A Holistic Framework for Designing Mental Health Technology

by

Yuanbo Liu

M.A. Psychology, Chicago School of Professional Psychology, 2013
B.S. Material Science and Engineering, Zhejiang University, 2011

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Signature of Author_____
Integrated Design and Management Program
October 15, 2021

Certified by_____
Rosalind W. Picard
Professor of Media Arts and Sciences, MIT Media Lab, Affective Computing Group
Thesis Supervisor

Certified by_____
Rama Ramakrishnan
Professor of the Practice, Sloan School of Management
Thesis Supervisor

Accepted by _____
Tony Hu
Director, Integrated Design & Management Program

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Abstract

The global burden of mental disorders accounts for an estimated 32.4% of years of healthy life lost due to disability. By 2030, mental disorders are forecast to become the leading cause of morbidity and mortality in the world. Mental health technologies (MHT) based on the internet, mobile apps, wearable sensors and artificial intelligence have great potential to expand the capacity of mental health resources, improve treatment efficacies and even revolutionize mental health care. However, the real-world adoption and engagement of MHT have been underwhelming.

In order to create MHT that can meet real patient needs, keep users engaged in the long run, while meeting the requirements of external stakeholders such as regulatory bodies, clinical systems and healthcare payers, I propose a holistic framework for designing MHT that integrates patient-centered design and technology life cycle design.

This thesis also uses designing for depression patients in China as a case study to illustrate, on a high level, how the framework can be used to guide the design process in a specific real-world setting.

Thesis Supervisor: Rosalind W. Picard

Professor of Media Arts and Sciences, MIT Media Lab, Affective Computing Group

Thesis Supervisor: Rama Ramakrishnan

Professor of the Practice, Sloan School of Management

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This thesis is another starting point for my mission to promote psychological resilience and wellbeing in the world. Here is to thank all who helped me to start again!

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Chapter 1. Mental Health Challenges & Technologies

1.1 Challenges in Global Mental Health

Mental disorders are alarmingly prevalent in the global population. An estimated 1.1 billion people are suffering from mental or substance use disorders (Whiteford et al., 2016). Globally, more than *one in four* people will experience mental illnesses[1] at some point in their lives (World Health Organization, 2001). The lifetime prevalence of any mental disorder in the United States is reported to be as high as 47.4% (Kessler et al., 2007). A recent workplace survey in the UK even showed that *nine in ten* workers had been affected by mental health challenges directly or through people close to them (Accenture, 2018).

By the year of 2030, mental disorders are projected to become the leading cause of morbidity and mortality in the world (World Health Organization, 2012). The global burden of mental disorders accounts for an estimated 32.4% of years lived with disability (years of healthy life lost due to disability) (Vigo et al., 2016). Mental disorders also amplify the health impact and suffering of other leading illnesses such as diabetes, heart disease and cancer. People with severe mental disorders have a life expectancy that's 20 years shorter than those who do not (Hewlett & Moran, 2016). Every 45 seconds someone succeeds in a suicide attempt, leading to more than 700,000 deaths each year (World Health Organization, n.d.).

This tremendous burden of mental disorders is further worsened by the widening treatment gap. More than 70% of patients worldwide lack access to care for their mental health challenges (Kohn et al., 2004). Even for the patients who do receive treatments, the quality is often poor. For instance, only one in five depression patients in high-income countries receive minimally

[1] Terms including mental disorder, mental illness and mental health challenge are used interchangeably in this thesis.

adequate treatment, while the number for low-income and middle-income countries is a staggering one in 27 (Thornicroft et al., 2017).

There is little evidence that the treatment gap is reducing, especially in middle- or low-income countries. In China, more than 80% of people with a mental or substance use disorder do not seek any treatment at all (Huang et al., 2016). One major reason behind the treatment gap is the lack of high-quality healthcare professionals. There are 5.2 mental health professionals per 100,000 people in China, compared to 28.2 per 100,000 people in Western developed countries (V. Patel et al., 2016). Additionally, the level of professional training for psychiatrists and nurses in China is astoundingly low, with 29% of physicians having only a technical school degree and 46% of nurses having no academic qualifications (Liu et al., 2013).

The magnitude of the problem, as well as the lack of adequate resources make up the foundation for the global mental health challenge. Moreover, persistent stigma still exists in most countries, propelling misunderstanding of mental illness, compelling patients to hide their conditions, and preventing them from receiving the support they desperately need. The lack of effective treatments also contributes greatly to the challenge, with low treatment engagement, declining effectiveness of pharmaceutical interventions, and lack of data on effectiveness "in the wild."

1.2 Mental Health Technology

Mental health technology (MHT) has the potential to address the challenges mentioned above and even revolutionize mental healthcare (Mohr et al., 2017). Technological solutions such as mobile apps, wearable sensors, artificial intelligence, and mixed reality, can assist or even lead patient self-care, diagnosis, monitoring, management and treatment. For instance, MHT has been created in the forms of mental health trackers, online patient communities, online

assessment tools, online automated therapy, tele-therapy, tele-psychiatry, AI chatbot therapy, and digital therapeutics.

MHT can be highly scalable, meeting the needs of patients in large numbers. It can be accessible to patients wherever and whenever, with low cost. It can battle stigma by creating a safe environment that keeps patients anonymous, and facilitating a consistently non-judgmental narrative. It can help track real-world data to deepen our understanding of mental illness subtypes and treatment effectiveness. At the core, MHT can enable health professionals to support patients more effectively and empower patients to take control of their own mental health.

1.2.1. The Progress in MHT

Technology is being widely used in mental health care right now (Doraiswamy et al., 2019). In recent years, there has been an explosive growth in the number of mental health technologies developed with the goal to manage or treat various mental disorders. There are well over 10,000 mental health apps available for download (Torous & Roberts, 2017). Multiple meta-analyses have reported significant improvement on targeted symptoms by smartphone app based interventions (Firth et al., 2017; Linardon et al., 2019; Weisel et al., 2019; Wu et al., 2021). For instance, Linardon et al. (2019) found that mobile interventions can make significant improvements on depressive and generalized anxiety symptoms, stress levels, general psychiatric distress, social anxiety symptoms and positive affect compared to the control conditions. These effects were robust even after adjusting for common biases in randomized controlled trials, including publication bias and type of control condition.

In the past two years, the declining stigma and rising demand during the Covid-19 pandemic have boosted the development of and investment in mental health technology significantly. The venture capital investment on MHT in 2020 topped $1 billion, and is on track to surpass $2

billion in 2021 (PitchBook, n.d.). Leading MHT companies like Headspace, Cerebral, Talkspace, Woebot, and Mindstrong have made strides in raising venture funding, acquiring market authorization from regulatory bodies, or expanding their client base.

One of the many exciting developments in MHT is Prescription Digital Therapeutics (PDTs), which has created a new therapeutic class similar to traditional drugs. These PDTs such as Pear Therapeutics' reSET-O for the treatment of Opioid Use Disorder, and Akili Interactive's EndeavorRx for the treatment of Attention Deficit Hyperactivity Disorder all have demonstrated strong safety and efficacy in randomized clinical trials, and received FDA's clearance to be prescribed by physicians to support patients' recovery (N. A. Patel & Butte, 2020; Woebot Health, n.d.). As one of the pioneers in developing PDTs for the mental health market, Pear Therapeutics has been able to use real-world data to showcase not only the efficacy of their product, but also the economic return for the healthcare system (Maricich et al., 2021; Velez et al., 2021).

The cutting-edge research in Artificial Intelligence (AI) and mental health is another encouraging area for MHT. While the application of AI in real-world mental healthcare settings is still rare, research has shown great promises in using predictive machine learning (ML), natural language processing (NLP) and Explainable AI (XAI) etc. to aid clinical diagnosis, prognosis, treatment and management of mental disorders (Lee et al., 2021).

For instance, ML algorithms can employ data from electronic health records, brain imaging, wearable sensors and social media platforms to classify mental disorders and predict progression of patients' conditions (Lee et al., 2021). NLP, which includes speech recognition, dialogue generation, sentiment analysis, etc. is particularly relevant for mental health because speech is the primary source of data used in treatment and diagnosis of mental disorders. NLP applications like automated chat therapy (e.g., Woebot) have already shown robust efficacy in

supporting patient recovery. XAI is a critical element in driving the traditional mental healthcare system's adoption of AI, because part of the challenge in AI adoption is rooted in issues like trust and transparency. XAI supplements the ML "black box" with semantic reasoning and causality models to make recommendations more understandable (Nariman & Shaban-Nejad, 2020). By integrating AI into MHT, patients in the future could enjoy technology-based mental health care that offers personalized, contextualized, just-in-time interventions to promote their mental health and wellbeing.

1.2.2. The Challenges of MHT

Even with all the exciting progress and solid evidence on intervention efficacy, MHT still faces a steep hill on the way to fulfill its great potential. The success that technology-based mental health interventions achieved in clinical trials and research hasn't been able to be translated into the real-world health care settings (Mohr et al., 2017). The overall adoption of MHT and user engagement have been consistently low. An analysis of real-world usage of mental health apps found a median 15-day retention rate of 3.9% (Baumel et al., 2019), meaning if 25 people signed up for a mental health app, by the start of the third week, there's only one user left.

MHT is also facing a number of challenges related to quality standards, data privacy, interoperability and ethics. Even though the American Psychiatric Association published a strong framework for evaluating MHT (APA, 2021), available products in the market still tend to have very low quality. Only 3.41% of apps on the market can justify their effectiveness claims with research, and the majority of the research was led by the team who developed the apps (Marshall et al., 2019). As promising as mental health AI is in creating highly personalized support experiences, the actual intelligence level of these agents is very limited and the risk of catastrophic responses that can lead to significant harms to patients is still not well mitigated. The sensitive nature of mental health data also makes privacy concerns especially strong, since

mental health is a highly stigmatized topic and patients could face strong prejudice and discrimination in life if their mental health related data was leaked. Moreover, integrating new technologies with the current mental healthcare system also takes trial and error, and in a conservative industry like healthcare, the speed will be especially slow.

The ethical dilemmas that all stakeholders in MHT, including the developers, regulators, healthcare professionals, etc., have to navigate also play a significant part in the slow adoption. To allow the industry to confidently push MHT forward, some of the ethical challenges need to be highlighted and addressed, including: how to use transparency and security to build trust, how to develop big data protocols that enable data sharing while protecting individual privacy, how to ensure MHT can promote equal access to effective treatment, rather than widening the gap, how to balance the need to address treatment gaps quickly and the need for safety and efficacy.

1.3. The Role of Design in Realizing the Potential of MHT

The development and research of MHT is full of excitement and frustration, just as any process of innovation to solve a complex social problem. Failures and challenges allow the MHT community to learn and adjust directions. Through stronger collaboration among all stakeholders in MHT, more rigorous validation regarding the efficacy of MHT in real-world healthcare settings, as well as progress in creating standards for safety, data security, and privacy, MHT development and adoption will progress over time (Tan et al., 2020). However, if the community doesn't change the current top down design approach, where the clinical researchers and developers design tools they believe are important for successful treatments, instead of getting comprehensive input from patients about their needs, challenges, and preferences, the low engagement and low adoption problem will be near impossible to tackle (Mohr et al., 2017).

Disciplined design practices need to play a pivotal role in the advancement of MHT. Patient-centered design can help MHT serve real patient needs, create user-friendly interfaces, and fit into patients' life rhythms through personalization, thus leading to higher chances of long-term user engagement. Whole life cycle design can help MHT better integrate with the mental health care system, incorporate cutting-edge research, and develop alignment with business models that can disseminate the technology into the hands of more patients. This thesis presents a holistic and structured design framework that details three layers of design to guide the complex and nuanced process of creating a MHT: the patient-centered design, the life cycle design and the infrastructure design. In Chapter 2, a detailed discussion will be shared on understanding real patient needs being the foundation for good MHT design. In Chapter 3, the focus is on the top challenges and guidelines for designing an engaging MHT through a patient-centered approach. In Chapter 4, I discuss designing a MHT to facilitate its whole life cycle, and meet the needs of various internal and external stakeholders beyond the patients. In Chapter 5, I present a structured design framework that integrates the guidelines on patient-centered design and designing for the life cycle.

Throughout the thesis, I use designing a MHT to support depression patients' long-term recovery in China as a case study to demonstrate how the design framework can be used in a real-life setting. Depression in China was picked as the focus of the case study because of the author's personal connections, the ever-worsening burden of mental illnesses in China and the growing interests in innovative mental health solutions.

Chapter 2. Understanding Real Patient Needs

In this chapter, I discuss the significance of understanding real patient needs as the foundation for designing a successful MHT, and how design teams can collect and analyze data to understand real patient needs, using depression patients in China as the example.

2.1. Significance of Understanding Real Patient Needs

A critical mistake teams make when designing a mental health technology (MHT) is to skip the comprehensive user research that enables deep understanding of the patient population they're serving. A technology that is based on unfounded assumptions about patients' needs and expectations will likely have difficulty keeping patient users engaged and supporting their recovery. Teams tend to dive into product ideation, or commit to product direction much before they develop a detailed and nuanced understanding of the real problems users face.

One of the problematic assumptions often held during MHT development is that patients SHOULD and WILL do what the product expects them to do. For instance, many mental health products expect users to engage with it daily, while in reality, the product doesn't serve important daily needs the user group has. Besides, over the journey of managing or recovering from mental health challenges, patients' needs evolve. If we don't understand the dynamic of patients' needs, the product won't fit into the user's lifestyle and rhythm, thus leading to quick disengagement from the product.

What helps keep patient users engaged in the long-term is that they're consistently getting values from the product; in other words, they are getting their needs met, from basic psychological needs (e.g., autonomy, relatedness) to specific functional needs (e.g., medication side effects understanding, connecting with clinicians, etc.). To do that, the design team must develop strong empathy with the patient population it is serving. Otherwise, the development

process will be just like assembling a puzzle in the dark. Understanding patient needs can shed light on the puzzle, allowing a better view of the interconnected pieces that comprise the complexity of mental health challenges.

Can a team skip user research if some of the team members are patients themselves, thus having strong empathy with the patient group the team is serving? Having team members who used to or still belong to the target patient group can offer a strong boost for the design quality, because these team members have unique perspectives to help dissect patient data, and highlight the insights that matter the most for product design. However, to conflate personal experiences with real understanding of the patient group is dangerous. The experience of any given mental illness is notoriously heterogeneous. One patient's top set of needs may be negligible to other patients. While user innovation has been proven to be a powerful mechanism for creating successful products, personal experience has its limits. Even if we keep reminding ourselves that personal experiences vary significantly, we still assume our experiences are common among the population because of consensus bias. One of the strongest examples comes from the differences in symptoms among depression patients from different cultures. For instance, Chinese depression patients report and emphasize cognitive function impairment more often than patients studied primarily in North America and Europe (R. Zhang et al., 2018).

How about if we have a group of mental health experts who can make evaluations of patient needs from various perspectives? This again can be a tremendous help, but there are still risks of missing top needs, or misinterpreting patient needs. As this thesis will show, while expert ratings sometimes align with patients' ratings, in other instances, experts can dramatically diverge from patients.

The above arguments have not yet touched on the need to understand subgroups of patients for the same condition. For instance, depression patients who are highly educated have very

different needs that contribute to medication adherence, compared to patients who have lower levels of education; depression patients with comorbidity (e.g., diabetes) face extra challenges in medication management than patients who don't have other chronic conditions. The depth of understanding we need to seek in order to have a chance to design a MHT that's relevant to the patients we're supporting requires us to collect patient user data from various streams, and see through the noise to find helpful insights. For the rest of this chapter, I use the depression patients in China as a case study on how a MHT design team can collect and analyze data to understand real patient needs.

2.2. Data Collection for Understanding Patient Needs

To understand user needs as deeply and vividly as possible, the design team wants to capture patients' experiences that are as close to their lived experiences as possible. Since real life is messy and complex, collecting data using multiple methods, including observation, interview, survey, etc. is necessary. It is additionally important to collect data through various channels, including direct data from patients, and secondary data through clinicians, families, and researchers.

However, the experiences of depression patients are often sensitive and highly private, which makes it more challenging to collect data that's close to the lived experiences. For instance, observing mental health patients' daily lives without influencing it is unlikely. Interviewing a patient while he or she is suffering through a mental illness also poses special challenges: many mental illnesses cause patients to distort their reflections so the interviews don't necessarily represent their real experiences.

For all these reasons, I relied on interviews & surveys with depression patients who are currently in remission or recovery as the main method of primary data collection. I also conducted literature reviews and interviews with clinicians to gain a holistic understanding of

depression patients' needs throughout their recovery journey. Thirty-nine semi-structured interviews with depression patients in China, who self-identified as either in the remission or recovery stage, were conducted in Mandarin Chinese. Each interview lasted between 70-90 minutes. The first 40-50 minutes focused on understanding their journey of recovery, from early symptom onset to where they were at the time of interview. The next 30-40 minutes focused on leading participants through an interactive survey to rate and rank top patient needs as well as potential MHT features that could support long-term recovery. The top patient needs were identified through preliminary literature review and pilot interviews. From those identified needs, thirteen were selected to include in the survey. I've also interviewed five mental health providers (four psychiatrists and one therapist) from China to incorporate their perspectives on patients' recovery journey, as well as patients' needs along the journey. All interview guidelines and surveys are included in the Appendix.

All interviewees were recruited through two organizations in China. One of the organizations was the leading telehealth platform connecting psychiatrists and patients, and the other was the biggest depression patient community in China. Recruiting materials were posted on their social media accounts. Participation was voluntary and unpaid. The interviews were conducted through video conference calls, and only audio was recorded.

