HEDI: An Online Platform for Healthcare Engineering Design and Innovation

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Abstract. Healthcare is a specialized sector in which products and service provision are embedded with professional requirements that are unfamiliar to most of the designers, and different stakeholders have quite different knowledge backgrounds, viewpoint of concerns, working styles, etc.. which make the communication and innovation among them complex and difficult. The Design Council in UK launched a free-to-access online EBCD (Experience Based Co-Design) toolkit to facilitate designers working closely with healthcare providers and patients in design process. In the College of Design and Innovation (D&I) of Tongji University in China, we are planning to establish an online platform based on the EBCD methodology to promote effective and efficient communication among different parties in healthcare design and innovation (healthcare providers, engineers, designers, patients, etc.) to encourage idea generating and sharing. In this paper, the functionality of the platform as well as some experience we obtained from the EBCD practice will be presented.

Keywords: Experience Based Co-design · Healthcare service system design
Online platform

1 Introduction

Healthcare is a specialized sector in which products and service provision are embedded with professional requirements, such as laws and regulations, norms and standards, technical terms, etc. which become the barrier preventing outsiders from knowing and making contribution to healthcare industry. Different parties and stakeholders in healthcare industry have obviously quite different knowledge background, viewpoint of concern, behavior and working style, habit, etc. which make the communication and innovation among them complex and difficult. Therefore, many efforts have been exerted to change such situation and to promote healthcare design and innovation.

1.1 International Researches in Healthcare Design

Many researches have shown that the concept of service design is helpful in managing huge and complicate healthcare service net, which potentially leads to break the barrier in healthcare design innovation. In 1991, professor Erlhoff in KISD firstly introduced

the concept of service design into design domain. Carnegie Mellon University, Polytechnic University of Milan and other design school made up a service design net, which contributed to the great development in academic study and practical practice of service design. The application of service design in healthcare domain was owned to the reform of NHS (National Health Service) in Britain [1] (Department of Health 2000). In 2005, NHS proposed an experience-based work model of healthcare service design-EBCD (Experience Based Co-Design) [2].

1.2   EBCD in Healthcare Design

NHS conducted more in-depth research on the EBCD methodology, made usage guides and toolkits freely available to interested designers via website. Therefore, EBCD has been well promoted. Freire and Sangiorgi found that involving service acceptors in the process of service design promoted patient's experience, but it also influenced the stability of service. After studied up to 80 healthcare service design projects which used Experience Based Co-design as a method, Donetto and other researchers [3] found that 50% interviewers believe it is a time-consuming program, and only 50% of them plan to apply EBCD to their work in the future, even out of 90% agree the biggest benefit of it lies in the involvement of patients indeed. This report demonstrated that study in EBCD should go further as far as in healthcare service design domain.

1.3   Healthcare Situation in China

Mention hospitals, people will always think of many bad experiences, such as a long line of waiting, bad smell of corridors, complex healthcare inspection items and so on. In recent years, frequent disputes between doctors and patients in our country have occurred, and some of them have become extremely polarized issues. Patient experience and healthcare staff experience were ignored by us.

Patients' experience was glaringly absent from the whole process of medical for a very long term, what's more, hospitals and doctors, not patients, are seen as the center in the whole process of healthcare service, but now, thing goes differently. In 2006, Medical Center in Cleveland, the top hospital in American, built "Patient Experience Office". In 2014, Shanghai First Maternity and Infant Hospital set up the "Patient Committee". In 2016, Dr. Smile Medical Group set a job position called "patient experience officer", who is in charge of examining the treatment process and getting feedback from patients. It indicates that the mounting public attention has been launched into EBCD in healthcare industry.

China has entered the age of aging. It is estimated that by 2023, the elderly population will exceed 300 million. The aging population will inevitably bring about more medical needs and further increase the medical burden on our country. High-quality medical service requirements and strong medical demand will inevitably bring more opportunities and challenges to China's medical industry.

2 Experience-Based Co-design (EBCD) in Healthcare Domain

2.1 Introduction of EBCD

EBCD is a form of participatory action research [4] that seeks to capture and understand how people actually experience a process or service. EBCD improves users' experience by deliberately involve service providers, users and stuff in the service activities, collect their subjective, personal feelings to identify touchpoints—key elements that influence a user's overall experience [5].

