Investigation on Online Healthcare Social Platforms and Patient/Physician Performance through Data Analytics

by

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Abstract

Essay 1

It is unclear whether online patient communities are effective for health goal striving activities. Based on social cognitive theory, we identified two online mechanisms – social support and self-regulation – to examine three facets of health goal striving performance (i.e., goal progress rate, verbal update, and updating recency). We collected a longitudinal dataset from a leading online patient community. After the fixed effect first order autoregressive analysis to the unequally-spaced panel data, we find that the two online mechanisms bring different effects to patients' health goal performance through peer interaction. Our findings show that one category of social support (informational support) increases goal performance. Another type of social support (companionship) decelerates patients goal progress. We also find a "sophomore slump" phenomenon existing within the self-regulation cycle toward goal attainment. In addition, the findings reveal that health-related response to peers shortens updating recency, which indicates the liveliness of online goal activities.

Essay 2

Health goal striving activities are a major part of the lives for those who are fighting chronic diseases. In this study, we are interested in understanding the effectiveness of social media-enabled online patient communities on the final point of health goal striving endeavor – health

goal attainment. Applying social cognitive theory, we study the antecedents of health goal attainment from the respects of social support and self-reflection in online patient communities. We apply Survival Analysis to a data set of patients' interactions and their health goal progress from a leading online patient community. Our findings show that emotional social support can increase patients' chance to achieve their goals while informational social support does not appear to be effective. In addition, health-related self-reflection increases online patients' likelihood of goal attainment, but leisure-oriented self-reflection negatively affects the possibility.

Essay 3

E-health programs in low- and middle-income countries are proliferating at a substantial rate to offset limitations of medical resources among burgeoning populations. A variety of social media-enabled hospitalized communities initiated in China is a representative example of healthcare reform that is taking place world-wide. Grounded in the social exchange theory, we examine doctors' adoption of such hospitalized communities in China and investigate the impact of doctors' extra-business activities toward gaining respect and financial benefit. Doctor-level data was collected from a leading online hospitalized community. The empirical findings reveal a positive influence of the extra-business activities on both received respect and financial benefit. In addition, we also find a contributing mediation effect of the received respect (a socioemotional reward) on the nexus between the extra-business activities and the received financial reward for online doctors. This investigation provides important evidence for the

research body of innovative e-health and for the literature related to socioemotional and economic wealth/rewards.

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List of Abbreviations

FE-AR (1)	Fixed-effects first order autoregressive
EHR	Electronic health records
OLS	Ordinary least squares
OPC	Online patient communities
PGC	Patient-generated content
PVAR	Panel vector autoregression
SCT	Social cognitive theory
SUR	Seemingly unrelated regression
VIF	Variance inflation factor
WHO	World Health Organization

Essay 1: Social Media-enabled Patient-to-Patient Interaction and Health Goal Striving: An Empirical Investigation

Introduction

Due to the convenience of social media platform, patients with chronic diseases have been increasingly seeking health-related information in online patient communities. According to an online survey, one in five Internet users has gone online to join others with similar health concerns (PewResearchCenter 2013). In another survey, 53% of online patients with chronic disease reported that their most recent health-related online activity was to interact with people having the same condition (Fox and Duggan 2013). Social media provide patients with an interactive environment to manage their health. In this research, we are interested in the health goal striving aspect of online chronic condition management. Different from the traditional offline goal management in which patients are usually monitored by physicians or nurses (Von Korff et al. 1997) based on predefined evaluation measure and technique (Ruble et al. 2012; Wagner et al. 2001), striving for goal attainment on social platforms is likely to be motivated by patients' intrinsic desire for better health and crowd support. For example, many people enjoy losing weight with others on diet social communities (e.g., SparkPeople.com). However, the effectiveness of online patient communities on goal striving performance remains under-investigated.

Previous literature has suggested social media platforms are beneficial to tasks that are well-structured and knowledge intensive, such as crowdfunding and product innovation (Burtch

et al. 2013; Hildebrand et al. 2013). Yet, we are not clear how social media platforms assist personal activities that require strong determination and self-regulation, continuous monetary/labor input and countless emotional management (e.g., chronic disease management). In addition, it is argued that online peer support on social media platforms takes the form of informational support, emotional support and companionship. So far, there have been few empirical studies cast light on the effect of each aspect of social support on assisting chronic condition sufferers to achieve health goals. In addition, past research in chronic conditions has mentioned that social environment can support or impede self-regulation performance (Burg and Seeman 1994; Karlsen and Bru 2014; Schafer et al. 1986). We are still not clear how social support and self-regulation interact with each other and together impact the outcome of health goal striving.

Adopting social cognitive theory as the theoretical foundation, we conceptualize *online social support* and *online self-regulation* as the main mechanisms for goal performance. Extant studies show that social support among online patients provides health benefits to community members (Berkman et al. 2000). Within social support, however, each sub-category has a different orientation and thus may lead to different outcomes. For example, informational support conveys practical information and is in forms of personal experience, medical treatment recommendation, and so forth. We do not expect informational support to carry the same effect as companionship, another type of social support that focuses more on leisure topics and chatting. Given that each sub-category of social support has its unique nature, we examine the variate effects of social support on goal striving outcomes. In the perspective of self-regulation,

prior studies tend to focus on the offline environment (e.g., McClellan et al. 2003). When patients monitor their goals via social media platforms, they not only provide self-evaluated information (e.g., goal progress and verbal update) to the public, or at least their online friends, but also post health or goal oriented responses per request. We consider both patient-initiated goal report and responses per request as part of the self-regulation process.