Before sharing the findings, it needs to be emphasized that the insights shared about this group are only representative of a specific subgroup of patients, and do not represent the "typical" depression patient in China. The average age of the 39 patient participants is 29. 72% of them are female, compared to 49% in the Chinese population. Also, 72% of the participants have a college degree, compared to 15% in the population (National Bureau of Statistics of China, 2021). 100% of the participants used medication as a treatment modality, while less than 20% of the depression patient population in China actually receive clinical treatment (Huang et al., 2019).

2.3. Patient Needs Data Analysis

Throughout the data analysis process, our leading questions have been: 1. What are depression patients' top needs? 2. Why are they patients' top needs? 3. What insights can be developed to guide MHT design?

In the second half of the interview process, I asked patients to rate the importance of 13 needs we've identified through preliminary user research. These 13 needs include:

1. Reduce fear and accept depression.
2. Have hope for long-term recovery.
3. Understand depression scientifically (e.g., symptoms, treatments, facts).
4. Improve self-awareness and self-understanding (e.g., emotional and cognitive patterns, environmental impacts).
5. Record and analyze personal data and patterns (e.g., mood, symptom, exercise, sleep).
6. Recover from psychological trauma.
7. Have willingness and motivation to make persistent recovery efforts.
8. Learn depression management & recovery skills (e.g., mood regulation, stress management, communication).
9. Change health behaviors effectively (e.g., sleep, exercise, nutrition, social activities).
10. Personalized and contextualized recovery support (e.g., recommendations of most relevant information and suggestions based on individual characteristics and needs in various stages).
11. Manage medication systematically (e.g., medication education, adherence & tapering).
12. Be accepted and supported by others (e.g., society, family, friends).
13. Manage close relationships (e.g., family, intimate relationships) effectively.

Participants were asked to rate the importance of these needs in their recovery journey, with a scale from 1 to 5 (1 meaning "very NOT important", and 5 meaning "very important"). After the participants had rated all the needs by importance, they were then directed to rank the needs they deemed "very important", by assigning the number 1 to the most important, and 2 to the next most important, until they have ranked all the needs they gave a rating of 5. They were then asked to rate their satisfaction level of how well each need is being met at the moment of the interview, also with a scale from 1 to 5 (1 meaning "very NOT satisfied" and 5 meaning "very satisfied").

Table 2.1 Patient Needs with Average Importance Rating

Patient Needs	Important Ratings (out of 5)	Percentage of 5/5 Rating
Manage medication systematically (e.g., medication education, adherence & tapering).	4.77	83%
Recover from psychological trauma.	4.56	69%
Reduce fear and accept depression.	4.54	71%
Improve self-awareness and self-understanding (e.g., emotional and cognitive patterns, environmental impacts).	4.51	74%
Have willingness and motivation to make persistent recovery efforts.	4.51	66%
Have hope for long-term recovery.	4.41	69%
Manage close relationships (e.g., family, intimate relationships) effectively.	4.41	66%
Be accepted and supported by others (e.g., society, family, friends).	4.38	57%
Change health behaviors effectively (e.g., sleep, exercise, nutrition, social activities).	4.33	66%
Personalized and contextualized recovery support (e.g., recommendations of most relevant information and suggestions based on individual characteristics and needs in various stages).	4.28	57%
Understand depression scientifically (e.g., symptoms, treatments, facts).	4.26	63%

Learn depression management & recovery skills (e.g., mood regulation, stress management, communication).	4.03	46%
Record and analyze personal data and patterns (e.g., mood, symptom, exercise, sleep).	3.23	17%

The results of the ratings are shown in Table 2.1, 2.2 and 2.3. Based on the average importance rating, the 13 needs can be sorted into three categories: 1. five very important needs with an average rating of 4.5 or higher; 2. seven important needs with an average rating between 4 and 4.5; 3. one not very important need with an average rating lower than 4. Note that all the needs included in the survey were selected by the research team because they were considered important needs, so the fact that a large majority of them were rated as important was expected.

In the section below, I describe the perspectives and experiences shared by interview participants on why they rated each need the way they did.

Top Needs

Manage medication systematically (e.g., medication education, adherence & tapering). Rating: 4.77/5.

All participants in our interviews have used medication as part of their treatment. For the majority of them, medication made the most significant difference in their recovery, and they strongly recommend other depression patients to seek out clinical help as early as possible and adhere to the doctor's guidance on medication strictly.

Many of the patients learned how important this need is the hard way. They had stopped medication prematurely because the side effects were too strong, or because they thought they could develop dependency on the medication. They would find themselves relapsing on depressive symptoms soon after, and having to start medication again. Eventually, they come to

realize how critical it is for them to manage medication according to doctor's recommendations. For instance, interviewee P.15 came to the conclusion that "the impact of relapse on our mind and body is way worse than whatever impact taking medication for the long-term has."

Throughout the interviews with clinicians and patients, I've found that even though clinicians have a strong sense of treatment planning for their patients, their patients don't perceive it that way. To them, everything is visit by visit: doctors make adjustments based on how they are doing when they see the doctors, and there's no long-term planning for their treatment. The reality is that psychiatrists can only spend around 10 minutes with a patient when he or she comes back to see them, and the frequency of visit is weekly or once every two weeks at best, and often monthly or more sparse. Doctors don't have enough time to address patients' concerns and questions regarding medication side effects or efficacy, or talk them through the evolving treatment plans. Without these knowledge, patients often find it challenging to interpret how their body is reacting to medication. In the end, they have to take up the responsibilities to research on medication online, and have too many opportunities in between visits to make medication changes on their own.

Recover from psychological trauma. Rating: 4.56/5.

The majority of depression patients can identify traumas they've experienced in the past that played a key role in them developing depression. Both the clinicians and patients emphasize that even though medication can help patients relieve symptoms in the short-term, to truly recover and lower the risk of relapse in the future, they need to "face the trauma, accept their existence," and "work on themselves." (P.11) They also agree that therapy is the best way to help meet this need.

However, because it's very difficult to find high-quality therapists in China, and therapy is very expensive (monthly expense for therapy is often around 3-4 times as high as medication

expense), the majority of the patients don't work with a therapist in the long-term to help them relieve their psychological trauma. Though, many patients have found other ways to help work through their internal struggles, like talking with family and friends, reading self-help books, or watching talks from expert therapists.

Reduce fear and accept depression. Rating: 4.54/5.

Mental illnesses are still highly stigmatized topics in China, with the majority of the society having few clues about what mental illnesses actually are, how they're caused, how to treat them, or what they mean to the patients and people around them, etc. Because of this, when patients are first diagnosed, even if they feel some sense of relief because now they found a reason behind their suffering, they often have immense fear and find it hard to accept the fact that they have depression.

It's not uncommon for patients to reject the diagnosis and even refuse treatment from doctors. For many, they have to go through a long process to finally accept depression. In the early stage, encouragement and confidence from doctors or friends and families can go a long way. Learning from other patients' recovery stories could offer reassurance as well. For most, a better understanding of depression makes it less mysterious and less scary. But sometimes, it takes desperation for a patient to finally face it. "It's either death or facing it, and I don't want to die." (P.06)

Many participants have identified that it was when they started to accept depression, to not fight it or to push it away, that they started to recover faster, and became better able to take control even when they run the risk of relapse. "Accept depression like it's your friend, then you can start to recover." (P.14) "I'm prepared to live with it my whole life. No matter if it's just a couple months, a couple years, or my whole life, it's OK. I don't set expectations now, and take it day by day." (P.30）

Improve self-awareness and self-understanding (e.g., emotional and cognitive patterns, environmental impacts). Rating: 4.51/5.

Patients understand that the recovery journey for depression is long and winding. Along the way, one of the most important things, which also has been identified as a benefit of the illness by many patients, is to learn more about themselves. "The most critical of all is to know the self... It solved more than half of the problem for me." (P.08) After improving self-understanding, patients are able to understand their own actions and emotions better, and make adjustments more effectively.

While patients often use "self-reflection" as the way to improve their self-understanding, long-term therapy has been identified as the most highly effective way to help them improve self-awareness and develop a stronger sense of who they are.

Have willingness and motivation to make persistent recovery efforts. Rating: 4.51/5.

Recovering from any debilitating illness takes persistent effort. What makes recovering from depression even more difficult is that some of its most typical symptoms include: feeling of hopelessness, loss of interest in most activities, and lack of energy. All these symptoms make the smallest recovery effort feel like a giant undertaking.

During the acute stage of treatment, it's very difficult for patients to feel motivated to take on any recovery activities. This is when support from the doctor, family, and friends can make a huge difference. Little nudges and encouragement can help patients move forward one step at a time. Later on, after their symptoms improve and they can take more initiatives to recover, it's still very challenging to rely on self-discipline or willpower to motivate themselves, even though it has been the most mentioned method by patients. What patients often benefit greatly from are

mechanisms that have the potential to lead to more automatic positive behaviors, e.g., pursuing a hobby, or joining a social group etc.

Important Needs

Have hope for long-term recovery. Rating: 4.41/5

“Without hope, there is only one thing left: death!" (P.03) Hope has been regarded by many patients to be necessary for a successful recovery. They often get their hope from other patients' successful stories, from doctor's confidence and encouragement, as well as the progress they feel during recovery. Yet, many patients have shared the sentiment that "you cannot hold too much hope... living with depression is good enough for me." (P.06) For, during the journey of recovery, setbacks are just around the corner. The higher the hopes are, the more disappointments the patients feel when relapses happen.

Manage close relationships (e.g., family, intimate relationships) effectively. Rating: 4.41/5

Close relationships have the strongest and longest impact on a patient's recovery. But, the impacts are often negative. For many patients we interviewed, their family was the biggest source of stress and conflict, and even the cause of depression. "Many kids who suffer from depression are suffering FOR the family." (P.30) Patients developed a pragmatic mindset in managing their relationship with family: "If you still have hope with your family, then manage your relationship actively; if there is no hope, stay away from them!" (P.13) However, very few patients in the study actually mentioned deliberately learning new communication skills to help them manage their relationships more effectively.

Be accepted and supported by others (e.g., society, family, friends). Rating: 4.38/5

Participants shared that being accepted and supported by people close to them was the most powerful influence during recovery. Both clinicians and patients agree that strong support systems in life make recovery more likely and faster. Yet, many patients have given up on being accepted by their family or society, because of the misconceptions and stigma around mental health. “As long as my family doesn't add more pressure, I'm thankful." (P.07) "I feel strong shame about my depression. Others can't and won't accept my depression. It's almost a disability." (P.40)

Change health behaviors effectively (e.g., sleep, exercise, nutrition, social activities). Rating: 4.33/5

Clinicians and patients all agree that healthy habits in life often contribute to better mental health. However, even when patients intend to change their health behaviors for the better, they find it hard to actually do it. "You understand the benefits and all, but changing is what's difficult." (P.21) "Most people cannot do it... unless there's external pressure, like living with your family can help you develop a better daily rhythm." (No. 02). Some clinicians would heavily emphasize the benefits of exercise, and go so far as to "prescribe" exercise to their patients. Many patients have attributed their successful recovery to consistent exercise or healthy social activities.

Personalized and contextualized recovery support (e.g., recommendations of most relevant information and suggestions based on individual characteristics and needs in various stages). Rating: 4.28/5

Many participants had to go through experimentation to find the medication that really works for them. Some gave up on therapy while trying to find the therapist that "clicks" with them. They understand the heterogeneity of patient needs, and "every patient is different." (P.14). Yet, very few patients we interviewed had highly personalized support, where they developed deep

relationships with their care providers, because they barely spend any time with their psychiatrists, and good therapists are rare and expensive. It also takes great energy for them to research online extensively to try to find trust-worthy information that's helpful for them.

Understand depression scientifically (e.g., symptoms, treatments, facts). Rating: 4.26/5

While 63% of participants believe developing a scientific understanding of depression is important for recovery. Many do believe you don't have to understand depression too deeply to recover. "For most people, it's difficult to develop a deep understanding (of depression)." (P.04) "For a patient in the acute stage, they can easily just focus on the negative side (when they try to learn about depression)." (P.14). Free educational content related to depression has exploded in the past 5 years in China, making it much easier to learn about depression. Many patients read popular science articles about depression, books about therapy, and watch videos from psychologists on mental health.

Learn depression management & recovery skills (e.g., mood regulation, stress management, communication). Rating: 4.03/5

While the rating for this need is still "important," many patients don't associate skill learning with depression recovery. "Hope is way more important than skills." (P.01) Even though most believe learning cognitive and behavioral skills doesn't solve the core problems in depression, they still think it could be helpful. But patients in China have very little support in learning skills that can support their recovery. "I don't know where to go to learn these skills. Even when I was hospitalized, we didn't learn these." (P.06)

The Not too Important Need

Record and analyze personal data and patterns (e.g., mood, symptom, exercise, sleep). 3.23/5

Very few patients attempted to record their behaviors and moods during recovery through journals or forms they get from their therapists. Many expressed that "there's no motivation for recording my own behavior during the acute stage. It's very challenging, close to impossible." (P.15) Besides, some patients also believe "the more I'm reminded how bad I'm doing, the more annoyed I will feel." (P.02) In general, recording and analyzing personal data is not a need that patients actually feel strongly about. However, as will be discussed later on patients' rating of depression recovery MHT functionalities, a feature that can serve this need is actually highly rated in importance.

Table 2.2 Patient Needs with Average Priority Ratings

Patient Needs	Priority Ratings
Manage medication systematically. (e.g., medication education, adherence & tapering)	3.31
Reduce fear and accept depression.	3.40
Understand depression scientifically. (e.g., symptoms, treatments, facts.)	4.05
Have hope on long-term recovery.	4.17
Improve self-awareness and self-understanding. (e.g., emotional and cognitive patterns, environmental impacts.)	4.48
Have willingness and motivation to make persistent recovery efforts.	4.69
Recover from psychological trauma.	4.71
Personalized and contextualized recovery support. (e.g., recommendations of most relevant information and suggestions based on individual characteristics and needs in various stages.)	5.25
Change health behaviors effectively. (e.g., sleep, exercise, nutrition, social activities.)	5.48
Be accepted and supported by others. (e.g., society, family, friends.)	5.60
Manage close relationships (e.g., family, intimate relationships) effectively.	5.88
Learn depression management & recovery skills. (e.g., mood regulation, stress management, communication, etc.)	6.25
Record and analyze personal data and patterns. (e.g., mood, symptom, exercise, sleep, etc.)	8.67

Learnings from the Need Priority Ratings

The need priority rating represents how highly patients rank a need against other needs. The smaller the number is in priority rating, the more important patients believe a need is. As shown in Table 2.2, priority rating of recovery needs has been mostly consistent with what the average importance ratings tell us. Three needs do stand out with significant differences.

Understand depression scientifically.

The need to understand depression scientifically jumped up from number 11 (out of 13) in average importance rating to number 3 in priority ranking. It means this need is highly polarizing: for the 63% of patients who rated this 5/5 for importance, they believe this is one of the top needs; but for the 37% of patients who didn't rate it 5/5 for importance, they tend to think it's not an important need. This is consistent with the comments from the patients: the majority of them believe their understanding of depression is central to their recovery journey, because it helps them manage medication, reduce fear and maintain hope for long-term recovery; but many of the patients don't believe this can make a real difference in their recovery. Even clinicians shared the perspective that the best approach of patient education is to match their desire and ability to learn.

Recover from psychological trauma.

In contrast, the need to recover from psychological trauma dropped from the number 2 highest average importance rating to number 7 in priority rating. While patients generally believe the need to recover from psychological trauma is very important, they tend to put it on the back burner, compared to many other needs. The reason behind this is likely that even though the need to recover from trauma is central to long-term recovery, patients can still reach remission

without addressing the trauma directly. What's more, the process to recover from trauma is full of uncertainty and can take a long time.

Manage close relationships.

While managing close relationships was generally considered as important by the participants, its priority rating ranked it at number 11 (third to the last). As discussed above, many patients have developed a pragmatic mindset, where they've given up hope to develop a good relationship with their family, and have chosen to disengage with them because their family is a major source of stress in their lives. To them, a relationship takes two sides, and the best strategy is to let it go when they don't have any control on how the other side acts.

Table 2.3 Patient Needs with Average Satisfaction Rating

Patient Needs	Satisfaction Ratings (out of 5)
Manage medication systematically. (e.g., medication education, adherence & tapering)	4.36
Understand depression scientifically. (e.g., symptoms, treatments, facts.)	4.26
Reduce fear and accept depression.	4.23
Improve self-awareness and self-understanding (e.g., emotional and cognitive patterns, environmental impacts.)	4.08
Have willingness and motivation to make persistent recovery efforts.	3.90
Have hope on long-term recovery.	3.85
Recover from psychological trauma.	3.82
Personalized and contextualized recovery support. (e.g., recommendations of most relevant information and suggestions based on individual characteristics and needs in various stages.)	3.72
Change health behaviors effectively. (e.g., sleep, exercise, nutrition, social activities.)	3.62
Be accepted and supported by others. (e.g., society, family, friends.)	3.46
Manage close relationships (e.g., family, intimate relationships) effectively.	3.33
Record and analyze personal data and patterns. (e.g., mood, symptom, exercise, sleep, etc.)	3.33
Learn depression management & recovery skills. (e.g., mood regulation, stress management, communication, etc.)	3.28

Learnings from the Satisfaction Ratings

Table 2.3 shows the satisfaction ratings of patients' recovery needs at the time of interview, when they are in remission or recovery. Satisfaction rating represents how well patients feel each need is being met.

