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Depression is the most common mental health problem in older adults; however, a lack of understanding in the interaction between physical and social causes hinders effective treatment. Unique issues such as age-specific increases in comorbid physical problems and alienation from social contact can make it difficult for health providers to identify instances of depression. These also make it difficult for depressed older adults to communicate with their social resources, such as friends, family, and health providers. Integrating technology-assisted collaboration with members of patients' social network to observe and manage multidimensional factors in depressed older adults' states is a potential way to improve the quality of practitioners' treatment-planning around these multi-dimensional factors, as well as provide assistance for family and friends' involvement in managing the depression. We conducted an interview study on stakeholders' perceptions of depression and communication to understand the opportunities and challenges involved in implementing such collaborative design. Interviewees included 16 depressed older adult patients, 10 of their family members, and two psychiatrists. Our findings reveal new insights into 1) patients' and families' social values and understandings of patients' condition, as well as 2) how these values and understandings influenced decisionmaking on communicating with each other and acting on depression. These insights have implications for the consideration of information and communication systems to aid depressed older adults' recovery and engagement with social network members.

CCS Concepts: • Human-centered computing \rightarrow Empirical studies in collaborative and social computing; Empirical studies in HCI; • Applied computing \rightarrow Health informatics.

Additional Key Words and Phrases: older adults, depression, collaborative health, mental health, health technology, qualitative methods

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1 INTRODUCTION

Depression is the leading cause of psychiatric hospitalization in older adults [63]. However, it remains under-recognized and under-treated [23, 74]. Developing a clear treatment plan is often hindered by age-specific factors that obstruct practitioners from clearly assessing depression symptoms [67]. Older adults experience increasing comorbidity of physical problems with growing age [32], and psychosocial stressors such as health anxiety [10] or difficulties interacting with younger individuals [60]. Under these conditions, it can be difficult for practitioners to differentiate effects of aging from symptoms of depression. However, understanding the link between physical and mood-related symptoms is vital for effectively treating depression in older adults [70]. Collaborative care is widely advocated as an important element in treatment for depressed older adults. This approach provides more social and informational resources to deal with dynamic multi-dimensional issues such as comorbidities, medication sensitivity, and cognitive changes [18, 57, 72].

Although there are many ways to integrate collaborative symptom management for treating older adult depression (such as alternative care models [72] or policy-level measures [29]), technology is also a resource well-positioned to facilitate collaborative management given its ability to coordinate social communication and analysis of detailed information. These abilities fulfill the key need of distinguishing depression symptoms from other manifesting health issues in this population. The professional resources required for a collaborative care team may not be available to all patients; more versatile involvement of social network members in mental health care has also been highly encouraged in the field [22]. Collaborative health technology can be particularly valuable where symptom management may be distributed among different individuals (e.g., patient, family, friends, doctor), by managing different sources of information and social dynamics.

Research on collaborative health technologies has demonstrated its effectiveness in assisting with depression and older age, in separation; the unique domain of depression in older adults remains unexplored. Technology research addressing depression has focused on illness features such as memory and symptom fluctuation [41, 56]. Explorations of collaborative depression management have also identified social connections of depressed individuals as both a resource for solution planning and source of conflict [12]. Collaborative health information design has also benefited older adults by reinforcing positive health activities and self-esteem through the mutual empowerment of family members [14, 43]. Nonetheless, to the best of our knowledge, past work has not yet focused on investigating how collaborative health technologies can be designed for depressed older adults, though the issues described in the older adult depression literature demonstrate that the individuals involved, including practitioners, struggle to treat this condition due to difficulty of managing the complex and ambiguous sources of diagnostic information. Our work is motivated by this opportunity to inform the design of technology to support the management of intertwined social dynamics and illness information in older adult depression.

In the current study, we focus on the perceptions of depressed older adults and their family in order to explore from the stakeholders' perspective the feasibility of technology-mediated collaborative depression management. No previous work has investigated the social feasibility of involving different social network members to assist this population, but there is a particular need to understand patient state in older adult depression. Social factors affect how depressed older adults perceive and present their mental state to those around them, which becomes information then used in the treatment process. Our work aspires to uncover the perceptions of depressed older adults and their social network members (e.g., family) to inform design considerations for the collaborative management of depression state information. Hence, our research questions focus on perceptions of health and communication in the context of depression, and their influences on treatment and communication choices: **RQ1:** How do depressed older adults and their family members perceive the **depressed older adults' mental and physical health issues, including their experiences and beliefs around depression**? And, how do these perceptions affect communication and actions regarding the depressed older adults' depression?

RQ2: How do depressed older adults and their family members perceive **depression-related communication with one another, as well as with other members of the social network**? And, how do these perceptions affect communications and actions regarding the depressed older adults' depression?

We investigated these questions by conducting semi-structured interviews with the following members of the treatment network: 16 patients diagnosed with older adult depression, 10 of their family members, and two psychiatrists specializing in treating depressed older adults. Our findings inform novel considerations for designing collaborative depression-information management to address the experiences of depressed older adults.

The specific contributions of our work are as follows:

- We provide evidence that understanding physical-mental symptom relationships is a key mediator of recovery-supportive behavior and communication in the social network of depressed older adults. Past work has only demonstrated the difficulty practitioners have in clarifying these relationships, occurring uniquely in depressed older adults [32, 74]. Our findings demonstrate how specific perceptions and the behavior of patients and their social network impact the overall ability to elucidate these relationships and identify points of improving understanding.
- We identify how understandings of the depression condition itself are perceived and acted upon by patients and their families. Our analysis reveals the specific depression perceptions and social factors which affect patients' differential communication styles with social network members.
- Based on the points of improvement identified in this work, we propose design approaches to mediate constructive communication for managing depression in older adults, such as: more considerate integration of multi-person observations on patient state, collaborative reflection on patient's health state for mutual understanding, and social endorsement of actions conducive to recovery.

2 BACKGROUND & RELATED WORK

In the following section, we consider the context in this work. We begin by explaining the psychosocial characteristics unique to depression in older adults, which complicate the condition and demonstrate the potential benefits of incorporating social resources as multiple viewpoints to help understand the patient state and promote recovery. We follow by reviewing psychosocial factors of older adult depression in context of relevant approaches in HCI.

2.1 Complexities in Late-life Depression

Depression is a common mental disorder with wide-ranging effects on patients' mood and one's ability to function mentally and physically. It is generally more difficult to treat depression in older adults than in younger adults due to difficulties in differentiating between the symptoms of depression and the effects of aging. In older adults, depression is the leading cause of psychiatric hospitalization [63]; however, it is under-diagnosed and under-treated [74]. The complexity of issues surrounding depression in older adults is reflected by the lack of criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) by which to identify depression in the context of aging; it is difficult for practitioners to distinguish depression symptoms from chronic pains,

anxieties, and disabilities experienced by aging individuals [74]. There have been recent changes in the DSM-V [6] to make apathy-characterized depression (which is more common in older adults) more identifiable; however, little has been done to address the issue of physical comorbidity [61]. Many features of depression in older adults are specific to aging, such as concentration difficulty and enhanced health anxiety, but are not addressed in any DSM category. Depressive symptoms in older adults are also often overlooked or misdiagnosed due to frequent assumption that they are due to a concurrent medical illness [10].

