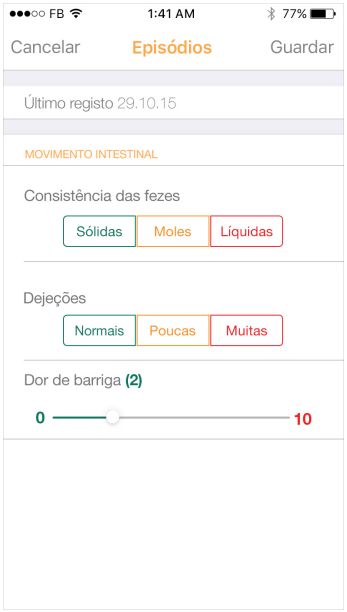


Fig. 8.52 – Screenshot of "myCrohn" high-fidelity prototype – "Episódios" area

Fig. 8.53 – Screenshot of "myCrohn" high-fidelity prototype – Example of feedback button Green

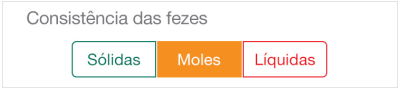


Fig. 8.54 – Screenshot of "myCrohn" high-fidelity prototype – Example of feedback button Orange

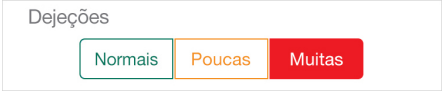


Fig. 8.55 – Screenshot of "myCrohn" high-fidelity prototype – Example of feedback button Red

Another graphic design decision tested in the scenario referred to in figures 8.52, 8.53, 8,54, 8.55, was related to secondary screens. In this case new medical symbols were not created as they would, considering the "User Patient" and a "User Designer" perspective, would be non-standardized. This is based on the conclusions of the preliminary studies in chapter 6 , that explained how complicated it was for participants to recognise non-standard symbols, and also which features that they should be used to collect data (e.g., figures 6.47, 6.55, 6.68, 6.17). Graphically, in the high- fidelity prototype, for the features tested, a common rectangle button with rounded corners followed by a label was created. After the user tests, it became apparent that participants clearly comprehended the relationship between colour and the meaning of a label.

In section 6.2.2 from chapter 6, after analysing how micro interaction rules influence user perception (Saffer, 2013, p. 4), with small problems like symbol button recognition, as well as difficulties in understanding in charts history disease results, e.g., figures 6.70 and 6.71 (section 6.2.2 from chapter 6), items referred to before were solved in "myCrohn" interface design proposal. Related to the first issue, symbols in buttons were not adopted. Instead, written labels were used. E.g., "Gerar gráfico" button or "Gerar lista" button, figure 8.58. For the second topic, difficulties in understanding the information in the charts, and the decision was to decrease the cognitive load by keeping the scale from 1 to 10 which was placed only on the left side. With this decision, patients would identify the range more easily, because it is similar to other features seen. To support user recognition in terms of differences between values, from 0 to 5 and from 5 to 10, a scaling background of three colours, green, orange, and red was created – figure 8.59. This design strategy is similar to that applied to the interface buttons of areas like "Episódios" or "Alimentação". Green is when patients feel healthy without any critical symptoms; Orange represents the scenario in which patients should be careful, because the disease is starting to cause problems; Red means a dangerous situation with bad IBD conditions.

User Innovator | User Patient | User Designer

2nd Scenario – User tests

"Imagine that you are traveling in Eastern Europe. After a meal that was unusual but tasty, you feel ill. With a fever reaching 39ºC, you go to the local hospital, but you have difficulties explaining the symptoms, as well as your disease history. However, you recorded the episodes on a mobile application."

2nd Scenario – 1st Task

"Enter in the mobile application" myCrohn "and create a history report from January, 1 2015 until today. Automatically create this report graphically,, choosing from the following options: "Consistência das fezes", "Dejeções", "Dor de barriga", "Rastreio do sangue".

2nd Scenario – Participants feedback

Most participants didn't have any difficulty concluding the task, and they stated that the colour gradient in the background that uses the same three colours, green, orange, and red, helped to visually understand the limits of each stage.

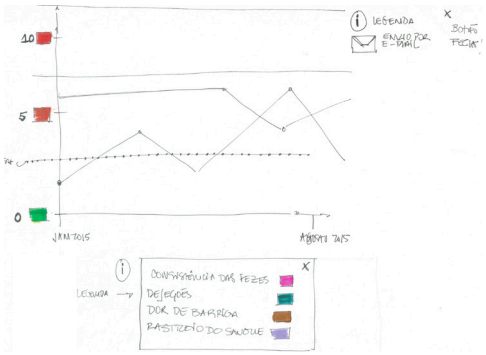


Fig. 8.56 – "myCrohn" sketch – Chart with history and critera "Episódios area"

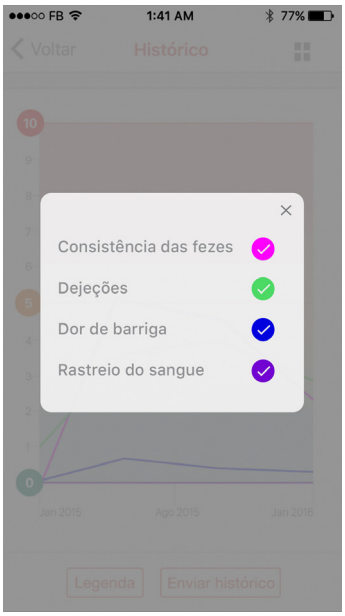


Fig. 8.57 – Screenshot of "myCrohn" high-fidelity prototype – Chart criteria to select

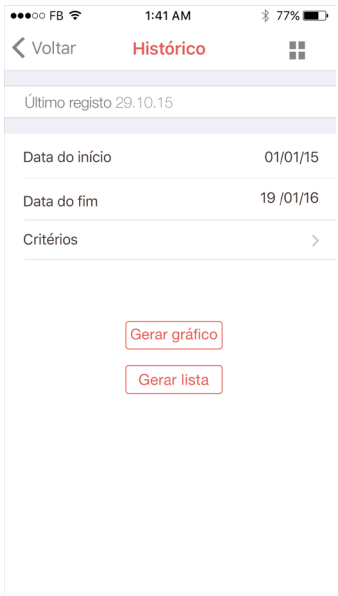


Fig. 8.58 – Screenshot of "myCrohn" high-fidelity prototype – "Histórico" area

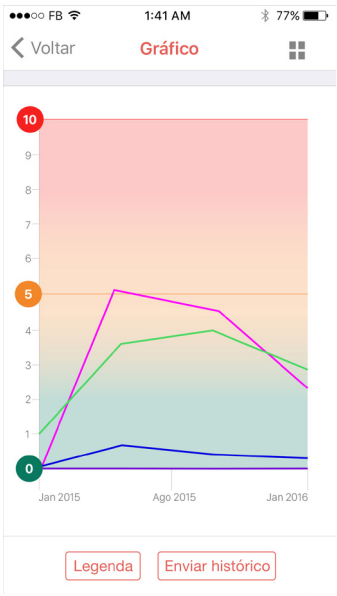


Fig. 8.59 – Screenshot of "myCrohn" high-fidelity prototype – History graph

User Innovator | User Patient | User Designer

3rd scenario – User tests

"After your gastroenterology appointment (today), you receive news that your IBD disease is in remission. However, you want to continue to track basics symptoms in the "myCrohn" application, as well as the next appointment, 24.04.2016, and your medication is "Humira", to take every fortnight during 6 months."

3rd scenario – 1st Task

Open mobile application "myCrohn" and change the dashboard, placing only the areas "Medicamentos", "Calendário" and "Histórico".

3rd scenario – Participant feedback

All participants concluded this task with success, but one suggested that the launchpad should always have a minimum number of areas. At least, one completed line with three icons – figure 8.60.

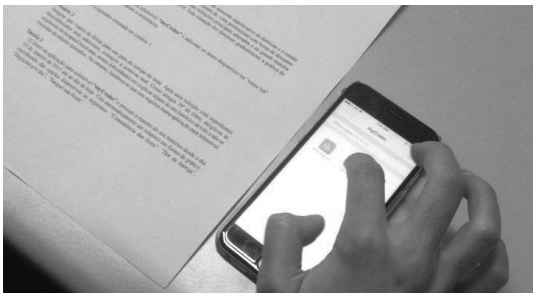


Fig. 8.60 – "myCrohn" first click test – 1st Task

The calendar presents a common top navigation menu organized into "Semanal", "Trimestral", "Semestral" and "Anual" – figures 8.62 and 8.63, but what is different is

that the list is divided into months and this is where patient information appears.

User Innovator | User Patient | User Designer

3rd scenario – User tests

"After your gastroenterology appointment (today), you receive news that your IBD disease is in remission. However, you want to continue to track basics symptoms in the "myCrohn" application, as well as the next appointment, 24.04.2016, and your medication is "Humira", to take every fortnight during 6 months."

3rd scenario – 2nd Task

In the "calendar" area, register the next appointment and request an alert message, 1 day before each appointment.

3rd scenario – Participants feedback

One participant suggested to provide a list which includes all scheduled events: A navigation menu to select a date range where they could have all the information listed. During the tests, figure 8.61, the best solution to sort the events was also discussed. The conclusion was to organize them based on the previous criteria: “Semanal”, “Trimestral”, “Semestral” and “Anual” – figures 8.62 and 8.63

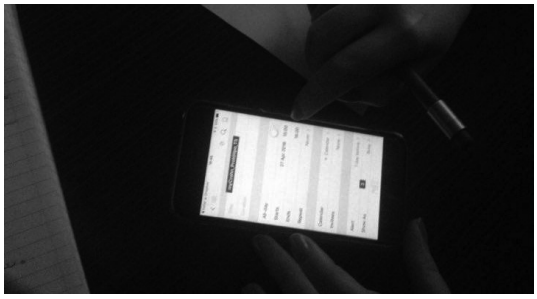


Fig. 8.61 – “myCrohn” first click test – 5th Task

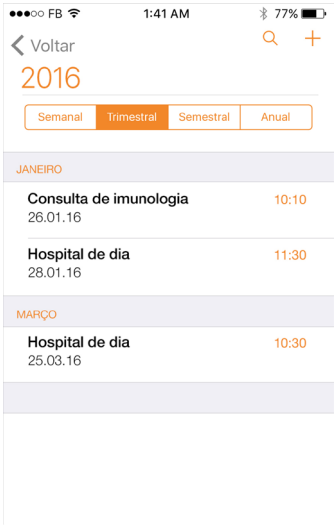


Fig. 8.62 – Screenshot of "myCrohn" high-fidelity prototype – “Calendário” > “Lista de eventos trimestral”

Fig. 8.63 – Screenshot of "myCrohn" high-fidelity prototype – “Calendário” > “Lista de eventos anual”

8.5.2 High-fidelity prototype validation

After collecting participant feedback, the detected problems were fixed. Subsequently, they received a link with the "myCrohn" high-fidelity prototype to test again, but this time on their personal mobile phones. At the end of these first click user tests, participants were requested to fill-in an online survey using a 5-point Likert scale (Joshi et al., 2015) which ranged from strongly disagree (1) to strongly agree (5) (annex 25). Table 8.5 presents the three scenarios, the questions and the most relevant results.

Table 8.5 – Survey results

1st scenario		
"Imagine that you arrive exhausted at the end of a week with a significant increase in diarrhoea and mood change. You had an exhausting professional week without resting enough hours, high levels of stress, changing meals schedules and in most of cases, eating fast food. These situations gradually decreased your week's exercise routine."		
Task	**Questions survey**	**Results (Using Likert scale)**
1st	The user has the opportunity to customize the dashboard application with the available areas, depending on their health condition.	Five participants totally agreed, two partially agreed and one was neutral.
	The alert page which appears the first time users proceed to login helps them understand how to customize the application dashboard.	Five participants totally agreed and three partially agreed.
2nd	The icons of each different area have a clear meaning.	Four participants totally agreed, three partially agreed and one was neutral.
	The icons of each different area are legible.	Four participants totally agreed and the other four partially agreed.
2nd scenario		
"Imagine that you are traveling in Eastern Europe. After a meal that was unusual but tasty, you feel ill. With a fever reaching 39ºC, you go to the local hospital, but you have difficulties explaining the symptoms, as well as your disease history. However, you recorded the episodes on a mobile application."		

Task	Questions survey	Results (Using Likert scale)
1st	In the “Alimentação” area, the displayed items are enough to have a general idea of the context during a disease episode.	All participants totally agreed.
	In the “Episódios” area, the displayed items are enough for the patient to have a general idea of the context during a disease episode.	Three participants totally agreed, three partially agreed and the last two were neutral.
1st	The feature used to send the graph by e-mail after generated it, is totally clear.	All participants totally agree.
1st	The interactive method used to accomplish task three is simple and does not raise any doubts about icon interpretation, readability or visual consistency.	Five participants totally agree and the other three partially agree.
3rd scenario		
"After your gastroenterology appointment (today), you receive news that your IBD disease is in remission. However, you want to continue to track basics symptoms in the "myCrohn" application, as well as the next appointment, 24.04.2016, and your medication is "Humira", to take every fortnight during 6 months."		
Task	**Questions survey**	**Results (Using Likert scale)**
1st	The interaction style on the second screen of each area is consistent.	Four participantes totally agreed and the other four partially agreed.
2nd	The registration method used in “Calendário” for the appointment does not raise any doubts in terms of the feature.	All participants totally agreed.

In summary, most participants considered the layouts to be visually clear, as well as the interactions styles adopted coherent with the visuals. They agreed with introducing new features like for example, dashboard customization to organize the available areas on the main screen according to each disease scenario would be

beneficial for IBD patients, and may change their future use of mobile applications, meaning that participants felt confident about the tasks. Another consideration that they referred to was the visual solution used for secondary screens. The visual strategy changed according to the areas where the users were supposed to collect data manually, like in the "Episódios" section. Using colour patterns like, green, orange and red, that are culturally well known from another context, also accompanied by labels, would help patients recognize the meaning of where to click (figures 8.53-8.55). According to the survey conducted after the user tests, participants considered all the points to be potentially beneficially to the IBD community.

After finishing this phase, the "myCrohn" high-fidelity prototype was presented to APDI board advisors, including the president, , who usually directly works with both sides, patients and clinics. An interview to identify what kind of benefits, and which benefits the project could bring to the IBD patients community, was conducted (annex 26). During this interview, the following strengths of the project were identified by the APDI president: the simplicity of the proposed interface design in simplifying the IBD experience to all age groups; the clinical literacy used in IBD features allowed any individual to easily record all relevant information to better control disease evolution. Another detail pointed out was the fact that the "myCrohn" project didn't include complex medical language which, in most cases, is not well accepted by patients. The APDI president argued that this application could help IBD patients improve their disease knowledge; to control when they have to take medication; when the next medical appointment is or the date of an exam. The APDI president believes that these steps increase commitment between patients and doctors. Taking this into account, the APDI president was asked about the kind of problems an approach like the "myCrohn" application, a system totally dedicated to patients, could involve? The APDI president answer was clear. "There could be difficulty, for physicians, in approving recorded disease evaluation, and how IBD criteria are measured using mobile technology".

The user test results, combined with the information collected in this informal interview suggests another point: if the aim of this research project is to create a customized interface that is easy to interact with through the use of a visual approach

which is much more intuitive and focused on patient healthcare condition, instead of clinical needs, there needs to be consensus on both sides, clinics and patient. Nevertheless, as a “User Patient” (Pernencar, 2014), the opinion is that the more informed patients are about their health condition, the more aware of how useful managing the disease is.