On average, patients don't feel highly satisfied with any of the needs (all ratings are below 4.5). However, these participants do feel satisfied with some of the top needs, including 1. The needs to manage medication systematically, 2. Understand depression scientifically, 3. Reduce fear and accept depression, and 4. Improve self-awareness. It means they managed to find services or resources that supported these needs during their recovery journey. The satisfaction ratings for many needs with lower importance ratings were low, but they don't represent the strongest opportunities to help the patients. The following needs were highly ranked in importance but received low satisfaction scores: 1. have willingness and motivation to make persistent recovery efforts, 2. have hope for long-term recovery, and 3. recover from psychological trauma. These three needs are the strongest unmet needs, even for patients who have found a way to recover from depression.

2.4. Feature Ratings Analysis

Patients were also presented with 17 ideas on technological tools or features that could potentially help them recover from depression, and asked to rate the importance of these ideas on a scale of 1 to 5. They were then directed to rank the ideas they rated as "very important", by assigning number 1 to the most important, and 2 to the next most important, until they've ranked all the ideas with a rating of 5. These 17 ideas include:

1. Recovery goal setting and progress tracking feature.
2. Diagnosis and assessment on cognition, affect and behaviors.

3. Personalized intervention (e.g., treatment modules, content) recommendation system.
4. Personal information recording, analysis, and report.
5. Easy to understand depression knowledge series (e.g., video, articles).
6. Patient online support and learning community (e.g., support groups, live lecture, expert Q&A).
7. Patient online community safety features (e.g., privacy, post management).
8. Positive psychology learning and practice module.
9. Mindfulness and meditation learning and practice module.
10. Cognitive and behavioral skills learning and practice module.
11. Gamification for positive feedback and engagement.
12. Mental health status and trend monitor/prediction with wearable and mobile data.
13. Patient recovery story/case study.
14. Clinician connection module (e.g., messaging, sharing personal information).
15. Family, friends and other support system connection modules (e.g., share personal information, share depression educational materials).
16. Medication management module (e.g., education, adherence, tapering).
17. AI therapist/recovery assistant.

Table 2.4 Feature Ideas with Average Importance Rating

Feature Ideas	Importance Ratings (out of 5)	Percentage of 5/5 Rating
Medication management module (e.g., education, adherence, tapering).	4.63	74%
Clinician connection module (e.g., messaging, sharing personal information).	4.53	74%
Patient online community safety features (e.g., privacy, post management).	4.47	56%
Personalized intervention (e.g., treatment modules, content) recommendation system.	4.37	62%

Cognitive and behavioral skills learning and practice module.	4.34	56%
Diagnosis and assessment on cognition, affect and behaviors.	4.34	53%
Personal information recording, analysis, and report.	4.24	53%
Patient recovery story/case study.	4.21	53%
Easy to understand depression knowledge series (e.g., video, articles).	4.21	50%
Positive psychology learning and practice module.	4.18	50%
Mindfulness and meditation learning and practice module.	4.16	38%
Mental health status and trend monitor/prediction with wearable and mobile data.	3.92	38%
Patient online support and learning community (e.g., support groups, live lecture, expert Q&A).	3.82	35%
Recovery goal setting and progress tracking feature.	3.82	32%
Family, friends and other support system connection modules (e.g., share personal information, share depression educational materials).	3.49	32%
Gamification for positive feedback and engagement.	3.32	9%
AI therapist/recovery assistant.	3.21	29%

As shown in Table 2.4, based on the importance rating for these feature ideas, we can sort them into 4 categories: 1. Two most important features, with rating higher than 4.5; 2. Four more important features, with rating between 4.3 and 4.5; 3. Five less important features, with rating between 4 and 4.3; 4. Six least important features, with rating lower than 4.

The two features with the highest rating, and with 74% of participants rating as "very important" are: *medication management module* and *clinician connection module*. This is strongly aligned with the needs ratings. Because clinical care was the foundation for the recovery of the participant group, a huge majority of them believe these features will help amplify the efficacy of clinical support and reduce their sufferings along the way. More specifically, patients believe "medication management is way more important for new patients," (P.21) and "clinician connection module can make it much easier to interact with your doctor, especially when you need them the most." (P.16)

The following four features can also be very helpful, but only around 60% of the participants rated them as "very important." *Patient online community safety* features are considered fundamental requirements, because privacy is particularly important for mental health patients. Patients want to *receive personalized recommendations* on their recovery process and helpful content, yet also have doubts on how accurate the personalized treatment journey could be because of the heterogeneity of patient needs. Surprisingly, even though "learning depression management & recovery skills" was one of the lowest rated needs, patients actually believe *digital Cognitive and Behavioral Therapy (CBT) modules* can be helpful for their recovery. Part of the reason behind this is that CBT resources are not very popular or accessible in China. Both patients and clinicians have doubts on how accurate *diagnostic surveys* can be in mental health, but they do agree it offers the best option to measure and track progress in a standardized way.

The next five features are less important, with only around 50% of participants rating them as "very important". *Personal information recording, analysis and report* is surprisingly highly rated, as the need to "record and analyze personal data and patterns" was the lowest rated patient needs. This highlights two interesting dynamics: 1. patients do want to learn more about their behavioral and affective patterns, so if there are effective tools, they're open to try them; 2. However, they're not inclined to put in a lot of effort to record and analyze the data themselves, and they're looking for passive data collection and insights.

Many patients look to gain hope and inspiration from the *journeys of recovered patients*, though they're also wary about comparing with others too much, because "people are so different, what works for others may not work for me." (P.09) *Easy to understand depression knowledge* series didn't receive a higher rating because many patients have highlighted that "you can already access this online, in a lot of places now." (P.08) However, patients are still looking forward to an approach that's more systematic and evidence-based. Many patients acknowledge that

positive psychology and *mindfulness* can be helpful in long-term recovery, but they can only support, instead of leading the recovery. The majority of the participants have not explored these interventions in the past.

The next six features were not considered as important, with only around 30% of participants rating them as "very important." *Using mobile and wearable data to monitor and predict mental health trends*—one of the hottest mental health technology research areas—is not well understood or accepted by the participants. "I'm very self-aware, so I prefer personal reflection (to understand how I'm doing), not being told by data." (P.01) "I'm not sure how accurate this can be, since mental health is highly subjective." (P.03) They also have concerns on privacy and data security, understandably. "This can be helpful for suicidal prevention or relapse prevention, but I don't know how I feel about being monitored all the time, and maybe my personal information can be leaked." (P.05) Some also emphasized that they don't need to be reminded more about the negative information, and "what matters more is what I can do to improve, not knowing what I already know..." (P.07).

Patient online community plays an important role in many patients' recovery, but it has to be under one condition: there are mental health professionals or recovered patient volunteers actively managing the community. Otherwise, "reading other patients' messages just make you feel worse and more hopeless." (P.14) With proper management, patient communities can help people feel less understood, less lonely, and learn helpful information that can facilitate their recovery.

Recovery goal setting and progress tracking feature is not favored by most patients because they believe "this will add more pressure, and I'll feel disappointed in myself if I don't meet the goals." (P.06) Pathological self-criticism is a typical symptom for depression patients, so goal-

setting needs to be more flexible, and the focus should be on accomplishment and self-compassion, instead of missing the goals.

Support system connection module and *gamification* received two of the worst ratings because most patients don't want to share the details of their recovery journey with their supportive system, and they don't believe gamification could help create more motivation for depression patients. However, the lowest rating is for the feature of an *AI therapist or AI recovery assistant (as shown in Table 2.4 above)*. Many patients have very low expectations on the intelligence level of an AI therapist at this time, citing how their experiences with chatbot in other contexts were highly unsatisfying. They also don't believe AI can build emotional connections with them. "Machine is machine, the interactions are emotionless; human connection is more important." (P.23)

Learning from the Feature Priority Ratings

Table 2.5 Feature Ideas with Average Priority Ratings

Feature Ideas	Priority Ratings
Medication management module (e.g., education, adherence, tapering).	3.28
Diagnosis and assessment on cognition, affect and behaviors.	**3.33**
AI therapist/recovery assistant.	3.90
Recovery goal setting and progress tracking feature.	3.91
Clinician connection module (e.g., messaging, sharing personal information).	4.00
Personal information recording, analysis, and report.	4.00
Cognitive and behavioral skills learning and practice module.	4.42
Personalized intervention (e.g., treatment modules, content) recommendation system.	**4.67**
Patient recovery story/case study.	4.94

Easy to understand depression knowledge series (e.g., video, articles).	5.00
Gamification for positive feedback and engagement.	**5.33**
Mental health status and trend monitor/prediction with wearable and mobile data.	5.38
Mindfulness and meditation learning and practice module.	5.62
Positive psychology learning and practice module.	**5.71**
Patient online community safety features (e.g., privacy, post management).	6.05
Patient online support and learning community (e.g., support groups, live lecture, expert Q&A).	6.75
Family, friends and other support system connection modules (e.g., share personal information, share depression educational materials).	7.27

As shown in Table 2.5, priority rating of features has been mostly consistent with the ranking based on importance rating. Three features do stand out with significant changes in relative importance.

Recovery goal setting and progress tracking feature was ranked at number 4, but only by 32% of the patients, even though the average importance rating put it at number 14 out of 17. So even though the majority of participants feel hesitant about this feature, because it could add more pressure and make people feel worse about themselves, the ones who are into goal setting and tracking believe this is one of the top features that could lead to significant boost for their recovery.

While the majority of patients believe it's critical to protect patient safety in online communities (ranked number 3 by average importance rating), they tend to rank the feature much lower relative to other features (ranked number 15 out of 17). Fundamentally, patients believe privacy and a healthy online environment is important by default, but that won't contribute greatly to the recovery process. Besides, patients always have the option to disengage with an online community when it's creating a negative impact on their recovery.

AI therapist/recovery assistant is the most polarizing feature of all. While ranked last with average importance rating, and only 29% of the patients think it's "very important," the ones who believe it is valuable are very excited about the potential, and ranked it number 3 relative to other features. Patients are excited about the opportunity to engage with the AI anytime, anywhere, and for it to reach as many patients as needed.

Patient Opinion on Digital Mental Health Tool

Patients also shared their sentiment about a MHT that potentially includes some of the features mentioned above, to support depression recovery. The average importance rating for such a product is 4.57 out of 5. Participants believe a digital therapeutic product that takes on a systematic and evidence-based approach can save patients a lot of effort in having to find all the relevant information and resources from various places by themselves. As hospital visits are so short, doctor appointments are hard to get and therapy is so expensive, this product has the potential to make affordable therapeutic interventions accessible and convenient. The product could also offer patients who are more private to get help without having to talk to other people.

However, patients are also very aware of the constraints of the current technology. Participants believe the value of the product is limited during the acute stage when they don't have much agency to engage with an app. It's also a challenge to gain patient's trust on its efficacy, as the concept of digital therapeutic is very new. Many patients also mentioned that for patients with older age or lower level of education, it may also be more difficult for them to try or keep engaging with these products.

Table 2.6 Feature Ideas Team Ratings vs. Patient Ratings.

Feature Ideas	Team Rating	Feature Ideas	Patient Rating

Personalized intervention (e.g., treatment modules, content) recommendation system.	5.00	Medication management module (e.g., education, adherence, tapering).	4.63
Cognitive and behavioral skills learning and practice module.	4.80	Clinician connection module (e.g., messaging, sharing personal information).	4.53
Patient online community safety features (e.g., privacy, post management.)	4.60	Patient online community safety features (e.g., privacy, post management).	4.47
Recovery goal setting and progress tracking.	4.40	Personalized intervention (e.g., treatment modules, content) recommendation system.	4.37
Clinician connection module (e.g., messaging, sharing personal information).	4.40	Cognitive and behavioral skills learning and practice module.	4.34
Medication management module (e.g., education, adherence, tapering.)	4.33	Diagnosis and assessment on cognition, affect and behaviors.	4.34
Patient online support and learning community (e.g., support groups, live lecture, expert Q&A.)	4.20	Personal information recording, analysis, and report.	4.24
Easy to understand depression knowledge series (e.g., video, articles.)	4.00	Patient recovery story/case study.	4.21
Patient recovery story/case study.	4.00	Easy to understand depression knowledge series (e.g., video, articles).	4.21
Positive psychology learning and practice module.	3.80	Positive psychology learning and practice module.	4.18
AI therapist/recovery assistant.	3.80	Patient online support and learning community (e.g., support groups, live lecture, expert Q&A).	3.82
Diagnosis and assessments on cognition, affect and behaviors.	3.20	Recovery goal setting and progress tracking feature.	3.82
Personal information recording, analysis, and report.	3.20	AI therapist/recovery assistant.	3.21

Differences between Design Team Ratings and Patient Rating.

As shown in Table 2.6, the feature ratings from a design team that consists of two seasoned mental health technology product leaders, two researchers, one designer (three of the five team members are recovered depression patients) are very different from the ratings of our participant group. While the design team rated "personalized interventions recommendation

system" and "cognitive and behavioral skills learning and practice module" on top and put "medication management module" and "clinician connection module" in the second tier, patient ratings are the opposite. The design team also put "diagnosis and assessment on cognition, affect and behaviors" in the lowest tier, while patients put them in the second tier. What the design team is missing in this mismatch is the lived reality of how big the healthcare resource gap is in China, both in quality and quantity. From patients' experiences, these fundamental needs that are supposed to be served by the traditional mental healthcare system are nowhere near being met.

The design team also rated "recovery goal setting and progress tracking" as an important feature, without the nuanced understanding that for the majority of the patients, this might backfire by adding more anxiety and disappointment, fueling patients' self-criticism that's already problematic. Design team also believed "patient online support and learning community" would be a good addition to patients' toolkit, seeing how popular depression patient online communities are getting. Yet, we also missed the reality that without proper management, the negative impacts can overshadow the positive. At last, "personal information recording, analysis and report" received the lowest rating from the design team, which also missed the mark, as patients are actually open to the values it can bring, but prefer not to put much effort into it.

While the design team was surprised by some of the rating differences, we were not surprised by the fact that we missed them. To have solid confidence in the understanding of patients, the design team MUST talk to enough patients, and triangulate data streams to understand the ins and outs of their needs and find insights that are most helpful for product design.

2.5. Distilling Insights to Aid Design.

As stated in the beginning of the chapter, an in-depth understanding of patients' experiences is the foundation for good product design. First of all, it highlights the strongest needs or the

biggest opportunities we should target. Then, it gives us a detailed understanding of patients' journey that the new solutions must fit into. Lastly, it generates insights that will help us make design decisions like idea selection or feature prioritization. This section focuses on presenting the synthesized understandings based on the depression patient research.

2.5.1. Top Needs

Based on patients' ratings and rankings of important needs, as well as patient and clinician interviews, we've identified the needs that are most widely rated as very important. Patients need to:

1. Manage medication systematically, so they can adhere to their treatment plan, reduce misconception of medication, manage side effects, and taper off medication safely.
2. Connect with care providers easily, so they can reach out during emergencies, and get timely answers for their concerns and questions.
3. Reduce their fear of depression, and accept the fact that they have depression, so they can face the illness and focus on recovery.
4. Understand depression well, so they can escape stigma around depression, and have the right expectation for their recovery process.
5. Improve self-awareness and self-understanding, so they can understand their behaviors and emotions, and make efforts that truly address their personal challenges.
6. Feel hopeful and motivated to keep making persistent recovery efforts, so they can take the necessary small steps towards recovery.
7. Recover from psychological trauma, so they can develop long-term resilience against depression.

While these top needs are the foundational drivers of recovery, the opportunity to drive engagement and efficacy by meeting needs that patients have nuanced requirements for should

not be lost. For instance, patients need a behavioral data tracking and analysis system that doesn't require much effort from them, so they can improve self-awareness with ease. Patients need accessible digital Cognitive and Behavioral Therapy features, so they can learn and practice depression management skills. Patients need accurate personal recommendations on their interventions, so they can focus on efforts that are more effective for themselves.

Additionally, there are needs only specific groups of patients feel are strong. For instance, some subgroups of patients need support for their goal setting and tracking initiative, so they can make steady effort and make adjustments as they go. Some subgroups of patients need a 24/7 accessible AI recovery assistant, so they can reach out for help anytime, anywhere. We should never design for the "average" patients, because they don't exist, and the best approach is always to create stronger affordance in the product, and allow patients to engage with it in ways most helpful for each individual.

There are also needs not listed in the survey, but were highlighted by both patients and clinicians in their interviews. The most frequently mentioned is that patients need adequate financial resources, so they can afford treatments recommended by clinicians. All clinicians agree that patients' financial situation can make or break their recovery quality or speed. Some patients go so far as to say "money is the real cure." (P.21) With mental healthcare resources in China so scarce and unequally distributed, fewer financial resources lead to lower chances of patients getting the help they need.

Patients' needs can be categorized into five groups:

1. Emotional needs, including the needs to accept depression, feel hopeful and motivated for long-term recovery, and recover from psychological trauma.
2. Cognitive needs, including the needs to understand depression, develop stronger self-awareness, and learn cognitive skills for recovery.

3. Functional needs, including the needs to manage medication, record and analyze personal data, and receive personalized recovery support.
4. Social needs, including the needs to connect with clinicians timely, be accepted and supported, and to manage close relationships.
5. Behavioral needs, including the needs to change health behaviors, and learn behavioral skills for recovery.