The symptoms unique to or more common in older adults' depression make it particularly difficult to manage the condition. The enhanced health anxiety in older adults is commonly exacerbated by depression-comorbid anxiety and persistent physical illness to create feelings of hopelessness in the patient [42, 67]. In many instances, cognitive impairment due to depression can be combined with existing cognitive decline to obscure the symptom accounts patients provide to their doctors and affect treatment efficacy [7, 44]. Another major issue is the prevalence of somatization (a focus on physical symptoms) in depressed older adults, which delays and obstructs treatment by preventing patients from noticing important symptoms and patterns in their depression [32, 57].

This is particularly problematic because the physiological and mood-related symptoms of depression are known to be tightly linked [70]. Depressive moods are often perceived as common features of old age and may go unnoticed and under-diagnosed as a result [67]. Such issues call for multi-dimensional approaches to clarify depression symptoms in older adults.

These issues also complicate specific aspects of treatment for depression in older adults. Many of the most effective medications for depression are not as effective in older adults as they are in younger patients due to general physical frailty which may also exacerbate drug interactions [38, 39]. Thus, activity-based treatment plans such as psychotherapy and exercise are particularly important for this population group [67]. Combining psychosocial interventions with biological treatment is known to provide better support and promote treatment compliance [5, 38, 42]. It is likely that multi-modal treatment regimens are more important to patients with growing physical and cognitive impairments, and the need to also be considerate of their social and physical ecosystems creates a challenge for creating these treatment plans [37].

Depression in older adults presents multi-dimensional factors, ranging from psychosocial to physical complications. Our study proposes the use of social resources to help incorporate these different dimensions, which can reflect depressed older adults' experiences and needs. This in turn can facilitate the development of successful strategies to support their treatment process.

2.2 Social Design Opportunities for Late-life Depression

Generally, past approaches in technology and design have explored different ways of assisting with depression, such as various methods of monitoring (behavioral and sensor-based) to understand depressed individuals' health condition [4, 6, 16, 54, 71, 75] — but there appear to be no examples of work addressing depression in the aging context or issues specific to this population, such as the unique social burdens or confusion of physical symptoms with depression. Technology directed towards addressing depression in older adults is limited, but includes advances in model-based prediction of depression in older adults [81] and design of assistive robots to engage with independently-living depressed older adults [58]. Notably, rapport-building and the contextualization of activities were identified to be important for engaging depressed older adults in the design process.

2.2.1 *Collaborative Health Design.* Collaborative care has been particularly beneficial for dealing with the multi-dimensional nature of depression in older adults. It is able to consider factors like comorbid disease, cognitive changes, medication response, and patient state [57]. Research has

shown that enhanced social support, alone, has positive effects on patient conditions. Perceived social support bolsters a sense of control and feelings of self-esteem in depressed older adults [82]; VanDerHorst and McLaren [73] also demonstrated the importance of social support among depressed older adults with evidence of the negative correlation between social resources and levels of depression in older adults.

The benefits of collaborative health care include increased awareness and positive attitude towards healthy behavior changes [53]. Community-level health interventions can appropriate community influences and tangible resources to reduce disparities among community members and sustain healthy behaviors [78]. However, integrating collaborative health for depressed older adults may necessitate closer consideration of their social environments.

The experience of aging causes changes in social roles and environment which affect the individual's social perceptions. Depression may cause individuals to become even more socially withdrawn [21, 33], and feed into perceptions of stigma. Depressed older adults were shown to experience higher levels of internalized stigma than younger populations. The perceived stigmatization correlated with more severe depression symptoms, predicted treatment discontinuation, and less positive attitudes towards seeking mental health treatment [19, 65, 76]. To cope with certain social predicaments of aging, such as perceived stereotyping and patronizing behavior, older adults may moderate their self-presentation more strongly than younger individuals do. Younger conversation partners may also present a caring but patronizing attitude [60]. Older adults who feel that they are not taken seriously resort to 'confrontive coping', which can be interpreted as stubbornness by others [26]. Older adults may also use impression management to promote themselves as competent and self-reliant in order to mitigate social consequences [8, 28].

Research in the HCI community has investigated social information and technology design for aging, family, and depression, but only discretely and not in combination. A large body of work has looked at how to involve family members for collaborative health pursuits, given the benefit of close social proximity [9, 47, 62, 83]. Some of this work has investigated the sharing of personal health data with significant others and found the social aspect to raise an individual's awareness and intention to engage in healthy routines [83], while others suggested that effective health information sharing with intergenerational family members should be positive and subtle, delivered in a caring and unobtrusive manner [9]. This concept of supporting health coproduction with family has been encouraged for its ability to reduce family members' feelings of anxiety about patients' conditions [69], and increase their peace of mind [40]. Studies by Yamashita et al. on supporting caregivers of depressed family members also demonstrated that social monitoring tools could be helpful for facilitating communication between depressed individuals and family members, as well as improving attention to symptoms and quality of social support [79, 80].

2.2.2 Social Information Design for Depression. Sociotechnical interventions for depression in general have also been proposed or discussed in various studies [12, 24, 31, 45, 51, 68], but many are exploratory investigations of how to integrate social resources into direct management of the condition. Some individuals with depression utilize social technology to share information and develop actionable solutions. Although social channels were a valuable resource, social connections can still be a complex issue for depressed individuals. They can become a potential source of conflict, necessitating improvements in the mediation of social interaction [12]. Other interventions primarily rely on online platforms. Doherty et al. [24] presented a platform to facilitate higher levels of engagement compared to previous online interventions, while a case study by Li et al. on users of a Chinese online depression community identified how cultural beliefs could affect patients' understanding and management of depression. Their results prompted sensitization of future design to the role of cultural beliefs in public awareness and understanding of depression [45].

These approaches are in no doubt useful in supporting widespread discussion and sensemaking, but are less tailored to each patient's specific situation, which is a key issue for depressed older adults due to the complicated health issues that tend to be unique to each patient.

Dealing with the aforementioned issues faced by the target population, such as social pressure and withdrawal, mental health stigma, and cognitive impairment calls for the support of social network members, and particularly those of close proximity, such as family members. They can be highly beneficial for actively managing depression and recovery. Despite the benefit demonstrated by previous work in collaborative health management, the specifics of this involvement and how it relates to other sociotechnical considerations of designing an interface to support health management of depressed older adults remain unclear. Our work contributes an empirical investigation on how patient, family members, and psychiatrist stakeholders perceive the role of socially-resourced health management technology in recovery from older adult depression. Our main objective was to identify the types of interactions and information most suitable or important to the treatment process.

3 METHODS

Our study goals were to understand how depressed older adults and their family members (as social network members of close proximity) perceived the patients' depression state, and how they communicated to each other regarding those perceptions. The semi-structured interviews included depressed older adults, their family members, and psychiatrists. These psychiatrists were consulted as a reference of professional opinion to aid the analysis of other interviews. From the results, we draw design implications to facilitate the integration of social resources into depressed older adults' treatment management. This study was approved by the Institutional Review Board of Taipei City Hospital, from which interviewees were recruited (IRB No. TCHIRB-10812039).