The data collection venue is a large online patient community that hosts more than 500 types of medical conditions and serves more than 400,000 members. The website's pre-set goal types, well-designed progress scales, and the convenience of social functions make this website an ideal for examining the online social mechanisms and goal striving outcomes. We gather an unequally-spaced unbalanced panel data set from open users on the website and measure the *change* of patients' goal performance in continuous time periods. The fixed effect first order autoregressive model is applied to analyze the data. We also estimate a Panel Vector Autoregression (PVAR) model to examine the dynamic interaction among the three aspects of goal striving.

We find that not all factors within the two mechanisms are created equal. For example, informational support appears to be beneficial for goal initiators and thus should be encouraged among online peers, whereas companionship has a negative effect and thus should be communicated in a limited amount. The results also indicate that a "sophomore slump" phenomenon may occur during the loop of self-regulation (e.g., the loop for progress and verbal update). Thus, online patients need to be encouraged by their online organizers to keep their goal

moving forward. We also find that the control variable, positive mood, can help online patients accelerate their goal progress.

This research provides several implications for the literature and practice in the following aspects. First, it provides an overall understanding of health goal striving and attainment in a social media setting. Second, two important online mechanisms, social support and self-regulation, for health goal performance are conceptualized. Third, we initiate an in-depth empirical approach to reveal different effects of these two mechanisms on online goal management. Next, professionals who have a close connection with online patients might want to encourage these patients to initiate more disease-related conversation (informational support) and guide patients to moderately engage in casual chatting (companionship) to take more advantage of social media's power for goal attaining activities. In addition, patients should be encouraged to keep moving forward on their goals since a short-term drop in the goal performance is not rare to chronic illness sufferers. Last, caregivers, physicians, and nurses should pay attention to their patients' mood state since mood is revealed as an important factor for online goal management based on our analysis results.

The rest of the paper is organized as follows. The literature background and hypothesis development are discussed in the second section, followed by research context, data collection, and analysis in the next section. In section 4, we discuss the key findings, contributions for research, and implications for practice. Finally, we conclude the research in section 5.

Conceptual Background and Research Hypotheses

Goal, Health Goal, and Health Goal Striving

Goal is also called "purpose," "expectation," or "entelechy" (Miller et al. 1986). In this research, a *health-driven goal* is defined as a beneficial health outcome set by a patient regarding his/her conditions. Chronic condition related goals are the focus of this paper, since it takes longer and requires much more effort to achieve the health goals for patients with chronic diseases than those with acute diseases. Examples of such goals can be "improve mental healthiness" for a mental disorder patient, "lose weight" for a high blood pressure patient, "manage diabetes" for a diabetes patient, "finish chemotherapy treatment" for a cancer patient, etc. Past research has revealed that focusing on a well-defined problem, establishing realistic objectives, and developing a plan to achieve the objectives are beneficial activities for self-management on chronic condition (Clark et al. 1992; Glasgow 1995; Lorig 1993).

In healthcare, patients and their caregivers (including physicians) can assess health states based on patients' health goal performance, which is usually indicated by *goal attainment* (Reuben and Tinetti 2012). We define health goal attainment as the act of achieving a beneficial health outcome. The success for goal attainment relies upon the positive performance during *goal striving* activities as striving behavior involves time and endeavor patients spend.

Today, an increasing number of people have been realizing the crucial influence social media brings to human health. By joining social media-enabled online communities, patients can engage themselves in online goal setting along with other functionalities (e.g., blogging, forum posting, liking, and making friends) (e.g., De Martino et al. 2017; Hawn 2009; Househ et al.

2014; Moorhead et al. 2013; Sarasohn-Kahn 2008). Patients can receive encouragement, suggestions, and advice provided by their peers in online communities (e.g., SparkPeople.com) to assist themselves in health goal striving process. Although research has noted the motivating role of the use of online communities on health-related goals, the lack of empirical evidence limits researchers and practitioners on clearly understanding the online mechanism for health goal striving and attaining performance. Thus, this study contributes to the literature by shedding light on this critical perspective of the effectiveness of health social media.

In this research, we capture three aspects of health goal striving behavior in an online environment: (1) change in progress, (2) verbal update on goal, and (3) updating recency. Specifically, *change in progress* monitors the rate of patient progress toward goal attainment. *Verbal update* is a patient's willingness and/or capability to report his/her reflection of goal striving experience. *Updating recency* refers to the length of time between the last update and the current update on a health goal. We place the research focal point at the goal striving process monitored in health community, aiming to provide a holistic understanding of the effectiveness of social media for chronic condition self-management.

Social Cognitive Theory

Social cognitive theory (SCT) values a triadic reciprocal causation in which personal (cognitive), behavioral, and environmental factors intertwine with and influence each other (Bandura 2001). In his work of SCT, Bandura points out that human's self-development, adaptation, and change are embedded in the social environment and that any individual operates

within a broad network of socio-structure influences. In their review of SCT, Luszczynska and Schwarzer (2005) note that SCT has been applied to many health related topics (e.g., emotional disorders, mental and physical health, etc.) and has become a fundamental resource in clinical, health, and personality psychology research. Thus, grounded in social cognitive theory, we conceptualize two sets of factors – *social support (environmental)* and *self-regulation (cognitive)* – that can influence health goal striving in online patient communities. The theoretical framework is elucidated in Figure 1-1.