Based on the number of top needs in each category, emotional needs and cognitive needs are the most critical, and behavioral needs are the least important. However, these needs are not mutually exclusive, and they often work together to build up an upward spiral that takes patients out of the depression mire. For instance, patients report that the early efficacy of medication gives them hope and motivation to stick to exercise routines, and allows them to have the energy to understand depression and themselves better. As their symptoms keep improving, they acquire behavioral skills, and change their cognitive patterns with therapy or self-help. Eventually, they find themselves standing at the other end of the recovery journey, having grown and developed resilience against future relapses. To understand how patients' needs evolve along the recovery process, I examine the patient journey more closely in the next section.

2.5.2. Patient Journey

While each patient's journey of recovery is unique, having a detailed understanding of each stage of the journey allows us to generate more contextualized insights. Those insights can then help the design team create products that fit patients' reality, and adapt to their need changes along the journey. Based on patient and clinician interviews, we've mapped out depression patients’ recovery journey consisting of 10 distinct phases. These 10 phases are separated by patient milestones along the journey. In contrast to the ideal processes often recommended in

clinical settings, we present the processes grounded in patients' actual experiences, including the emotions they often feel, their driving needs, and the top opportunities to support them with technology. The 10 phases are:

1. Depression Onset
2. Path to Diagnosis
3. Diagnosis
4. Early Treatment
5. Response
6. Remission
7. Continuing Treatment
8. Relapse
9. Chronic Depression
10. Long-Term Recovery

1. Depression Onset

Depression Onset is the phase during which patients start to have depressive symptoms. In the ideal world, individuals will have enough resilience and support to bounce back quickly from stresses in life, and recover from early symptoms.

In reality, during this phase, either a major life stressor (e.g., loss of a loved one) or accumulated stress (e.g., academic pressure) exceeds the resilience level of the individual. They start to develop depressive symptoms like low mood, insomnia, trouble with concentration, suicidal ideation, etc. and the symptoms stay with them for longer than two weeks. Patients often feel fearful of these symptoms and confused about why they feel this way during this phase.

The driving need for patients at this stage is to improve their self-awareness and self-understanding, so they know what is going on behind the symptoms, thus setting up the foundation for help seeking. A good opportunity for patient-centered MHT at this stage can be to improve accessibility to mental health education and resilience training.

2. Path to Diagnosis

The Path to Diagnosis is the phase after a patient develops clinically depression, and before they seek professional help from a clinician or therapist. In the ideal world, patients or people close to them would recognize their depression symptoms and reach out for professional help immediately, so they can prevent further deterioration of symptoms and start therapeutic interventions.

In reality, patients keep suffering without help, and symptoms deteriorate until they become insufferable so they have to see a doctor. Increasingly, more patients, especially in the younger generation, look up their symptoms online to try to understand what's going on, but most patients don't realize they need to seek professional help, or don't have easy access to high-quality care. Often, the support system (family) not only doesn't help in getting patients the support they need, but also becomes an obstacle in help-seeking, because of their lack of understanding of depression and the stigma around mental health. Patients feel frustrated, isolated and often desperate without getting the help they need during this phase.

The driving need for patients at this stage is to connect with mental healthcare providers, so they can get an accurate diagnosis and start interventions as early as possible. A good opportunity for patient-centered MHT at this stage can be to create accessible early screening tools and interventions.

3. Diagnosis

Diagnosis is the phase after a patient starts seeking professional help until they receive a clear diagnosis and start interventions. In the ideal world, patients would go through standard processes to receive an accurate diagnosis from a trustworthy clinician in a high-quality hospital or clinic near them.

In reality, many patients will have been to other departments in the hospital (e.g., internal medicine) before being recommended to the psychology or psychiatric department. Patients go through very diverse diagnostic experiences that differ from hospital to hospital. Doctors from some hospitals (especially psychiatric hospitals) lead patients through comprehensive evaluations, while some other doctors will make a diagnosis only based on a ten-minute conversation. The quality of clinicians varies greatly. Some patients have to go to multiple hospitals, or travel to hospitals in bigger cities to get a diagnosis they can trust. Also, comorbidity with other mental illnesses especially anxiety) is common, making it difficult to have a clear-cut diagnosis. Besides, patients' symptoms could evolve, and they may develop more bipolar symptoms over time.

Patients experience diverse emotions during diagnosis. They could feel a sense of relief, knowing what's behind the symptoms, or they could feel a sense of doom, feeling their life has been ruined forever now that they have depression, or they could feel a mixture of these two emotions. Many patients also feel shameful about having depression. But for patients who have a better understanding of mental health, acceptance is much easier.

The driving need for patients at this stage is to understand and accept depression, so they can focus on their recovery journey. Some opportunities for patient-centered MHT include: developing accurate and trustworthy diagnostic tools, and educational media to help patients with various backgrounds accept depression and set the right expectations for recovery.

4. Early Treatment

Early Treatment is the phase after a patient starts receiving treatment, and before they respond to therapeutic interventions (have 50% reduction in symptoms). In the ideal world, clinicians work together with patients and their family to decide on the best treatment plan (e.g., what treatment modalities to include: hospitalization, medication, psychotherapy, alternative therapy, etc.). Clinicians make personalized treatment plans based on patient conditions and preferences, etc. Patients visit doctors weekly, and doctors make treatment adjustments based on patients' experiences and progress. With the right treatment, it takes the patient 2-4 weeks to feel the positive impact of interventions, and 4-6 weeks to feel significant reduction in symptoms.

In the real world, some patients may refuse to accept the fact that they have depression, and don't accept any treatment. Available treatment modalities are limited for many patients, and medication is the default option even though most patients fear side effects and dependency. Psychotherapy is not an accessible modality, with the severe lack of high-quality therapists in China, along with the high cost. Many patients have tried to find a therapist to work with for the long-term, but quickly given up. Patients also can't visit the doctor weekly because it's hard to get an appointment. Even when they do visit, doctors only spend around 10 minutes with them.

Most patients feel even worse in the first two weeks of medication, because side effects are painful and the positive effects of medication often take weeks to kick in. Finding the medication that works for a patient can take several months, as patients go through experimentations with dosage and type of medication. Some patients deviate from the treatment plan quickly by stopping their medication because of painful side effects or lack of positive effects.

Patients tend to go through emotional roller coasters during early treatment. They feel hopeful but doubtful in the beginning. Then if side effects kick in, they feel fearful and confused, until

when positive effects start to show, and then they feel relieved and more hopeful. But if medications don't work for them, patients will feel more frustrated and hopeless.

The driving needs for patients at this stage are managing medication so they can better adhere to effective treatment and maintaining motivation for recovery efforts. Some opportunities for patient-centered MHT include: improving medication adherence, and creating a recovery narrative to help patients feel safe, hopeful and motivated.

5. Response

Response is the phase after a patient starts to respond to interventions and before most if not all of their clinical symptoms disappear. In the ideal world, patients adhere to the effective treatment plan, and continue to improve. Within 12 weeks, they have no or minimal depression symptoms.

In reality, patients sometimes reach a bottle neck with the same treatment, and their symptoms may start to deteriorate because of the stresses in life. Some patients might develop new symptoms, partially because of the impact of medication. Some patients seek help from new doctors when their symptoms stop improving or worsen, and they lose trust in their doctors. Many patients prematurely reduce or stop their medication now that they're feeling better.

Patients often feel relieved and hopeful with continuous improvement, but also frustrated and doubtful when setbacks happen. A lot of patients on medication (especially mood stabilizers) feel "numb" without any strong negative or positive emotions.

The driving needs for patients at this stage are maintaining motivation for recovery efforts and healing from trauma so they can ease their internal struggles and facilitate deeper recovery. A good opportunity for patient-centered MHT at this stage can be to deliver accessible, engaging and evidence-based therapy.

6. Remission

Remission is the phase when patients are mostly symptom free, and stay that way for two months. In the ideal world, patients keep adhering to treatment and remain symptom-free for two months. They have recovered most if not all of their social functions. With support and compassion from people around them, they are back to engage with life fully.

In real life, it may take the patients a long time (many months or more than a year) to reach remission. Many patients prematurely stop medication by themselves and stop visiting doctors. For patients who don't get to go through psychotherapy, they use books and online resources to self-help, but the impact is nowhere close to that of therapy. Patients also don't receive enough support to go back to work or school, which ends up causing setbacks in recovery. During this phase, patients feel hopeful and grateful for their successful recovery, but also trepidation about setback or relapse.

The driving need for patients at this stage is also maintaining motivation for recovery efforts and healing from trauma for long-term resilience. A good opportunity for patient-centered MHT at this stage can be to facilitate effective health behavior change (e.g., developing healthy habits).

7. Continuing Treatment

Continuing Treatment is the phase when patients continue to go through interventions after reaching remission, to improve their resilience and prevent relapse. In the ideal world, patients continue to build their long-term resilience by taking lower doses of medication, and more importantly going through psychotherapy to learn stress-management skills, change cognitive patterns, and build healthy habits. Continuing treatment lasts for 6 months to several years, depending on how many depression relapses the patients have gone through. With the guidance of clinicians, patients slowly taper off their medication during this phase.

In real life, many patients (especially for their first episode) opt not to receive continuing treatment after reaching remission. Patients often visit doctors very infrequently or stop the visit altogether, and the visit is mostly just to get a prescription. Patients often are the ones driving the conversation on medication tapering, and many end up making the decision to stop meditation by themselves without going through a taper-off process. Patients feel the normal ups and downs in life during this phase, but with extra sensitivity towards their low mood.

The driving needs for patients at this stage are also maintaining motivation for recovery efforts and healing from trauma. A good opportunity for patient-centered MHT at this stage can be to support safe and effective medication tapering.

8. Relapse

Relapse is the phase when patients develop a new depressive episode. More than half of depression patients go through at least one relapse. Many may go through several cycles of relapse-treatment-remission-relapse throughout their lives. In the ideal world, patients never relapse after going through treatment successfully, because they not only recovered but also built up stronger resilience. But if they do, they seek out help at early signs of relapse, then with the help of clinicians, recover quickly.

In the real world, big stressors in life trigger patients' relapses, and patients often don't react to early signs of relapse quickly enough to control it before they develop into a severe episode. Each relapse makes it harder for patients to recover, and causes patients to have less hope for long-term recovery. For earlier relapse (1st or 2nd), patients feel frustrated and hopeless. But for later relapses, many patients start to feel accepting of the reality that they may have to live with depression their whole lives.

The driving need for patients at this stage is connecting with care providers, so they can intervene quickly and effectively. Some opportunities for patient-centered MHT include: predicting relapses accurately and escalating care for relapsed patients timely.

9. Chronic Depression

For some patients, Chronic Depression is the phase when depression becomes chronic, and patients develop dysthymia, a low-level chronic depression, with high risks of major depressive episodes. In the ideal world, patients find a new equilibrium, where they can function in acceptable ways while living with chronic depression. In reality, patients continue to suffer from all the pains depression brings to their lives. Big stressors can trigger bouts of major depression more easily for them, and they keep feeling chronic hopelessness and low mood.

The driving need for patients at this stage is reducing fear and accepting depression, so they can find their new balance living with depression. A good opportunity for patient-centered MHT at this stage can be to facilitate resilience-building activities (e.g., meditation, exercise, social connections, etc.).

10. Long-Term Recovery

For other patients, Long-Term Recovery is the phase when they stay symptom-free for a long time, and develop strong resilience against future relapses. In the ideal world, patients come out of depression with stronger resilience towards future episodes. They've matured psychologically through the depression recovery process, and even enjoy life more than before. In reality, relapse will always be a possibility for recovered depression patients. Some even relapse after decades. During this phase, patients feel the normal ups and downs in life, and a more positive attitude towards life.

The driving need for patients at this stage is to continuously improve self-awareness and self-understanding, so they can keep growing as a person and adapting to new life circumstances. A good opportunity for patient-centered MHT at this stage can be to facilitate self-care actions (e.g., stress management, personal growth).

2.5.3. Top Insights

By going through the user research and analysis, the design team can develop a comprehensive understanding of the patients' needs throughout the recovery journey. But to use that understanding to guide the design process, the team needs to distill the strongest insights and generate design principles from them to guide the detailed decisions during the design process. Here are the top insights about patients' needs and behaviors during depression recovery.

Insight 1: Clinicians' wants are often not patients' strongest needs. During the recovery process, patients are often recommended and expected by clinicians to take specific actions in order to facilitate effective recovery, but patients don't necessarily feel the need to take those actions, or the needs they feel the most strongly about are not going to drive them to adhere to doctors' recommendations. For instance, during the remission stage, doctors recommend patients to keep taking medication to help prevent relapse. But patients often decide to do the opposite, because they have stronger needs to stop the side effects, or to avoid medication dependency. Another example is that many clinicians recommend their patients to adopt a regular sleep schedule, which is often not high on patients' need list, so most of them will never follow that recommendation. It's important for design teams to always remember what patients "should" do are not the same as what they will do.

Insight 2: Heterogeneity of patient needs and preferences is an inevitable challenge in designing mental health technology. Different patients have different needs, and the same patients' needs

evolve throughout the recovery. There are indeed many shared characteristics with different depression patients across recovery. But, while some groups of patients have great needs to set and track recovery goals, others are focused on just doing what they can each day. Some groups of patients are eager to dive into academic papers to understand depression, while others just want their doctors to tell them they will be able to recover. Heterogeneity of needs and motivations is a fundamental feature for mental health challenges.

Insight 3: The recovery process is nonlinear. Even though we laid out seemingly linear stages of the recovery journey, the actual process never follows a straight line. Patients go back and forth between stages. One day they're responding well to treatments, the next day, their symptoms start to deteriorate because a highly stressful event happens in their lives. Even within one week or one day, patients go through the ups and downs that we all go through in our lives, but in a much more amplified manner. Recovery doesn't happen outside of the ebb and flow of stressful events, it happens through them. (Kornfield et al., 2020)

Insight 4: Recovery happens through a combination of small actions. There is no fast cure, and no one intervention will make all the differences. Patients take the medication one dosage at a time, exercise one minute at a time, go through one cognitive and behavioral intervention at a time. There are no shortcuts. This makes the recovery process particularly hard especially during the acute stage, because lack of motivation and energy are typical symptoms of depression. In the end, a productive mindset a patient can have is to take small actions without expectations, and accept living with depression for the moment. That's when the speed of recovery really ramps up.

Insight 5: Emotions are fundamental in depression recovery dynamics, but they are often neglected. Patients' acceptance, hope, self-compassion, and motivation are strong drivers of recovery, but psychiatrists don't have enough bandwidth to address them because feelings are

intangible and difficult to intervene within a short visit. Even experienced psychotherapists could get lost in their own processes and techniques, and neglect to stay attuned to the patients' affective states. Patients' emotional journey deserves strong attention during recovery.

Insight 6: The resources available to a patient decide recovery speed and efficacy. The resources include both internal and external resources. When patients have the bandwidth to work on their recovery, when they can take a step back from the stresses in life, when they have enough financial support to receive the clinical help they need, when they have the social support to recover from the trauma, they will have faster recovery, and develop stronger resilience against relapses. Recovery without resources is a grueling uphill battle.

Insight 7: Social influence is a powerful double-edged sword. When patients are connected with positive social influence like a good psychiatrist, therapist, or supportive family, friends, online community, they feel hopeful and motivated and are well on their way to recovery. But when patients are taking in negative social influences such as societal discrimination, family conflicts, toxic relationships, or even complaints other patients share online, the detriments to recovery can be limitless. What makes social influence particularly powerful is that it's often an inevitable part of patients' lives.

Insight 8: The stories patients tell themselves about depression drive their behaviors. It's not the scientific understanding, or the facts and numbers, it's patients' beliefs about the nature of depression, the possibility of long-term recovery, the influences of medication and therapy, the opinions of society on their depression that drive patients' behaviors.

Insight 9: Clinical care is the best bet for patients. For most patients, clinical care could have the biggest and most positive impact on their recovery, even though recovery through self-help is a possibility. However, the majority of patients don't have access to the ideal care they should

receive, because the needs of the patient population far exceed the capability of the mental healthcare system.

2.6. Summary

A grounded and in-depth understanding of the patient group a MHT is designed to serve allows the design team to empathize with the users about their real-life experiences and preferences. With insights including patients' top needs, patient journey and preferences on potential technological features, the team can develop design guidelines to support the ideation, prototyping, and iteration process. These design guidelines, in return, can lead the MHT to be more engaging, trustworthy, and effective in driving behavior changes.

Chapter 3. Patient-Centered Design for Engagement

In this chapter, I discuss the current challenges and recommendations around improving MHT engagement. Then through integrating user research insights from the previous chapter with current literature, I present the top challenges and guidelines for designing a MHT for the depression patient group represented by the research participants.

3.1. The Engagement Enigma

When designing a MHT, two of the most important goals are to make it engaging for the intended users, and effective in improving health outcomes. These two goals are closely connected. Generally, products that incorporate more engagement features are associated with higher efficacies in symptom reduction (Linardon et al., 2019). For instance, features like CBT based interventions, reminders to engage with the product, and infrastructure for professional guidance (e.g., personal messages from therapists) can lead to significant effects in improving depressive symptoms, anxiety symptoms, stress levels, and positive affect (Linardon et al., 2019).

However, engagement and efficacy don't always go hand in hand. Stronger engagement does not necessarily mean greater clinical efficacy. For instance, Renwen et al. (2019) identified that while engagement with self-tracking at all levels of intensity is associated with improvement in depression symptoms, only moderate intensity of engagement with learning and goal-setting are connected to reduction in symptoms. Too much or too little engagement with learning and goal-setting features may not contribute to health outcomes (R. Zhang et al., 2019).