3.1 Participants

From Taipei City Hospital, we recruited 16 older adult patients diagnosed with depression (three males and 13 females; P01 \sim P16) aged 60 to 75 years old (Mean = 68 years old; SD = 4.60). Patients were recruited based on referrals from their psychiatrists, who determined whether they were fit to participate in an interview study (i.e., not in acute distress). All participants were thus receiving treatment for their depression at the time of the study.

The formal inclusion criteria for this study were as follows: (1) Age 60 years or above; (2) Diagnosed as major depressive disorder or persistent depressive disorder in accordance with DSM-5; (3) A score of at least 10 on the 17-item Hamilton Depression Rating Scale [27] at the time of recruitment; (4) Capacity to provide informed consent; (5) Ownership of a smartphone, or ability and willingness to use smartphone applications. Based on these criteria, participants had at least mild depression symptoms but were assessed by their treatment providers of whether they were fit to participate in our study.

All of the patients were first diagnosed with depression between the ages of $39\sim66$ years. Ten of the patient interviewees (P01 ~ P10) participated in this study with one family member each. These ten family members (F01 ~ F10) included patients' partners or daughters, aged 29 to 81 years old. We also recruited two psychiatrists (Psy1 and Psy2) from Taipei City Hospital with more than nine years of experience in treating older adult patients with depression. Table 1 summarizes the demographic information of the patient and family participants.

3.2 Procedure

We first conducted semi-structured interviews with the depressed older adult patients and their family members to explore how depressed older adults and their family members perceived the

74.7

Depressed older adult				Family member			
ID	Age	Gender	Age of first time diagnosis	ID	Age	Gender	Relationship
P01	74	F	54	F01 81 M		P01's partner	
P02	74	F	58	58 F02 41 F		P02's daughter	
P03	73	F	53	F03 45 F		P03's daughter	
P04	65	F	45	F04	F04 29 F		P04's daughter
P05	71	F	39	F05	F05 71 M		P05's partner
P06	70	F	53	F06 42 F		P06's daughter	
P07	69	М	47	F07 62 F		P07's partner	
P08	68	М	66	F08 67 F		P08's partner	
P09	75	F	43	F09 44 F		P09's daughter	
P10	62	F	55	F10 67 M		P10's partner	
P11	66	F	53	-			-
P12	67	F	50			-	
P13	68	F	42	-	-	-	-
P14	64	F	57	-	-	-	-
P15	62	М	42	-	-	-	-
P16	60	F	50	-	-	-	_
Avg	68	-	50.69	-	55.57	-	-
Std	4.60	-	7.58	-	18.49	-	-

Table 1. Demographic data of participating depressed older adults and family members.

patients' depression state and communicated with each other. Overall themes of the interview questions included: (1) how the depressed older adult patients perceive their own health status, (2) how family members observe and perceive the patients, and (3) how patients and family members communicate with each other as well as with psychiatrists regarding depressed status. Family-patient interviews were conducted in separate rooms in order to encourage open discussion about the questioned issues. The interview questions for psychiatrists included: (1) treatment experts' opinions towards geriatric depression, (2) their clinical experience of interacting with patients and/or family members, and (3) how they provide suggestions and reminders to depressed older adults. Our objective was to collect information describing the health monitoring and perceptions of patient status and characterize the social and informational interactions involved in the depressed older adults' recovery progress. Each participant (patient or their family members) was reimbursed with NTD 250 (~ USD 9), and interviews lasted between 90 and 120 minutes on average.

3.3 Data Analysis

Audio recordings of the semi-structured interviews were transcribed to facilitate the identification of salient themes based on thematic analysis [11]. Transcription and initial coding were done by the first and second authors, and all authors discussed interpretation of the codes to reach a mutual understanding or consensus. Examples of resulting actions are changing terminology or splitting/merging themes as seen fit. Therefore, the resulting themes reflect the thoughts of the entire team. Through iterative open coding, we identified salient themes revolving around mental models and beliefs of patients about their personal state, social relationships affected by older adults' depressed status, rationale for decision-making and communication patterns, and the role of family members in the recovery process. We present our findings in the following sections.

4 RESULTS

Our interview results uncovered characteristics of how patients and family perceived their depression and social relationships. Our findings are presented in three parts. First, we identify main themes in interviewees' perceptions of depression and mental and physical health (RQ1). Second, we identify social factors which affected openness toward sharing and communicating about depression (RQ2). Lastly, we describe how perceptions of social network members' relation to depression affected patients' receptiveness to communication about their depression (RQ1, RQ2).

4.1 Conceptualization of Physical and Mental States

We found that the majority of patients and many family participants focused on physical symptoms and well-being over mental influences on patients' health. We also identified pronounced differences in the self-care of participants who were dismissive of mental health issues and those who actively acknowledged their fluctuating psychological state. The findings here depict themes relating to **RQ1**: of patient and family perceptions of depression and mental/physical health.

4.1.1 *Emphasis on the physical over the emotional.* Most of the participants demonstrated an overall focus on physical conditions when describing their depression experience, tending to only acknowledge or prioritize physical symptoms of depression. Likewise, participants who fixated on physical presentations of their condition also did not notice likely causal relations between their physical state and mood.

Participants displayed prioritized concern about their physical ailments associated with old-age. Their accounts reflected the known health anxiety which increases with older age [25, 30]. For example, P07 spoke of how age-related prostate issues, degrading vision, and tooth loss made him overtly aware of any potential illness: *"I get worried… wonder when my gums will start to recede, when my teeth will start falling out, and if I feel a tooth wiggle, then that really gets me going…"* F08 (P08's wife) also reported that during his depressive episodes, he would report bodily discomfort, headaches, and tinnitus as a result of his insomnia, which she observed to be consistently linked to his oft-expressed anxiety about bodily pains. The great majority of our patient interviewees reported key physical concerns which are known to be exacerbated by and coincide with depression symptoms, such as insomnia, medication side effects or general discomfort [67]. This indicates that these perceived physical concerns are likely connected to depression-related issues extending beyond just the physical domain.

Additionally, the majority of interviewed patients described medication as the only way to treat their depression, and were not receptive to behavioral treatment. The psychiatrists we interviewed also observed that their patients prioritized medical treatment over behavioral therapy. Psy01 described particular difficulty in referring his older depressed patients to behavioral therapy: *"When treating these patients, I usually have to prompt them for a long time, or wait for at least a year without recovery before trying to refer them to behavioral therapy."*

We also saw patients describe physical problems that appeared to coincide with mental-emotional state, without perceiving any relationship between the two. For example, P14 described that during depressive episodes she would lie in a heap, feel no energy in her body, and physically feel unable to engage in any sort of activity. When asked about the possibility of a relationship between her physical conditions and her feelings or thoughts, she replied, *"I'm never emotionally upset or in a bad mood… I just wouldn't describe it that way.*" P03 recalled an instance in which she went to see a cardiologist for a panic attack: *"During a previous depressive episode I felt like I was going to die… I went to the emergency room and really thought there was something wrong with my heartbeat, but after the examination, the cardiologist said there was no physical problem, that it was likely a panic attack.*" Some of the family members reported noticing potential connections between physical and

emotional states that may have gone unnoticed by the patients. P09's daughter (F09) described that her mother would only talk about bodily problems without observing their correlation with her mental state: "She would only say 'I haven't been sleeping, I just can't fall asleep...' She doesn't talk about her feelings, but I noticed that she sighs a lot during these times."