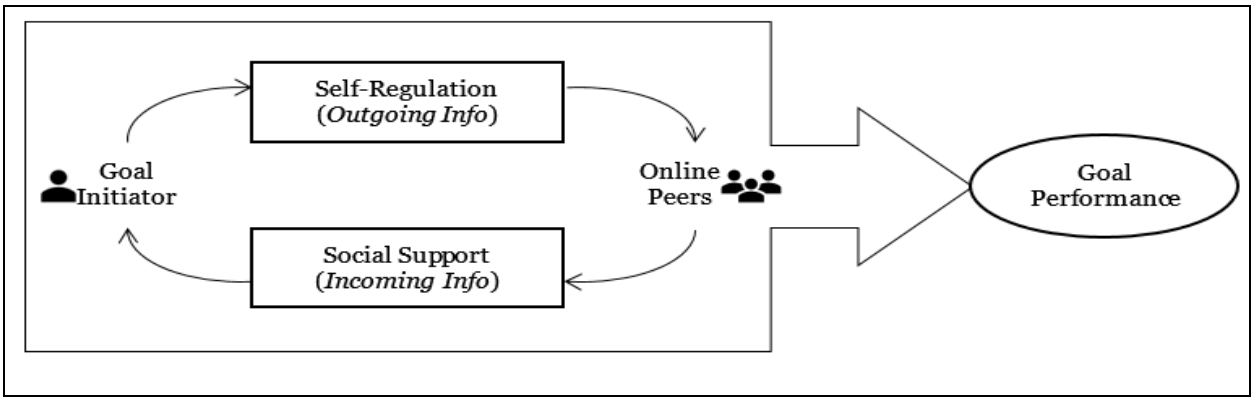

Figure 1-1. Self-Regulation and Social Support Driving Goal Performance in Online Patient Community

Online Social Support and Goal Striving

Social support refers to "a coping resource from which people may draw when handling stressors" (Thoits 1995, p. 64). In an online environment, social support can be exchanged between any individuals with social ties, i.e., friendship or following relationship. Bambina (2007) studied social support in an online environment and rationalized three categories: informational support, emotional support, and companionship. *Informational support* refers to the type of assistance that helps define, comprehend, and cope with stressful problems (i.e., health problems in this research) (Cohen and Wills 1985; Thoits 2011). Informational support contains three subcategories: advice, referrals, and teaching (Bambina 2007). *Emotional support* is affective and sentimental in nature and communicates love or caring (Yan and Tan 2014). It is represented by understanding/empathy, encouragement, affirmation/validation, sympathy, and caring/concern (Bambina 2007). *Companionship* conveys information mainly related to the sense of being connected via chatting, humor, and groupness (Bambina 2007). Patients who receive companionship tend to feel that their peers enjoy seeing them and they are part of something important (Wellman and Wortley 1990). Although companionship may not be directly focused on health conditions, past research shows that it can also contribute to people's wellness (Wills 1985). We discuss the effect of each type of social support on goal striving in our hypotheses.

Informational support. Informational support is practical in nature (Bambina 2007). When many patients with similar chronic conditions are grouped together in an online social platform, they tend to exchange information about their symptoms, share personal experience on

treatment, and even provide their peers with opinions and suggestions (Armstrong and Hagel 2000; Frost and Massagli 2008). These types of practical information give an online health goal initiator opportunities to either compare his/her goal striving effort with others' or learn something important about the disease and treatment. With the acquired knowledge via social interaction, the goal initiator is likely to rationally adjust the goal striving behavior, which may lead to a better progress in the future. For example, patients may underestimate or overestimate what they can proceed on a weight losing goal – excessive physical activities can cause injury, and eating too little leads to malnutrition. Some practical idea from online peers can help those patients move closer to their goal with less frustration. Thus, more informational support received can potentially help patients boost their progress toward goal attainment.

Updating a goal with verbal content does not just require time spent, but more importantly it needs the goal initiator to think over the recent goal striving experience with some degree of rationale. Constructive and practical information (informational support) given by peers might encourage patients to share general or goal-specific experience related to the disease with others in the community. Thus, we expect a boosting effect of informational support on the verbal update.

However, more informational support may not mean shortened updating recency from between one update and the next. A goal initiator is more likely to receive practical idea (informational support) from peers when this person shares negative feedback in a particular update entry. Such a negative feedback can be a decreased progress, frustration on the chronic condition, temporary failure of the plan, doubt about the goal attainment, etc. Since people tend

to provide more suggestions to those who are in need (Wasko and Faraj 2000), a goal initiator with negative update is likely to render more informational support. With different ideas and suggestions, the patient will not likely to post a new update soon. Instead, s/he will be more than likely to understand and evaluate the peer-generated information and try to acquire it into goal striving effort, which can cause more time until the next update. Thus, we expect that more informational support leads to longer time spent between two consecutive goal updates. Based on these arguments, the first hypothesis is presented as follows:

H1: Informational support accelerates goal progress (H1a), increases verbal update on goals (H1b), and prolongs the goal updating recency (H1c).

Emotional support. Emotional support is also viewed as esteem support (Cohen and McKay 1984). It is revealed that more emotional support links to higher health self-efficacy for online patients (Oh et al. 2013). When people gain high self-esteem or develop better confidence, they may be able to perform better on their tasks (Rosenberg et al. 1995). Similarly, if online patients obtain higher self-efficacy through the emotional support given by those who care them, they might be able to generate better performance toward goal attainment. Thus, these patients are likely to not only have better progress rate but also provide more health or goal related content in the future update. Hence, we expect a positive impact of emotional support on both incremental progress and verbal update on goals.