Nonetheless, adequate engagement is the precursor for high efficacy. It's been proven in numerous clinical trials that when patients do engage with a mental health technology regularly, their conditions can have significant improvement (Firth et al., 2017; Linardon et al., 2019).

Because of the close connection between engagement and efficacy, and the fact that mental health technology has a notoriously low engagement level, how to improve user engagement is considered the foremost challenge by the MHT community.

Many researchers have attempted to decipher the reasons behind low engagement with mental health technologies. Torous et al reviewed current mental health technologies and hypothesized that lower engagement with mental health apps can be attributed to the following factors: they are not designed to meet patient users' top needs; they have poor usability; they have low perceived credibility; they are not useful in an emergency situation; and they do not respect privacy (David et al., 2016). Similarly, Melcher et al. (2020) also identified, for the college student population, safety, simplicity, credibility and customizability are the top requirements for higher engagement.

In recent years, the number of MHT clinical trials has grown exponentially, allowing a more quantitative approach to understand the engagement dynamic (Linardon et al., 2019). Even though standard measurements of engagement still do not exist, making evaluations particularly challenging (Ng et al., 2019), many insightful meta analyses have been done to identify factors associated with higher engagement (Firth et al., 2017; Linardon et al., 2019; Wu et al., 2021).

These analyses don't provide the exact reasons for high or low engagement, but 55% of the variance in adherence among health technologies can be explained by intervention characteristics and persuasive technology elements, such as intended usage frequency, dialogue support features (e.g., praise, reward, reminder, suggestions, etc.), update frequency, etc (Kelders et al., 2012). Apps that focus on peer support and mindfulness/meditation features are getting significantly higher daily usage time than apps focusing on other features (e.g., tracker, psychoeducation) (Baumel et al., 2019). But, *more* features used in a product doesn't necessarily lead to high engagement. In fact, a review identified a negative association between

the number of engagement features and the completion rate of the digital interventions (Wu et al., 2021). This suggests: to develop an engaging mental health technology, not only do we need to incorporate the features the target population is most likely going to use regularly, we also need to be selective and keep the overall experiences focused.

While the understanding of the engagement enigma in MHT is deepening, the research in this area is still in the early stage. More mixed method studies incorporating qualitative and quantitative analysis are needed to help comprehend the rationales behind user's interactions with mental health technologies.

3.2. Generic Principles and Tools to Design for Engagement

In order to support future efforts in mental health technology development, frameworks that can guide high-level design decisions, as well as detailed design choices are needed. With respect to the high-level recommendations, many have been proposed in the past decade. Peters et al. (2019) emphasize that design decisions in mental health technology are especially critical compared to other technologies because they can have much stronger impact on their users, who are strained by cognitive and affective impairments due to mental health challenges. They proposed eight principles to support the design of these technologies:

1. Employ a human-centered approach and design with, not just for, people.
2. Follow guidelines for universal accessibility and tailor the level and mode of content to the spectrum of audience needs.
3. Design to support user autonomy.
4. Consider support structures and the large service system in design.
5. Evaluate impact throughout development and after release.
6. Ensure multidisciplinary collaboration and oversight.
7. Employ mixed-methods and research-based approaches for design and evaluation.

8. Apply health technology quality frameworks.

Whereas Peters et al.'s framework focuses on the highest-level principles that can help a design team set foundations for high-quality design work, Doherty et al. (2010) present a set of guidelines specifically targeting separate MHT creation processes, like design, development and evaluation. Their recommendations include: 1. design for outcomes, 2. develop protocol at the same time as system and refine throughout development, 3. accommodate clients with learning difficulties, 4. adhere to international and local ethical requirements, 5. build on accepted mental health care models, 6. highlight data security to users, 7. evaluate with multiple stakeholders, 8. evaluate in various stages of development, and 9. explore declined and unsuccessful cases (Doherty et al., 2010).

In comparison, Bakker et al. (2016) formulated sixteen highly specific recommendations based on a systematic review of the field and extensive experiences building mental health technology. These recommendations, as shown in Table 3.1, have also been ranked based on the strength of evidence behind each of them.

Table 3.1 Recommendations for Future Mental Health Apps

Evidence	Recommendation	Details
Demonstrably effective, but more research needed in MHapp field	1. Cognitive behavioral therapy based	Start with an evidence-based framework to maximize effectiveness
	2. Address both anxiety and low mood	Increases accessibility and addresses comorbidity between anxiety and depression. Also compatible with transdiagnostic theories of anxiety and depression
Probably effective, but more research needed in MHapp field	3. Designed for use by nonclinical populations	Avoiding diagnostic labels reduces stigma, increases accessibility, and enables preventative use
	4. Automated tailoring	Tailored interventions are more efficacious than is rigid self-help
	5. Reporting of thoughts, feelings, or behaviors	Self-monitoring and self-reflection to promote psychological growth and enable progress evaluation
	6. Recommend activities	Behavioral activation to boost self-efficacy and repertoire of coping skills
	7. Mental health information	Develop mental health literacy
	8. Real-time engagement	Allows users to use in moments in which they are experiencing distress for optimum benefits of coping behaviors and relaxation techniques
Supported by theory and indirect evidence but focused research needed	9. Activities explicitly linked to specific reported mood problems	Enhances understanding of cause-and-effect relationship between actions and emotions
	10. Encourage nontechnology-based activities	Helps to avoid potential problems with attention, increase opportunities for mindfulness, and limit time spent on devices
	11. Gamification and intrinsic motivation to engage	Encourage use of the app via rewards and internal triggers, and positive reinforcement and behavioral conditioning. Also links with flourishing
	12. Log of past app use	Encourage use of the app through personal investment. Internal triggers for repeated engagement
	13. Reminders to engage	External triggers for engagement
	14. Simple and intuitive interface and interactions	Reduce confusion and disengagement in users
	15. Links to crisis support services	Helps users who are in crisis to seek help
Necessary for validation of principles	16. Experimental trials to establish efficacy	It is important to establish the app's own efficacy before recommending it as an effective intervention

Note: Reprinted from "Mental health smartphone apps: Review and evidence-based recommendations for future developments." by Bakker, D., Kazantzis, N., Rickwood, D., & Rickard, N. (2016). In JMIR Mental Health (Vol. 3, Issue 1).

While these high-level principles can bring the design team's attention to the right problems, more detailed guidance is needed to support low-level decisions regarding users' specific interactions with the technology. The Persuasive System Design framework, developed in 2009 by Oinas-Kukkonen and Harjumaa, is a great tool to guide the design of behavior change technologies (Oinas-Kukkonen & Harjumaa, 2009). It identified four categories of mechanisms that can improve a persuasive system's engagement and efficacy, as shown in Table xx: 1. supporting users' primary task in the system, 2. promoting computer-human dialogue, 3. increasing system credibility, and 4. leveraging social influences.

With regard to designing a MHT, some of the more notable mechanisms include: reduction (reducing complex behavior into simple tasks), simulation (enabling immediate observation of the causal links), social role (adopting a social role in user's life, e.g., therapist), authority (referring to people in the role of authority, e.g., psychiatrist), social learning (providing means to observe other users), and social facilitation (providing means to perform along with others).

Table 3.2 Persuasive System Design Framework

Primary Tasks Support	Dialogue Support	System Credibility Support	Social Support
Reduction A system that reduces complex behavior into simple tasks helps users perform the target behavior, and it may increase the benefit/cost ratio of a behavior.	**Praise** By offering praise, a system can make users more open to persuasion.	**Trustworthiness** A system that is viewed as trustworthy will have increased powers of persuasion.	**Social learning** A person will be more motivated to perform a target behavior if (s)he can use a system to observe others performing the behavior.
Tunneling Using the system to guide users through a process or experience provides opportunities to persuade along the way.	**Rewards** Systems that reward target behaviors may have great persuasive powers.	**Expertise** A system that is viewed as incorporating expertise will have increased powers of persuasion.	**Social comparison** System users will have a greater motivation to perform the target behavior if they can compare their performance with the performance of others.
Tailoring Information provided by the system will be more persuasive if it is tailored to the potential needs, interests, personality, usage context, or other factors relevant to a user group.	**Reminders** If a system reminds users of their target behavior, the users will more likely achieve their goals.	**Surface credibility** People make initial assessments of the system credibility based on a firsthand inspection.	**Normative influence** A system can leverage normative influence or peer pressure to increase the likelihood that a person will adopt a target behavior.
Personalization A system that offers personalized content or services has a greater capability for persuasion.	**Suggestion** Systems offering fitting suggestions will have greater persuasive powers.	**Real-world feel** A system that highlights people or organization behind its content or services will have more credibility.	**Social facilitation** System users are more likely to perform target behavior if they discern via the system that others are performing the behavior along with them.
Self-monitoring A system that keeps track of one’s own performance or status supports the user in achieving goals.	**Similarity** People are more readily persuaded through systems	**Authority** A system that leverages roles of authority will have enhanced powers of persuasion.	**Cooperation** A system can motivate users to adopt a target attitude or behavior by leveraging human

	that remind them of themselves in some meaningful way.		beings' natural drive to cooperate.
Simulation Systems that provide simulations can persuade by enabling users to observe immediately the link between cause and effect.	**Liking** A system that is visually attractive for its users is likely to be more persuasive.	**Third-party endorsements** Third-party endorsements, especially from well-known and respected sources, boost perceptions on system credibility.	**Competition** A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to compete.
Rehearsal A system providing means with which to rehearse a behavior can enable people to change their attitudes or behavior in the real world.	**Social role** If a system adopts a social role, users will more likely use it for persuasive purposes.	**Verifiability** Credibility perceptions will be enhanced if a system makes it easy to verify the accuracy of site content via outside sources.	**Recognition** By offering public recognition for an individual or group, a system can increase the likelihood that a person/group will adopt a target behavior.

Note: Adapted from "Persuasive systems design: Key issues, process model, and system features." by Oinas-Kukkonen, H., & Harjumaa, M. (2009). Communications of the Association for Information Systems, 24(1), 485–500.

Strong usability has been identified as a basic requirement for high engagement (Melcher et al., 2020; Wu et al., 2021). Frameworks like the Ten Usability Heuristics for User Interface Design, developed by Nielsen and Molich, should be used to improve the usability of the technology. This framework has been applied in the technology industry for almost three decades, and can help the design team identify and solve usability issues more systematically (Nielsen, 1994). The 10 heuristics are:

1. Visibility of system status.
2. Match between system and the real world.
3. User control and freedom.
4. Consistency and standards.
5. Error prevention.
6. Recognition rather than recall.
7. Flexibility and efficiency of use.
8. Aesthetic and minimalist design.

9. Help users recognize, diagnose and recover from errors.
10. Help and documentation.

When designing the specific experiences to facilitate patient behavior changes, the Ten Conditions for Change framework for creating positive behaviors is a comprehensive tool to consider (Spark Wave, n.d.). The framework was created by a team of behavioral change design experts at Spark Wave. It posits that if a new behavior was to be adopted in the long run, there are ten conditions that need to be met, and specific guidelines and practices can be used to help users meet each of the following conditions:

1. Consider the behavior.
2. Desire to engage in the behavior.
3. Intend to engage in the behavior.
4. Remember to perform each action.
5. Believe attempting each action will help achieve a goal.
6. Choose to perform each action over other available actions.
7. Know how to perform each action.
8. Have needed resources and permission to perform each action.
9. Embody skills and traits needed to perform each action.
10. Maintain internal attributes and external conditions required to perform future needed actions.

What's more, Behavioral Economics and "gamification" techniques have been shown to increase engagement when used in technology design (Wu et al., 2021). Using behavioral economics findings (e.g., people are strongly motivated by loss aversion, fresh start, and lotteries, etc.) helps products create stronger user engagement (Wu et al., 2021). Gamification mechanics such as reward and feedback, as well as serious games like The Guardians have

also been successfully used to improve engagement for mental health apps (Ferguson et al., 2021; Fleming et al., 2017).

Having frameworks, and principles available allows us to go through a more systematic process to tackle our design challenges. But, piling up engagement features and adding all these techniques together doesn't guarantee an engaging experience. We need to first identify the top design challenges for the specific condition and target population, then use the most relevant guidelines and frameworks, along with user research insights to tackle those challenges.

3.3. Challenges & Design Guidelines for MHT

Guided by the literature review, and the user research insights on depression patients in China, the following critical challenges have been identified in designing engaging MHTs to support depression recovery. For each challenge, design guidelines and ideas on how to tackle the challenge will be discussed. The intention is not to go through an exhaustive list, but to focus on the most influential ideas that can elevate the success of the MHT. The eight challenges include:

1. How do we set clear goals for the technology?
2. How do we design for the heterogeneity of patient needs?
3. How do we accommodate the ebb and flow of patients' recovery journey?
4. How do we drive small but consistent actions?
5. How do we create positive influences on patients' affective states?
6. How do we develop and maintain trust in the technology's efficacy?
7. How do we curate positive social influences?
8. How do we develop a patient friendly data strategy?

Challenge 1: how do we set clear goals for the technology?

The first step of designing a MHT is to set clear goals. Having clear goals will offer design teams the "true north" they need to guide design decisions ranging from feature selection to the choice of wording. For a depression recovery product, the goals include strengthening the therapeutic alliance between clinicians and patients, improving medication adherence, leading sustainable health behavior change, and reducing one-on-one therapy sessions without sacrificing efficacy, etc. Asking the following questions helps clarify the goals:

- What are patients' top needs the MHT will focus on?
- What roles does the MHT play in meeting those needs?
- What does success mean for the users?
- How can success be measured?

When trying to set clear goals, it's important to **focus on what "will" happen, instead of what "should" happen**. It's often challenging to lead users through theoretically effective interventions (e.g., daily 40 minutes mindfulness-based stress reduction exercise) that patients don't feel particularly motivated to do. In those scenarios, if the design team disregards the actual dynamic of human behavior, and sets unrealistic goals for users, they will be pushed away and disengage quickly. By focusing on what the users will actually do, they may not be taking the optimal actions for recovery right away, but they're engaged with the technology, and have the chance to do more as they make progress.

It's also important to **design with the ending in mind**. For a depression recovery app, how can we lead patients to a "happy abandonment" of the technology in the end, when their recovery goals are met? A foundational and ethical goal for a MHT should be to develop users' innate abilities to regulate their mental wellbeing, so they can function and thrive in the long run without relying on external solutions (Peters et al., 2019). Engagement should not lead to dependency.

MHT for depression recovery **needs to be designed with different spheres of experiences in mind** including user interface, in-app tasks, real-life behaviors and life in general (Peters et al., 2018). By analyzing users' needs in each sphere of the experience, a team will be able to set multi-layered goals, and align them, so experiences that user have in the app ultimately contribute to their wellbeing in life. For instance, in the interface sphere, it's common to have the goal of weekly or even daily engagement, but if we're designing for the "happy abandonment" stage, then the goal for the life sphere is to wind down the use of the technology. We will need to change the interface to facilitate the goal of winding down technology use.

Finally, **goal setting won't be complete until clear metrics are set.** Clear metrics afford the design team the possibility to track how well the goals are being met. They keep the team honest and focused on exactly what they are designing for, which is often very difficult since there are always multiple goals the technology aims to achieve. Moreover, metrics set the foundation for continuous iteration of the technology, and help make its engagement and efficacy stronger over time.

Challenge 2: How do we design for the heterogeneity of patient needs?

My interviews with 39 depression patients have shown that patients' needs during recovery are impacted by numerous factors, including their personal histories, personalities, social environments, treatment access, financial support levels, and comorbidities, etc. As a result, patients' needs are highly diverse, making it a big challenge to create experiences that will support the broad population. **A big mistake in designing a mental health technology is to design it for everyone.** What often happens when designers make that mistake is that the product can meet many patients’ needs to a lower degree, but cannot meet any specific patient needs well. So, the technology becomes something nice to have for a broad population, but not a must-have for anyone.

Having clear goals is tremendously helpful for tackling the heterogeneity challenge, because we'll inevitably have to **focus on a target population**. For instance, since all our research participants have received medication, we can choose to create a MHT targeting patients who had medication as an intervention modality. However, within the target population, we still have high diversity in patient characteristics. One of the leading methods to design for the heterogeneity of patients is to **create personas, or user profiles that can represent the most popular "types" of users we're serving**, including what goals and values they have, what motivates them most, etc. Then experiences can be tailored for different types of users.

In tailoring experiences for different patients, a big challenge is to find the right level of user autonomy. The product should not leave users to make all the decisions on what they engage within the technology, because they may be overwhelmed and lose direction. This is especially applicable in the healthcare setting, where patients look for the authority to offer them trustworthy guidance. Meanwhile, the MHT also should not dictate the experiences without flexibility. One direction to consider is to **deliver tailored experiences on content and interventions based on evidence-based frameworks, while giving patients options to make adjustments based on their individual preferences.** For instance, a 12-week digital intervention for depression recovery can be structured with 12 modules guided by cognitive and behavioral therapy protocols, but within each module, users can have flexible options to engage with activities that fit them best.

Challenge 3: How do we accommodate the ebb and flow of patients' recovery experience?

As discussed in the last chapter, throughout patients' recovery journeys, their needs will evolve depending on where they are in the journey. Besides, recovery is not linear and depression symptoms can go up and down, partially influenced by unpredictable life events and contexts.