Drawing upon participatory design principles, the co-design element in EBCD aims at opening up the boundaries of designing in healthcare services in order to include new stakeholders and forms of expertise; patients are called to share their specialist form of expertise (knowledge) and participate in the design process from the idea generation stage [3].

Given the increasingly influential notion of co-designing public services ('service development driven by the equally respected voices of users, providers and professionals') [6, 7], EBCD represents one approach to reposition (largely) passive recipients of a service as more active consumers and citizens in a coalition, or partnership, with staff [8].

2.2 Practices in EBCD

Study in service design for healthcare in China is just beginning, only a few researches involved general introduction and case study about it, without any practical program. For example, the introduction about the principles, methodologies and system components of applying service design in abroad made by Changfu [9], the concept of healthcare service design in the digital era imposed by Miaosen [10]. There are more and more researches focusing on quality improvement in healthcare service from the perspective of process management and optimization (Xiansong) [11], but it lacks systematic study and application for medical service design in general design domain. EBCD provides an effective mentoring and methodological model for the healthcare industry to improve service quality and enhance service experience. However, no case of EBCD used in healthcare practice in China has been found yet, and there is a lack of research on EBCD and the characteristics of medical environment in China. In the meantime, domestic research on service design is still in its infancy, and there are few systematic design processes or methodologies targeted at enhancing healthcare service experience.

2.3 Analysis of EBCD

EBCD methodology seeks to equip users, providers and designers to work together on service and quality improvement to let designers who lack enough professional knowledge in healthcare domain get a much stronger support in such special design that will explicitly strive to improve users' experiences. Five main points of it are discussed here:

Multi-model Method of Design Process. The design process of EBCD combined both linear process and cyclic iteration process and four steps are included, see Fig. 1:
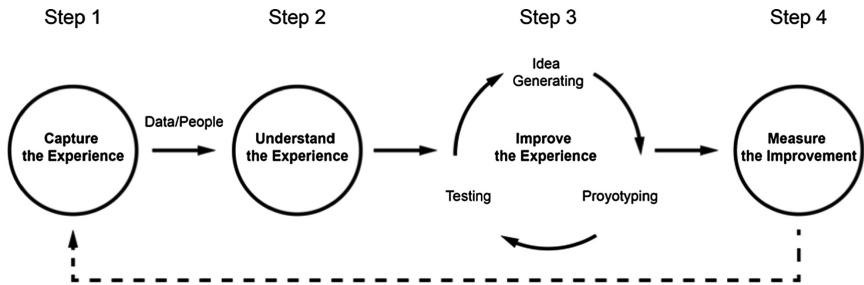
Fig. 1. Main process of EBCD methodology.

The First Step. Gaining users' experience and shooting videos correspondingly.

The Second Step. Defining the thing need to be improved and setting priorities. Since the videos made previously and patients, carers, and staff involved in the first step are brought into the second step to analyze, we can supplement and improve experience without returning to the first step, which is different from most of the cyclic iteration process in service method.

The Third Step. Design improvement, EBCD shared the similar process with other design method, by generating concept, making prototype, testing and getting feedback, to ensure designs meet real needs and promote design with more details.

The Fourth Step. Measuring the improvement, it links the end of this design process and the beginning of the next one to facilitate the improvement work in healthcare service design using EBCD become a sustainable and circular process.

Narrative-Based User Experience. What EBCD focused on is users' emotional experience which can indirectly reflect their demands and usability of service during that time, analyzing the reasons behind emotion can help to find out some potential demands. The primary way to collect users' emotion in EBCD is storytelling, that lead users to tell the real story when they accept service. Then we analyze the emotion involved in the story to explore the things need to be improved in service.

Make Patients, Carers and Staff Become Design Participators. Patients, carers and staff in EBCD methodology are not only seen as objects of study, but also the design participators, involved in every part of design process, who make active contribution to service improvement. It brings two benefits:

From the Short-term Design Process. It ensures improved service meet users' needs indeed, moreover, users' experience supply a gap that designers are unfamiliar with that service.

From the Long-term Design Process. It offers patients and stuff an opportunity to communicate and understand each other, which has the power to change their behavior

and attitude gradually, as a result, the quality of healthcare service will get improved with far-reaching influence.