8.6 CHAPTER OVERVIEW

During the design process of the “myCrohn” project (Pernencar, 2013), from sketching the initial ideas until finishing the high-fidelity prototype, several constraints appeared: In the beginning of the process, it was hard to balance both expectations as a “User Patient” and a “User Designer”, but after the decision to validate each design phase with IBD participants, the most crucial doubts disappeared: Firstly, if it made sense to create profiles like doctor and family, each with different data access. Secondly, which were the most appropriate symbols to use in an IBD digital context. Should standard health icons be used or, perhaps, create new medical symbols. Lastly, if the contribution as a "User Patient" to create a mobile application with features focused on patients would be enough to improve Portuguese IBD patient habits.

IBD patients deal with complex clinical language that is usually badly represented due the use of non-standard symbols. Because of this, another important feature that collects abstract data was added. From the case study design presented in chapter 6, and validated in chapter 7, some aspects that, as a “User Designer”, were considered to potentially create more difficulty for patients were removed, other features were redesigned, and other new ones were created, always following the best design practices like for example UCD guidelines.

After the validation phase with patients and APDI president, the conclusion is that the "myCrohn" high-fidelity prototype fully meets expectations. It presents a patient-focused IBD experience, does not over complicate by using general language whenever possible, and a layout with clear features and simplified concepts, such as

colour patterns. It is clear that solving communication and design problems in order to create a pleasant IBD user experience is the future for m-Health applications, and this issue will be seen in greater detail in the conclusions and future work sections below.

Conclusions and future work

CONCLUSIONS

In modern IBD m-Health systems there are challenges for the majority of patients with both user experience and interface design issues, like for example misunderstanding non-standard medical symbols, negatively affecting task conclusion; interactive IBD features that collect personal data subjectively, promoting doubts instead of clearly correlating all the information collected; weak consistency, both visual and functional, through the use of distinct communication strategies in cross-platform systems. Other problems, directly related to IBD disease, is activity management, like for example, tracking symptoms, or records. These should be easier to understand, making it easier to conclude the task successfully.

To solve these problems, which were discussed in section 1.2.1, the problem definition, from chapter 1, and guide the design process of the “myCrohn” project (Pernencar, 2013), the proposal involves both theoretical and practical approaches. The thesis starts with literature review divided into two chapters with specific goals. Firstly, it studied how aesthetic and functional issues influence the experience of interactive communication; how semiotic engineering affects the interpretation of computer sign systems; how designers may be able to create a pleasant healthcare experience for user engagement, focused on IBD patients. Secondly, how citizens deal with healthcare technology, especially if IBD patients are encouraged to change their disease management; which are the m-Health research projects that tried to include in their design process related methodologies or techniques; how patients that didn't find in the market solutions to solve personal problems and decided to improve the monitoring of their health conditions by themselves.

Chapters 2 and 3 show that the digital world involves design and communication in the interaction between users and systems. As literature showed, to accomplish beautiful design and usable systems can be affordable when the design process uses specific methodologies from UCD. There is a relationship between the sign systems in the interface, which means symbolic communication and the user experience converging. So, it is in this context that designers create experiences using specific methods and techniques. However, the healthcare environment, in particular when

working with chronic diseases, involves adding many additional details to the interface design. For example, specification about each symptom, and the complex data that goes with it. These issues cause, as seen in the analyses of the preliminary studies from Part III, bad design decisions as discussed in the case studies presentation, negatively affecting user experience.

Taking into account Kumar's statement that “Reframing problems are framing-up challenges differently (...)” (2012, p. 10), the intention was to additionally contribute with personal experience, considered in this thesis as the "User Designer" and the "User Patient", in an attempt to solve the problems referred to in the introduction, chapter 1. The research problem emerged from the fact of being both IBD patient and designer, with the desire to solve personal disease issues. The approach, converging with what Von Hippel (1976, 1986, 2005) claims for those who try to solve personal problems, 80% of innovation from different scientific mechanisms were created by users with a patient profile. Thus, in chapter 4 from Part III, after the state-of-the-art, the framework “Human-Social Interaction Model for e-Health Interfaces” (Pernencar, 2014) includes input from personal experience, as a "User Patient", a "User Designer", and a "User Innovator".

After this, chapters 5, 6 and 7 (Part III) focus on the preliminary studies, each supported by the framework. First, using survey methodology, 279 IBD patients were analysed: their routines related to the information about their disease such as, paper exams, recording treatment data, or medical appointments; If they use analogue or digital equipment for these tasks; If they track symptoms and what process they use. Afterwards, an empirical study of six IBD mobile phone applications was conducted with the purpose of understanding how subjects like graphic design, interface and interaction design were applied. Afterwards, some selected features and a few interface design details of two of the six IBD systems were compared through A/B usability tests by 10 IBD patients.

The third part of Chapter 5 showed that recording medication in digital environment was not a common habit for the majority of the patients that were surveyed. For them, taking medication is part of their daily routine as the survey

showed, with 90% taking medication – figure 5.3. But, from personal experience, when taking fortnightly medication, it is crucial to have an alert somewhere, in a digital or analogue system. Another relevant result is that 85% of participants stated that they did not use their mobile phone to record daily tasks like taking medication – figure 5.6. This means that both results show that for most participants with a daily routine and a fixed schedule, it is not a priority to have any kind of reminder. 15% of participants said they use reminders on mobile phones/computers as an alert to take medication, and these mostly belong to the age groups: 21- 30, 31-40 and 41-50 with a result of 31%, and the lowest, 10-20 with 0%. In terms of those that “Don’t use this method”, the highest value was that of the age group 31-40 with 37% and the lowest in the age group +60 with 4% (figure 5.7).

The results presented in Part III, helps understand that the survey participants do not have use mobile phones as a tool to monitor their disease as part of their daily routine, but they are interested in doing so. As the results of figure 5.11 showed, 82% stated that they were available in the future to manage their disease through a free cross-platform application, either on mobile or desktop.

In chapters 6 e 7, more conclusions emerged. Traditional m-Health applications still require users to manually register most data. The most abstract situation in this context is the subjective way – due to the abstract level of icon representation – that users record data in the systems (e.g., using a scale from 0 to 10 to measure the "Pain" level represented only by non-standard symbols, without any labels to help understand the meaning). The case study analysis, from chapter 6, demonstrated that most systems present complex features where IBD user experience is limited like the A/B usability tests revealed in chapter 7. Only expert users with some technological background managed to overcome the difficulties related to features that had obviously bad interface design decisions.

The preliminary studies helped reach several decisions on how to develop the project, especially in terms of its design. Firstly, to avoid the use of non-standard symbol communication, especially after users interact with first screen; Adopt healthcare icons for common IBD features with labels instead of symbols. This will

help users understand where they have to click; Implement "Universal Principles of Design" (Lidwell, 2003), like for example, well known colour patterns. In this case, the recognition of a feature will be clearer, as the examples in figures 8.53-8.55 showed; The use of more than one "Universal Principles of Design" (Lidwell, 2003) and the importance of feedback, guiding users. A good example of this is when during a user test the participant suggested that an alert page would help with the obstacle of dashboard customization – figure 8.41. The results of the usability tests conducted after finishing the project showed that reducing the cognitive impact of interpretation was a good design decision, implicit to a pleasant IBD experience.

After pointing out the most relevant details in each field and relating them to the goals of this thesis, the research questions referred to in section 1.2.2 from chapter 1 are answered:

How will m-Health user experience contribute to change IBD patient's behaviour?

The future of UX in IBD m-Health systems should be something that patients feel confidence with both in terms of content and technology. Understanding their attitudes towards health related applications, multidisciplinary teams can provide insight on how to create more meaningful systems that patients will actually use. Otherwise, changing their behaviour using technology without any useful and integrated experience will be much harder, because most healthcare mobile applications are largely recognized to have low levels of use, which reflects the lack of patient input in its development (Lia et al., 2015). Curiously, the authors stated in their article that providers and clinics are not yet prepared to discuss technology trustworthiness and they are therefore unfamiliar with currently available health-related apps. The opinion of other authors, Sing et al. (2017, p. 1323-1324), reflect the previous point of view expressed by Lia et al., 2015. They believe that the clinical environment is still often unfamiliar for the HCI community.

There is a huge opportunity for designers to work in multidisciplinary teams to help create solutions, like for example, where IBD symbols and features are well known, avoiding the use of technical words. Another important point is to help patients

by decreasing the abstract clinical data that they have to manually collect and add to current systems. Also, Bringing HCI to healthcare environment will help improve the design process.

Which are the main communication issues of current IBD m-Health interfaces?

The case study analysis from chapter 6 (Abbott, nd; "Diario de Crohn," 2011; Medivo Inc, 2009, 2013; SickKids, 2011)[20] indicated that most IBD m-Health applications had design and communication problems that negatively affected IBD patient's experience. These issues were divided into three parts: First, m-Health interface user experience, which in most cases is influenced by the incorrect use of design principles. Adopting a visual language and using non-standard references does not necessarily help comprehension; Second, to implement more features doesn't mean that IBD patients need all of them on a daily basis. A few are connected to desktop systems, but this does not mean they are efficiently collecting data to generate a database; Third, designing systems for non-chronic disease is not the same as for specific illnesses. Each disease "speaks a different visual language". Standardizing all existing symbols irrespective of the healthcare system is a process that designers should simplify by adopting another strategy: If possible, only use sign systems on the first screen that are well known, (essentially those that are applied to generic symptoms), whilst on the second screen trying to avoid these. The "Universal Principles of Design" (Lidwell et al., 2003) has guidelines that designers can follow, like for example the use of colour patterns.

How does a new Inflammatory Bowel Disease user experience empower patients to manage their health condition?

The user research conducted in chapters 5 (1st stage – IBD patient survey) and 7 (3rd stage – A/B testing – Case Studies) helped understand that 279 survey participants didn't have the habit of using a mobile phone to monitor their disease.

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20 Up to January 2018, three systems appeared in the app stores, Gut Check For People with IBD, 2016; IBD Diary, 2016; Poocount Lite, 2017. These systems were briefly analysed on mobile phones, and the decision was to not include them in this research as they didn't add anything relevant to the project.

As seen earlier, IBD systems adopt medical language that is not familiar to all participants and, they are also surrounded by the use of inappropriate signs and a huge amount of fields to fill in manually. So, "myCrohn" project (Pernencar, 2013) empowers patients by adopting clear symbolic communication and interaction styles focused on user needs.

The APDI president emphasised in the interview that: "myCrohn" provides users with a system that does not have medical language too technically complex for user interpretation.

How do "User Innovators" benefit from interdisciplinary work joining three disciplines – communication, design, and technology to improve technological healthcare systems?

The "User Innovator" profile was defined by Von Hippel in 1976, as well as by Baldwin at al. (2006), stating that "user innovation begins when one or more users of some good recognize a new set of design possibilities – a so-called "design space" – and begin to explore it". So, the "User Innovator" that both authors refer to are citizens who create solutions, analogue or digital, to solve personal problems, and their ideas are usually based on the use of flexible and low-cost solutions.

The "User Innovator" improves interdisciplinary work in healthcare when there is a designer with the disease that is involved in the design process and wants to innovate for their own benefit. This thesis shows that such a profile has more potential to create integrated solutions than any other kind of "User Innovators" because they can improve ideas by working based on three perspectives: Design, disease and innovation.

Answering the question above, chapter 4 presents the HCI framework (Pernencar, 2014) especially created to structure the concepts from each viewpoint, "User Designer", "User Innovator" and "User Patient".

How do IBD patients use technological systems to manage their disease?

The results of the IBD patient survey presented in chapter 5 were a surprise,

mostly because of the low rate mobile phone use as a tool to store data. The study showed that in Portugal IBD m-Health applications are not used much as tools to monitor healthcare problems. There are four possible reasons for this: One is related to the passive role of patients concerning their disease; Second, a lack of technological knowledge, especially in the older age groups; Third, the high complexity, visual and functional, of existing IBD healthcare mobile and desktop solutions; Last, the fact that there aren't any IBD mobile applications in Portuguese.

Without fixing the fourth issue, it will possibly take years for Portuguese patients with chronic diseases to becomes more aware of how managing their disease through applications can help them. Nonetheless, there is an American study about IBD patients which shows that they are now aware of this situation (Zia et al., 2015).

How does experience as a designer and patient challenge traditional research related methods in terms of access and management of healthcare information?

The belief is that this thesis is a first step in discussing this issue.

Personal experience as a “User Designer” (Pernencar, 2014) indicates that methods and techniques adopted in the design process of a system, either mobile or desktop, are traditionally the same, and what changes is the context, which in the case of this thesis is healthcare. As seen in chapter 2, this area involves information with sophisticated content organization. Sections 3.2 from chapter 3 and 6.2 from chapter 6, showed that the use of UCD guidelines such as user research, prototyping and usability tests in the design process, are not so well-integrated in healthcare to work with chronic disease (Pernencar, 2015). In the current information age, healthcare is a challenge that has an increasing amount of information.

Therefore, citizens have a greater need to use technology to easily access information. Smartphones offer media-rich and context-aware features that can be highly useful for e-Health as seen in section 3.3. Usually UCD guidelines cannot be used in the same way as working in a generic context.

From chapter 5 until 8, the idea was that it would be essential to increase the potential reach of the research by using personal experience as a designer and

a patient. This approach would solve design problems without losing focus on the user. Before starting the preliminary studies, a UCD framework was created to help validation of personal inputs, as patient and designer and what they could contribute. In section 4.2 the expected benefits to the project were presented. The contributions define the role, design and use of a patient which is also a designer. Of course, it is always vital to validate ideas with other end users but as seen, using personal experience helps substantially.

How to build a UCD framework based on a personal experience both as a designer and as a patient?

Experience with this thesis indicated that quantitative studies are always necessary so as to quantify problems, and qualitative studies are needed as exploratory research. In each type it is possible to apply distinct UCD methods, always depending on the defined goals. For example, if aimed towards understanding patient's attitude towards the disease, according to a demographic sample, conducting a survey with open and closed questions is essential. However, if the goal is to create a digital healthcare prototype, it is crucial to use quantitative and qualitative studies related to selected case studies. The results of the survey gave numerical data that helps in multiple phases of the process. The qualitative studies with their empirical studies provide insight into the problems and help develop ideas.

As a “User Designer” there is huge potential for both research approaches, like for example, sketching the ideas using a low-fidelity method; conduct first click user tests or even define the best IBD scenarios for a survey. The most important thing in this process, where personal experience contributes beneficially, is to always validate all stages of the design process using end users.

What kind of design guidelines should be helpful for creating a digital mobile healthcare prototype?

As the case study analysis from chapter 6 and 7 showed, modern day systems still need improvements to engage IBD patients. To change this situation, it is essential when designing the interface to reduce the use of non-standard symbols in features

created specially to monitor IBD symptoms; and to avoid measuring symptoms using abstract methods, even if they are used in a clinical environment.

In a mobile environment the clinics do not see patients in real-time when they are tracking data. It is therefore difficult to recognize how patients are doing at any given time; Adopting colour pattern, as showed in section 8.4.2 – Colour meaning study, is an interesting solution that as a "User Designer" was suggested for the research design guidelines of the healthcare project.

How to promote IBD patient interaction with current m-health systems?

Considering the framework "Human-Social Interaction Model for e-Health Interfaces" (Pernencar, 2014) created to support the preliminary studies of this thesis, the expected benefits come from two perspectives: (1) The "User Designer" helps manage research sources; guides the preliminary studies in a healthcare context; work as a medical information design translator related to the interface design; bring new perspectives on how IBD systems are experienced; find opportunities in the case studies to improve healthcare design; help understanding which are the best design practices to create IBD interfaces; define directions in medical information design. (2) A "User Patient", help understand the healthcare research context, especially a chronic disease; promote shared experience in the IBD community; identify opportunities and challenges in healthcare design. In summary, as a patient and designer, there is the possibility to empower and bring together patients.

LIMITATIONS OF THE STUDY

Although this research was carefully prepared, there are still some limitations and shortcomings. First of all, during the different phases of the research, several situations related to the analysis process were encountered: difficulties overcoming bureaucratic barriers in the initial phase of qualitative analysis, when it was necessary to work directly with IBD patients. The option to contact APDI, problems in managing expectations of those who worked closely to the project, and in part contributed to its development.