To meet the changing needs of the patients, and accommodate their recovery in the ups and downs, the **technology needs to include features that are suitable for patients under different states**. Features that can help support patients during emergencies should be part of the product, as well as features facilitating long-term cognitive and behavioral skill learning. Kornfield et al. (2020) suggested that technology can be designed in a way to allow patients to use their "up time" to support their "down time". For instance, by leading patients to build habits, establish plans, and organize resources when they're less symptomatic, they are better prepared when symptoms become stronger.

It's important to highlight that experiences intended for when patients' depression symptoms are strong need to **take into consideration their possible cognitive impairments**. It's been reported that depression patients have difficulty processing large amounts of text when their symptoms are strong (Doherty et al., 2010). When designing experiences for the down time, it becomes even more important to provide intuitive navigation, present information in an organized way, and avoid complicated language (Good & Sambhanthan, 2014).

Realistic expectations should be set on the frequency and intensity of user engagement, based on users' daily and weekly rhythm. **Re-engagement mechanisms** designed to get patients back to the technology are a necessary solution to keep them engaged through the ups and downs. Depression patients have been known to avoid using digital devices when they're more symptomatic (Doherty et al., 2010). Besides, patients might disengage with the technology simply because of distractions even when the MHT is helping them. Meaningful reminders that point to specific user experiences that can create immediate value is a great tool for re-engagement.

Training patients to deal with the ebb and flow is also an integral part of leading an effective recovery journey. It's important to understand that **patients don't recover *despite* the ups and**

downs, they recover *through* the ups and downs. By designing a learning experience to help patients develop stronger resilience when they have the energy and motivation to do so, and cope with symptoms when they are suffering the most, patients will be able to gain stronger control over their mood, which is a critical goal for long-term recovery.

Challenge 4: How do we help drive small but consistent beneficial actions?

Mental illness recovery and management is often a long process, even though patients always want fast cures. **Setting the right expectations** for how long the recovery can take, and how critical small actions are can give users a grounded mental framework to drive persistent efforts, especially when they can't feel the impact immediately. **Creating a growth-oriented narrative** throughout the user journey with concepts like neuroplasticity, can help set the right tone for behavior change as well. In this narrative, it's critical to encourage trying out new things, celebrate failures, and keep challenging oneself.

Using behavior change design frameworks like the Ten Conditions for Change can help us create the right conditions for the behaviors to happen (Spark Wave, n.d.). It's important to **make sure users' capabilities match the requirements of an action,** through lowering the difficulties of action, reducing the external frictions for the action, or training the patients on specific skills required to perform the action.

A powerful force for behavior change comes from users' intrinsic motivation. One of the influential motivation theories—Self Determination Theory—posits that human-beings are motivated by autonomy, competence and relatedness (Ryan & Deci, 2000). By giving users the option to personalize their experiences, make customized plans, they can feel a sense of ownership on their recovery journey. Through positive feedback, rewards, and appropriate challenges, we can help users feel capable. Lastly, carefully curated social experiences including social learning and facilitation can make people feel connected to others. The

Persuasive System Design framework, in particular, offers many specific techniques that can help leverage these motivational mechanisms.

Ultimately, we need to **design for upward spirals**, where small and easy actions lead to intrinsically positive feedback and rewards, which in return motivates the users to carry out more actions and challenge themselves further. Infrastructures like activity libraries, trackers, customized feedback, etc. will allow users to explore and embark on what can help them create the strongest upward spiral and power consistent actions.

Challenge 5: How do we create positive influences on patients' affective states?

The top challenge in creating positive influences on patients' affective states is to sense how they feel: Are they feeling positive or negative? How strongly do they feel it? What emotions exactly are they feeling? There are powerful evidence-based exercises that can help individuals regulate affect, but without understanding how the patients feel and what they need, effective influence is unlikely.

Technologies that use ambient sensing to understand patients' affective states still have a way to go before being used in clinical settings. A strong solution right now is to use the power of design to create interactions that allow the technology to understand how patients feel. A good place to start is to **create an empathetic and compassionate narrative** throughout the user experience. By guiding patients' internal narrative away from the self-criticism that was frequently reported in patient interviews, into a narrative that encourages self-compassion and acceptance, we allow users to be more self-aware and open to share their affective stages with the MHT.

The key in understanding patients' affective state is to **promote skillful reflections by the patients**. Designing reflective experiences in the technology doesn't just allow it to match

appropriate interventions to address patients' affective states, the reflection in itself is a powerful and necessary intervention for recovery.

Following reflections with appropriate interventions is necessary for creating positive influence. Online single-session interventions have been shown to improve depression symptoms like hopelessness and self-hate (Schleider et al., 2020). Also, by connecting reflection with interventions, we're creating a positive feedback loop for the action of reflecting on and reporting affective states, because their needs to address these states are being met with helpful interventions. With this feedback loop, patients are more likely to reflect on their emotions and report how they feel to the technology in the future.

Challenge 6: How do we develop and maintain patients' trust in the technology's efficacy?

Without persistent trust in the technology's efficacy, patients are unlikely to stay engaged. Persuasive System Design framework has laid out techniques using expertise, authority, and third-party endorsement, etc. to make the technology feel more credible. One effective mechanism to cultivate patients' trust in the technology is to **have humans in the loop**. It could be a clinician, a coach, an assistant or a navigator that interacts with the patients through the technology. By having humans interfacing with patients, they are more confident in the technology's ability to understand them and tailor experiences to support them.

Additionally, having humans in the loop can strengthen the therapeutic alliance between the technology and the users, as many patients interviewed believe technology is too "cold" and they need the warm feelings during recovery that can only be developed with humans. Therapeutic alliance represents the collaborative relationship between the helper and the helped, and strong alliance has been proven to be one of the strongest indicators for therapy efficacy (Flückiger et al., 2018).

However, evidence shows that mental health technology can also create strong working alliances with its users without humans in the loop (Alison et al., 2021). When humans cannot be part of the user experience, **creating strong therapeutic alliances between the technology and the patient user** should still be an important goal for any MHT. Early in the user experience, patients need to feel their recovery goals are being understood and respective tasks are agreed upon to help them reach their goals. Assessment mechanisms need to be included to understand the patients' motivational readiness as well as their capabilities to carry out those tasks. Very critically, we need to use content strategy and interaction design to promote the warm emotional bond with the patient users. For instance, the technology can take on the social role of a therapist, and use back and forth empathetic conversations to strengthen the emotional bonds.

Whenever possible, the technology should also be **integrated into the clinical system**. It's important for the design team to recognize the limitations of technology, so it's clearly understood when technology won't be able to support the patients effectively. For instance, an automated therapy technology should include an escalation feature to connect patients in emergency to the accessible clinical resources that can support them.

Challenge 7: How do we curate positive social experiences?

It's been discussed that social influence is a powerful double-edged sword. While the need for relatedness is an intrinsic motivation that can power many positive actions, when designed inappropriately, social experiences can harm the patients, as shown during patient interviews. Thus, social experiences need to be carefully designed, **starting with envisioning what specific social dynamics can be beneficial for the recovery of the patients**. For instance, depression patients feel less lonely and more hopeful when they can read stories of other patients who have successfully recovered.

After the intended social behaviors are identified, **a targeted reward and feedback system** needs to be designed to facilitate them. In the example of reading patient stories, we need to encourage patients to share their recovery stories first by acknowledging their contribution to the community, and give them feedback on how many patients have been positively influenced by their stories.

We need to be especially careful with experiences like social comparison and competition. During patient interviews, many have stated that these mechanisms tend to create negative pressure in patients' lives. Positive social experience doesn't necessarily mean that users will be interacting directly with the clinicians or other users. For instance, the system can use norms to encourage patients' behavior, or use social facilitation languages like "468 patients are doing this exercise with you."

It is imperative for patients to have strong control over their social experiences in the MHT. They need to be able to opt out of any social experiences, especially for patients who suffer from social anxieties. They need to have the level of privacy they're most comfortable with, since social stigma around mental health is still strong and many patients are not open to sharing their own conditions publicly.

Challenge 8: How do we develop a user-friendly data strategy?

To effectively solve many of the challenges discussed above, a robust data strategy is mandatory. Without the right data and enough data, the technology won't be able to understand patients' goals, preferences, and affective stats, etc. or customize the experiences for individual users accurately. But how do we collect data effectively? How do we use the data to share insights and guide users' experiences?

Transparency should be the No.1 principle in data collection. Users should be clearly informed of what data will be collected, how it will be used to support their goals, and how it will be protected. Users should also have the autonomy to manage or delete their data from the system as they wish.

However, even with the user's full consent, we face the challenge of relying on user reports for much of the critical data like their preferences and affective states. As shown in the patient needs analysis, reporting data to the system is not a particularly strong need patients feel. Design teams, then, should carefully identify the most essential data to collect, in order to avoid burdening the users. In addition, **data entry from users should always be followed by experiences that add value to the patients**. For instance, during onboarding, when users record personal information, the system can give instant feedback on where they stand in the user groups, or how a specific information like their preferences will impact their interactions with the technology. By making data entry a natural part of the recovery process, making patients feel the positive value of data collection, it's possible to turn it from a chore to an intrinsically motivated habit.

When sharing insights with patients based on data, it's important to only focus on insights that will have practical values in recovery. Often, **less is more**, and too much information without clear usage will overwhelm users. Sharing data becomes particularly nuanced when the data reflects negative emotional or behavioral patterns of the patients. The ostrich effect that states people avoid bad news even when the information could be useful for them is a common phenomenon. Also, by simply showing negative data to the patients, it can even increase their symptoms (Sanches et al., 2019). While avoiding sharing negative data is a legitimate option, the better approach is to **use the negative data to support constructive reflection**, and identify actions that can be taken to lead grounded positive progress. For instance, if a patient shows highly inconsistent sleep schedule, which has been shown to be associated with worse

depressive symptoms, instead of simply showing the behavioral data or avoid showing it at all, use the data to present the patient an improvement opportunity through awareness of the behavioral patterns and action-planning to change the behaviors over time.

3.4. Summary

The challenges and guidelines discussed above are in no way exhaustive when it comes to understanding the engagement enigma and trying to create a MHT for depression patients. But it helps us to develop a more comprehensive view of engagement, and realize that engagement is the result of various mechanisms. For engagement to be strong, many conditions need to come together.

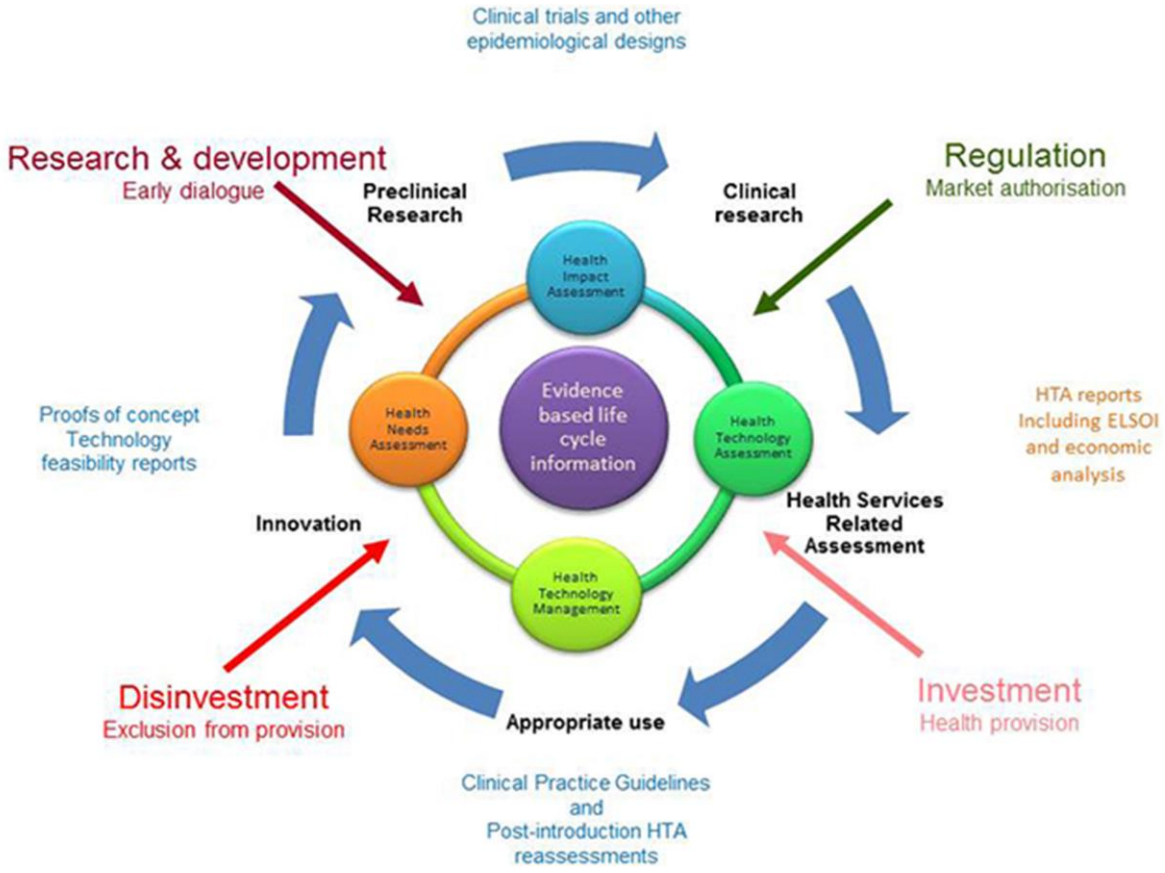
Chapter 4. Designing for the Whole Life Cycle

In this chapter, I discuss the challenges and guidelines in designing a MHT for its whole life cycle, while meeting the needs of various internal and external stakeholders. The guidelines are based on 12 interviews conducted with experts in the MHT community. The discussion is followed by a high-level analysis of the mental health care ecosystems, regulatory trends, and ethical challenges most relevant to designing a MHT in China.

Designing a MHT that can keep the targeted patient population engaged sets a great foundation for the success of the technology. However, there are many other stakeholders involved throughout the whole life cycle of the technology, who play pivotal roles in its success. Designers need to incorporate the needs and constraints of all these stakeholders into the design process. The stakeholders include the funders, developers, researchers, regulators, reimbursement bodies, healthcare providers, and healthcare professionals, etc. By anticipating and designing for their needs during different phases of the life cycle, the design team can increase the likelihood of the technology getting adopted by more target users and delivering stronger health outcomes.

A simplified way to frame the life cycle is to think of it as the combination of separate stages: funding, design & development, research & evaluation, market authorization, payer adoption, clinical implementation, marketing, use of technology, and post-launch management. However, in reality, the life cycle of a health technology is highly complex and dynamic, as shown in Figure 4.1 (Gutiérrez-Ibarluzea et al., 2017). The aforementioned stages are intertwined, and stakeholders are involved in a continuous collaboration. Given the scope and complexity of the whole life cycle, this chapter will not present a comprehensive analysis, but instead only focus on the challenges and guidelines most relevant for MHT design.

Figure 4.1 Life Cycle of Health Technology



Note: Reprinted from "The life cycle of health technologies." by Gutiérrez-Ibarluzea, I., Chiumente, M., & Dauben, H. P. (2017). Challenges and ways forward. In Frontiers in Pharmacology (Vol. 8, Issue JAN, p. 14).

4.1. Design Challenges throughout the Life Cycle

Design of a technology starts during the funding process, whether the funding comes from research grants or venture capital investments. During this time, the funders are looking to be convinced by an idea that has high promise of solving impactful problems. The design team often needs to develop and demonstrate a strong conviction over their idea, while still maintaining open-mindedness to allow grounded user research to guide their specific design decisions in the future. Early commitment towards a design direction can lead to confirmation

biases, where the design team will pay more attention to new information that aligns with the current design decision and ignore the contradicting data.

Understanding technological feasibility, as well as the implication of design choices on development timeline and cost is essential for the success of the technology as well. How can we design data collection experience to enable a successful Machine Learning feature? How does the implicit requirement of device-independence influence experience design? Moreover, what expertise would be required to implement specific design decisions? These are all questions that need to be asked during the design process in order to drive successful development. Digital technology development has a reputation for missing deadlines, going over budgets, and having bugs constantly. However, many of the problems are rooted in design choices, and are destined to happen even before the development process starts (Reel, 1999).

The evaluation process presents many design challenges as well. Researchers are guided by data security, privacy and safety requirements established by the ethics committee. The knowledge of these requirements can offer valuable guidance for the design team in regard to creating experiences that will protect user safety. Clinical trials are often subject to significant recruiting biases, because participants tend to be the people who are highly interested in using the technology, thus more likely to adhere to it (Mohr et al., 2017). Besides, user experiences within a research protocol can vary significantly from the user experiences in clinical implementations. Participants are often offered extra clinical support and financial incentives in trials, which serve as an external engagement mechanism beyond what the technology has to offer.

The design of the technology needs to be aligned with the go-to-market strategy. Which of the following options is the technology going to rely on: partnerships with pharmaceutical companies who have market access and established channels, claim-based reimbursement,

delivery through employers, or direct to consumers? Or maybe the technology is going to involve multiple go-to-market strategies over time. These options have strong implications on design decisions, because the stakeholders associated with each strategy have different expectations on the technology, from the look and feel, the data collection requirement, the privacy standards, all the way down to the tone of voice within the technology.