Besides, emotional support may potentially extend patients' updating length in time (updating recency) between two posts. Unlike informational support that is based on rationale and reasoning, emotional support, by definition, is given and received mainly with emotions. In other words, a patient, as the support receiver, tends to intuitively agree with the online friends who bring in positive vibe (e.g., Yan and Tan 2014). This means two things for support receivers. First, the positive words in forms of sympathy, affirmation, or caring are able to relax the receivers from stressful mood, which may cause optimism and thus a "lazy" moment to be away from striving mode. Alternatively, the support receivers might find the encouragement and empathy content aspiring, thus working even harder offline to achieve better. Since chronic conditions last long and are difficult to cope with, the encouraged patients are not likely to experience a better state of their goals overnight. Thus, they are also likely to experience a longer period of time without reporting anything online. The second hypothesis is, therefore, proposed as follows:

H2: Emotional support accelerates goal progress (H2a), increases verbal update on goals (H2b), and prolongs the goal updating recency (H2c).

Companionship. Unlike informational or emotional support, companionship is a form of support focusing on leisure topics rather than health conditions or goals. Disease-oriented conversation, even being appreciated, can be stressful due to the nature of any given chronic condition. In contrast, the carelessness of companionship (e.g., telling a family story, joking

around, and emphasizing the social tie) can generate intrinsic joy for the support receiver. Compare with a stressful topic (i.e., a health goal), online patients may be more willing to engage in an easy chat. However, too much companionship is likely to distract patients from focusing on health goals. This can cause support receivers to slow down their goal progress and reduce effort on generating verbal update on goal striving activities. Meanwhile, online companionship may decrease the time patients spend to post a new update as they enjoy the friendship and sense of connection enabled by chatting with others. Thus, we propose the third hypothesis:

H3: Companionship decelerates goal progress (H3a), decreases verbal update on goals (H3b), and shortens the goal updating recency (H3c).

Online Self-Regulation and Goal Striving

Self-regulation is a process in which an individual reacts to self-behavior (Bandura 1991a). Zimmerman (2000) defines self-regulation as the "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (p.14). Thus, self-regulation can also be seen as a goal-guidance process (Maes and Karoly 2005). Within the process toward goal attainment, a person usually adjusts behaviors based on the disparities between the perceived performance and the adopted standard (or the goal) (Scheier and Carver 1985). From this perspective, self-regulation is treated as a feedback loop (Miller et al. 1986; Scheier and Carver 1985), comparing reality with standard and pushing the individual to move

closer toward the finishing line. If the endeavor is not satisfied by the person's comparator mechanism, the feedback loop may be broken and the goal might be left incomplete.

In healthcare, a goal that is closely related to the chronic condition can hardly be fully controlled by human agency. Terry and Leary (2011) mention that such practical factors as sufficient time, knowledge, and access to health-promoting resources can strengthen patients' ability to regulating their goal striving activities. Conversely, the lack of any of these factors might restrict a patient from successfully pursuing a goal.

Social cognitive theory notes that social factors affect the operation of the self-regulative system (Bandura 1991b). In online patient communities, health goal initiators realize online self-regulation by posting their up-to-date information on the goal process and engaging in more detailed conversation with online friends.

We identify three behavioral aspects of online self-regulation that can be antecedents of goal striving performance. (1) The first antecedent is a *health-related response*. After updating a goal, patients may receive a variety of peer support. If the patients would like to talk more about their health or goal with any specific supporter, they can directly respond to that person in the conversation thread. This convenient function is enabled by social media, and we call it health-related response (or response), a potential antecedent for goal striving. By generating responding message, patients can understand, reflect, and evaluate goal striving effort in a more social-oriented mechanism. (2) The second potential antecedent is *progress change during the previous update* (t-1). It is the temporal deliverable or performance in the immediate past. As the product in each loop in the goal attainment process, the change in progress during time t-1 may be used

to predict the future performance. (3) The third potential antecedent is *verbal update during the previous update* (t-1). Verbal update during time t-1 functions as online self-monitoring and reflection that guide the patients to proceed further on their goals.

Health-related response. Sending responding message allows direct one-on-one conversation between a patient and a supporter. It requires that the patient reflects more on something that has not been well-thought of. The effort spent on generating response can also help the patient better understand self-behavior. As a result, the patient is likely to produce a better progress on the goal reported next time. Similarly, with the extra self-reflection motivated by peers' comments, the patient may be consciously or unconsciously better prepared to share more health or goal oriented information to others during the next update.

Additionally, by directly interacting with one or more online friend in regard to the condition after posting an update, patients can strengthen the belief that the community peers care about their current feeling to the chronic, the up-to-date progress on the goal, personal opinions or stories, or presence as a goal pursuer. This is likely to cause the patient to post something again about the goal striving journey in the near future. With these arguments, we propose the fourth hypothesis:

H4: Health-related response accelerates goal progress (H4a), increases verbal update on goals (H4b), and shortens the goal updating recency (H4c).

Previous progress change. First, a high incremental progress during time t-1 may help predict a low change during time t. This is caused by the nature of most of chronic conditions. Since chronic conditions are usually complex and complicated to understand and treat, patients tend to experience many ups and downs when they battle with their diseases (e.g., Lisman et al. 2010). Therefore, it is not common for these patients who have just made a significant progress on health goals to generate an even better one in the immediate future.

Second, a higher progress change can be seen as a small success during that period of time. Patients who experience such a success feel more confident than before, which can make them engaged more for the next round of goal striving. This will, in turn, help patients generate more well-thought output about health state and goal. Thus, the change in previous progress may positively associate with the verbal update in the near future.