Second, applying the three fields involved in this research: design, communication between science and technology, in the context of healthcare, working towards a specific goal which was to develop a project that would have impact in IBD. This was one of the most complex points of the whole process. At the beginning of the research in 2010, a few of the scientific articles were not helpful enough, and these articles and books were not from a combined perspective. On the other hand, the Interaction Design field, which includes user experience design and interface design studies, and has been recently introduced as a subject, and the analysis methods were mostly applied in a generic context, and were not focused on healthcare user experience.

With the professional evolution that naturally came as the project progressed, it became clearer that a project of this dimension should involve team work using skills from different areas, essentially a multidisciplinary approach, where Design as a subject should be able to combine multiple analytical methodological processes to solve problems.

CONTRIBUTION

As mention in section 1.4 in the introduction, the guidelines presented in the table below can be a contribution to help people with a chronic disease, and experience as a designer, for those that want to work on healthcare projects, involving similar situations of personal experience which can have a major role in the design process, helping understand which UCD research methods are appropriate for each design phase, as well as helping answer the question "What are the expected benefits of using a UCD framework based on personal experience?".

Research design guidelines for healthcare projects

Area		Stage	Research method	Goal
User Research	1	Compare patient behaviour from different age groups inside and outside of a digital environment	Ethnographic study	Explore patients disease and lifestyle
		Apply the perspectives of the "User Patient" and "User Designer"		

User Research	2	Check with other patients if their own experiences, concerns, and needs are similar	Online survey	Identify disease scenarios using closed questions to collect quantitative data
		Apply the perspective “User Patient”		
Market research	3	Select the case studies according to experience as a “Patient” and a “Designer” that better correspond	Research in distinct databases	Look for more recent systems or ideas that have been researched (Case studies)
		Apply the perspectives of the “User Patient” and “User Designer”		
User Research	4	From the case studies, choose two systems which answer the main questions, experiences, and validate the most important features with end users	A/B usability tests with a user survey at the end	Compare two different interfaces using the same scenarios and tasks with end users. Use a survey to collect quantitative data
Apply the perspective of the “User Designer”				
Interface Design	5	Paper prototyping	Low-fidelity wireframing	Draft the visuals
		Apply the perspectives of the “User Designer” and “User Innovator”.		
User Tests	6	Small scale usability tests	First click test using a paper prototype	Detect which are the most relevant errors on your proposal
		Apply the perspectives of the “User Patient”, “User Designer” and “User Innovator”		
Interface Design	7	Design the interface following universal principles of design that correspond to the project goals	Participatory design technique with end users	Collect qualitative data with feedback from end users in the middle of the design process
		Apply the perspectives “User Patient”, “User Designer” and “User Innovator”		

User Tests	8	Usability tests (for example online), to validate changes, features and design	First click usability test in high-fidelity prototype with a user survey at the end	Recognized if the end users understand the interaction and interface design decisions. After that, collect qualitative data
		Apply the perspective "User Designer"		
User Tests	9	If possible, also validate the application with the medical board or with disease associations	Open interviews	Get feedback on how in the future this kind of projects will have impact on the disease community
		Apply the perspectives "User Designer" and "User Innovator"		

The procedures presented above pay special attention to personal experience. Companies and their designers can improve similar healthcare projects, but the design perspective will always be different according to the experience of the designer involved.

FUTURE WORK

After concluding the high-fidelity prototype with a redefined healthcare experience using interface design solution more appropriate to the user's needs, another question appeared. How to change m-health experience in situations that need users to fill in fields using abstract data?

The use of smart technology like wearable devices and sensors to automatically collect patient data can be very beneficial. As seen, IBD patients need to monitor their disease (e.g. symptoms, medication intake, among others) to increase their autonomy. In order to control disease history, patients also need to collect physiological data, as well as find correlations (Pernencar & Romão, 2016). As referred to before, this was cited in an article published recently (Lai et al., 2017).

The challenge for future work is to reduce patient effort by, firstly, creating a biochip, a small label that use integrated smart technology to directly measure blood levels in the stool, and at the same time, recognize the consistency - net, soft or thick; Secondly, create a wearable with two main goals, track stress and fatigue levels in real-time using a wireless wearable device connected to a mobile phone with a small space to introduce the labelled stool. After, values are synchronized in real-time with the “myCrohn” (Pernencar, 2013) m-health application through a wireless connection. It would be interesting to have a correlation between the data collected from the label with the stress and fatigue levels measured with a wearable to understand if the symptoms influence patient health stages. Lastly, track medication with photo recognition using a mobile camera for package scanning.

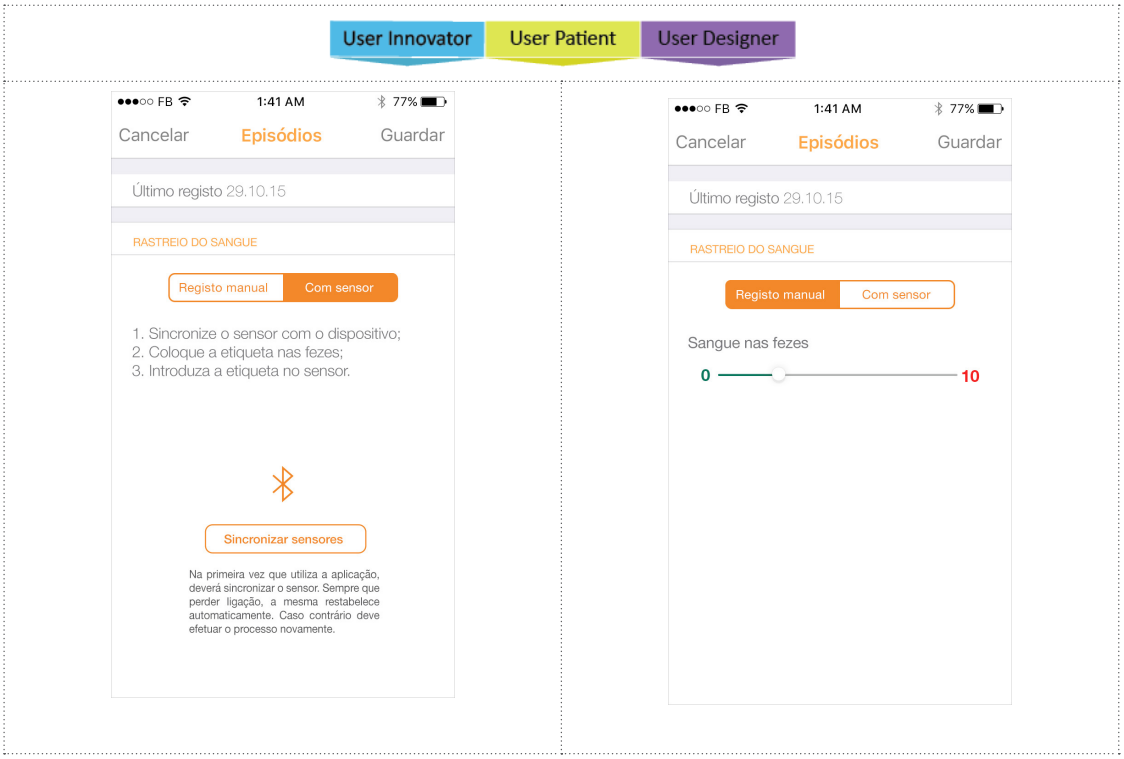

Fig. a – Screenshot of "myCrohn" high-fidelity prototype – “Rastreio do sangue” > Registration using a sensor

Fig. b – Screenshot of "myCrohn" high-fidelity prototype – “Rastreio do sangue” > Manual registration

Fig. c – Screenshot of "myCrohn" high-fidelity prototype – "Estilo de vida" > Registration using a sensor

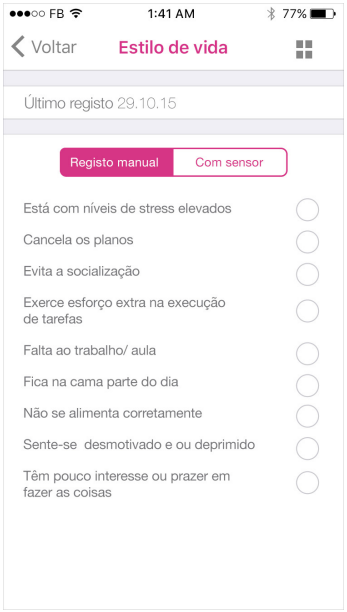

Fig. d – Screenshot of "myCrohn" high-fidelity prototype – "Estilo de vida" > Manual registration

To include all the ideas explained above, the "myCrohn" (Pernencar, 2013) interface needs adjustments, in terms of visuals and features, and different layouts provide opportunity for users to collect data through a sensor, instead of using manual registration. However, first there is a need to select, adapt, and evaluate intervention studies. Such work relies, in part, on deciding the feasibility of possible intervention and whether a comprehensive and multilevel evaluation is justified.

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LIST OF ABBREVIATIONS

AA -Heart – Activity-aware heart;

ACM – Association for Computing Machinery;

APDI – Associação Portuguesa da Doença Inflamatória do Intestino;

ATM – Automated Teller Machine

BM – Bowel Movement;

CD – Crohn Disease;

EFCCA – European Federation of Crohn's & Ulcerative Colitis Associations;

e-Health – Electronic Health;

EMR – Electronic Medical Records;

HCI – Human Computer Interaction;

HSI – Human Social Interaction;

IBD – Inflamatory Bowel Disease;

IOS – iPhone Operating System;

IT – information Technology;

MAVAAN – Mobilead Hoc Vicinity Area Application Network;

m-Health – Mobile Health;

NFC – Near Field Communication;

ROE – Return On Emotions;

UC – Ulcerative Colitis;

UCD – User-Centered Design;

UX – User Experience;

UXD – User Experience Design;

WWW – World Web Wide;

WP7 – Windows Phone.

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Annex. 1— Crohn Al Dia and Diario de Crohn mobile app – Features (Pernencar, 2013, p. 3)

CrohnAlDia			Diário de Crohn	
Menú	Estado general		Home	Como te encuntras?
	Dolor abdominal			Mi medicación
	Deposiciones			MYIBD de ánimo?
	Alimentación			Dolor de estómago
	Medicación perdida			Quantas deposiciones
	Sintomas personalizados			Outros sintomas
	Calidad de vida			-
Mi Estado	Without access to this nformation		Mi Estado	Without access to this information
Register	Añadir medication	Dosis	Consultas	Without access to this information
		Frecuencia		
		Establecer aviso de alarma		
Medication	Without access to this information		Usuários	Without access to this information
Mais	Without access to this nformation		-	

Annex. 2— GI Monitor and myIDB mobile app – Features (Pernencar, 2013, p. 3) — 1/3

GIMonitor		MyIBD	
Home	Info Button	Stool	Menu button
	Latest update area		Date
	BM		Add button
	Stress level		Cancel button
	Pain level		Save button
	Meal		Resume
	Weight		Details: Time of day; Consistency; Urgency; Blood.
	Custom Symptom		Add a note
	Questions for Doc		-
	Photo Therapy		-
	Dialy Logs		-
	Missed Meds		-
	Latest IBD		-
	How to Use GI Monitor		-
	Help		-
	My Doctors		-
My status	View chart button	Food	Menu button
	Week, moths and data range		Date
	My QOL		Add button
	Global diagram with: BM per day; Pain level; Stress level.		Cancel button
	View report button		Save button
	Send report button		Resume
	-		Details: Appetite; Nausea/vomiting after eating; Pain after eating
	-		Add a note

Annex. 2— GI Monitor and myIDB mobile app – Features (Pernencar, 2013, p. 3) — 2/3

GIMonitor		MyIBD	
Medications	Edit button	Pain	Menu button
	Add button with an alphabetic list of medications		Date
	View history		Add button
	-		Cancel button
	-		Save button
	-		Resume
	-		Details: Pain scale
	-		Add a note
Socialize	User profile button	Mood	Menu button
	Edit button		Date
	Main menu – Notifications; My notifications; Messages; Search		Add button
	-		Cancel button
	-		Save button
	-		Resume
	-		Details: School Attendance/ Activity Tracker; Fatigue; Stress; General Well-being
	-		Add a note
More	Settings	Meds taken	Menu button
	Latest IBD news		Date
	Questions for Doctor		Add button
	Photo therapy		Cancel button
	How to use GI Monitor		Save button
	Help		Resume
	-		Details
	-		Add a note

Annex. 2— GI Monitor and myIDB mobile app – Features (Pernencar, 2013, p. 3) — 3/3

GIMonitor	MyIBD	
	Other Issue	Menu button
		Date
		Add button
		Cancel button
		Save button
		Resume
		Details: Degree of Joint pain-hip pain
		Add a note
	History	Menu button
		History date
		Chart
		Graph
		Pain Tracker
	IBD Academy	Menu button
		IBD Academy
		Videos
		Website
	my IBD Passort	Menu button
		Name
		Date of birth
		Diagnosis
		Meds

Annex. 3— GI Buddy and My Crohn's Diary mobile app – Features

GI Buddy		My Chron's Diary	
Home	BM	Stool	Cancel/ Save button
	Stress level		Menu button
	Pain level		Time of day
	Meal		Consistency
	Missed meds		Urgency
	Custom Symptom		Blood
	-		Add a note
My status	My QOL	Food	Cancel/ Save button
	Global diagram with: BM per day; Pain level; Stress level.		Menu button
	View report button		Appetite
	Send report button		Nausea/vomiting after eating
	-		Pain after eating
	-		Add a note
Medications	View history	Pain	Cancel/ Save button
	Add button with an alphabetic list of medications		Menu button
			Pain scale
	-		Add a note
Socialize	Notifications	Mood	Cancel/ Save button
	Search		Menu button
	Share your thoughts		School attendance/ Activity tracker
	-		Fatigue
	-		Stress
	-		General well-being
	-		Add a note
More	Settings	Meds taken	Cancel/ Save button
	Latest IBD news		Menu button
	Questions for Doctor		It's necessary to choose first from the "Meds" list in myIBD Passport.
	Photo therapy		
	How to use GI Monitor		Add a note

Annex. 4— WellApps website – Features (Pernencar, 2013, p. 4)

WellApps Health Portal			
Login after a registration on the website			
GIMonitor	Socialize	My account	Logout
Data gap wizard	Share	Username	
Log events	My activity	First Name	
Daily logs	Search	Last Name	
Medications	Settings	E-mail Address	
My status report	-	Change Password	
My chart	-	Confirm Password	-
Compare	-	Date of birth	
Contact	-	Gender	
Settings	-	Race	
-	-	Ethnicity	

Annex. 5— GI Buddy website – Features — 1/3

GI Buddy			
Login after a registration on the website			
Dashboard	Get treatment reminders		
	Snapshot		
	Quick Log		
	Daily Activity		
	Find a restroom		
	CCFA Community Foru		
Symptoms	Date		
	Time symptom (s) occured	Hour	
		Minute	
		AM/ PM	
	How do you feel overall?§	Please select	
		Terrible	
		Very Poor	
		Poor	
		Fair	
		Very Well	
	Log symptoms	Select a symptom	Please select
			Bowel Movement (BM)
			Ostomy Output
			Abdominal (Belly) Pain
			Additional Symptoms
		Symptom tally	
	Save	Get report	
Treatment	Date		