However, not all family members were able to successfully perceive the link between physical and emotional states as part of the patients' health. Some, like most of the patient interviewees, expressed the belief that physical problems are more important. P03's daughter (F03) expressed the belief that psychiatric problems are less serious than physical problems: "So when [P03] told me she was going to see a psychiatrist, I was really relieved... At least it's not a physical problem. Psychiatric problems can be fixed with some medication or therapy, so it's really not that serious." Some other family members were dismissive of the mental symptoms associated with depression. P04's and P06's daughters questioned the validity of their mother's depression experiences, stating that their mothers "don't have any real illness" (F04) and "are just in a bad mood, not 'depressed' enough for a formal diagnosis" (F06). It is possible that the external physical behaviors of depression were difficult to understand for family members as bystanders, which made it hard for them to know whether mental struggles are the cause of patients' discomfort. P01's husband (F01) stated that, "if she didn't tell me straight up that we had to go to the doctor, I would have had no idea she was really that bad." P10's husband (F10) also expressed uncertainty in his own assessment of P10's lethargic behavior, adding that "It seemed like she just didn't want to go out, but please excuse me because I don't really understand her situation; this is just my one-sided observation."

This content highlights how most patients and family members did not perceive the important influence of mental depression symptoms on patients' physical and emotional health. Patients' health anxiety and family's bystander perspectives are possible contributing factors to this situation. Though it appeared possible for family members to be helpful in identifying physical and mental symptoms (e.g., F09), many family members lacked the knowledge and understanding required to grasp the patient's state of health and provide meaningful support.

4.1.2 Contrasting perspectives on mental and emotional health. We observed polarized attitudes and behavior toward mental and emotional needs across the interviewees. We characterize these attitudes into two contrasting types: *dismissiveness* and *active acknowledgment*. Participants presenting a *dismissiveness* attitude did not validate or actively respond to the mood-related symptoms they reported. In contrast, those presenting *active acknowledgment* demonstrated a strong understanding of the relationship between their own physical and emotional states and a sense of control over initiating recovery from depression episodes.

4.1.2.1 Dismissiveness. The majority of patients exhibited a dismissive attitude toward their own mental and emotional needs. We define *dismissiveness* as including actions such as choosing not to act on or change their behavior in response to mental or emotional stressors even after recognizing them, and/or the explicit de-prioritization of such feelings or experiences.

Dismissing characteristics of depression. We observed several instances where patients mentioned psychological problems, but did not actively acknowledge them. For example, P14 described being overwhelmed by mental and emotional struggles, which immobilized her during depression episodes, while simultaneously denying that these experiences had any significant impact on her. Similarly, when asked about his experience of depression P08 denied experiencing any "frustration or changes in mood", but shortly proceeded to describe that he would "feel angry and frustrated when [his] wife and kids played too loudly in the living room during his headache episodes."

We also recorded many accounts of patients rejecting behavioral treatment, which is meant to most directly address mental and emotional struggles in depression. P16 described her decision to

change doctors after being advised by her psychiatrist to meet with a therapist in addition to taking medicine. Both of the psychiatrists we interviewed emphasized that, in comparison to younger depression patients, it was harder to convince older depressed patients to undergo behavioral therapy. Even if successful, it often involved months or years of persuasion. They also mentioned that many of their older depressed patients were unwilling to accept the term *"depression,"* due to its connotation as a mental illness.

Individuals with a dismissive attitude toward their states of mental and emotional health were also shown to de-prioritize behavioral changes that are important to depression recovery. When asked about the possibility of engaging in more depression-alleviating activities (e.g., exercising, socializing) or monitoring her state, P14 remarked, *"I just don't want to make a lot of changes… I'm fine this way.*" Some family members also expressed a belief that these types of behavioral changes are not that essential to the patients' health. F02 (P02's daughter) made the following comment: *"Yeah exercise releases dopamine which helps with depression, but people aren't always cut out to be so hardworking. Sure, I think it's important but it's not like failing to exercise is going to kill her.*"

Failure to acknowledge the details of mental experiences can also make formulating treatment plans more difficult when dealing with inconsistent accounts of more physical or straightforward symptoms, such as sleep quality or body pain. These inconsistent accounts can easily happen with the frequency of somatization (psychological symptoms expressing as physical symptoms) in depression. For example, P14 recalled reporting poor sleep quality to her doctor without recounting experiential details that could have been related to the experience. Note that it is common for depression patients to have sleep difficulties due to mental or emotional disturbances. When asked about sharing with her doctor more details about her experience of not sleeping well, P14 responded, *"No I don't do any of that, I just tell him that I didn't sleep the entire night."* Psy02 also reported having to often address objectively inaccurate patient reports of symptoms that could have been magnified by negative bias. She recalled one patient earnestly claiming to hurt so much they could not walk at all, but observed this patient walking very naturally with no limp. Inaccurate reports of physical symptoms without a detailed account of the patient's mental experience or state made it difficult for her to define treatment for the recovery process.

Factors contributing to dismissive attitude. The above-mentioned dismissal or avoidance of mental experiences can be linked to patients' perceptions of the relationship between their moods and depressive symptoms, as well as their experiences with depression, some of which are reinforced by family members' accounts.

Many patients stated that they did not perceive a causal relationship between the moods they experienced and their physical depression symptoms (e.g., fatigue, insomnia). Many patients denied that negative moods were associated with any bodily or cognitive dysfunction (e.g. insomnia or impaired memory). However, memory problems are closely associated with depression severity [15]. P12, who had been hospitalized multiple times for severe depression, reported particularly serious memory problems, but felt sure that this had nothing to do with mood. She explained, "[The only problem is] just with the memory itself." P09 also rejected the possibility of thought patterns and feelings playing a role in the onset of her physical depression-related symptoms, stating "There isn't anything that particularly troubles or worries me... my head just felt bad, and then I started to have insomnia... that's all that happened."

Patients also experienced depression symptoms that lowered their motivation to make behavior changes, such as fatigue and negative thinking. Family members also reinforced the accounts of these struggles. Thirteen of our patient participants and their family members observed that the feelings of fatigue, being 'down', or inability to engage were very noticeable during depressive episodes. P04 recalled that when her mood and energy were particularly low, she felt incapable of doing anything, including work or household chores. Correspondingly, P04's daughter reiterated

that when her mother was in a slump she would stop doing any regular activities - just sit and do nothing for long periods of time. Negative thinking also prevented patients from being receptive to positive behavioral changes. When asked about initiating behavioral changes to help with her depression, P11 replied that she found it pointless: *"All of my past is just so unhappy, nothing good has ever happened.*" P03 expressed a similar sentiment, saying that the most prominent things in her heart were unhappy experiences. F03 (P03's daughter) also recalled the difficulty of assuaging her mother's negative thinking: *"It was extremely difficult to try changing [P03's] opinion… By the age she is at, she had formed strong impressions of the past that were hard to change."*

We see that patients with the *Dismissive* attitude did not acknowledge the impact of their mental and emotional state on their overall health, which affected their and providers' ability to work towards recovery due to lack of context into the nature of patients' depression episodes. However, this behavior was likely impacted by the burden of depression symptoms - and family members were able to effectively notice the behavioral effects of depression, demonstrating their potential to help manage these changing health states.