Third, similar to the first argument above, chronic illness patients are not likely to provide a frequent update soon after making a high progress. A positive progress inspires patients to achieve an even better progress. However, the improvement for a chronic disease does not follow a simple linear relationship. Patients are likely to take a longer time offline for their desired outcome. From this perspective, an increased progress change may prolong patients' updating recency. Thus, the fifth hypothesis is presented as follows:

H5: Last progress velocity decelerates the current goal progress (H5a), increases the verbal update on goals (H5b), and prolongs the goal updating recency (H5c).

Previous verbal update. First, verbal update is a reflection of careful goal management and desire to communicate. Being able to provide health or goal oriented information during a period of time can also reflect a patient's familiarity with the current situation. Such patients are likely to acquire more self and social-generated wisdom that will provide better guidance for the goal striving endeavor during the next time period. A better progress, thus, should be expected. Second, writing down detailed self-understanding and emotions about the goal striving experience require a variety of mental effort (e.g., recall events, express stress or joy, reasoning, logical thinking, etc.). Some individuals may even be stuck in this cognitive mode during a particular period of time (Grant 2003), which is likely to make them less interested in providing self-reflected information on new events in the current time. Thus, more prior verbal update may cause decreased current verbal update. Similarly, over-engaging in the prior moment can also lead to delay on fully devoting in the next round of pursuing endeavor. This, in turn, is likely to cause prolonged updating recency. Based on these arguments, we present the last hypothesis as follows:

H6: Last verbal update accelerates the current goal progress (H6a), decreases the current verbal update on goals (H6b), and prolongs the goal updating recency (H6c).

Methodology

Research Context

Our research context is a large online patient community launched in 2006. By 2016, the website had more than 400,000 members in over 500 health support groups. The major focus of the website is chronic illnesses (e.g., mental disorder, cancer, diabetes, etc.). All the support groups are predefined by the website, and each online support group has a clear focus on a specific disease or medical concern. An individual can voluntarily choose to become a registered member of this community, and all the available functionalities (e.g., forum, support groups, Facebook-type social function, goal management, etc.) are free of charge.

To use the goal function and track the goal progress, patients first need either to choose a goal type from a predefined goal list or to create one based on their special concerns. The website provides the most representative goal types based on the focuses of the health support groups; thus, most of the members would select one of the predefined goals upon registration. Next, along with a goal type, the patient should also write a short plan regarding how this goal may be accomplished. The tentative plan could not be edited once saved. The progress on the goal is set at 0% if there is no additional update. When the goal is saved, the member would start the self-regulation and social interaction activities right away.

A goal initiator needs to provide one update on the goal to interact with online peers. Update would be published in journal entry format, consisting of three main sections: (1) a written section related to the person's health goal, health state in general, or other life events, (2) a current progress section (in percentage, 5% per interval) on the goal, and (3) a current mood

state section (i.e., excellent, good, ok, bad, or terrible). Online friends and/or peer users would receive a notification about any goal update and could post information in the comments section below the update. At the same time, the goal initiator could respond to the peers in the same section as well.

Sample and Data Collection

We collected two years of data since the launch of the goal management function by the website, from December 2007 to December 2009. This is because: (1) for the chronic disease sufferers in the community, it usually took them a few months to two years to complete a health goal; and (2) patients tended to be very active at the earlier stage of this new goal management function, which can be observed on most newly added online features.

We chose 13 support groups (shown in Table 1-1) to collect data for the reasons as follows. (1) Group members tended to read other people's goal updates rather than managing their own initiatives. Thus, we selected groups with enough members engaging in their goal management activities. (2) Since the research focus is on *health goals*, we did not include family and relationship-related support groups (e.g., parenting, divorce, etc.).

Table 1-1. Detail about the Selected Goals and Illness Groups

Goal Type	Support Group	Total Group Members	Total Members with The Goal	Total Completed Goals	Completion Rate
Lose Weight	High Blood Pressure	1464	163	13	8%
	Diets & Weight Maintenance	12202	3085	199	6%
Manage Diabetes	Diabetes Type I	1488	89	5	6%
	Diabetes Type II	3928	218	16	7%
Beat HCV	Hepatitis C	3693	122	39	32%
Complete Cancer Treatment	Teens with Cancer	122	11	2	18%
	Breast Cancer	1323	44	5	11%
	Colon Cancer	763	33	4	12%
	Lung Cancer	865	17	1	6%
	Brain/CNS Tumors	851	17	2	12%
Improve Mental Disorder	Bipolar Disorder-Teen	1506	92	9	10%
	Bipolar Disorder-adult	21615	1325	91	7%
	physical & Emotional Abuse	11340	672	61	9%
5 Goal Types	*13 Support Groups*	*61160*	*5888*	*447*	*8%*

We employed a web crawler to collect data on the patient community. Due to the longitudinal nature of this research, we collected data from goal profiles containing enough time variation on updates. In other words, multiple (say, more than 3 times) updates during different time periods on one health goal is one of the criteria for data collection. This renders the exclusion of goals on which the patients did not provide more than 3 updates within the research time window. Table 1-1 presents the complete information about the selected groups and the

associated five types of goals along with the goal completion rate. There are numerous goals set up by the community members, we selected the most popular goal within each support group as the focused goal. For example, “Lose Weight” was the most popular goal in “High Blood Pressure” and “Diets & Weight Maintenance” groups; it is also relevant to members’ health in these two groups. Thus, we selected “Lose Weight” as the focused goal in these two groups. Similarly, the other four types of goals were selected from the rest of the groups. It is possible that one patient had more than one health condition and joined more than one support group. Thus, duplicate information was checked and eliminated before we finalized the data set. Finally, a total of 392 online patients were included in the panel data set due to the research time window. 87 patients managed to complete their goals, while 305 left their goals unfinished. The complete panel data contains 2570 data points, which represented by goal start points, update points, and end points, if any.