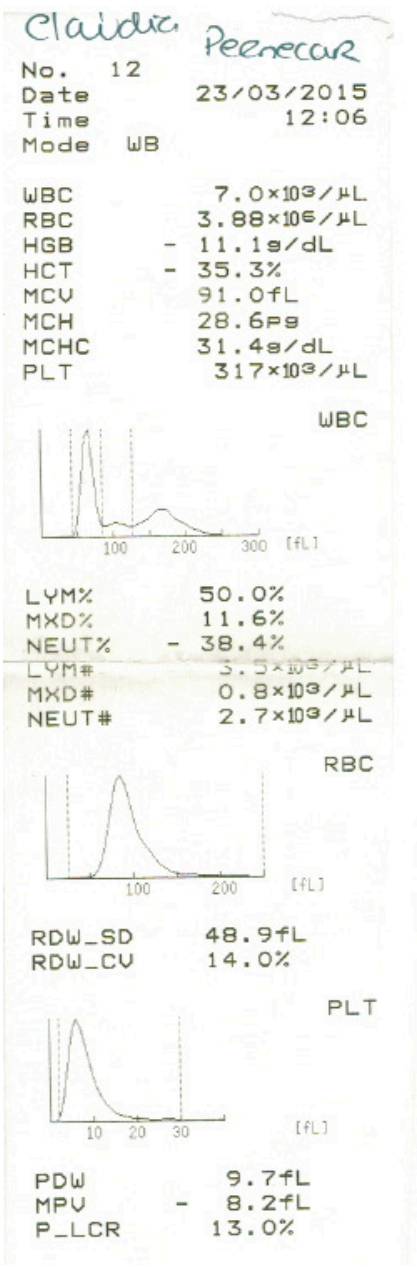
Annex. 5—GI Buddy website – Features (Pernencar, 2013, p. 3) — 2/3

GI Buddy			
Treatment	Log treatment	Mark all as	Please select
			Blank
			Missed
			Taken
		Select your medication	Please select
	Save	Get report	
Diet	Date		
	Meal Period	Please select	
		Breakfast	
		Lunch	
		Dinner	
		Snack	
	Log Food and Drinks		
	Save	Get report	
Lifestyle	Date		
	Log Lifestyle	Select a lifestyle category	Please select
			IBD Impact
			Well-Being Check
			Life Events
			Stress Level
			Exercises/ Activities
		IBD Impact	
	Save	Get report	
Reports			
My chart			

Annex. 5—GI Buddy website – Features (Pernencar, 2013, p. 3) — 3/3

GI Buddy		
More	Profile	First Name
		Last Name
		User Name
		E-mail Address
		Birth Year
		Zip Code
		Diagnosis
		Diagnosis Year
		Gender
		Race/ Ethnicity
		Medical History
		Medications/ Other Treatments
		Care Team
		Reports For Our Doctor
		Reset Password
		Save
	Notes	
	Resources	
	About CCFA	

Annex. 6— Four personal hemogram – Checking for disorders as anemia (Copy)



Claidia Pernecar

No. 12
Date 23/03/2015
Time 12:06
Mode WB

WBC		7.0×10³/μL
RBC		3.88×10⁶/μL
HGB	-	11.1g/dL
HCT	-	35.3%
MCV		91.0fL
MCH		28.6pg
MCHC		31.4g/dL
PLT		317×10³/μL

WBC

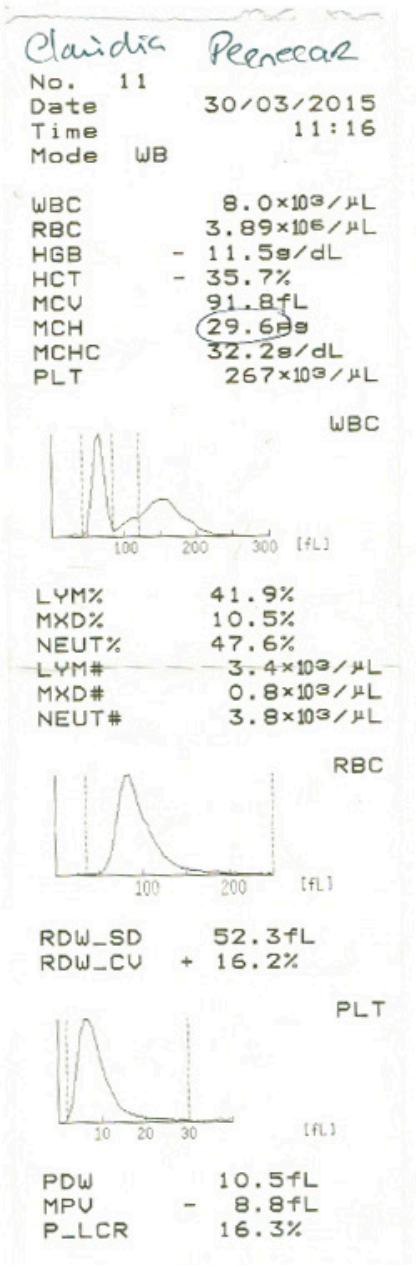
LYM%		50.0%
MXD%		11.6%
NEUT%	-	38.4%
LYM#		3.5×10³/μL
MXD#		0.8×10³/μL
NEUT#		2.7×10³/μL

RBC

RDW_SD		48.9fL
RDW_CV		14.0%

PLT

PDW		9.7fL
MPV	-	8.2fL
P_LCR		13.0%



Claidia Pernecar

No. 11
Date 30/03/2015
Time 11:16
Mode WB

WBC		8.0×10³/μL
RBC		3.89×10⁶/μL
HGB	-	11.5g/dL
HCT	-	35.7%
MCV		91.8fL
MCH		29.6pg
MCHC		32.2g/dL
PLT		267×10³/μL

WBC

LYM%		41.9%
MXD%		10.5%
NEUT%		47.6%
LYM#		3.4×10³/μL
MXD#		0.8×10³/μL
NEUT#		3.8×10³/μL

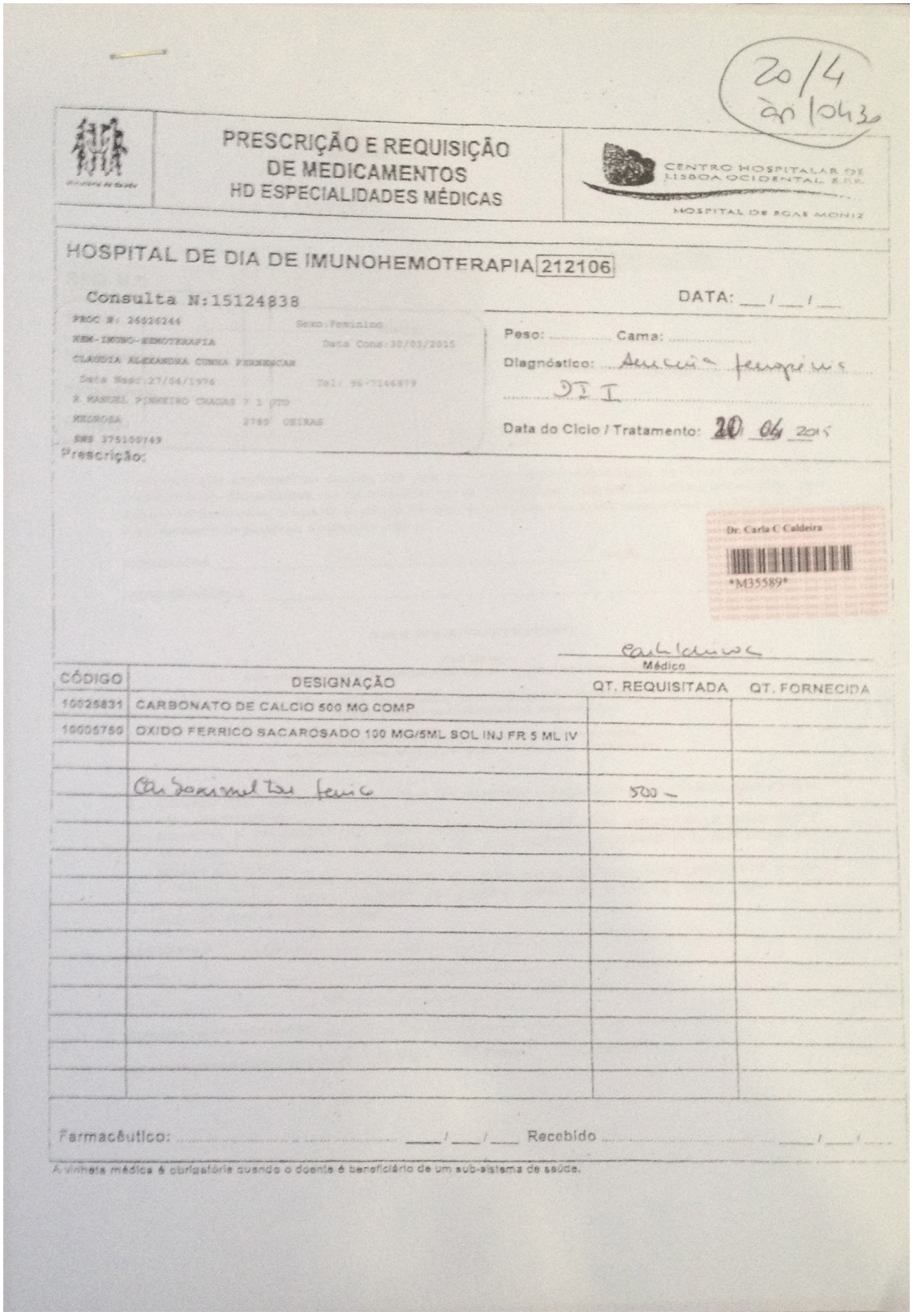
RBC

RDW_SD		52.3fL
RDW_CV	+	16.2%

PLT

PDW		10.5fL
MPV	-	8.8fL
P_LCR		16.3%

Annex. 7— Immunotherapy consultation procedures –
Hospital treatment appointment on paper (Copy)



PRESCRIÇÃO E REQUISIÇÃO
DE MEDICAMENTOS
HD ESPECIALIDADES MÉDICAS

CENTRO HOSPITALAR DE LISBOA OCIDENTAL, E.P.E.
HOSPITAL DE EGAS MONIZ

HOSPITAL DE DIA DE IMUNOHEMOTERAPIA 212106

Consulta N:15124838

DATA: __/__/__

PROC N: 26026244 Sexo:Feminino
HEM-IMUNO-HEMOTERAPIA Data Cons:30/03/2015
CLAUDIA ALEXANDRA CUNHA FERREIRCAR
Data Nasc:27/04/1976 Tel: 96-7146879
R MANUEL PINHEIRO CHAGAS 7 1 FTO
MEDROSA 2780 OEIRAS
SNS 375100749

Peso: ..... Cama: .....

Diagnóstico: Anemia ferropriva
DII

Data do Ciclo / Tratamento: 20/04/2015

Prescrição:

Dr. Carla C Caldeira
M35589

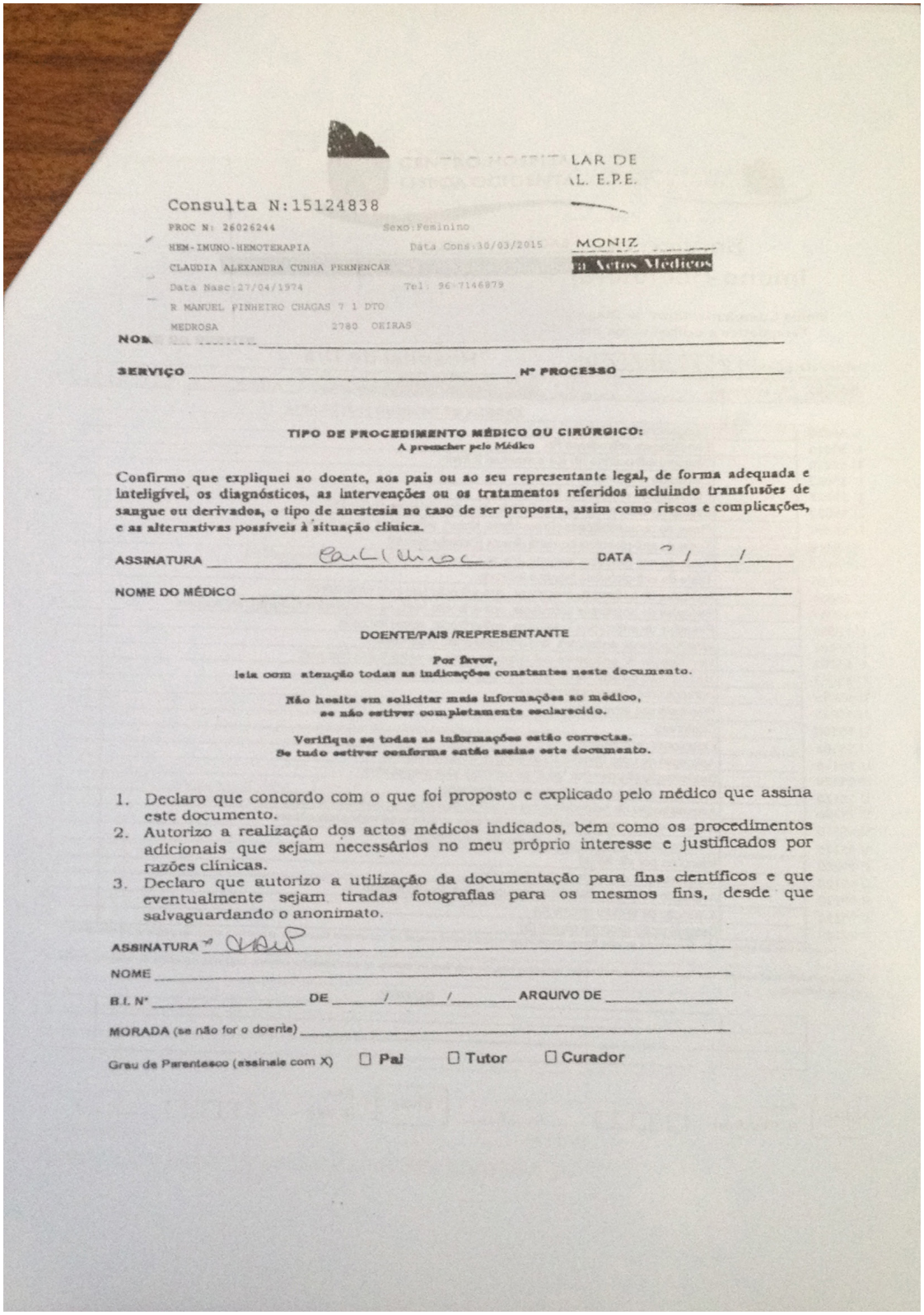
Médico

CÓDIGO	DESIGNAÇÃO	QT. REQUISITADA	QT. FORNECIDA
10025831	CARBONATO DE CALCIO 500 MG COMP		
10005750	OXIDO FERRICO SACAROSADO 100 MG/5ML SOL INJ FR 5 ML IV		
	Cloridrato de ferro	500 -	

Farmacêutico: ..... ___/___/___ Recebido ..... ___/___/___

A vinheta médica é obrigatória quando o doente é beneficiário de um sub-sistema de saúde.

Annex. 8— Immunotherapy consultation procedures –
Hospital treatment appointment on paper – Treatment accepting with patient sign (Copy)



LAR DE
L. E.P.E.

Consulta N:15124838

PROC N: 26026244 Sexo:Feminino
HEM-IMUNO-HEMOTERAPIA Data Cons:30/03/2015 MONIZ
CLAUDIA ALEXANDRA CUNHA PERNENCAR Actos Médicos
Data Nasc:27/04/1974 Tel: 96 7146879
R MANUEL PINHEIRO CHAGAS 7 1 DTO
MEDROSA 2780 OEIRAS

NOME _____

SERVIÇO _____ Nº PROCESSO _____

TIPO DE PROCEDIMENTO MÉDICO OU CIRÚRGICO:
A preencher pelo Médico

Confirmo que expliquei ao doente, aos pais ou ao seu representante legal, de forma adequada e inteligível, os diagnósticos, as intervenções ou os tratamentos referidos incluindo transfusões de sangue ou derivados, o tipo de anestesia no caso de ser proposta, assim como riscos e complicações, e as alternativas possíveis à situação clínica.