Depending on the strategy, some MHTs need to go through market authorization processes set up by the regulatory bodies like U.S. Food and Drug Administration (FDA) or Chinese National Medical Products Administration (NMPA). These regulatory bodies are responsible for ensuring the safety, efficacy and security of medical products. However, because most MHTs are digital in nature, and can benefit from frequent updates to improve their engagement and efficacy, regulatory bodies are exploring new paradigms that can more efficiently evaluate them throughout the life cycle, without compromising safety protection or patient access. For instance, FDA's Software Precertification Pilot Program (U.S. Food and Drugs Administration, 2021) is aiming to help "inform the development of a regulatory model to assess the safety and effectiveness of software technologies without inhibiting patient access to these technologies."

If the MHT is designed to be implemented into the clinical settings, then getting the buy-in of healthcare providers is required. This is especially true if healthcare professionals need to prescribe the technology to their patients or if they're the end-users of the technology as well. How does the technology integrate with the existing workflow and technological system seamlessly? How does the technology minimize education and training needed to use it? How does the technology induce trust and promote perceived usefulness from physicians? All these questions need to be asked during the design process. Otherwise, the patient-centered technology will have less chance of getting into the patients' hands.

After all these processes, the patients finally get to use the technology to improve their mental health. During this stage, it's essential to have an evaluative mechanism to understand the efficacy of the technology in the real world, as well as the economic impact it has within the healthcare system. The data will help demonstrate the efficacy of the technology to facilitate further payer, provider, and patient adoptions, while powering the continuous improvements of the technology. The challenge for the design team is to ensure the technology can collect the data needed for the evaluation, while protecting patient privacy, and don't sacrifice usability.

It's a daunting task for the design team to incorporate the needs and constraints of so many stakeholders throughout the life cycle of a MHT, especially when most of these questions don't have straightforward answers, and many are evolving with new insights developed along the way. In the next section, seven high-level design guidelines are proposed to offer pragmatic heuristics that can support designing for the whole life cycle.

4.2. Design Guidelines

There are countless combinations of design challenges when taking into account all the requirements throughout the life cycle of a MHT. High-level heuristics can offer directional guidance for such complex problems. To identify the most critical life cycle design principles, I conducted 12 expert interviews with professionals in the MHT community. The participants include executives (e.g., Chief Executive Officer, Chief Medical Officer, Chief AI Officer) from top mental health platform and technology companies, data scientists and product managers from leading digital therapeutics companies, as well as researchers and entrepreneurs in the MHT space. The interviews were focused on the top recommendations for designing MHT for the whole life cycle, while questions were adapted depending on the experiences and positions of the participants. Based on these interviews, I propose seven design recommendations to help design teams incorporate a full life cycle perspective.

Recommendation No. 1: Always put the patients first. The previous two chapters detailed the significance of focusing on patient needs and engagement. This recommendation is a necessary reminder, because "patient first" is a critical mindset that needs to be protected constantly. As the design team tries to incorporate the needs of various stakeholders, the focus on patient needs can be lost easily. Often it seems like the design team needs to make a choice between serving patient needs and meeting other requirements like data collection, privacy protection, or partner demand. During these times, putting patients first doesn't mean giving up on other requirements. It means the team needs to create a solution that can serve the patients' needs first, without compromises on other requirements. "Patients first" mindset is the most fragile when the design teams are not communicating with the population they're designing for. Without the design team creating intentional practices and processes (e.g., organizing a user feedback group, planning regular user testing) to collect input from the users, falling down a slippery slope that takes us away from patient needs is almost inevitable.

Recommendation No. 2: Ensure multidisciplinary collaboration. An effective method to support a design process that needs to incorporate the requirements of many stakeholders is to include expertise that covers the whole life cycle of the technology in the design team. At the minimum, an advisory board needs to be created, formally or informally, to include experts who can offer in-depth perspectives on the requirements of each stage of the life cycle. Simply having access to diverse expertise is not enough. Frequent and clear communication needs to be set up, so that designers can integrate diverse input and feedback as early as possible and as often as needed. The design team also bears the responsibility of educating diverse team members about the team's process and tools, to prepare them for the most relevant and productive input. For instance, if the design team is creating personas for different stakeholders (e.g., psychiatrist), they need to make sure these advisors understand what personas are, and how personas can help create values throughout the technology life cycle.

Recommendation No. 3: Design the MHT within the context of intended implementation and use. When designing the user experiences for a mental health technology, it's critical to situate them in the realistic context. The design team needs to develop grounded understanding by getting their boots on the ground to observe and analyze the processes and constraints of all stakeholders involved in the implementation. Will and how will the MHT be used with other treatments (e.g., medications, psychotherapy)? Will and how will the MHT involve healthcare professionals (e.g., case manager, psychiatrist)? Will and how will the MHT engage patients' personal support system? The answers to these questions should guide the user experience design and ensure patients' interactions with other elements of the care system included in the experience. Particularly, the technology needs to fit into the providers' workflows and create meaningful values for them, and the system needs to be able to easily integrate with the current health technology systems already in use like the Electronic Health Records (EHR).

Recommendation No. 4: Enable technology evaluation in the real world. One of the big problems with mental health technology is that the value it creates in the real world differs greatly from the promises shown in trials. More advanced trial designs such as the effectiveness-implementation hybrid trial design and adaptive design can help generate results that more closely reflect real-world usage (Curran et al., 2012; Pallmann et al., 2018). However, to accurately evaluate the engagement and efficacy of the technology, there are no better ways than to enable evaluation in the real world. Real-world data can support everything from market authorization, price negotiation, to product improvement. To make real-world data generation and analysis an impactful competitive advantage, the design team needs to collaborate closely with the development team, data team and research team to make sure necessary experiences are designed to help capture the right data while not sacrificing or even boosting overall engagement.

Recommendation No. 5: Design with the long-term product vision and development process in mind. This means, from the beginning, the design team needs to understand the technical feasibility of specific features (e.g., the data requirements for implementing machine learning in the user experience). We're at an exciting moment in the history of MHT. It's not hard to imagine how different the future user experiences of MHTs will be from those of today. Creating an empathetic and personalized experience for mental health patients is becoming increasingly possible. Designing with a clear plan on how the user experience will evolve to incorporate more advanced technology is necessary for long-term success. For instance, if the vision for a mental health technology is to use patient data to guide personalization, then the team should design a personalization experience that may start with a rule-based system, while collecting the necessary data to power a machine learning based recommendation system in the future.

Recommendation No. 6: Create clear processes for data-driven, iterative design processes. Data-driven design and iterative design are hot topics in the world of technology development. They're powerful methods to improve a technology through constantly testing it and using feedback to guide grounded iteration decisions. However, the standard for implementing data-driven iteration in MHT will be higher, particularly when the technology is in regulated markets. As discussed above, regulatory bodies all over the world are still exploring new paradigms that can accommodate the fast-changing nature of digital technology used in healthcare. However, what will most likely be required is clear documentation on the rationales behind changes made in technology, including: what data and evidence was used to support the design decision, what positive impacts are expected, what testing will be done or has been done to showcase the results. Setting clear processes for what data will be collected, how it will be processed with which teams, and how the results are incorporated into design decisions will ensure higher effectiveness of the iterative design, while supporting regulatory processes.

Recommendation No. 7: Design with clear value proposition. The last and many would argue the most important recommendation is to develop and maintain a clear value proposition for the technology being designed. Having a strong and concise understanding of how the technology will create value within the mental healthcare ecosystem is foundational for long-term success. No matter how noble the intentions behind a technology design is, if it doesn't create and capture enough economic value, the technology will not survive. The design team needs to identify the sweet spots where strong patient needs and the willingness to pay meet each other. At the same time, it's important to collaborate with the marketing team to craft the right message that can help whoever will be paying for the technology understand the evidence-based mechanism behind the technology and the process it went through to deliver efficacy.

4.3. Designing MHT in China

Designing for a MHT in China faces broadly the same challenges discussed above. But the huge patient population, the fast-changing nature of the market and the progress in the past decade call for special emphasis on some of the guidelines.

China's Mental Health Law came into effect in 2013, after a long 27-year drafting process (Shao et al., 2015). Because of the lack of national baseline research on mental health care services in China, it's difficult to evaluate the exact impact of the law. However, since 2013, many MHT companies (e.g., Hao Xin Qing, Simply Psychology, Yi Dian Ling, etc.) have been founded, successfully leveraging the internet and mobile technologies to serve tens of millions of patients needing mental health support. In the *Healthy China 2030* plan released by the State Council in 2016, mental health care was listed among the top priorities. At the same time, more private funding is being invested into the development of innovative mental health solutions. Even though there is a steep mountain to climb on the way to improve mental health care in China, MHT will play a big role in expanding the capacity of China's mental health care system, and

improving the efficacy of prevention, diagnosis and treatment of mental illness. To design for the whole life cycle of a MHT in China, it's essential to understand the reality in the clinical mental health care system, the reimbursement scheme, the regulatory trend, as well as the ethical risks.

Not only are mental health care resources in China severely limited, the resources are also unequally distributed (Qin & Hsieh, 2020). While eastern regions like Shanghai and Zhejiang have much higher numbers of psychiatrists and psychiatric beds, the less economically developed regions in Central and Western China have dire needs for mental health resources (Qin et al., 2016). Because of the huge disparity, mental health care systems from various regions employ highly diverse work flows. This has been reflected through our interviews with patients. While some patients got to stay with one psychiatrist throughout their treatment, other patients had to travel to different cities to find psychiatrists who could help them. Also, some patients got to receive psychotherapy from their psychiatrists, while others only got to have 10-minute conversations focused on medication. The diversity of clinical workflows makes it even more challenging to design MHTs that fits well with the clinical system.

In 2012, the Chinese central government expanded the coverage of health insurance to include major mental disorders (e.g., schizophrenia, bipolar disorder). Health insurance coverages on mental illnesses have been improving ever since. However, there are currently over 3,000 local health insurance plans, with reimbursement rates on mental health care ranging from 90% to 0%, depending on the regions, treatments, and whether it's in-patient or out-patient care (Qin & Hsieh, 2020). The majority of the insurances don't cover psychotherapy at all. While in economically better developed regions, it's possible for a mental health patient to get 50-70% of their expenses reimbursed, a Chief Operation Officer from one of the leading MHT companies estimated that an average mental health patient is still paying more than 80% of their mental

health care expenses out of pocket. This means even if a MHT gets approval from the National Medical Products Associate (NMPA), patients are still mostly paying for the product themselves.

However, this situation might change soon as digital therapeutics start to take off in China. The first prescription digital therapeutic product, which focuses on chronic disease management, received approval from NMPA in November of 2020, after going through a process very similar to that of FDA clearance. Currently, patients are still paying for digital health products out of pocket. As more prescription digital therapeutics products get approved, and real-world evidence of efficacy becomes increasingly stronger, it's likely that government insurances will start to cover the expenses of these products. Over the past two years, NMPA has evolved quickly to accommodate the regulatory needs for Software as Medical Devices, by adopting processes very similar to that of the FDA (National Medical Products Administration, n.d.). However, a new paradigm that can accommodate the evaluation of the technology's whole life cycle is still being explored in China as well.

In the meantime, China is set to implement its first comprehensive law regarding data privacy and protection—the Personal Information Protection Law (PIPL)—on November 1st 2021 (Latham & Watkins, 2021). PIPL imposes personal information protection standards as stringent as, if not more than, the European Union's General Data Protect Regulations (GDPR). The two laws share mostly the same main concepts, with minor differences (T. Zhang, 2021). For instance, PIPL includes broader categories of information like financial information and location tracking in the definition of "sensitive personal information," which requires data processors to obtain separate user consent before processing it. PIPL also includes more strict requirements when data is shared or used outside of China, citing national security. This law will have a profound impact on the design of MHT, requiring existing and new technologies to incorporate data protection experiences without sacrificing user engagement. The time of the Wild West in China’s data regulation is over, however, it needs to be reminded that the implementation of the

law—just like other laws—will take significant time. For instance, even though the Mental Health Law came out 8 years ago, discriminative policies are still highly prevalent in the workplace. Moreover, it remains to be seen how China's political system and PIPL come together to guide the government's access and use of personal data.

The top ethical risks of designing a MHT include safety and oversight, privacy and data protection, access, and bias. While the first two can be regulated through NMPA and PIPL, access and bias issues are particularly concerning. For the less economically developed regions in China, all odds are stacked against the mental health patients there, as the mental illness prevalence is higher, but mental health care resources are fewer and insurance coverage rates are lower. MHT like online therapy and tele-psychiatry have been able to provide more resources to these regions, but the improvement is not as strong as the improvement it has in the more economically developed areas. The access inequality is only getting bigger with MHT. Besides, since patients with higher educational levels are more willing and likely to pay for mental health care, new MHTs are often designed for this group. These solutions often do not work well for patients with lower levels of education.

To design a successful MHT in China, it's critical for the design team to develop a particularly close collaboration with policy-makers such as NMPA. As new regulatory requirements and data protection policies are rolled out and continuously evolve, a close collaboration not only allows the design team to keep track of the regulatory trend, but also gives the team a unique opportunity to educate policy-makers on how MHT can support patients safely and effectively. Besides, as new regulations are implemented, ambiguities are inevitable, and a close relationship with regulators allows more frequent communication to clarify the legitimacy of specific design decisions quickly.

The fast-changing pace in China also makes the long-term roadmap that can balance meeting current patient needs and incorporating cutting-edge technology more important. The diversity of clinical resources and workflows in different settings requires the design team to focus on more specific use cases in the beginning that have the potential to expand more easily to cover bigger populations. This can be supported by a fast iterative process afforded by the huge population of mental health patients. Being able to recruit and collect feedback from more patients allows technology developers to take advantage of user data on a larger scale, powering faster and more accurate iteration.

Lastly, the widening access inequality and bias in MHT can also become a great opportunity if the design team can collaborate with the government directly. The Chinese political system makes a top-down initiative that addresses the huge treatment gap in the underserved community more possible. However, strong caution needs to be exercised when designing a MHT alongside the government. Patient needs should, again, be put in the front and center. The technology should be rooted in the deep empathy of the target population, instead of any political population or top-down judgement. The protection of the new law PIPL can also provide the much-needed discipline to negotiate data privacy and oversight issues with the government, to ensure the safety of the patients and the efficacy of the MHT.

4.4. Summary

What makes designing a MHT a particularly tough challenge is that even though ultimately it is the patients' needs that matter most, we also must meet the needs of other stakeholders in the mental health care system, so together we can serve the patient population well. Designing for the whole life cycle of MHT pushes the design team to analyze how involving certain stakeholders over others can impact the technology's values, and make early strategic decisions to support regulatory application, clinical implementation and go-to-market processes.

More importantly, it drives the team to take on a collaborative mindset during the process of creating a MHT. Instead of viewing all the requirements by other stakeholders as hurdles to overcome, the design team can use these requirements to boost the value of the MHT.

Chapter 5. A Holistic Framework for Mental Health Technology Design

In this chapter, I present a holistic design framework that integrates the guidelines on patient-centered design and designing for the life cycle, to offer a structured and disciplined approach for MHT design teams in the future.

A successful MHT is one that serves patients' painful needs, keeps them engaged, and guides them through necessary interventions to improve resilience and wellbeing. A successful MHT is also one that supports a sustainable business model, exemplifies safety and efficacy in clinical evaluations, and elevates the overall mental health care system. Moreover, a successful MHT requires a clear vision for its long-term values, and keeps evolving in the real world to improve its efficacy and promote ethical standards. Because of all these expectations for a successful MHT, the design process takes great discipline and expertise, as discussed in the previous chapters. To offer a structure for tackling the numerous challenges in designing a MHT, a holistic design framework is proposed, synthesizing the guidelines presented throughout this thesis.

5.1. The Holistic MHT Design Framework

The proposed MHT design framework consists of three layers of design guidelines, as shown in Figure 5.1: 1. the patient-centered design layer focusing on meeting patient needs, 2. the life cycle design layer focusing on meeting external stakeholder requirements, and 3. the infrastructure design layer focusing on the underlying processes that both serve and connect the patient-centered and the life cycle design. Within any layer of the framework, the design team is never working in isolation. The further away from the center, the more it is required that the design team join forces with other stakeholders.

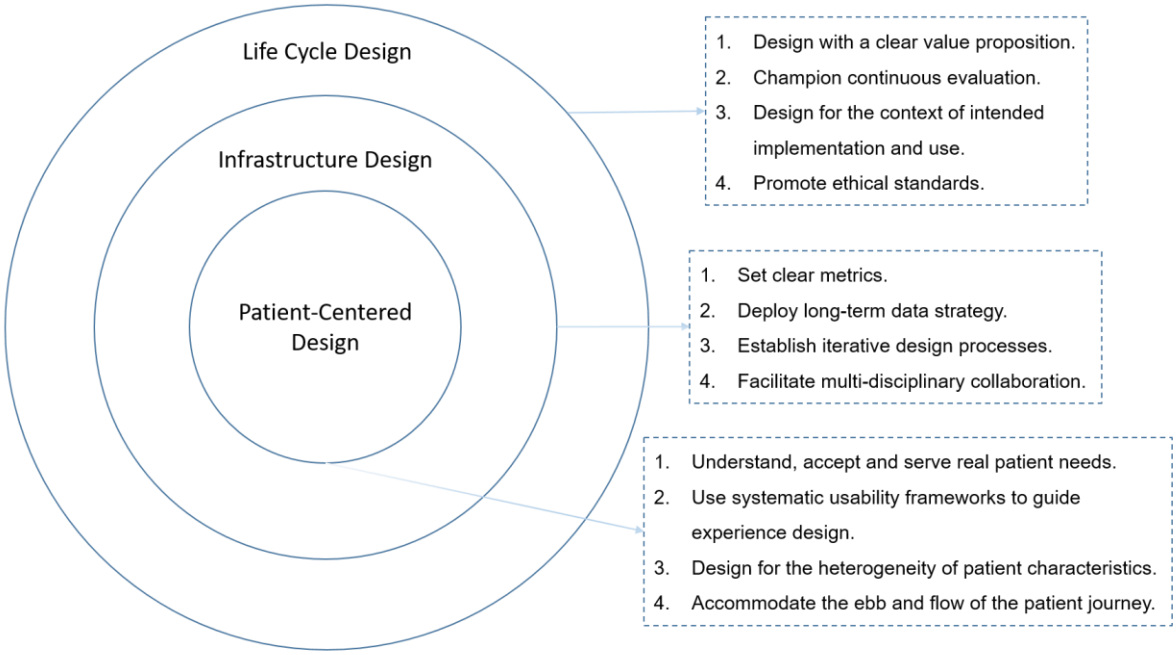


Figure 5.1 Holistic Mental Health Technology (MHT) Design Framework

In the **patient-centered layer** of the framework, the design team collaborates with patients closely throughout research, ideation, prototyping and testing. The design guidelines include: 1. Understand, accept and serve real patient needs; 2. Use systematic usability frameworks to guide experience design; 3. Design for the heterogeneity of patient characteristics; 4. accommodate the ebb and flow of the patient journey.