4.1.2.2 Active acknowledgment. We define active acknowledgment as patients' active validation of mental or emotional states impacting their well-being. The understanding gained by this acknowledgment becomes useful for making decisions pertaining to behavior change. Patients exhibiting active acknowledgement reported that they would recognize changes in their mental and emotional state and respond accordingly, such as actively making changes to their activities (e.g. work) when detecting themselves to be in a depressive episode or emotionally overwhelmed.

These patients prioritized engaging in behavior to improve mood when coping with a depressive episode. P07 explained that he would encourage himself to address his emotional state during depressive episodes, telling himself: "Ok, I want to be in a better mood now. What should I do to achieve that? I remind myself that it's ok to put the thing I was just doing to the side, tell myself I'm not in a hurry, so I don't end up feeling like I have to deal with too many things at one time... after a while it's gotten easier not to get caught up in [the depressive episode] experience, which was like being pulled into a whirlpool." P07's wife also noticed changes before and after he was able to evaluate his own emotional state, noting the difference between the current situation and previous periods of depression when he would panic at work: "He now knows what to do when he's not well." P03 also described how being more attuned to her experience helped her find ways to deal with depression symptoms. She used to feel helpless while suffering from insomnia until she noticed listening to recorded sermon made it easier to fall asleep, and started to use this as a solution.

By acknowledging and validating their own feelings and experiences of depression, patients gained the power to alter and improve their own mental state. P01 was able to identify the pressure from family responsibilities in her traditional marriage as a specific source of her emotional troubles and stress. This allowed her to face and address those responsibilities as a tangible issue, which differed from dismissive patients who did not make the step to identify specific sources of psychological burden. P07 also described becoming aware of mental changes and how this led him to engage in behaviors to cope with his own mental state: *"Having negative thoughts put me in a bad mood... I noticed that this tended to come in bursts, or episodes. After I became familiar with these patterns, I was able to understand that they would not go on forever as they seemed to feel like in the moment. It was then possible for me to start thinking of ways to deal with or resolve these uncomfortable episodes." This patient would attend community events or engage in exercise particularly when he was in a bad mood, citing the ability to change mood by through physical behavior: <i>"I realized that I had to hurry up and exercise, because past experience showed me that it would make me feel better almost immediately.*" Here, P07 was able to acknowledge and act constructively on the onset of his depressive episode.

In contrast to the *Dismissive* attitude, patients who engaged in *Active acknowledgment* would validate and attune more to their own mental experiences and feelings. This allowed them to not only discover unique approaches that effectively addressed depression for them, but also manage their depression more securely by knowing the scope of their own depression episodes and being confident in the effect of their own behavioral strategies.

4.2 Social Pressures of Sharing and Support-Seeking

Patients tended to limit the sharing of their own experiences of depression, which they regarded as very personal, with family and peers. The findings here shed light on **RQ2** by identifying the lack of depression communication openness and the social concerns that contribute to this.

The desire to maintain independence and privacy in relation to others was often cited as a reason to not share, particularly in the presence of younger family members. For example, when P02 was asked if she would be willing to let her children see data related to her depression condition, she replied, "Only if they don't boss me around after seeing it." This sentiment of P02 wanting to not feel managed by or dependent on her children was also reflected by her daughter. F02 described that her mother (P02) felt supervised, and that P02 would often act against this feeling in ways such as telling her daughter not to ask of her whereabouts while she was out with friends. P07 emphasized independence in general when asked about sharing with family, as follows: "It's important to rely on yourself to adjust to those symptoms... in the end it's all on you, whether you want to make yourself better or not." Correspondingly, his wife (F07) remarked that, "He takes care of his condition on his own... I feel that [P07] just isn't the kind of person who talks to others about what's troubling him." Many patients were also open to sharing about the topic of depression in an impersonal way with the goal of helping others, but refrained from sharing about themselves. P16 mentioned that she talk to her peers about depression only if it was to encourage them to seek psychiatric help. P05 similarly stated: "I often accompany and comfort others (even strangers) in order to help them out of their depression." However, she said that she did not want to share details with her children or husband explaining, "I just want to keep it to myself."

Social responsibilities and pressures unique to the role of seniority also prevented patients from confiding in others about their depression, which they perceived as both a weakness and a burden upon others. Participants may withhold information sharing as an effect of perceived additional responsibility and maturity resulting from seniority. P03 stated that she did not share deeply with her children about her condition "because they would not understand an adult's heart." She also explained why she did not share her troubles with her siblings by stating: "I'm the oldest sister, so I have to be more independent." In intergenerational interactions, many older adults felt obligated to play a strong supportive role for younger individuals. This also meant valuing the maintenance of harmony and interpersonal relationships over expressing their own needs or doubts. In the context of communicating about depression with his family, P15 described that "Instead of talking about my personal problems, I think that there are more constructive topics of conversation." Other patients sought to avoid expressing too much personal emotion during conflicts: P02, P07, and P16 described that they would strategically switch to remote messaging for communication during interpersonal conflicts, "as too much emotion comes out in face-to-face confrontations" (P02). Most (11 of 16) of the patient participants placed importance on not burdening others by emphasizing the belief that other people have their own issues. They used this belief to explain why they did not want to share details about their condition with family or friends. Patients also felt responsible for sharing more uplifting and not burdensome information to others. For example, P02 made the following comment on sharing details about her condition with family: "I don't want to give my children more unnecessary pressure. They are not doctors, so why would I do that to them?" This sentiment was

echoed by P14 who explained that because her children could not help, "I don't want to add to their difficulties, as they will still worry about me."

However, nearly all of the interviewed family members of patients whom were reluctant to share explicitly expressed that they cared very much about the patients' condition and would like to know more about their health. For example, P02's daughter described, "When I noticed that she starts to get depressed, I'll really try to encourage her to go outside and have some fun since it was one of the things the doctor recommended." She also described exchanges she and her mother (P02) would have every day over instant messaging, where she would check in on P02 with questions like "What are you having for dinner?" or "What are you up to right now?". P03's daughter talked about a similar routine: "My mother [P03] lives alone, and I visit her every day after I get off of work to chat with her and check in on things." Even those who were not yet able to acknowledge or understand the complexity of depression, such as P01's husband (see Section 4.1), still expressed a keen care and desire about P01's health: "I want to know how she is doing every day, where she plans to buy groceries, if she needs help with anything... She doesn't walk well due to a bad foot, so I always ask her where she is going and I am really worried whenever she goes out."

Unsurprisingly, patients perceived their health state around depression as both private and personal. However, we also saw that features unique to this older depressed population such as strong responsibility and expectation of self-reliance additionally contributed to patients' caution towards sharing with close others. Nevertheless, family members still expressed the desire to understand more about their health.