ASSINATURA _____ DATA __/__/____

NOME DO MÉDICO _____

DOENTE/PAIS /REPRESENTANTE

Por favor,
leia com atenção todas as indicações constantes neste documento.

Não hesite em solicitar mais informações ao médico,
se não estiver completamente esclarecido.

Verifique se todas as informações estão correctas.
Se tudo estiver conforme então assine este documento.

1. Declaro que concordo com o que foi proposto e explicado pelo médico que assina este documento.
2. Autorizo a realização dos actos médicos indicados, bem como os procedimentos adicionais que sejam necessários no meu próprio interesse e justificados por razões clínicas.
3. Declaro que autorizo a utilização da documentação para fins científicos e que eventualmente sejam tiradas fotografias para os mesmos fins, desde que salvaguardando o anonimato.

ASSINATURA _____

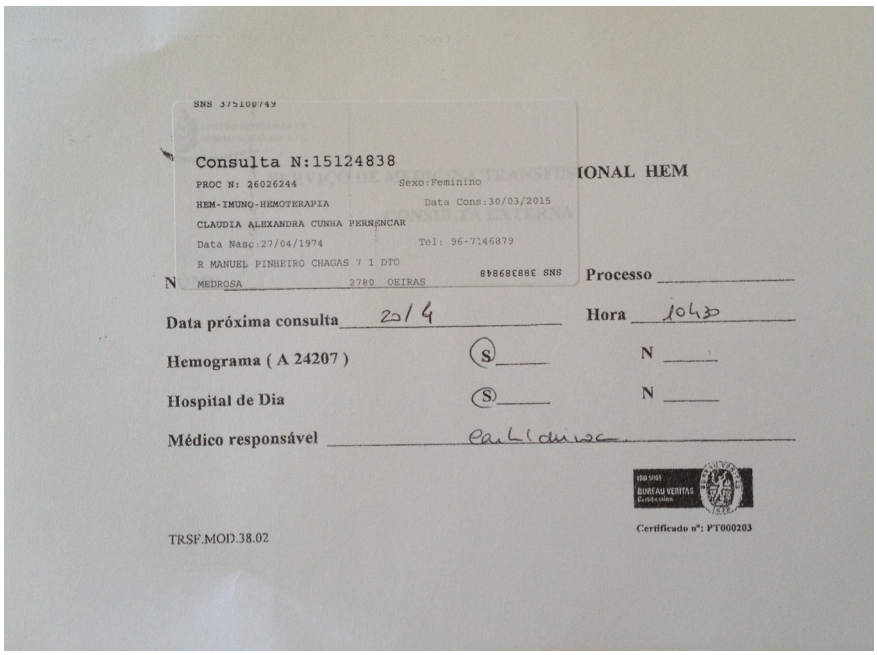
NOME _____

B.I. Nº _____ DE __/__/____ ARQUIVO DE _____

MORADA (se não for o doente) _____

Grau de Parentesco (assinale com X) ☐ Pai ☐ Tutor ☐ Curador

Annex. 9—Immunotherapy consultation procedures – Next appointment (Copy)



SNS 375100749

Consulta N:15124838
PROC N: 26026244 Sexo:Feminino
HEM-IMUNO-HEMOTERAPIA Data Cons:30/03/2015
CLAUDIA ALEXANDRA CUNHA PERNENCAR
Data Nasc:27/04/1974 Tel: 96-7146879
R MANUEL PINHEIRO CHAGAS 7 1 DTO
MEDROSA 2780 OEIRAS SNS 388398848

IONAL HEM

N Processo

Data próxima consulta 25/4 Hora 10h30

Hemograma (A 24207) (S) N

Hospital de Dia (S) N

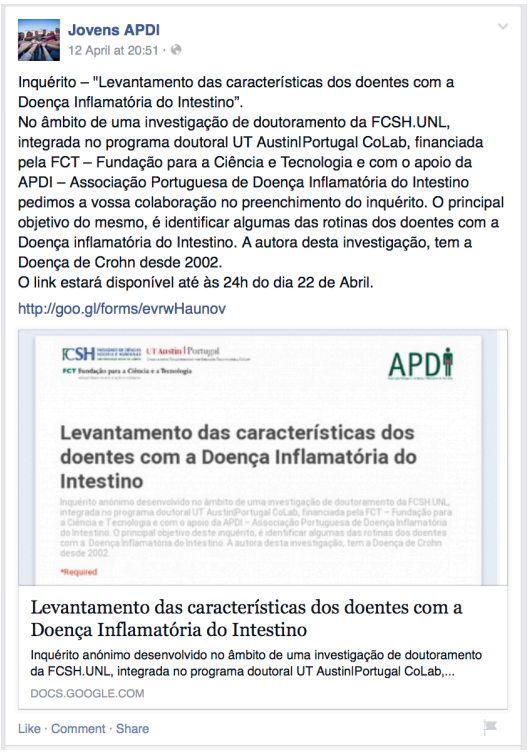
Médico responsável Paulo Lúcio

BUREAU VERITAS

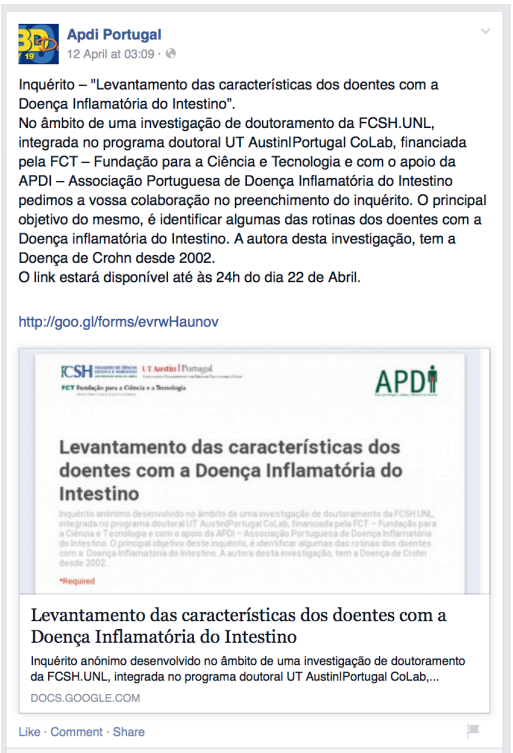
Certificado nº: PT000203

TRSF.MOD.38.02

Annex. 10— APDI members online survey release – Facebook page “Jovens APDI”



Annex. 11— APDI members online survey release – Facebook page “APDI Portugal”



Annex. 12— APDI members online survey (Copy) – Page 1/4

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Ministério da Educação e Ciência

APDI Associação Portuguesa da Doença Inflamatória do Intestino

Levantamento das características dos doentes com a Doença Inflamatória do Intestino

Inquérito anónimo desenvolvido no âmbito de uma investigação de doutoramento da FCSH.UNL, integrada no programa doutoral UT Austin|Portugal CoLab, financiada pela FCT – Fundação para a Ciência e Tecnologia e com o apoio da APDI – Associação Portuguesa de Doença Inflamatória do Intestino. O principal objetivo deste inquérito, é identificar algumas das rotinas dos doentes com a Doença Inflamatória do Intestino. A autora desta investigação, tem a Doença de Crohn desde 2002.

*Required

1] Faixa etária *
Informações gerais.

- ○ 10-20
- ○ 20-30
- ○ 30-40
- ○ 40-50
- ○ 50-60
- ○ +60

2] Sexo *
Informações gerais.

- ○ Feminino
- ○ Masculino

3] Área de residência *
Informações gerais.

- ○ Norte
- ○ Centro
- ○ Lisboa e Vale do Tejo
- ○ Alentejo

- ◯ Algarve
- ◯ Madeira
- ◯ Açores

4] Habilitações literárias *

Informações gerais.

- ◯ 5º Ano
- ◯ 9º Ano
- ◯ 12º Ano
- ◯ Licenciatura
- ◯ Pós Graduação
- ◯ Mestrado
- ◯ Other: [ ]

5] Qual o tipo de doença que possui? *

Perguntas gerais relacionadas com a Doença Inflamatória do Intestino.

- ◯ Doença de Crohn
- ◯ Colite Ulcerosa

6] Há quanto tempo tem uma das doenças? *

Perguntas gerais relacionadas com a Doença Inflamatória do Intestino.

- ◯ < A 5 anos
- ◯ Entre 5 a 10 anos
- ◯ > A 10 anos
- ◯ Entre 15 a 20 anos
- ◯ > A 20 anos

7] Atualmente faz medicação diariamente, semanalmente ou quinzenalmente? *

Monitorização da medicação do doente.

- ◯ Sim
- ◯ Não

8] Como é que habitualmente regista a toma da sua medicação? *

Monitorização da medicação do doente – Pergunta de escolha múltipla.

- ☐ Num papel solto
- ☐ Numa agenda de papel na data/hora exata da toma
- ☐ No calendário do seu telemóvel na data/hora exata da toma
- ☐ Não regista, mas utiliza uma caixa com separadores de medicamentos para diferentes horários
- ☐ Nunca regista
- ☐ Other: [ ]

9] Utiliza lembretes no telemóvel e ou no computador para o avisarem, que deve tomar a medicação em determinada hora? *

Monitorização da medicação do doente.

- ○ Sim
- ○ Não

10] Quando tem consulta de especialidade, como caracteriza a sua rotina para com esta situação? *

Monitorização das tarefas relacionadas com uma consulta para a Doença Inflamatória do Intestino – Pergunta de escolha múltipla.

- ☐ Consulta – Tem lembrete no telemóvel para o avisar da data/ hora
- ☐ Consulta – Tem lembrete no computador para o avisar da data/ hora
- ☐ Consulta – Verifica na agenda em papel a data/ hora
- ☐ Consulta – É alertado por um familiar da data/ hora
- ☐ Medicação – Regista em papel os detalhes da prescrição (quantidade e hora do dia da toma, entre outros)
- ☐ Análises – Recebe em papel e guarda num arquivo físico (pasta)
- ☐ Análises – Recebe em papel, guarda num arquivo físico (pasta) mas, regista também num arquivo digital (computador)
- ☐ Análises – Recebe em papel e passado 1 ano, deita fora
- ☐ Exames complementares – Recebe em papel e guarda num arquivo físico (pasta)
- ☐ Exames complementares – Recebe em papel, digitaliza e guardar num arquivo digital (computador)
- ☐ Próxima consulta – É-lhe facultado o aviso em papel ou num cartão do hospital
- ☐ Other: _____

11] Da informação que recebe em papel, regista alguma no telemóvel? *

Monitorização das tarefas relacionadas com uma consulta para a Doença Inflamatória do Intestino.

- ○ Sim
- ○ Não
- ○ Não sabe

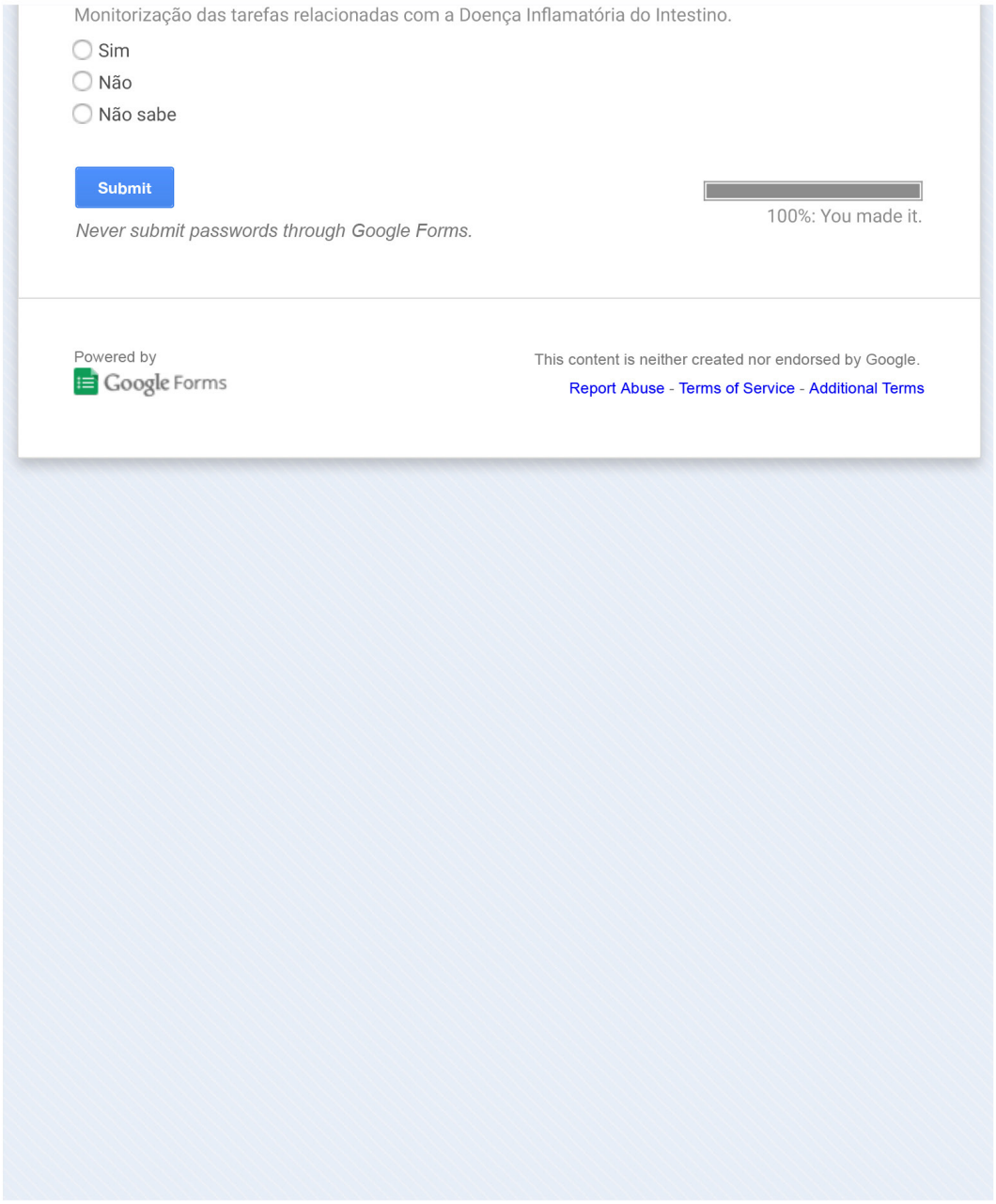
12] Que tipo de informação? (Se respondeu "Sim" no ponto 11, responda a esta pergunta)

Monitorização das tarefas relacionadas com uma consulta para a Doença Inflamatória do Intestino – Pergunta de escolha múltipla

- ☐ Data/ hora da próxima consulta
- ☐ Quantidade/ dia/ hora da medicação
- ☐ Data/ hora das próximas análises
- ☐ Data/ hora do próximo exame complementar
- ☐ Other: _____

13] Se tivesse disponível gratuitamente uma aplicação multiplataforma (Telemóvel e computador) que permitisse uma melhor gestão da informação da sua doença, estaria disposto a utilizar?

Annex. 12— APDI members online survey (Copy) – Page 4/4



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Ministério da Educação e Ciência

APDI Associação Portuguesa da Doença Inflamatória do Intestino

Testes de usabilidade – Análise de tarefas

1. **Enquadramento e objetivos**
   Testes de usabilidade desenvolvidos no âmbito de uma investigação de doutoramento da FCSH.UNL – Faculdade de Ciências Sociais e Humanas da Universidade Nova de Lisboa, integrada no programa doutoral UT Austin|Portugal CoLab, financiada pela FCT – Fundação para a Ciência e Tecnologia e com o apoio da APDI – Associação Portuguesa de Doença Inflamatória do Intestino.
   O estudo solicitado tem como principal objetivo, analisar um conjunto de tarefas pré-definidas em duas aplicações informáticas. Ambas em ambiente telemóvel (*smartphone)* com sistema operativo IOS 8.3 e uma delas, em computador.
   A autora desta investigação, tem a Doença de Crohn desde 2002.