Variables

Dependent variables

There are three dependent variables in this research to capture three different aspects of health goal attainment. All the variables are measured with the *incremental* value between two consecutive time periods, *t-1* and *t*. (1) *Progress* is measured in percentage and represents the progress change (or rate) updated by a patient from *t-1* to *t*. Users of the website can only report an overall (cumulated) progress on goals due to the design of the site. Thus, *Progress* is calculated by subtracting the reported progress during time *t* from that during time *t-1*. (2)

VerbalUpdate is a count variable and captures the number of times a patient updated on health or the health goal in the t^{th} time period. (3) *Recency* is measured in days and captures the time elapsed between the last update (*t-1*) and the current one (*t*).

Independent variables

Based on Bambina's (2007) categorization for *online social support*, three independent variables were extracted from the semantic information from online friends' (peers') comments: *Informational, Emotional,* and *Companionship*. All these variables are documented per *incremental* values. (1) *Informational* represents the informational support category and is measured by the number of times online friends provided informational support to a patient. (2) *Emotional* represents the emotional support category and is measured by the number of times online friends gave emotional support to the patient. (3) *Companionship* captures the companionship category and is measured as the number of times the patients received companionship from his/her peers. For *self-regulation* mechanism, we used all the self-reported information provided by the health goal initiators in their updates. Such information includes: (1) the lag of *Progress* (*Progress* $_{i, t-1}$), the value of *Progress* during time period t-1, (2) the lag of *VerbalUpdate* (*VerbalUpdate* $_{i, t-1}$), the value of *VerbalUpdate* during time period t-1, (3) the lag of *Recency* (*Recency* $_{i, t-1}$), the value of *Recency* during time period t-1, and (4) *Response*, which captures the patient's self-regulation during the response to peer posts regarding health issues or the goal. Responding message is measured as the number of responses the patient posted under his/her own journal update during time period t-1.

Table 1-2. Variable Definition and Descriptive Statistics

Variable	Description	Mean	S.D.	Min	Max
logInformational	Logarithm of the number of informational support patient i receives from online friends during time t-1.	0.128	0.334	0.000	2.708
logEmotional	Logarithm of the number of emotional support patient i receives from online friends during time t-1.	0.388	0.627	0.000	3.332
logCompanionship	Logarithm of the number of companionship patient i receives from friends during time t-1.	0.146	0.362	0.000	2.398
logResponse	Logarithm of the number of messages patient i writes in comments section during time t-1.	0.024	0.139	0.000	1.386
Progress	Patient i's goal progress change during time t-1.	0.066	0.154	-0.900	0.950
logVerbalUpdate	Logarithm of patient i's verbal update on goal during time t-1.	0.433	0.342	0.000	1.609
logRecency	Logarithm of the patient i's updating recency during time t-1.	1.689	1.283	0.000	6.402
HighMood	Patient i's mood state during time t-1. (= 1 if the mood is positive; = 0 otherwise)	0.872	0.334	0.000	1.000

Control variables

It has been suggested that people's emotional condition might affect their health outcome by impacting the immune mechanism (Pressman and Cohen 2005). To control for the effect of positive emotion, we control for patients' self-reported mood state via a binary variable, *HighMood*, which equals to 1 if the patient's mood updated along with the journal entry is

positive and 0 otherwise. There are five different mood states available for each patient to choose during the goal update: excellent, good, ok, bad, and horrible. The first two states are considered positive. Descriptive statistics are presented in Table 1-2.

Content Analysis

We adopted Bambina's (2007) categorization on online social support, which consists of informational support, emotional support, and companionship. We conducted a directed content analysis (Hsieh and Shannon 2005) to code 2570 records in the data set for online social support. The coding started with a clear definition of each category. Then, two coders were involved in coding the text, and the reliability of the content analysis was checked for confirming the results. We discuss the coding process in detail in this section.

We followed Krippendorf's (2004) and Landis and Koch's (1977) suggestions on categorical content analysis. First, a meeting was held between two researchers (as the coders) to understand and discuss the concept and definitions. A coding book (Appendix 1A) was generated during the meeting. Second, we conducted a pilot coding. 30 patients' goals, or 197 records, were randomly selected from the data set to test whether the pilot coding result exceeds the threshold *kappa* value of 0.7 (Krippendorff 2004; Landis and Koch 1977). The *kappa* value of 0.7 indicates that the agreed understanding between coders is significantly higher than what can be concluded by chance. The coders conducted two rounds of independent coding until they reached the threshold kappa value of 0.7. During the third round, each coder coded another 40 patients' goals (248 records), and the result exceeded the kappa value of 0.7. This pilot coding

confirmed that the coding book is robust. Third, two coders separately coded the rest of the data set (2125 records). Finally, all the codes were documented in the panel data set for the data analysis.

Data Analysis Method

The data in this study is unequally-spaced unbalanced panel data. First, patients updated at different pace based on their personal schedule, perceived performance on the goal, stickiness to the online community, etc. This natural updating frequency should be respected in the analysis. Thus, this makes the panel data *unequally spaced*. Second, it is noticed from the website that different users have a different number of updates. This makes the data set *unbalanced*.