4.3 Depression-Relevance as a Determinant of Communication

The relevance and experience of a social network member with regard to depression appeared to strongly affect both how receptive patients were to communication *from* other individuals, as well as their own willingness to share. Receptiveness and proactive communication (two-way communication) is an important dynamic for recovery from depression, as it determines whether a patient is able to receive support and guidance. We observed that patients exhibited high receptivity and openness when in dialogue with those who they perceived as domain experts or highly experienced in dealing with depression. Thus, they were not as open toward socially-close individuals (such as family members) who may be more naïve to the condition, but still received social support which was not directly related to depression. This finding connects both **RQ1 and RQ2** by demonstrating that the perceptions of depression itself (RQ1) also affects the perception toward social interaction and communication (RQ2).

Patients were distinctly more open to doctors and to depression-experienced peers in terms of depression communication and taking treatment advice. F02 (P02's daughter) described that her mother (P02) was not emotionally expressive around her after a family death that triggered a depressive episode, but was able to cry during her session with her psychiatrist. F02 commented: *"I think it was good that she cried it out. Afterwards, [P02] told me that she thought well of the doctor for getting her to cry, and that we (my brother and I) simply didn't know the right thing to say to her."* P13 reported being more open with their doctor than their friends: *"I don't share my thoughts with my friends, maybe only the surface; as for my real inner thoughts, I only dare to tell my doctor.*" The involvement of emotional struggles in depression means that the ability to share thoughts and feelings is important for successfully resolving those struggles, so understanding this selectivity is crucial. Patients were also more receptive to information delivered by the doctor. In fact, patients and family members generally reported patients' higher compliance with doctors than with other members of the social network. F09 (P09's daughter) reported: *"It really depends on who is communicating with [P09]; there was no use in us kids telling her not to sleep so much, or to go out and be more active. It had to be a doctor or a nurse telling her the same thing for it to work."* Not limited to

doctors, participants also communicated more openly with peers perceived to have more experience with depression and mental health. P16 reported that her primary confidant for depression issues was a colleague (a psychiatric nurse). Similarly, P04 discussed depression-related issues mainly with a church friend about her depression, *"because her son had been seeing a psychiatrist for a while."*

The focus on depression-relevance in sharing also extended to an eagerness towards sharing about depression with the goal to help others. For example, both P15 and P16 reported they would try to provide others with resources and encouraged peers to seek help for depression or mental struggles. P05 also mentioned, "I like to comfort others, even strangers, and try to help them step out if they are struggling with depression."

We saw from Section 4.2 that patients had social concerns which prevented them from sharing about depression with their family, but Section 4.1.1 also showed us that family members could have misconceptions of depression. Such lack of understanding also prevented patients from sharing with those close family members. For example, F01 (P01's husband) remarked throughout the interview that his wife (P01) *"just thinks too much"* which caused her depression. When we asked P01 about whether she confided in her husband about her thoughts or feelings, she responded, *"I think that my husband may sometimes just get annoyed hearing about this kind of thing, it seems to feel like I'm saying the same things every day..."* This dynamic can be very hurtful for patients, and they may strongly benefit from ways to enlighten family members about the nature of depression and the implications of their behavior.

Nonetheless, even with the same family members whom they did not tend to confide in about their depression, many patients experienced and encouraged support through physical actions. Some interviewees (P01, P03, P05 and P07) mentioned that despite not confiding in their family members, their children or spouses showed support by keeping them company, helping with chores, cooking for them, and/or performing other small gestures. P01 mentioned that, though she wasn't able to talk to her husband about thoughts or feelings, she learned that he was more than happy to express care through physical actions such as asking to help rub her feet whenever she felt discomfort. Her husband (F01) also told us, *"Before her depression we used to be very independent of each other, but now we interact a lot more, even when we are just watching TV together."* When asked about how her daughter (F03) shows support, P03 said, *"She comes over to chat and keep me company, and helps me with the chores."*

Apart from the specific social concerns detailed in Section 4.2, the findings here show through examples from interactions with doctors, friends, and family, that explicit experience with or understanding of depression (as well as the lack thereof) are strong determinants of whether patients are open to collaborating with someone on their depression recovery. There is also some redeeming hope for family members who may misconceive depression but still clearly care about and support these patients through other means.

5 DISCUSSION

We have described how the complexity of increasing health conditions in older adults presents difficulty in providing effective care to depressed older adults, due to these comorbid health conditions intermixing with both mental and physical symptoms of depression. Treatment plans for mental health issues such as depression must be highly individualized, but the difficulty of differentiating depression-relevant symptoms complicates this process for older adults. Collaborative care and involvement of patients' social network members in the management process are hence also highly encouraged for this population. In this study, we explored the social feasibility of integrating technology and information design as a coordinating mechanism to facilitate collaborative symptom management, doing so from perspectives of the depressed older adult patients and also their family members as part of their social network.

5.1 Revisiting Our Findings

Our results indicate how the understanding of what symptoms or experiences constitute important signs of depression can be obscured across both patients and their family members, even though family members are helpful in identifying symptoms patients may miss (*RQ1: What are interviewees' perceptions of health and depression?*). Sharing health accounts and experiences of depression is also subject to perceptions of self-reliance, privacy, and responsibility as an older member of the social group. Nonetheless, family members still expressed a desire to know about patients' health experience and help them overcome difficulties (*RQ2: What are interviewees' perceptions of communicating w.r.t depression?*). The eligibility of social network members to be privy to patient communication is also explicitly moderated by the level of understanding or experience the individual has of depression (*a combination of the perceptions explored in RQ1 and RQ2*). As family members still expressed care and support through other means, improving their understanding of depression could increase patients' openness to sharing with them.

Uncovering these views informs the design of mechanisms to assist collaborative depression management, by revealing what beliefs of the different stakeholders must be considered for them to successfully communicate important thoughts and observations with each other.

Our findings are in line with previous research on the difficulties of distinguishing other existing physical health problems from depression-related health problems in older adult depression [8, 10, 57, 84]. This was shown in the confusion of what patients and family regarded as depression symptoms or not (Section 4.1). The difference in recovery trends for people who were able to successfully identify and utilize emotional and physical symptomatic patterns to their benefit (Section 4.1.2.2) also underlines the importance of validating and understanding symptoms. The literature confirms that the experience of depression contributes to the struggle with forming representative accounts of symptoms, as well as the unique social burdens experienced by older adults which hamper communication [42, 44, 67]. However, our findings still indicated that family members do have strong potential to help with managing the depression [22], as they notice issues patients may miss and express care for the patients (Section 4.1, 4.3).

Our findings have also expanded previous work on multiple dimensions. Past work on collaborative health technology in a depression, family, or older adult context has tended to focus on only one of these contexts or on supporting a specific role (e.g. either the caregiver or the patient) instead of both perspectives. These efforts focused on ways to promote day-to-day information sharing in an intergenerational family structure, or support the significant emotional challenges faced by caregivers of depressed family members [9, 79]. Our work is the first to attempt exploring both depression perceptions and social issues that span across the context of older adult depression patients and their social network members – this specific context of depression in older members of the social group has revealed different findings. In comparison to findings of prior research, we have found the need for even stronger validation of, particularly, patients' mental health experience, as well as clarification of the health accounts provided by patients and others: we are working with a specific context in which the patients struggle with sensitive experiences that require validation, but in which both they themselves, and those in close proximity have difficulty understanding the health problem and its experience. These are struggles that have not been reported in past work, but which we saw in interviewees' dismissiveness (Section 4.1.2) and confusion about what constituted symptoms (Section 4.1.1).