2. **Aplicações informáticas em ambiente telemóvel e computador**
   - **myIBD (By The Hospital for Sick Children)**
     Telemóvel *(smartphone)*
     https://itunes.apple.com/us/app/myibd/id444728980?mt=8

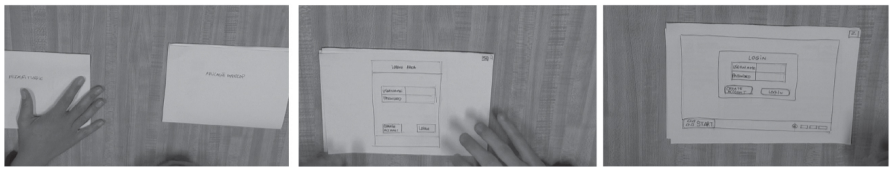
   - **GI Buddy (CCFA – Crohn's & Colitis Foundation of America)**
     Telemóvel (*smartphone)*
     https://itunes.apple.com/us/app/gi-buddy/id579320415?mt=8
     Computador
     https://gibuddy.ibdetermined.org

3. **Duração dos testes/questionário (Previsão)**
   - 01h00 – Testes de usabilidade;
   - 15mt – Questionário *online*.

4. **Data, hora e local**
   - 18 de Abril – Das 10h00 às 16h00 • FCSH.UNL (Av. de Berna 26 C – Lisboa);
   - De 20 a 24 de Abril – Das 18h00 às 21h30 • FCSH.UNL (Av. de Berna 26 C – Lisboa).

5. **Instruções**
   Para a **GI Buddy** será necessário criar um *Log In* no *link§*, antes da realização dos testes.
   https://www.ibdetermined.org/Register/default.aspx?source=gibuddy

6. **Nota**
   Os testes vão decorrer nos dispositivos da autora (iPhone 4S e Apple Mackbook Pro) bem como, filmados em tempo real. Nas filmagens, vão aparecer somente as mãos dos intervenientes (Ver exemplo em *printscreens* extraídos de um vídeo). Instruções mais detalhadas são divulgadas aos utilizadores que aceitarem realizar os testes.



Printscreens pertencentes à investigação (Pernencar, C. 2014. pp: 562)

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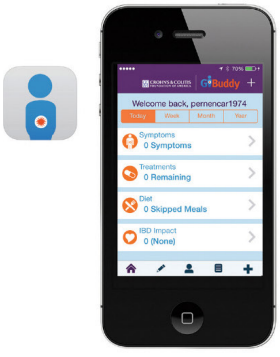
Testes de usabilidade – Análise de tarefas

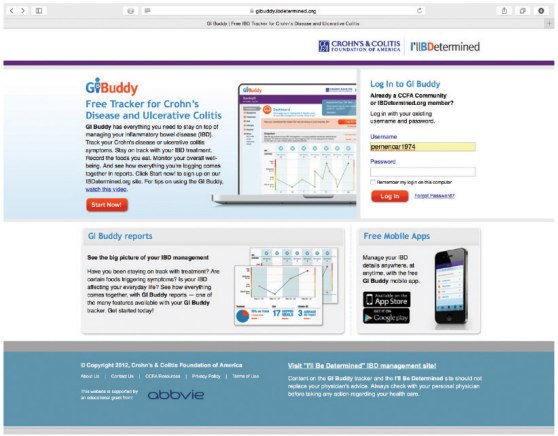
- **myIBD** (By The Hospital for Sick Children)

Printscreen – Smartphone

- **GI Buddy** (CCFA – Crohn's & Colitis Foundation of America)



Printscreen – Smartphone



Printscreen – Computador

Annex. 14— Release for APDI members who accepted to participate in Usability Tests – Instructions, scenarios and tasks – Page 1/2

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APDI Associação Portuguesa da Doença Inflamatória do Intestino

Testes de usabilidade – Análise de tarefas

Este estudo desenvolvido no âmbito de uma investigação de doutoramento da FCSH.UNL – Faculdade de Ciências Sociais e Humanas da Universidade Nova de Lisboa, integrada no programa doutoral UT Austin|Portugal CoLab, financiada pela FCT – Fundação para a Ciência e Tecnologia e com o apoio da APDI – Associação Portuguesa da Doença Inflamatória do Intestino tem como principal objetivo, analisar um conjunto de tarefas pré-definidas em duas aplicações informáticas – **myIBD** & **GI Buddy** – ambas em ambiente telemóvel e uma delas em computador. O tempo de duração do processo, é aproximadamente de 01h15 e inclui a resposta a um breve questionário online, após a realização dos testes.

Instruções para os participantes
1] Deve seguir a ordem de escolha das aplicações conforme solicitado para cada tarefa;
2] Deve respeitar a sequência de execução das tarefas.

Cenário 1
Imagine que chegou exausto ao fim-de-semana, teve um aumento significativo de diarreias e o estado de humor alterou. Teve um semana desgastante do ponto de vista profissional com horas de descanso reduzidas, elevados níveis de stress, horários das refeições principais alterados e na grande maioria das vezes, optou por comida menos saudável. Esta situação fez diminur gradualmente a prática de exercício fisico.

Tarefa 1
1] Entre na aplicação para telemóvel **myIBD** e registe o episódio retratado no **cenário 1** selecionando as funcionalidades, que na sua opinião melhor caracterizaram esta ocorrência. Dentro da aplicação, a sequência do registo em cada área, fica ao seu critério;
2] Entre na aplicação para telemóvel **GI Buddy** e registe o episódio retratado no **cenário 1** selecionando as funcionalidades, que na sua opinião melhor caracterizaram esta ocorrência. Dentro da aplicação, a sequência do registo em cada área, fica ao seu critério.

Cenário 2
Imagine que após uma consulta de gastroenterologia, ocorreram alterações à rotina do tratamento da sua doença. Foi introduzido um novo medicamento bem como a prescição de um tratamento endovenoso hospitalar de 6 sessões a decorrerem quinzenalmente e com início de hoje a uma semana.

Tarefa 2
1] Entre na aplicação para telemóvel **myIBD** e registe o episódio retratado no **cenário 2** selecionando as funcionalidades, que na sua opinião melhor caracterizaram esta ocorrência. Dentro da aplicação, a sequência do registo em cada área, fica ao seu critério;
2] Entre na aplicação para telemóvel **GI Buddy** e registe o episódio retratado no **cenário 2** selecionando as funcionalidades, que na sua opinião melhor caracterizaram esta ocorrência. Dentro da aplicação, a sequência do registo em cada área, fica ao seu critério.

1

Cenário 3

Imagine que viajou de férias para um país da europa do leste. Após uma refeição com ingredientes desconhecidos mas saborosos, começou a sentir-se mal. Como atingiu 39º de febre, dirigiu-se às uregências do hospital local mas, sentiu dificuldades em explicar na língua inglesa, os seus sintomas bem como o algum do histórico relacionado com a doença. No entanto, lembrou-se que tem registado os episódios – desde o dia 1 de Janeiro de 2015 – numa aplicação para telemóvel.

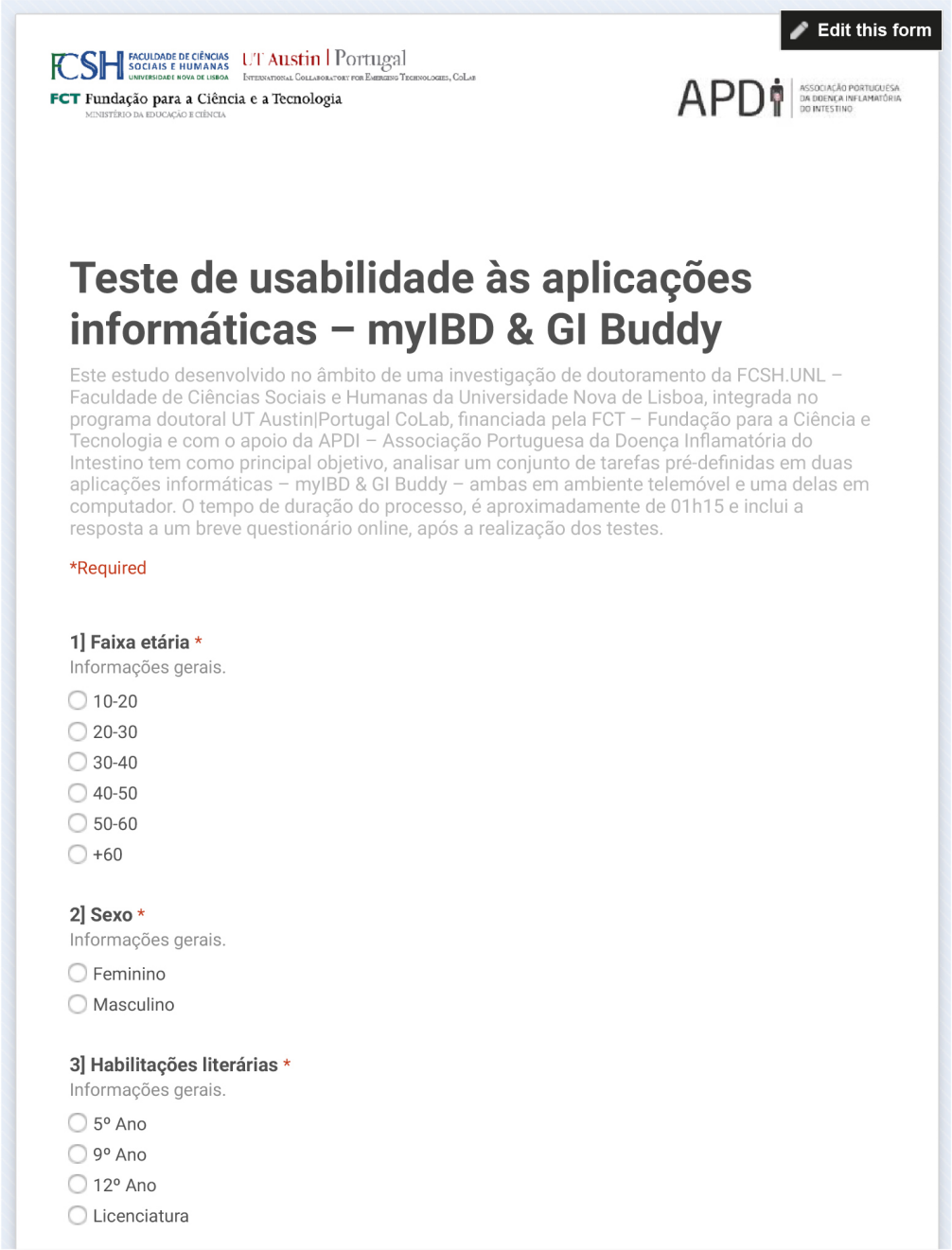
Tarefa 3

1] Entre na aplicação para telemóvel **myIBD** e procure o resumo do seu histórico desde o dia 01 de Janeiro de 2015 até ao dia de hoje. Crie automaticamente um relatório em forma de gráfico, escolhendo das opções disponíveis as que, pretende recolher informações – Melhor descrevem o que precisa;

2] Entre na aplicação para telemóvel **GI Buddy** e procure o resumo do seu histórico desde o dia 01 de Janeiro de 2015 até ao dia de hoje. Crie automaticamente um relatório em forma de gráfico, escolhendo das opções disponíveis as que, pretende recolher informações – Melhor descrevem o que precisa;

3] Entre na aplicação para computador **GI Buddy** e procure o resumo do seu histórico desde o dia 01 de Janeiro de 2015 até ao dia de hoje. Crie automaticamente um relatório em forma de gráfico, escolhendo das opções disponíveis as que, pretende recolher informações – Melhor descrevem o que precisa.

Annex. 15— Release for APDI members who accepted to participate in Usability Tests – Instructions, scenarios and tasks – Page 1/4



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APDI Associação Portuguesa da Doença Inflamatória do Intestino

Teste de usabilidade às aplicações informáticas – myIBD & GI Buddy

Este estudo desenvolvido no âmbito de uma investigação de doutoramento da FCSH.UNL – Faculdade de Ciências Sociais e Humanas da Universidade Nova de Lisboa, integrada no programa doutoral UT Austin|Portugal CoLab, financiada pela FCT – Fundação para a Ciência e Tecnologia e com o apoio da APDI – Associação Portuguesa da Doença Inflamatória do Intestino tem como principal objetivo, analisar um conjunto de tarefas pré-definidas em duas aplicações informáticas – myIBD & GI Buddy – ambas em ambiente telemóvel e uma delas em computador. O tempo de duração do processo, é aproximadamente de 01h15 e inclui a resposta a um breve questionário online, após a realização dos testes.

*Required

1] Faixa etária *
Informações gerais.

- 10-20
- 20-30
- 30-40
- 40-50
- 50-60
- +60

2] Sexo *
Informações gerais.

- Feminino
- Masculino

3] Habilitações literárias *
Informações gerais.

- 5º Ano
- 9º Ano
- 12º Ano
- Licenciatura

Annex. 15—Release for APDI members who accepted to participate in Usability Tests – Instructions, scenarios and tasks – Page 2/4

- ◯ Pós Graduação
- ◯ Mestrado
- ◯ Other: _____

4] Qual o tipo de doença que possui? *

Perguntas gerais relacionadas com a Doença Inflamatória do Intestino.

- ◯ Doença de Crohn
- ◯ Colite Ulcerosa

5] Há quanto tempo tem uma das doenças? *

Perguntas gerais relacionadas com a Doença Inflamatória do Intestino.

- ◯ < A 5 anos
- ◯ Entre 5 a 10 anos
- ◯ > A 10 anos
- ◯ Entre 15 a 20 anos
- ◯ > A 20 anos

6] Relativamente à execução da Tarefa 1 sentiu dificuldade em realizá-la?

Pergunta relacionada com o Cenário 1 – Tarefa 1.

- ◯ Sim
- ◯ Não
- ◯ Não sabe

7] Em que aplicação sentiu maior dificuldade? *

Pergunta relacionada com o Cenário 1 – Tarefa 1.

- ◯ myIBD (Telemóvel)
- ◯ GI Buddy (Telemóvel)
- ◯ Nenhuma das duas

8] Quais foram as principais razões das dificuldades que sentiu? *

Pergunta relacionada com o Cenário 1 – Tarefa 1 e de resposta múltipla.

- ☐ Aplicação visualmente pouco clara, causando dificuldades de interpretação
- ☐ Aplicação com funcionalidades demasiado complexas que levou-me a não conseguir concluir a tarefa
- ☐ A aplicação não tem as funcionalidades que necessito para completar a tarefa
- ☐ Other: _____

9] Relativamente à execução da Tarefa 2 sentiu dificuldade em realizá-la?

Pergunta relacionada com o Cenário 2 – Tarefa 2.

- ◯ Sim
- ◯ Não

Annex. 15— Release for APDI members who accepted to participate in Usability Tests – Instructions, scenarios and tasks – Page 3/4

- ◯ Não sabe

10] Em que aplicação sentiu maior dificuldade? *

Pergunta relacionada com o Cenário 2 – Tarefa 2.

- ◯ myIBD (Telemóvel)
- ◯ GI Buddy (Telemóvel)
- ◯ Nenhuma das duas

11] Quais foram as principais razões das dificuldades que sentiu? *

Pergunta relacionada com o Cenário 2 – Tarefa 2 e de resposta múltipla.

- ☐ Aplicação visualmente pouco clara, causando dificuldades de interpretação
- ☐ Aplicação com funcionalidades demasiado complexas que levou-me a não conseguir concluir a tarefa
- ☐ A aplicação não tem as funcionalidades que necessito para completar a tarefa
- ☐ Other:

12] Relativamente à execução da Tarefa 1 sentiu dificuldade em caracterizar a ocorrência?

Pergunta relacionada com o Cenário 3 – Tarefa 3.