We followed Baltagi and Wu's (1999) suggestion on unequally-spaced unbalanced panel data and applied fixed effect first order autoregressive, FE-AR (1), model to analyze the data set. With patient fixed effect estimation, we are able to eliminate patients unobserved heterogeneity, such as patient's demographic information and life style. To reduce the skewness of the variables, we conduct natural logarithmic transformation for all count variables before including them in the estimation. All the independent and control variables are the lag values, to avoid the simultaneity concerns. In models (1), (2) and (3), α_i captures the individual specific effects, and ε_{it} is the error term.

The model of incremental change in goal progress (*Progress*) is given as follows:

$$Progress_{it} = \beta_1 logInformational_{i,t-1} + \beta_2 logEmotional_{i,t-1} + \beta_3 logCompanionship_{i,t-1} + \beta_4 logResponse_{i,t-1} + \beta_5 Progress_{i,t-1} + \beta_6 logVerbalUpdate_{i,t-1} + \beta_7 HighMood_{i,t-1} + \alpha_i + \varepsilon_{it} \quad (1)$$

The model of verbal update (*logVerbalUpdate*) is shown below:

$$logVerbalUpdate_{it} = \beta_1 logInformational_{i,t-1} + \beta_2 logEmotional_{i,t-1} + \beta_3 logCompanionship_{i,t-1} + \beta_4 logResponse_{i,t-1} + \beta_5 Progress_{i,t-1} + \beta_6 logVerbalUpdate_{i,t-1} + \beta_7 HighMood_{i,t-1} + \alpha_i + \varepsilon_{it} \quad (2)$$

For *Recency* model, we included the *lag* value of recency as a control variable to control the effect of recency during t-1 on that during t. The model of recency for goal update (*logRecency*) is given as follows: (3)

$$logRecency_{it} = \beta_1 logInformational_{i,t-1} + \beta_2 logEmotional_{i,t-1} + \beta_3 logCompanionship_{i,t-1} + \beta_4 logResponse_{i,t-1} + \beta_5 Progress_{i,t-1} + \beta_6 logVerbalUpdate_{i,t-1} + \beta_7 logRecency_{i,t-1} + \beta_8 HighMood_{i,t-1} + \alpha_i + \varepsilon_{it}$$

The Pearson Correlation results ($0 < |corr.| < 0.82$) show that high correlation is not a concern in the research. We also conducted a collinearity check among the variables. VIF of each variable is less than 10, and the average VIF is less than 6. This suggests that collinearity is not a significant problem in the data set. These results are shown in Appendix 1B (Tables 1B-1 and 1B-2). For each of the three regression models, we first analyzed the model with main effects. Next, we added the control variable, *HighMood*, into the model. The results are presented in the following section.

Results

The analysis results are shown in Table 1-3. Models 1, 3, and 5 include the main effects only, and models 2, 4, and 6 consist of the main effects and the control variable.

Table 1-3. FE-AR (1) Estimation Results on Each Dependent Variable

Dependent Variable	*Progress* $_{it}$		*logVerbalUpdate* $_{it}$		*logRecency* $_{it}$	
Model	(1)	(2)	(3)	(4)	(5)	(6)
logInformational $_{i,t-1}$	0.027ǂ	0.025	**0.070****	**0.069****	0.138	0.135
	(0.016)	(0.015)	(0.026)	(0.026)	(0.094)	(0.094)
logEmotional $_{i,t-1}$	0.004	0.006	-0.022	-0.022	**0.161****	**0.163****
	(0.010)	(0.010)	(0.017)	(0.017)	(0.061)	(0.061)
logCompanionship $_{i,t-1}$	**-0.028***	**-0.030***	-0.035	-0.035	-0.014	-0.015
	(0.014)	(0.013)	(0.022)	(0.022)	(0.081)	(0.081)
logResponse $_{i,t-1}$	-0.046	-0.029	-0.048	-0.047	**-0.472***	**-0.463***
	(0.035)	(0.033)	(0.057)	(0.057)	(0.206)	(0.206)
Progress $_{i,t-1}$	**-0.386*****	**-0.362*****	0.037	0.038	**0.384***	**0.396***
	(0.030)	(0.028)	(0.048)	(0.048)	(0.172)	(0.173)
logVerbalUpdate $_{i,t-1}$	0.005	0.002	**-0.259*****	**-0.258*****	0.016	0.015
	(0.019)	(0.018)	(0.030)	(0.030)	(0.110)	(0.110)
HighMood $_{i,t-1}$		**0.149*****		0.007		0.083
		(0.014)		(0.024)		(0.086)
logRecency $_{i,t-1}$					**-0.204*****	**-0.202*****
					(0.030)	(0.030)
Constant	**0.085*****	**-0.047*****	**0.610*****	**0.603*****	**2.647*****	**2.570*****
	(0.008)	(0.013)	(0.013)	(0.021)	(0.065)	(0.085)
R^2 overall	0.019	0.065	0.163	0.164	0.081	0.080

R^2 within	0.138	0.210	0.073	0.072	0.062	0.063
N	1417	1417	1417	1417	1417	1417
Note: ǂ p<0.10, * p<0.05, ** p<0.01, *** p<0.001						