Open Framework and Systematic Toolkit. EBCD provides methods and tools can be used in every step of design process, to be specific, poster design, conference agenda, etc. allowing people without getting trained can operate and implement EBCD according to the guidance. For designers, EBCD is an open methodology which provide inclusive framework of thinking to guide goals and outputs in each step, not just restricted to the application of some method or tool. In some practical projects, designers adjusted and adopted design tools in other field according to actual requirement like brainstorming, business canvas, etc. NHS and scholars in other institutions are keep going deeper in exploring and enriching theory system of EBCD, like introducing evidence-based design.

Online-Based Open Resource Pool. NHS provides free instructor of EBCD methodology and toolkit on its official website to people who are interested in to understand and use it, which contributed to the great accumulation of practical projects rapid development in theory in recent years. In order to promote the development in healthcare service design efficiently, NHS call on building user experience video library to collect user experience data to support relevant projects in the future. Video library is proved to reduce the working time and difficulty level effectively.

These innovation points of EBCD provide a strong back and reference for the online platform we want to build.

2.4   Limits of EBCD in China

Some experience we obtained from EBCD by analyzing its main features include: (1) EBCD was a direct response to observing how early projects – which includes extensive work to understand patient experience (much of it innovative at the time) - were paying insufficient attention to the co-design phase. Staff involved were relying on traditional, narrower approaches to making improvements to services. (2) Since the requirements on designers are much higher than before, online EBCD toolkit is not effective enough in current situation, however the approach to entering healthcare service design domain is still limited. We need a tool for designers to get better involvement, training, and communication in healthcare design. (3) Study of service design in China is just beginning, lacking methods and tools of design process. EBCD is not used in any practical projects in China so far, and there is lack of studies combining the features of healthcare environment in China with that in abroad. Localize EBCD to adapt to Chinese environment is the first step.

Healthcare industry in China is undergoing a series of changes: from product design to service design, from medical centered to healthcare centered, from offline hospital to online platform, from high-end hospital to primary hospital. China's healthcare industry is already at the critical point of innovation and reform. But the development of healthcare technology and the assignment of healthcare resource are different in the country. EBCD method can point a new direction of the development of Chinese healthcare industry. Based on EBCD, we need a more efficient tool for promoting healthcare design and innovation, with an accessible way to use.

3   HEDI (Healthcare Engineering Design and Innovation Platform)

In the College of Design and Innovation (D&I) of Tongji University in China, we are planning to establish an online platform based on the EBCD methodology to combine different fields (research, technology and practice) and promote effective and efficient communication among different parties in healthcare design and innovation (healthcare providers, engineers, designers, patients, etc.). HEDI (an online platform for healthcare engineering design and innovation) offers an opportunity for knowledge learning, information sharing, ideas generating and data collecting. It bridges the professional gap between multi-parties in healthcare design and lowers the collaboration obstacles between different parties and involves healthcare users in this process, see Fig. 2.
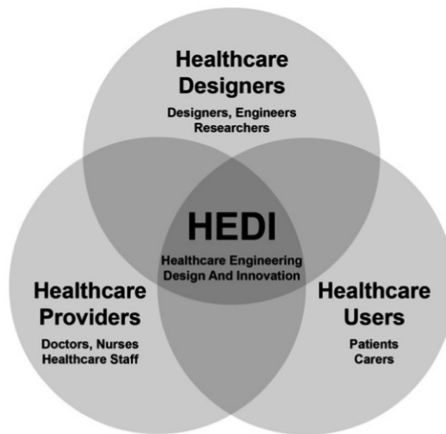

Fig. 2. Role of HEDI.

3.1   Importance of Building HEDI

By now, many efforts have been exerted to promote healthcare design and innovation. More and more designers and design organizations are engaged in design projects aiming at improving healthcare efficacy and quality. It raises the urgent need of a tool which enables the co-design be accepted and used in healthcare field.