To *understand, accept and serve real patient needs*, the design team needs to conduct in-depth and comprehensive user research to gain grounded empathy with the target patient population. It requires the team to respect patients' needs and preferences while suspending personal judgements. Patient needs can be categorized into five dimensions: 1. the affective needs (e.g., to feel hopeful and motivated to take actions), 2. the cognitive needs (e.g., to understand their condition), 3. the behavioral needs (e.g., to take consistent, small actions of recovery), 4. the

social needs (e.g., to learn and be inspired by others' stories) and 5. the functional needs (e.g., to acquire prescribed medications conveniently).

To *use systematic usability framework to guide experience design*, the design team needs to adopt the best practices in user interface design, and to hold the MHT to the highest standards in the industry. Moreover, designers need to go above and beyond to accommodate the likely cognitive impairments of patient users, and lower their usability related friction to the minimum.

To *design for the heterogeneity of patient characteristics*, the design team needs to have a focus on a specific user population, to develop personas that can represent different groups within the population, and to tailor user experiences with intelligent systems. Another critical element of designing for the heterogeneity of patients is to promote user autonomy. Offering options that can accommodate variation of patient characteristics, and leading users to own their experiences within the technology allows diverse groups of users to choose their own path.

To *accommodate the ebb and flow of the patient journey*, the design team needs to accept and design for the inevitable ups and downs of any mental health challenge. To maintain long-term engagement, it's necessary to design experiences that can support the patient users when they have different levels of agency. It means amplifying patients' ability to cope with their negative mental states and leveraging their positive mental states to build resilience, so eventually the patients can take control of the unavoidable fluctuation cycles and lower their intensities over time.

In **the life cycle layer** of the framework, the design team needs to work closely with external stakeholders (e.g., the payers, the regulators, the providers). There are four core guidelines: 1. Design with a clear value proposition; 2. Champion continuous evaluation; 3. Design for the context of intended implementation and use; 4. Promote ethical standards.

To *design with a clear value proposition*, the design team needs to identify strong opportunities where the MHT can create, deliver and capture economic values in the ecosystem, and to find the sweet spot where the needs of patients, the gaps of the ecosystem and the capability of technology meet one another. The design team needs to use this "true north" to guide design decisions, and align user experience design with desired outcomes in the healthcare system.

To *champion continuous evaluation*, the design team needs to recognize the differences between clinical trials and real-world usage, and to design necessary user experiences to allow continuous evaluation after the technology is launched. It's imperative to include reflective experiences or incorporate ambient sensing to collect real-world data for accurate evaluation of the technology.

To *design for the context of intended implementation and use*, the design team needs to develop a realistic understanding of the clinical and personal support systems around the patient, and to design the MHT experiences in a way that integrates with and elevates the support system. It's especially critical to make sure the new technology can easily integrate with the workflows of mental health providers and the technological systems they use.

To *promote ethical standards*, the design team needs to highlight ethical concerns throughout the design process and to support systematic oversights around potential risks. The design team bears the responsibility to create transparency and trust through informed consent and alliance-building experiences. It also needs to collaborate with other stakeholders and institutions to protect patient privacy, minimize algorithmic bias, and reduce access barriers for mental health care.

The infrastructure layer focuses on the processes that are not addressing key stakeholder needs directly. Instead, it focuses on setting up the foundations to make meeting stakeholder needs more likely. The design team needs to co-create the infrastructure with other teams in the

organization (e.g., development team, data team, talent team, etc.). There are also four core guidelines: 1. Set clear metrics; 2. Deploy long-term data strategy; 3. Establish iterative design processes; 4. Facilitate multi-disciplinary collaboration.

To *set clear metrics*, the design team needs to identify the tangible measurements that can give us feedback on how far away we're from the "true north." The team needs to support the implementation of MHT metrics including usability metrics, engagement metrics, efficacy metrics, safety metrics and even ethics metrics.

To *deploy long-term data strategy*, the design team needs to help identify the necessary data to collect and design the required user experiences to collect the data. The design team should balance the need for more data and the burden of data collection on both users and the technology. Moreover, the design team needs to develop a strategy for presenting user-friendly insights that can make the data meaningful for users, driving higher quality data self-report.

To *set up iterative design processes*, the design team needs to establish protocols for user testing, data analysis, and data-driven decision making, to ensure the product can be improved continuously based on user input and real-world data. This guideline becomes particularly important and difficult when the MHT is in a regulated market, where changes to the technology need to be well documented and supported.

To *facilitate multi-disciplinary collaboration*, the design team needs to recruit diverse expertise into the team, and partner with other teams in the organization. The design team needs the diverse expertise and experiences to ensure the MHT is designed to cover all important requirements. More importantly, the team needs to lead structured communications to incorporate diverse perspectives and create a safe and open space that allows people to challenge the deeply held assumptions in mental health care, and come up with innovative ideas.

Each of the three layers of the design framework intends to guide the design team to focus on meeting the needs of different stakeholders: the patients, the external partner, and the internal partners specifically. At the same time, the infrastructure layer guidelines ensure that all design efforts are aligned with one another to create and continuously improve a successful MHT that can help tackle the global mental health pandemic.

5.2. Contribution, Limitation & Future Work

Even though many recommendations have been proposed regarding how to improve the design of MHT, to my best knowledge, none have offered a structured framework. The holistic framework proposed in this thesis is rooted in practical expertise in the MHT industry, as well as widely shared perspectives in the current literature. The three layers of design challenges and guidelines can serve as a checklist for future MHT design work to ensure inclusion of stakeholder requirements from the beginning. It also allows the design team to zoom into specific guidelines for detailed decisions and zoom out to ensure a design decision is well aligned with the big picture of the MHT and supports the diverse requirements. The theoretical framework was created to serve as a general guidance for MHT design, while the case study on designing a MHT for depression patients in China served as examples for how different guidelines can be used in a specific real-world setting, albeit at a high level.

However, the value of the design framework needs to be tested in the real-world design setting. Feedback needs to be collected through interviews with MHT designers on the significance of each guideline, the validity of the three-layered structure, and the strengths of the interconnectedness among elements within the framework. More importantly, the framework needs to be used in future design settings to showcase how practical it is for setting up design strategies and daily practices. Meanwhile, further recommendations on how a design team should approach various guidelines together when designing for different populations, or even

the sequences of guidelines a design team can follow to reach optimal efficiency should be explored as well.

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Appendix

A. Patient Interview Guidelines

Before Interview Starts:

We really appreciate you taking the time to talk with us! We want to emphasize that your participation is voluntary, and you're free to stop the interview at any time or skip any questions you don't feel comfortable answering.

If you're ready, we will start the interview and recording right now. Also, the recording will only be accessible to the researchers, and will be destroyed after the transcripts are done.

Patient Interview Questions (60-90 min):

Basic information:

1. Age: ___
2. Gender: ___
3. Employment category: full-time, part-time, students, unemployed, other___.
4. Relationship status: single, in long-term relationship, married, other___.
5. Location category: top tier cities, second tier cities, small cities, small towns, other___.

Seeking Treatment:

1. When was your first ever depressive episode?
    a. What happened before the episode?
    b. Please describe what your days looked and felt like during the episode.
        i. What were your symptoms?
        ii. What was the hardest part for you?

    c. When were you officially diagnosed by clinicians?
        i. If no official diagnosis, how did you do your self-diagnosis? Why didn't you go to see a clinician?
2. Have you worked with psychiatrists, therapists or other mental healthcare providers? Please describe your experiences.
    a. How did you start to engage with them?
    b. How long and frequently did you work with them?
    c. How have they been helpful or unhelpful with your recovery?
    d. What worked the best for you?

Treatment:

1. On a high-level, what treatments have you gone through?
    a. What were your experiences?
    b. Did you understand how these treatments were going to help you, how long they would take, etc.?
        i. If yes, how did you learn about it? Did the clinician explain it? Did you do your own research?
    c. How much did those treatments cost you? How did that fit into your financial situation?
2. Did you take medications as part of your treatment?
    a. When did you start and for how long did you take them?
    b. How helpful or unhelpful were they?
    c. What side effects did you experience?
    d. Are you taking medications right now?
        i. If not but you have taken medication before, please describe how you managed to taper off medication.

3. What other resources, tools have you used to help recover from depression?
    a. How did they work for you?
        i. What has been most helpful for your recovery? Why do you think so?
        ii. What do you like the least? Why?
    b. How did you learn about these resources and tools?
    c. How much did they cost you?
4. Have you told people around you about your depression? Why or why not?
    a. How have those experiences influenced your recovery?

Recovery Journey:

1. How would you describe your overall depression recovery journey?
2. Please describe what your day looks and feels like in remission now.
    a. What are you doing (if anything) to improve your resilience against relapse?
3. What would you have done differently to help with your recovery?
4. What suggestions would you give other patients to help them recover?
    a. What tools, resources, or treatments would you recommend to other patients?
5. What tools, resources, treatments would you like to see created that could have helped you?
6. Imagine having your own designated psychiatrist that you can reach any time, how do you imagine that would help you?
    a. What would you ask for help on?
    b. When would you reach out?
    c. How frequently would you want to speak with them?
7. What are your goals for long-term recovery from depression?
8. Looking back, do you see silver-linings from your experience? If yes, what are they?

B. Clinician Interview Questions

Before Interview Starts:

We really appreciate you taking the time to talk with us! We want to emphasize that your participation is voluntary, and you're free to stop the interview at any time or skip any questions you don't feel comfortable answering.

If you're ready, we will start the interview and recording right now. Also, the recording will only be accessible to the researchers, and will be destroyed after the transcripts are done.

Depression Healthcare Providers Interview Questions (45min)

Basic information:

1. Work Affiliation
2. Expertise
3. Years of Practice

Patient Intake:

1. Please describe, on a high level, your daily experiences supporting depression patients.
    a. How many patients do you work with every day?
    b. What happens during your interactions with the patients?
2. When a new depression patient comes in, how do you engage with them?
    a. What drives the patients to seek help, from your clinician's perspective?
    b. What are the best strategies to engage with patients in the beginning for long-term recovery success?
3. What do you see as the biggest challenges in engaging with new patients?
    a. What are good ways of approaching the challenges?

Treatment:

1. What are some typical treatment journeys for depression patients?
    a. Can you please give some anonymized examples of how your previous patients recovered under care?
        i. What are some common characteristics (if any) of cases where the patients recovered very quickly?
        ii. How long does it normally take for patients to recover?
    b. Can you please also give anonymized examples of how some patients didn't react to the treatments?
        i. What are some common characteristics (if any) of cases where the patients had a hard time recovering from depression?
2. What do you see as the biggest challenges in helping depression patients recover?
    a. What are good ways of approaching these challenges?

Recovery Journey:

1. After patients reach remission, how much do you work with them?
    a. Please describe your interactions with patients during their remission.
    b. What suggestions & support do you give patients in remission to help them better recover and prevent relapse?
    c. What resources or tools do you recommend to your patients to help with their long-term recovery?
2. What do you see as the biggest challenges in helping depression patients in remission prevent relapse?
    a. What do you see as good ways of approaching these challenges? Any technologies you see that could be helpful?

C. Patient Interactive Surveys

C.1 Patient Needs Survey

Ranking	Patient Needs	患者需求	Importance	Satisfaction
	Reduce fear and accept depression.	消除恐惧，接纳抑郁症的现实。（抑郁症的普遍性；患抑郁症没有那么可怕；接纳自己患病的事实）		
	Have hope for long-term recovery.	对抑郁症的康复抱有希望。（控制消极信念；任可阶段性进步）		
	Understand depression scientifically (e.g., symptoms, treatments, facts).	科学理解抑郁症。（症状，治疗方法，康复历程；易复发的性质，等）		
	Improve self-awareness and self-understanding (e.g., emotional and cognitive patterns, environmental impacts).	加深对自我的认识和理解。（个人情绪和思维方面的特征；行为和周边环境与情绪状态的影响；负面情绪的触发机制）		
	Record and analyze personal data and patterns (e.g., mood, symptom, exercise, sleep).	记录和分析个人行为信息和规律。（情绪，症状，运动，睡眠，等）		
	Recover from psychological trauma.	缓解和疗愈内心创伤。（认识创伤的影响；改变观念，思维和行为习惯，等）		
	Have willingness and motivation to make persistent recovery efforts.	拥有持续的意愿和动力来坚持做出康复努力。（配合治疗；参加有积极影响的活动，学习，练习，等）		
	Learn depression management & recovery skills (e.g., mood regulation, stress management, communication).	学习管理抑郁症和抑郁康复的技能。（情绪管理技能；压力管理技能；社交技能，等）		
	Change health behaviors effectively (e.g., sleep, exercise, nutrition, social activities).	有效改变健康行为。（睡眠，运动，饮食，社交，等）		

	Personalized and contextualized recovery support (e.g., recommendations of most relevant information and suggestions based on individual characteristics and needs in various stages).	接受个性化，针对不同情境的抑郁康复支持。（推荐与个人需求相关的信息；满足不同情境下的需求：情绪低落 vs. 情绪积极）		
	Manage medication systematically (e.g., medication education, adherence & tapering).	科学管理用药过程。（理解药物功能，副作用，疗程；辅助坚持用药；科学逐步停药）		
	Be accepted and supported by others (e.g., society, family, friends).	被社会认可和支持。（家庭和周边朋友认可和支持；网络社群支持）		
	Manage close relationships (e.g., family, intimate relationships) effectively.	有效管理家庭（及亲密）关系。（缓解家庭/亲密关系矛盾；避免负面关系对康复的不良影响）		

C.2 Feature Ideas Survey

Ranking	Digital Therapeutics Feature	数字疗法产品功能	Importance	Satisfaction
	Recovery goal setting and progress tracking feature.	帮助患者设定康复目标，并且跟踪进度的功能。（健康行为改变目标设定和跟踪）		
	Diagnosis and assessment on cognition, affect and behaviors.	认知，情绪和行为测量与诊断功能。		
	Personalized intervention (e.g., treatment modules, content) recommendation system.	个性化疗程推荐系统。（根据个人的需求和特质来推荐不同的内容和康复历程）		
	Personal information recording, analysis, and report.	个人信息记录，分析，报告功能。（帮助用户了解个人特征；记录变化规律；分享个人信息给医生和家人(患者控制)）		
	Easy to understand depression knowledge series (e.g., video, articles).	简单易懂的抑郁症知识系列（视频，文章）。（涵盖：病理，治疗办法和原理，康复过程，典型误解，等等）		
	Patient online support and learning community (e.g., support groups, live lecture, expert Q&A).	患者网络互助和学习社区（互助小组；直播课程；专业人士问答）		
	Patient online community safety features (e.g., privacy, post management).	患者网络社区保护功能（个人身份保护，社区不良信息删除）		
	Positive psychology learning and practice module.	积极心理学练习模块。（感恩，自我接纳，乐观，原谅，等）		
	Mindfulness and meditation learning and practice module.	正念和冥想练习内容和功能。（帮助长期，规律性的练习；启发新思维，新视角）		
	Cognitive and behavioral skills learning and practice module.	认知和行为技能的学习与训练功能。（帮助练习情绪管理技能等）		
	Gamification for positive feedback and engagement.	游戏化的积极奖励机制。（帮助用户		

		记录进步过程，鼓励用户持续努力）		
	Mental health status and trend monitor/prediction with wearable and mobile data.	利用健康手环和手机信息来监控和预测心理健康状态。		
	Patient recovery story/case study.	接触和学习过往病人康复案例。（从前人经验学习和获取希望）		
	Clinician connection module (e.g., messaging, sharing personal information).	连接医生，咨询师的功能。（分享个人信息；得到专业反馈）		
	Family, friends and other support system connection modules (e.g., share personal information, share depression educational materials).	连接家人，朋友等能够帮助用户康复的人。（分享个人信息；转发关于抑郁症的教育信息）		
	Medication management module (e.g., education, adherence, tapering).	科学用药和停药的指导与计划模块。（帮助病人配合用药，科学停药）		
	AI therapist/recovery assistant.	人工智能咨询师/康复助手。（AI 对话咨询；康复助手 24/7 协助用户康复）		
	Digital Therapeutics Product as a whole	数字疗法作为一个产品		