- ◯ Sim
- ◯ Não
- ◯ Não sabe

13] Em qual da aplicações sentiu maior dificuldade? *

Pergunta relacionada com o Cenário 3 – Tarefa 3.

- ◯ myIBD (Telemóvel)
- ◯ GI Buddy (Telemóvel)
- ◯ GI Buddy (Computador)
- ◯ Nenhuma das três

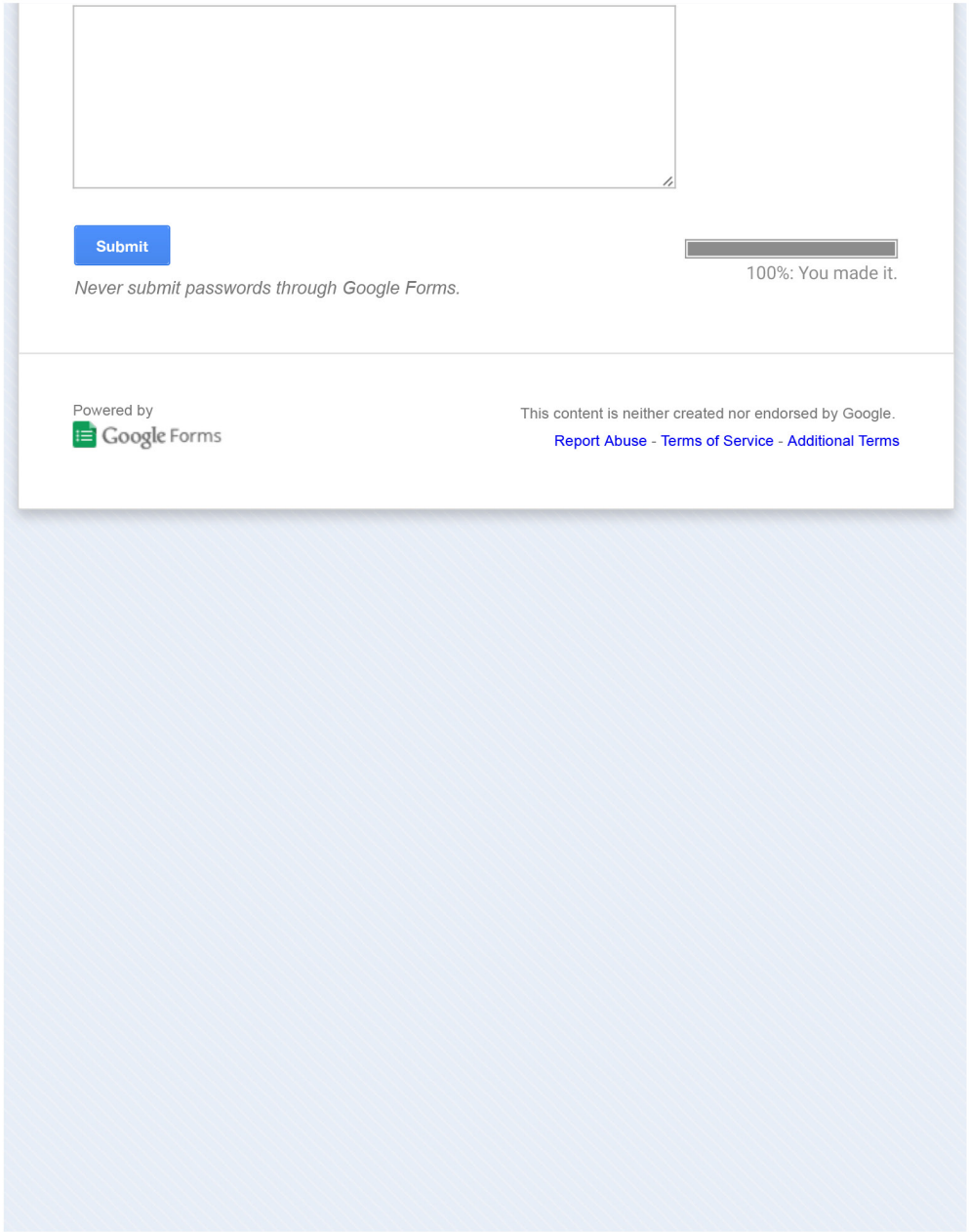
14] Quais foram as principais razões das dificuldades que sentiu? *

Pergunta relacionada com o Cenário 3 – Tarefa 3 e de resposta múltipla.

- ☐ Aplicação visualmente pouco clara, causando dificuldades de interpretação
- ☐ Aplicação com funcionalidades demasiado complexas que levou-me a não conseguir concluir a tarefa
- ☐ A aplicação não tem as funcionalidades que necessito para completar a tarefa
- ☐ Other:

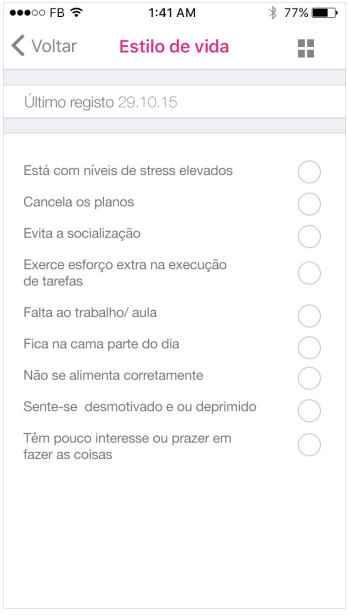
15] Deixe aqui as suas sugestões

Annex. 15— Release for APDI members who accepted to participate in Usability Tests – Instructions, scenarios and tasks – Page 4/4



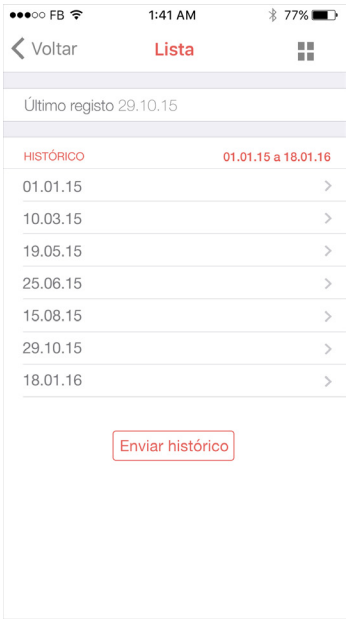
Annex. 16— Screenshot of "myCrohn" high-fidelity prototype – Login

Annex. 17— Screenshot of "myCrohn" high-fidelity prototype – "Estilo de vida" > Check list



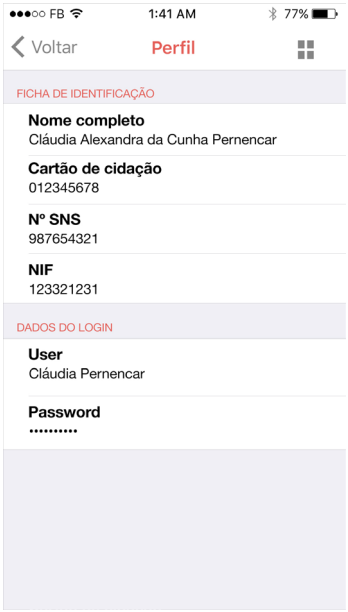
Annex. 18— Screenshot of "myCrohn" high-fidelity prototype – "Estilo de vida" > Checked items

Annex. 19— Screenshot of "myCrohn" high-fidelity prototype – “Medicamentos” >”Adicionar”

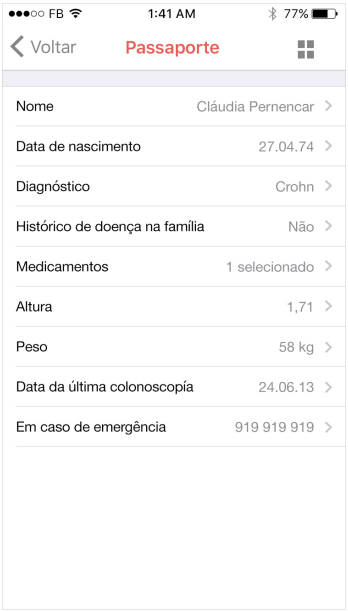


Annex. 20— Screenshot of "myCrohn" high-fidelity prototype – “Medicamentos” >”Adicionar”

Annex. 21—Screenshot of "myCrohn" high-fidelity prototype – “Perfil”



Annex. 22— Screenshot of "myCrohn" high-fidelity prototype – “Passaporte”



Annex. 23—Screenshot of "myCrohn" high-fidelity prototype – "Alimentação"

Annex. 24— "myCrohn" first click test – Release for APDI members who participate in the first Usability Tests – Instructions, scenarios and tasks – Page 1/3

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FCT Fundação para a Ciência e a Tecnologia
Ministério da Educação e Ciência

APDI Associação Portuguesa da Doença Inflamatória do Intestino

Testes de usabilidade – Análise de tarefas

Pacientes participativos
Monotorização da Doença Inflamatória do Intestino

1. Enquadramento e objetivos

Testes de usabilidade desenvolvidos no âmbito de uma investigação de doutoramento da FCSH.UNL – Faculdade de Ciências Sociais e Humanas da Universidade Nova de Lisboa, integrada no programa doutoral UT Austin | Portugal CoLab, financiada pela FCT – Fundação para a Ciência e Tecnologia e com o apoio da APDI – Associação Portuguesa da Doença Inflamatória do Intestino.

O estudo é solicitado aos pacientes que realizaram os anteriores testes de usabilidade. Tem como principal objetivo, analisar um conjunto de tarefas pré-definidas à aplicação informática em ambiente telemóvel com o sistema operativo IOS 9.0 e em computador. Ambos os sistemas foram criados em língua portuguesa e pertencem ao projeto *"myCrohn Disease on Real Time Information"*.

A autora desta investigação, tem a Doença de Crohn desde 2002.

2. Duração dos testes/ questionário (Previsão)

- 01h00 – Testes de usabilidade;
- 15mt – Questionário *online*.

3. Local, data e hora

Lisboa

FCSH.UNL (Av. de Berna 26 C – Lisboa)

- Janeiro – 14 (5ªf), 18 (2ªf), 20 (4ªf), 21 (5ªf) – Das 18h30 às 21h30;
- Janeiro – 16 (Sáb.) – Das 11h00 às 13h00.

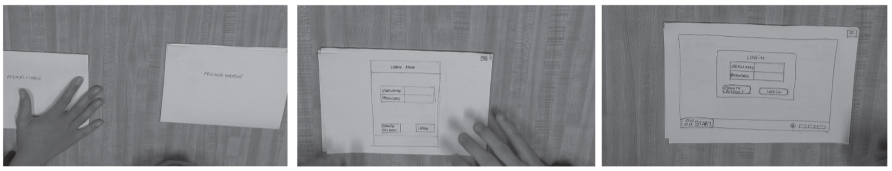
Porto

Sede APDI (Avenida Rodrigues Vieira, nº 80 - sala A Leça do Balio)

Janeiro – 12 (3ªf), 19 (3ªf) – Das 15h00 às 20h00.

4. Nota

Os testes vão decorrer nos dispositivos da autora (iPhone 4S e Apple Mackbook Pro) bem como, filmados em tempo real. Nas filmagens, vão aparecer somente as mãos dos intervenientes (Ver exemplo em printscreens extraídos de um vídeo). Instruções mais detalhadas são divulgadas aos utilizadores que aceitarem realizar os testes.



Printscreens pertencentes à investigação (Pernencar, C. 2014. pp: 562)

Annex. 24—"myCrohn" first click test – Release for APDI members who participate in the first Usability Tests – Instructions, scenarios and tasks – Page 2/3

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Testes de usabilidade – Análise de tarefas

Pacientes participativos
Monotorização da Doença Inflamatória do Intestino

Instruções para os participantes

1] Tipo de teste – "First Click";
2] Respeitar a sequência de execução das tarefas;
3] No final dos testes, preencher o questionário.

Cenário 1

Imagine que chegou exausto ao fim-de-semana, teve um aumento significativo de diarreias e o estado de humor alterou. Teve um semana desgastante do ponto de vista profissional com horas de descanso reduzidas, elevados níveis de stress, horários das refeições principais alterados e na grande maioria das vezes, optou por comida menos saudável. Esta situação fez diminuir gradualmente a prática de exercício fisico.

Tarefa 1

1] Entre na aplicação para telemóvel **"myCrohn"** e adicione os items disponíveis na "menu list" que melhor caracterizaram a ocorrência;

Tarefa 2

2] Registe o episódio retratado no cenário 1.

Cenário 2

Imagine que viajou de férias para um país da europa do leste. Após uma refeição com ingredientes desconhecidos mas saborosos, começou a sentir-se mal. Como atingiu 39º de febre, dirigiu-se às urgências do hospital local mas, sentiu dificuldades em explicar algum do seu histórico devido a não se recordar de alguns episódios. No entanto, lembrou-se que tem registos numa aplicação para telemóvel.

Tarefa 3

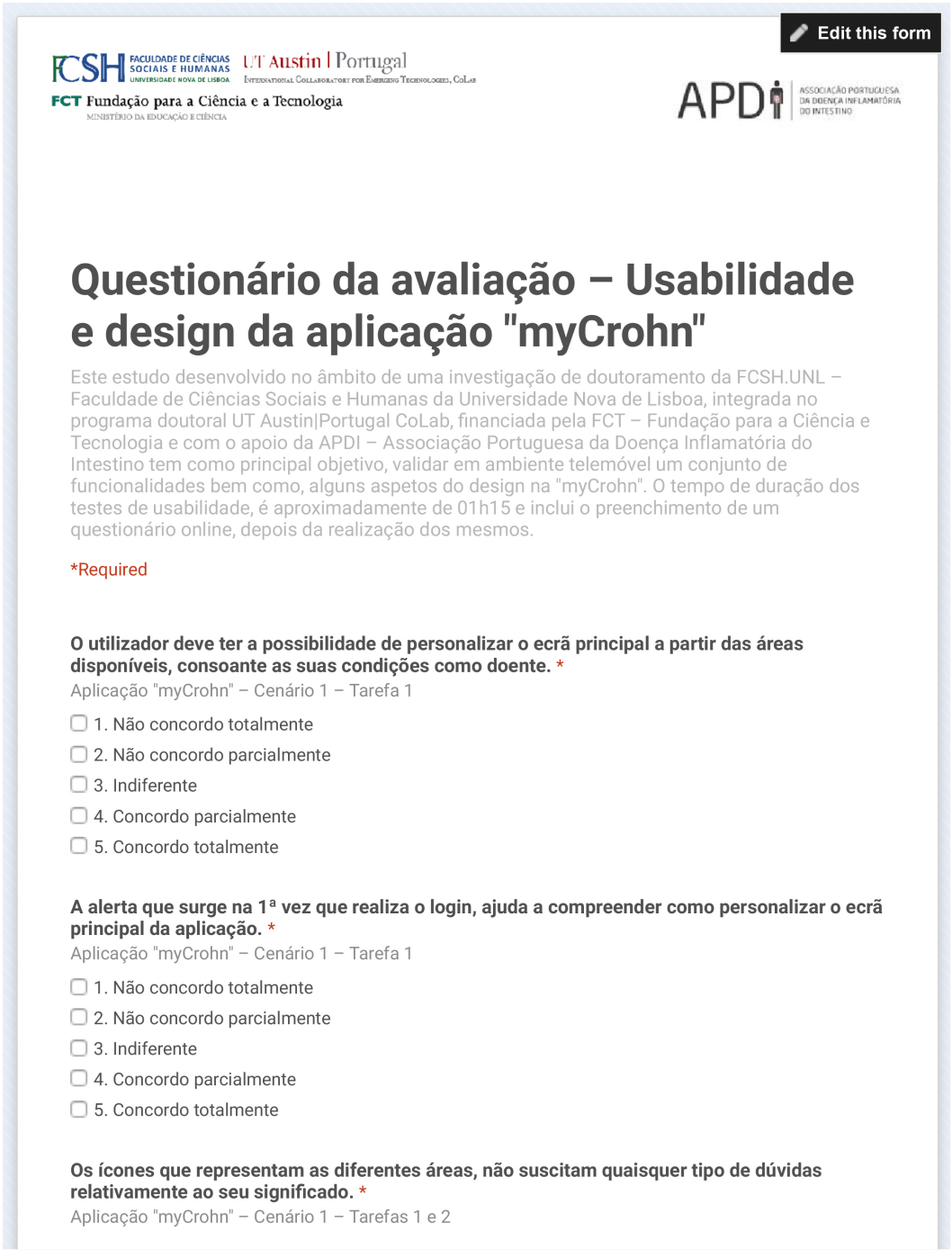
3] Entre na aplicação para telemóvel **"myCrohn"** e procure o resumo do seu histórico desde o dia 01 de Janeiro de 2015 até ao dia de hoje. Crie automaticamente um relatório em forma de gráfico, escolhendo das opções disponíveis as seguintes: "Consistência das fezes"; "Dor de barriga"; "Dejeções por dia" (Movimento inestinal) ; "Sangue nas fezes" (Rastreio do sangue).