Professionalism Knowledge Gap. It appears that the co-design discussions in which patients, staff and designers worked together to agree priorities were a crucial aspect of EBCD intervention and it focus on patient-centered care [12]. *But there is still a huge gap caused by professionalism between healthcare providers and designers, designers need to be involved in the EBCD method to make their contributions more useful and practical. In order to bridge the gap, it is essential to build an EBCD based platform which enables designers have access to healthcare knowledge.*

Multi-party Collaboration. Now more than ever, we need healthcare professionals working in the design field. Professional disciplines are bringing their expertise to the same table, yet these approaches still require a significant amount of translation. In this role, front line clinicians and other professionals need to translate healthcare to the designer in design field where significant improvement of user experience could be made [13]. To meet these demands, we need a resource sharing platform which can make the communication among different parties (researchers, engineers, healthcare providers, quality managers, patients and relatives, designers, etc.) more convenient and efficient.

Following Design Opportunities. The range of ideation tools within EBCD have been reviewed as limited, since they do not support participants to go beyond suggesting simple solutions to immediate issues [14]. It raises concern that more radical solutions as well as systematic possibilities for new service innovations are not explored following this participatory approach. It indicates a demand for individualized tools used within these activities to assist design activities. Therefore, some other improvements can be made following EBCD process such as data analysis, case study and personnel assignment.

3.2 Users of HEDI

Users of this platform can be divided into two parts: professional one who worked in healthcare industry and know it very well (healthcare providers, engineers, senior designers) and amateur one who want to know more about this domain (new designers, patients, carers), see Fig. 3.
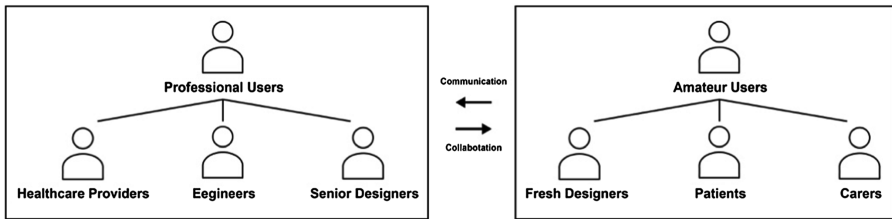
Fig. 3. Classification of users on this platform.

Patients and carers are the main users of healthcare service, they are also a huge missed group of people with true needs of healthcare service. It is essential to get patients and carers involved, they are encouraged to express their true feelings and comments about the service or processes they experienced in HEDI. Connections are built between them and healthcare service providers and designers.

EBCD projects typically take between 6–12 months to complete [15]. The relationship between each parties need to be maintained during this long process in order to make the experience consistent and fluent. By HEDI, they have access to discuss their project and share ideas. In this way, patients, as healthcare service users, gain a

sufficient attention from others. Designers have access to know more professional knowledge about healthcare and bring design methods into it. Healthcare providers have opportunities to know the real needs of users, existing problems and ways to deal with it.

3.3   Functionality of HEDI

EBCD is not only a part of the content, but also the structure of HEDI. We learn from EBCD process to build the framework of HEDI. Each functions, tools and materials are arranged according to a logical way (from capture experience, understand experience, improve experience, measure improvement to data analysis). Components of HEDI covered each main steps of EBCD, which completes the functions and highlights the logic in using it, see Fig. 4.
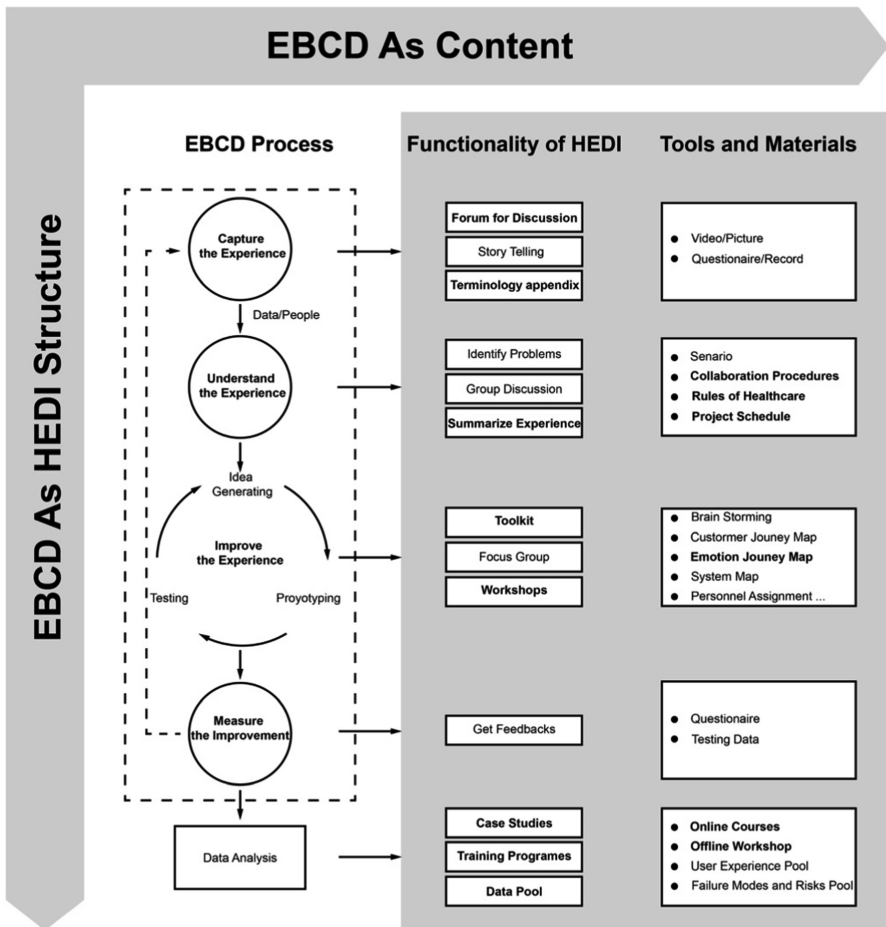