Though it is common for people struggling with mental health to seek advice from peers with relevant knowledge [51, 52], our finding of older adults choosing to *limit* their communication with social resources based explicitly on depression relevance (Section 4.3) has not been reflected in past related work. Prior work on depression and social support generally identified the complexity

of social support in managing depression, but have not identified this specific obstacle [13, 82]. Depression understanding, specifically as a gateway to communication with the social network, can be a crucial point of knowledge for improving depression collaboration.

The conflicting relationship between some family members' dismissiveness of depression and their coexistent care for the patient is another unique finding that inspires sensitive design to resolve this contradiction. We found that family can be confused by and invalidate patient's depression (Section 4.1.1), but that even the family members who do this may still deeply care and want to improve the patient's experience of depression (Section 4.3). These contradictory behaviors could in part be due to a lack of understanding, which is addressable by designing activities and information to increase understanding through practice.

Our findings distilled three key design implications (Table 2) that can inform how technology could facilitate integrating collaborative social resources into older adults' depression management: (1) Balancing flexibility of social participation with expression of care, (2) Integrating and validating valuable accounts from social network members, and (3) Presenting information to increase depression understanding in a social context.

5.2 Balancing Flexibility of Participation with Expression of Care

Our design implications are situated in the context of a more flexible social resource system with the goal of helping depressed older adults manage their condition. It can be used by the patients themselves, close others, and/or people with experience who are willing to provide counsel. Our findings showed that patients had very distinct social boundaries for sharing about depression, and the implications in Section 5.1 aim to allow the most benefit from these diverse social resources by respecting users' boundaries while creating opportunities for social and emotional support.

It was clear from patients' accounts that they also sought guidance from depression-knowledgeable peers outside the family (Section 4.3). Therefore, the inclusion of such peers as part of the system can have significant benefit if they are trusted by patients. Prior work on online mental health communities has shown particularly strong social support from similar others, especially in the context of stigma [35, 66]. Patients also more easily find value in comparing their own health state with that of others with whom they feel affinity [52]. When close others such as family members are not yet understanding of depression, including these trusted others on the discussion and sensemaking of symptoms may still hold value for depression symptom management.

Despite family members' lack of understanding, the roles they play could change over time as their understanding of symptoms potentially change (Section 5.3 discusses approaches to help make this happen). The dynamic nature of changing social ties for individuals managing mental health has been noted in the literature [49] and is also echoed by the complex relationships patients had with family and peers in our findings. Flexibility of users' participation in collaborative depression management systems must be an important quality of the interface. The level of access to the patient's health information, as well as accessibility to communicate regarding the patient's information, should be customized with priority to the patient's privacy, but while respecting all users' boundaries. Such settings for maintaining boundaries must also be easily modified to accommodate changing levels of trust. Facilitating indirect exchange of messages for patients and close others with whom they may refrain from sharing for fear of emotional volatility (Section 4.2) could also be helpful for encouraging useful discussions to occur without escalating conflicts, by enabling users to express their thoughts while enabling discussion to occur during more emotionally-stable times. An example of this may be a shared notepad which can be checked only at will, implementing more ambient forms of notification compared to standard forms of messaging.

As a means to mediate the different roles of close others and depression-relevant peers, a mechanism for accounts provided by naive close others to be endorsed by depression-knowledgeable

others could provide access to appropriately transition social ties while respecting the patient's boundaries and communication etiquette. For example, if the information provided by a family member who is less prioritized by the patient (in context of depression) is endorsed by a higher-priority user of the system (e.g., depression-experienced), patients may slowly gain trust for the family member through explicit endorsements. This authority-based model is used widely for social endorsement of job skills on LinkedIn [59]. However, an open community of peers in this context may also create risks of misinformation or uncomfortable interactions. Expertise-driven social question-and-answer forums, like Quora, can combine mechanisms such as social voting with topic bios of expertise and experience to identify and promote suitable content [55]. Automated filtering of health-related misinformation is also a viable method [46]. Additionally, patients and all users should have the ability to restrict interactions, and patients who are in a more sensitive place may need an option to filter out content that has not yet been widely validated by others.

Family members' role in the support of patients' depression was complex and sometimes contradictory in our findings, but all of the family member interviewees expressed that they cared a lot for the patients. This was shown through physical acts of support, but did not always come through as supportive of the depression itself. Reasons for the lack of explicit support ranged from lack of understanding depression, to feeling as if their words had no effect on the patient (Section 4.3). However, achieving depression support is important for successful communication on both sides to promote symptom management, and emotional support of the depression experience is also important to depression recovery [82]. Routinely prompting or reminding close others to express emotional support for the patient may still be helpful - particularly when these people do not yet understand much about depression or feel confident, yet care for the patients.

5.3 Integrating and Validating Accounts from Social Network Members

Our findings show that family members were capable of making important direct observations about patients' health state, even if they could lack understanding of the depression itself. Patients also valued the guidance knowledgeable peers provided for depression management, and some even expressed enthusiasm for helping and guiding others' depression (Section 4.3). This leads us to posit integrating these uniquely valuable social information sources to mitigate the difficulty in making sense of older adult depression symptoms.

However, our findings also showed how lack of understanding of physical and mental symptoms, and their influence on the patients' health state, can lead to severe consequences for recovery, psychiatrists' understanding, and patient-family relationships. A way to integrate accounts and narratives from patients, family, and peers to be both respectful of and useful to patients could make a huge difference for treatment planning, social support, and patients' mental health.

These accounts can be integrated in a structure of longitudinally-synchronizing health, behavior, or emotion information noted by patients and by those who are in their physical presence (e.g., family, close friends, etc.). The longitudinal synchronization would help to construct a greater understanding of confusing symptoms by integrating different sources of information and their patterns over time. Additional support for sensemaking from knowledgeable others (e.g., remote peers) can be further integrated by allowing social interactions around the patients' data or for direct comparison with similar others' data, which has been found to be helpful for managing mental health [49]. Multiple views of patients' changing state generally allow for clarifying uncertainties, and experience sampling (ESM) is an existing method that has been used to consistently record mental health state in depressed individuals in discrete entries over a longer time [36, 77].

In entertaining these possibilities, very strong consideration must be given to the perspective of the patient in particular, as this approach pertains to their personal information being shared or others' scrutiny of their personal health. Our findings echoed the concerns of depressed older adults

regarding their independence from others, and that not all social network members' accounts of depression were diagnostically correct or supportive. The decision of whether a social network member can contribute to or interact with this account of health information lies in the patient. Even when allowing these informational accounts and discussion surrounding them, the presentation must be designed to clearly indicate that each piece is a subjective account by a specific individual and not an objective piece of information. Because others' views and understanding of depression heavily influence the patient, this precaution must be taken especially if there are signs of dismissiveness coming from social network members. Affordances for dynamic and immediate moderation of these accounts and interactions must also be easily accessible to the patient.