Cenário 3
Após a sua consulta de gastroenterologia (hoje), recebe a notícia que a sua doença entrou em remissão. No entanto pretende continuar a registar as tarefas básicas na aplicação **“myCrohn”** como a marcação da próxima consulta – Dia 27.04.2016 – e que passa a tomar medicação “Humira” quinzenalmente durante 6 meses.

Tarefa 4
4] Entre na aplicação para telemóvel **“myCrohn”** e altere a página principal da aplicação, colocando somente os items “Medicamentos”, “Calendário” e “Histórico”;

Tarefa 5
5] No item “Calendário”, registe a próxima consulta e solicite um pedido de alerta, 1 dia antes de cada toma;

Tarefa 6
6] No item “Medicamentos”, registe a toma quinzenal da medicação “Humira” na dosagem de 40mg para os próximos 6 meses.



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Questionário da avaliação – Usabilidade e design da aplicação "myCrohn"

Este estudo desenvolvido no âmbito de uma investigação de doutoramento da FCSH.UNL – Faculdade de Ciências Sociais e Humanas da Universidade Nova de Lisboa, integrada no programa doutoral UT Austin|Portugal CoLab, financiada pela FCT – Fundação para a Ciência e Tecnologia e com o apoio da APDI – Associação Portuguesa da Doença Inflamatória do Intestino tem como principal objetivo, validar em ambiente telemóvel um conjunto de funcionalidades bem como, alguns aspetos do design na "myCrohn". O tempo de duração dos testes de usabilidade, é aproximadamente de 01h15 e inclui o preenchimento de um questionário online, depois da realização dos mesmos.

*Required

O utilizador deve ter a possibilidade de personalizar o ecrã principal a partir das áreas disponíveis, consoante as suas condições como doente. *
Aplicação "myCrohn" – Cenário 1 – Tarefa 1

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

A alerta que surge na 1ª vez que realiza o login, ajuda a compreender como personalizar o ecrã principal da aplicação. *
Aplicação "myCrohn" – Cenário 1 – Tarefa 1

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Os ícones que representam as diferentes áreas, não suscitam quaisquer tipo de dúvidas relativamente ao seu significado. *
Aplicação "myCrohn" – Cenário 1 – Tarefas 1 e 2

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Os ícones que representam as diferentes áreas são legíveis. *
Aplicação "myCrohn" – Cenário 1 – Tarefas 1 e 2

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Na área "Alimentação", os items apresentados são suficientes para o doente ter uma ideia geral deste contexto durante um episódio da doença. *
Aplicação "myCrohn" – Tarefa 2

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Na área "Estilo de vida", os items apresentados são suficientes para o doente ter uma ideia geral deste contexto durante um episódio da doença.
Aplicação "myCrohn" – Cenário 1 –Tarefa 2

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Na área "Episódios", os items apresentados são suficientes para o doente ter uma ideia geral deste contexto durante um episódio da doença. *
Aplicação "myCrohn" – Cenário 1 – Tarefa 2

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Gerar o relatório em forma de gráfico na aplicação, é de fácil percepção (visual) e execução

(sequência da tarefa). *
Aplicação "myCrohn" – Cenário 2 – Tarefa 3

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Enviar o relatório em forma de gráfico por e-mail na área "Histórico", é claro no que diz respeito à sequência da tarefa. *
Aplicação "myCrohn" – Cenário 2 – Tarefa 3

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Na área "Histórico" é útil também, ter disponível a opção para realizar o relatório em forma de lista. *
Aplicação "myCrohn"

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

O método interativo utilizado para realizar a tarefa 3, é simples e não levanta qualquer tipo de dúvida, seja ela relacionada com interpretação do ícone, legibilidade do mesmo, e ou com a consistência visual do design da aplicação. *
Aplicação "myCrohn" – Cenário 2 – Tarefa 3

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

O método de registo da consulta no "Calendário", não levanta quaisquer tipo de dúvidas do ponto de vista funcional. *
Aplicação "myCrohn" – Cenário 3 – Tarefa 5

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente

- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Na área "Calendário" é útil ter disponível a consulta dos diferentes eventos, com a opção de visualização semanal, trimestral, semestral e ou anual. *

Aplicação "myCrohn" – Cenário 3 – Tarefa 5

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

A interação com a aplicação a partir do segundo ecrã em cada uma das áreas, é coerente no geral. *

Aplicação "myCrohn"

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Na área "Episódios", o significado das cores – verde, laranja e vermelho – representa corretamente o contexto de cada item. *

Aplicação "myCrohn"

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

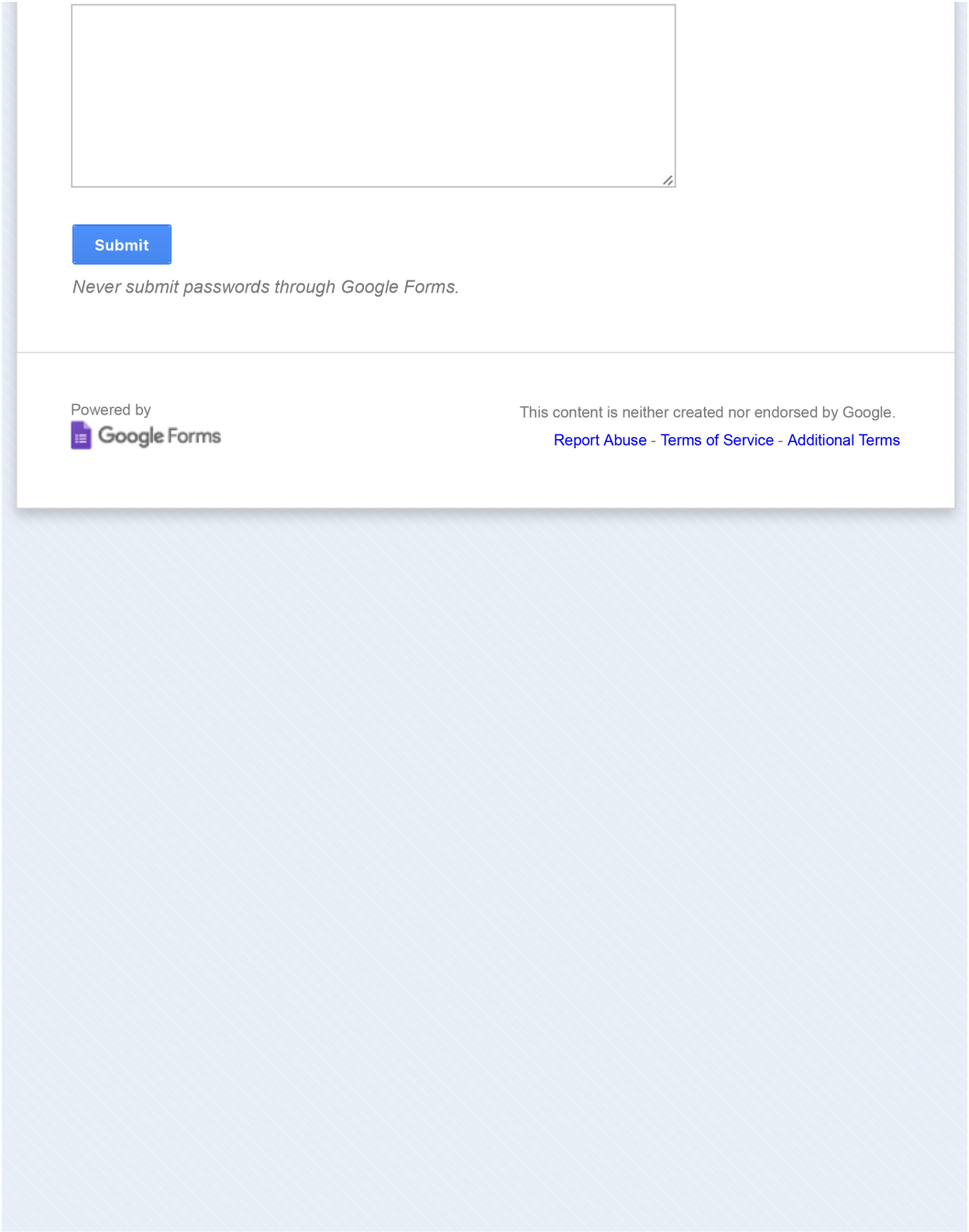
Nas áreas "Episódios" e "Alimentação", ao clicar nos botões – verde, laranja e vermelho –, a aplicação responde visualmente – "feedback" – sem suscitar quaisquer tipo de dúvidas relativamente à seleção de cada item *

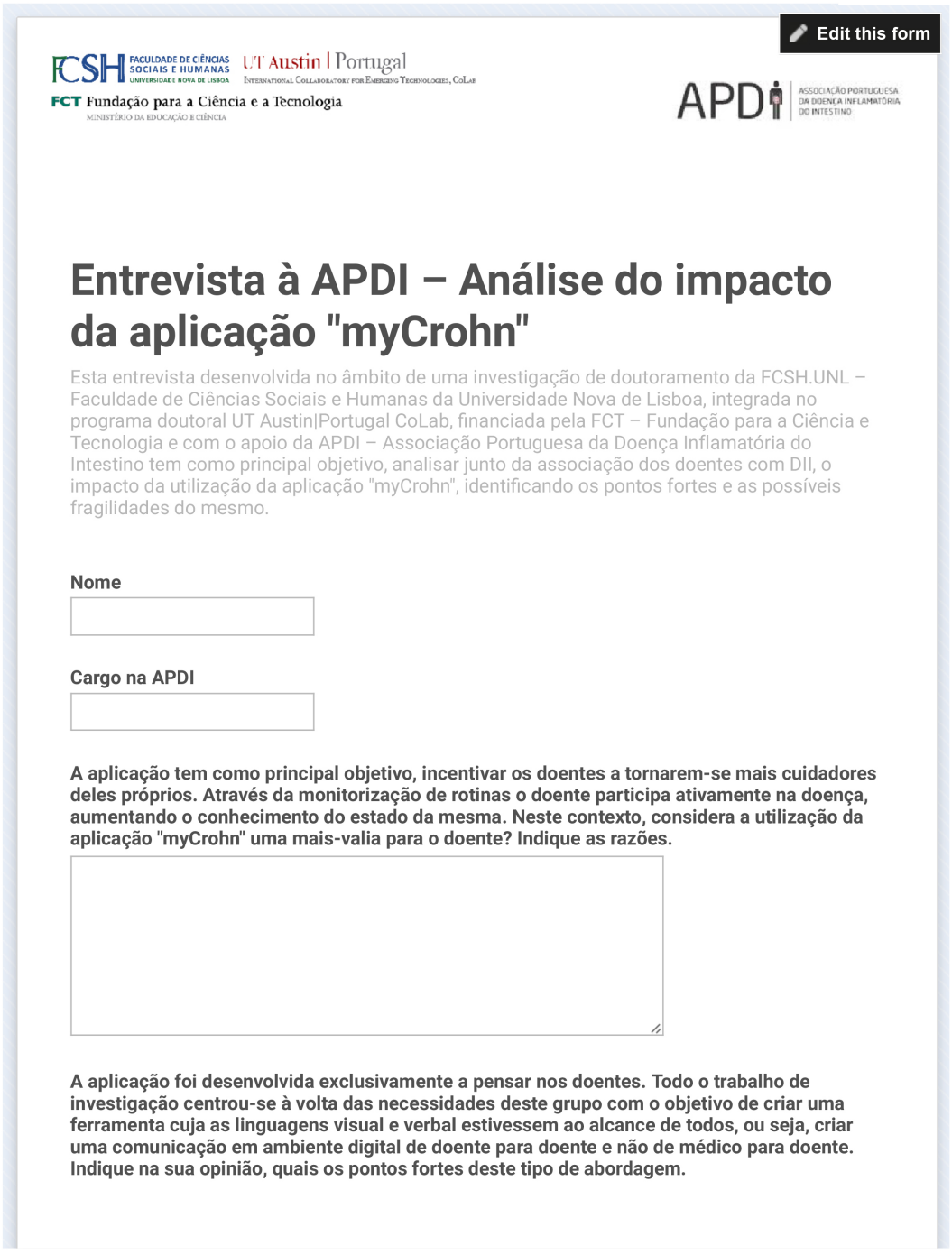
Aplicação "myCrohn"

- [ ] 1. Não concordo totalmente
- [ ] 2. Não concordo parcialmente
- [ ] 3. Indiferente
- [ ] 4. Concordo parcialmente
- [ ] 5. Concordo totalmente

Área de sugestões

Annex. 25— “myCrohn” first click test – Online survey – Page 5/5





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Entrevista à APDI – Análise do impacto da aplicação "myCrohn"

Esta entrevista desenvolvida no âmbito de uma investigação de doutoramento da FCSH.UNL – Faculdade de Ciências Sociais e Humanas da Universidade Nova de Lisboa, integrada no programa doutoral UT Austin|Portugal CoLab, financiada pela FCT – Fundação para a Ciência e Tecnologia e com o apoio da APDI – Associação Portuguesa da Doença Inflamatória do Intestino tem como principal objetivo, analisar junto da associação dos doentes com DII, o impacto da utilização da aplicação "myCrohn", identificando os pontos fortes e as possíveis fragilidades do mesmo.

Nome

Cargo na APDI

A aplicação tem como principal objetivo, incentivar os doentes a tornarem-se mais cuidadores deles próprios. Através da monitorização de rotinas o doente participa ativamente na doença, aumentando o conhecimento do estado da mesma. Neste contexto, considera a utilização da aplicação "myCrohn" uma mais-valia para o doente? Indique as razões.

A aplicação foi desenvolvida exclusivamente a pensar nos doentes. Todo o trabalho de investigação centrou-se à volta das necessidades deste grupo com o objetivo de criar uma ferramenta cuja as linguagens visual e verbal estivessem ao alcance de todos, ou seja, criar uma comunicação em ambiente digital de doente para doente e não de médico para doente. Indique na sua opinião, quais os pontos fortes deste tipo de abordagem.

Relativamente ao contexto referido na pergunta anterior, indique quais possam ser as fragilidades existentes neste tipo de estratégia.

Os critérios de seleção dos conteúdos apresentados na aplicação tiveram as seguintes referências: (1) experiência da autora da investigação como designer que foi aplicada durante a avaliação dos casos de estudo e construção do projeto; (2) necessidades constatadas no meio digital relativamente à DII; (3) experiência pessoal como doente de crohn. Neste sentido, e tendo em conta um dos principais objetivos da investigação – ajudar a comunidade de doentes a ultrapassar barreiras do conhecimento através do meio digital – o projeto foi desenvolvido sem recurso a qualquer supervisão clínica. No entanto, todo o trabalho de campo, foi realizado com recurso a doentes com DII. Indique quais os benefícios e as problemas que este tipo de estratégia pode trazer para o doente?

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