Fig. 4. Applying EBCD process in building framework of HEDI platform.

Considering different groups of users have different knowledge backgrounds, needs and potential contributions, this platform is designed as having two main function modules: communicating module and learning module. In terms of healthcare, designers who have little knowledge and experiences about it have access to professional people, target users and design methods. Patients who have direct experience on healthcare service have right channel to express and be involved in practical programs, see Fig. 5.
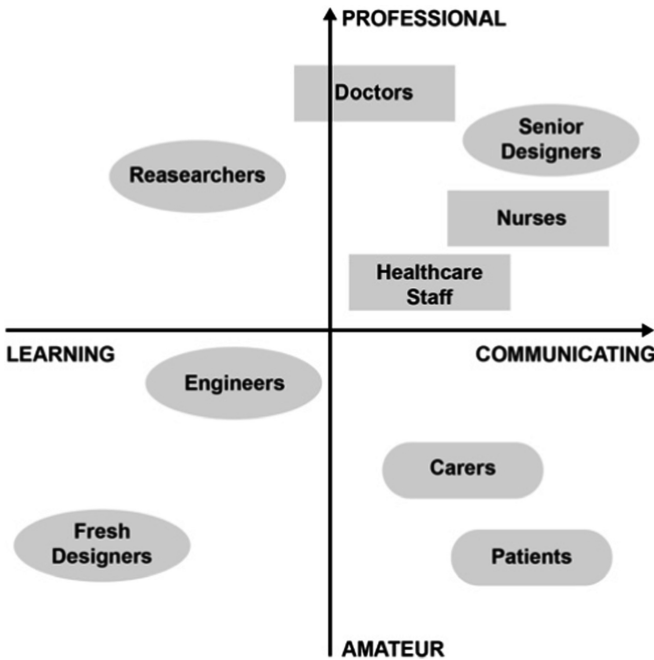

Fig. 5. Applying EBCD process in building framework of HEDI platform.

Communicating Module: For Different Stakeholders in Healthcare Design Domain

Forum. An open forum can facilitate knowledge sharing and idea expression between different parties. Every user can start new topics and post replies on the forum, for the purpose of discussing service quality, asking questions about service process, giving professional suggestions, sharing good experiences, etc. All information is classified in different sections according to different groups of people who engaged in (service providers, designers, service users, etc.), which enables information attaches to target people easily.