5.4 Presenting Information to Increase Depression Understanding

Aside from identifying points to improve communication, our results clearly found that depression understanding was a struggle for both the depressed older adults and their family members. This lack of understanding not only affected treatment planning, but also trust and validation between patients and their family. Therefore, emphasis must be placed on how the presentation of this consolidated health information is designed; it must be done so in a way that promotes understanding and empathy for the *depression experience*. This would not only improve the quality of symptom monitoring, but also the level of actionable recovery and quality of emotional support from close others.

Documenting and contextualizing specific observations as well as longitudinal monitoring can help patients and close others see relationships between variables such as specific coping behaviors and subsequent trends in physical and mental state. These changes between complex physical and mental symptoms can be visualized to emphasize the temporal trends in those changes, which is important for determining any correlations between behaviors and health states. The process of identifying these trends in real data could help to convince patients or family members who do not currently see the relationships between certain health symptoms and patients' mental state (Section 4.1) of the reality in depression as both a physical and mental illness. Knowing the specific depression patterns for each patient can also make recovery much more actionable, as we saw in the active acknowledgement group (Section 4.1.2.2). Prior work on visualizing complex health data for older adults has recommended comparing current and past data for reflection, as well as using brief, straightforward presentation of information points [3, 48].

Patients could struggle with motivating themselves to understand their own health state as a result of apathy and fatigue in their depression (Section 4.1.2.1). Initial encouragement of active reflection on this information about their own health has been shown to steer these patients to develop increased motivation for recovery and understanding if it successfully leads to a positive result, such as improved recovery [2, 64]. Active reflection on autobiographical content has also been shown to consistently reduce these effects of depression in older adults [34], making the act itself of reviewing this personal information beneficial as well. The inclusion of other patients (if patient users are willing to share their health information with similar others) in collaborative reflection and discussion, too, can provide more motivation and understanding through social support and useful comparisons of health information [52].

5.5 Lessons Learned for Collaborative Information Design in CSCW

Our results both echo and supplement CSCW work on collaborative information design for aging and health. Prior work has found perceived relevance and feelings of being recognized or valued to be important factors in older adults' information sharing and health coproduction with peers [14, 43, 50]. The regard our interviewed patients held for those with knowledge about their condition,

Concept	Main Findings	Examples		
Balancing flexibility of participation with expression of care (Section 5.2)	 Patients are differentially open to sharing with depression-relevant others Social pressures restricted sharing with close others 	 Include participation of both close others and knowledgeable others Social endorsement by knowledgeable others to mediate potential changes in social network members' reliability 		
Integrating and validating valuable accounts from social network members (Section 5.3)	 Both family and knowledgeable peers are sources of support Depression symptoms can complicate judgment of both patient and bystanders Patients are differentially open to sharing (based on both social and depression-related factors) 	 Longitudinally-synchronize accounts of patients and close others Enable similar others to discuss and/or compare own health information 		
Presenting information to increase depression understanding (Section 5.4)	• The ability to understand mental and physical symptom relationships was a key deciding factor in failure or success to validate and take action on depression episodes	 Emphasize temporal trends in symptom relationship to prove significance of mental state Encourage active reflection with similar others to improve motivation and actionability 		

Tab	le 2.	Key	Design	Imp	lications
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as well as the need for family members to value their experiences and perceptions of their own depression, reflect these points very vividly.

We have also learned the sensitive and complex nature of how important stakeholders can both be useful and detrimental to the health goal, and how strongly this is moderated by understanding of the health condition. From studying how complex psycho-physical symptom relationships mediate the behavior of key stakeholders, we have seen that knowledge contributed by every role (e.g. patient, family, peer, doctor) can have unique and irreplaceable value. Only patients can impart their own personal experiences, and only bystanders can depict physical manifestations without a subjective filter. However, both family members and patients could also weaken treatment and management of the condition if they have misconceptions of what constitutes the illness, which can be a more primary concern in situations with many comorbid mental and physical illnesses.

Collaborative information systems which need to assist with managing health issues that are difficult to understand must sensitively balance between mediating appropriate accessibility to interaction, and designing to fill gaps in understanding that may be experienced by the users themselves. If this is done well, the contributions of each social role can successfully form a comprehensive understanding of the condition. Technology design is capable of guiding social interactions while bearing responsibility for it instead of the users themselves, to reduce pressures on the stakeholders involved. A system focused on integrating diverse accounts and viewpoints can allow patients more power over who can view or contribute, as well as more flexibility around each party's representation to facilitate understanding of complementary information.

6 LIMITATIONS AND FUTURE WORK

Due to the difficulties in approaching and recruiting depressive older adult patients and their family members, we were limited to recruiting participants accessible through our collaborating psychiatrists, which may have introduced selection bias towards patients who were more willing to speak about their condition in an interview. We were also only able to recruit participants who were in a more manageable phase of depression, in consideration of feasibility of our detailed interview. However, more severe depression may include differences in judgment that were not covered in this work. Furthermore, we were unable to recruit family members for every patient interviewee that we recruited, due to willingness to participate. Further research may be needed to understand how the depression severity and the nature of family relationships may play a role in the implementation of collaborative health for depressed older adults.

This study was conducted in East Asia, meaning that our results may have limited generalizability outside of East Asian cultures or collectivist society. This may be the case particularly in terms of seniority effects, divorce stigma, and mental illness stigma, which are magnified in Asian cultures and Confucian societies [1, 17, 85]. In contrast, the stereotypical views of older adults as incompetent or stubborn are found to be consistent across cultures [20]. Future research may still be needed to clarify cultural differences concerning inter-generational communication and social perceptions of depressed older adults.

Some of our findings demonstrated potential value for more in-depth study on non-patient stakeholders of this target group, such as family or peers. The older adult participants retained some differential attitudes towards younger family members, which affected how they communicated about their depression (Section 4.2). Though our sample of different family roles cannot reveal robust trends in inter-generational interaction dynamics, further exploration of these factors can help understand how this might influence design for social communication. We also saw that family members could hold highly unsupportive views regarding the patient participant's depression due to misconceptions about depression, while demonstrating support and care for the patient in other forms (Section 4.1, 4.3). Future studies are needed to inform how to educate and communicate with these individuals in a way that can promote their willingness to understand the patient.

7 CONCLUSION

Collaborative care has been shown to be beneficial for dealing with the multi-dimensional nature of depression in older adults, which is characterized by difficulty of identifying symptoms due to physical comorbidity and cognitive changes in older adults. We conducted an interview study investigating perceptions and behaviors relevant to communicating about and understanding depression in order to promote recovery planning and action based on older patients' depression state. Our key findings provide insight on how struggles in understanding depression itself and their own communication. We provided design implications on how to integrate social resources into recovery planning in consideration of our findings, and advocate its use to resolve issues in illness understanding and promote better social support for depressed older adults. This research is a first step in uncovering the opportunities and challenges of facilitating social support systems for depressive older adults. Overall, we believe the insights we gained from this study could shed light on future research for this older adult population and on design for socially-complex health issues (e.g., geriatric depression).

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