Terminology Appendix. It also makes the communication between different parties easier by translating the complex technical nature of their language into plain language, for the purpose of making unprofessional people understand. Terminology

appendix section can be built by users of HEDI, each of them have access to edit or create terminology appendix, especially in their own professional field. Some tables and objective questions are used for user testing, it helps healthcare users express their feelings and give suggestions. Set credit mechanism, building trust and finding a common ground between participants to stimulate information sharing in designers and service providers, and feedback from patients and carers, see Fig. 6.
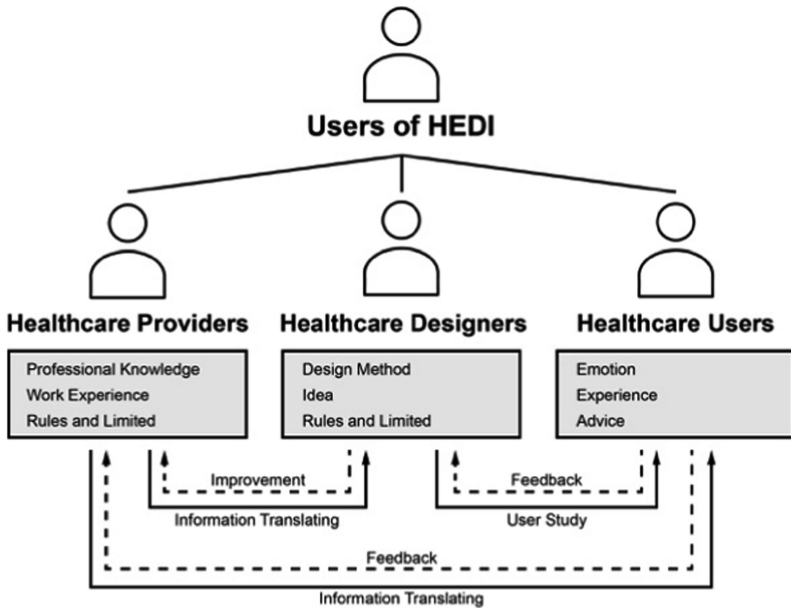

Fig. 6. Information flow between three main user groups.

Toolkits. Provide a suite of toolkits to facilitate communication between different parties, it includes useful models and tools like collaboration procedures, personnel assignment in focus group, questionnaire model, etc. which are managed according to design phases. These toolkits are generated from the experience of previous designers in healthcare service design, then exposed to fresh designers to work in a efficient way. It includes not only the rules need to be obeyed and skills designers have to command in healthcare design, but also the experience and advices about how to enter healthcare industry as quick as possible.

Workshops. Offline EBCD based workshops help to transfer knowledge and skills into concrete service outputs. Multi-parties can communicate and interact with each other in a direct way during workshops. Since users of HEDI have better acquaintance about how it works than people outside this field, it is convenient to recruit volunteers from HEDI to participate in focus group.

Learning Module: For Fresh Designers Who Want to Work in Healthcare Domain

Case Studies. Providing case studies and best practice examples to indicate the practical application of EBCD in healthcare, for new designers, is a good way to avoid unnecessary effort in exploiting principles and also a guidance. These cases, ranging from idea generation to implement phase, were uploaded by senior designers or experienced staff in the hospital by different ways like photos or videos, so that the authority of it could be confirmed.

Training Programs. Approximately 50% of those who have led EBCD projects did not receive any formal training in the approach [15]. It is necessary to provide training program like online courses for designers who plan to work at healthcare service design. Training programs are charge for a little fee for making videos and hiring teachers who can be senior designers and experienced professors. Offline workshops could also be reached in some fixed time in order to gather people who shared the same interests together to get trained and promote mutual learning.

Data Pool. The relevant data we collect from HEDI platform could be divided into different groups according to keywords, stages and stakeholders for later use. These data including subjective outcomes like user experience data, service quality, and objective outcomes like waiting time, numbers of users, etc. which indicate the touchpoints and problems in service system that will be quite useful in analyzing design trend and users' needs. These data, after manipulated and analyzed by statistical tools, could be an evidence base for building user experience pool, failure modes and risks pool. All of these are important for designers to do their work in a radical way.

4   Conclusion

HEDI provides designers an opportunity to enter the healthcare design industry to integrate their perspective and expertise into the real design and healthcare facilities with the strong support of users and healthcare professionals. On the implement of HEDI, several key questions are mentioned and solutions are provided accordingly. But some problems still need to be considered carefully in future, like the security of personal information, the facilitating mechanization of encouraging people to express their ideas, and statistics and analysis of big data we collected. Based on these general design guides, in consideration of different parties has different needs for engaging in HEDI, a design concept with large potential to develop really promising online learning, sharing and co-working platform are proposed in this study.

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