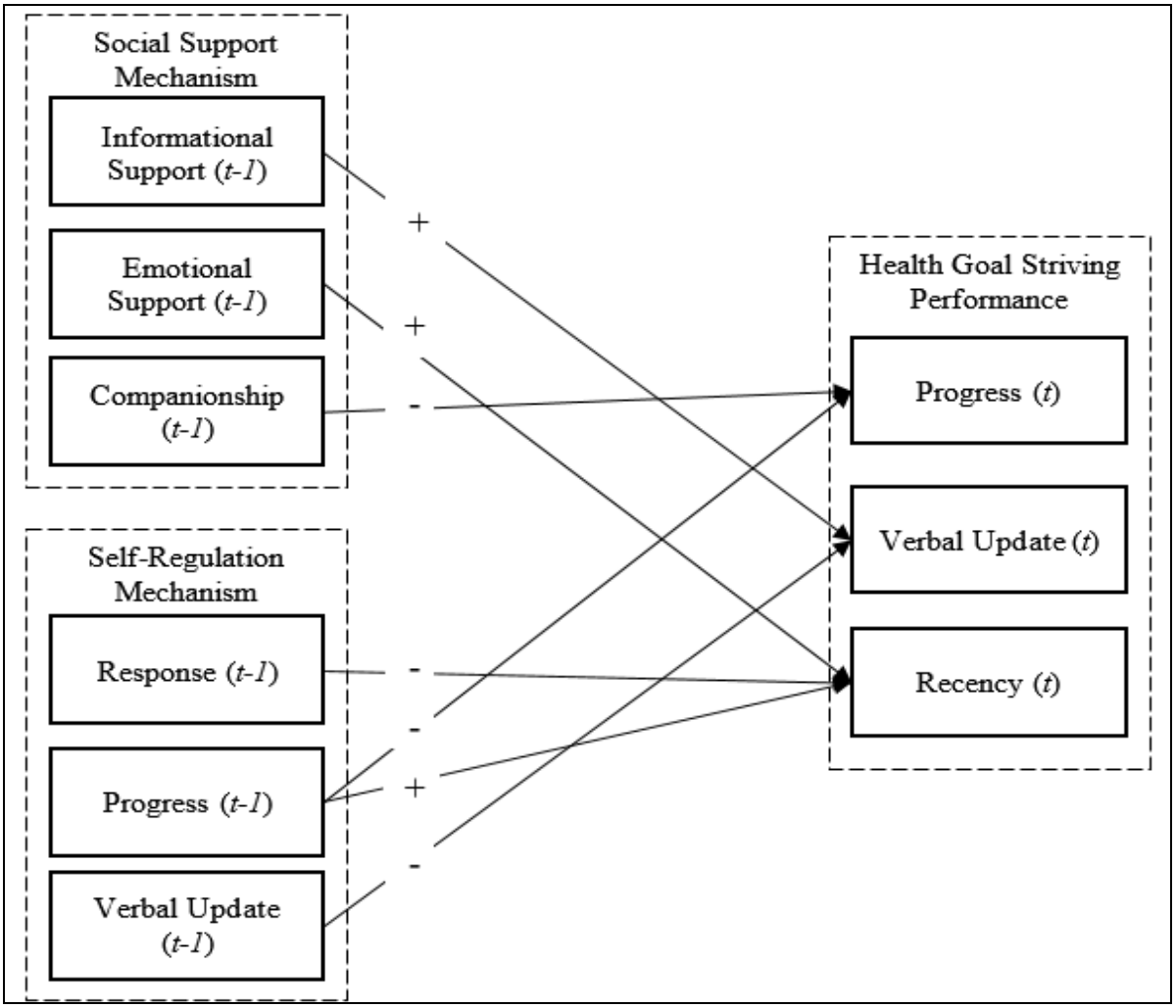

Figure 1-2. Verified Effect of Social Support and Self-Regulation on Goal Striving Performance

For progress, the regression results show that both companionship and the lag value of progress negatively affect progress at the significant levels of $p < .05$ and $p < .001$, respectively. Thus, H3a and H5a are supported. In addition, positive mood (HighMood) appears to positively influence the progress rate at a significant level of $p < .001$. For verbal update, informational support positively affects verbal update at $p < .01$, while the lag value of verbal update negatively affects current verbal update at $p < .001$. Therefore, H1b and H6b are supported. For updating recency, both emotional support and the previous progress rate positively affect recency at the significant levels of $p < .01$ and $p < .05$, respectively. Thus, H2c and H5c are supported. On the other hand, response (i.e., patient's health-related response to peers) negatively affects recency at $p < .05$, which supports H4c. Additionally, previous updating recency can negatively influence current recency at the significant level of $p < .001$.Table 1-3 illustrates the estimates across all the models, and Figure 1-2 shows the supported relationships.

Robustness Check

We estimate a Panel Vector Autoregression (PVAR) model (Love and Zicchino 2006) to verify the robustness of our results. Because self-regulation includes the lag values of the dependent variables, each dependent variable is a linear function of its own past values and the past value of other dependent variables. A PVAR model is an appropriate approach to take care those endogenous dependent variables. The model is specified below in model (4):

$$y_{i,t} = \begin{pmatrix} Progress_{i,t} \\ logVerbalUpdate_{i,t} \\ logRecency_{i,t} \end{pmatrix} = \sum_{s=1}^{p} \Phi_s \cdot \begin{pmatrix} Progress_{i,t-s} \\ logVerbalUpdate_{i,t-s} \\ logRecency_{i,t-s} \end{pmatrix} + \beta \cdot Highmood_{i,t-1} + \sum_{s=1}^{q} \delta_s \cdot logResponses_{i,t-s} + \varepsilon_{i,t} \quad (4)$$

where $y_{i,t} = (Progress_{i,t}, logVerbalUpdate_{i,t}, logRecency_{i,t})'$ is a three-element column vector for each patient *i* at time *t*; $\Phi_s{}'$ represent 3×3 matrices of slope coefficients for endogenous variables; p is the number of lags; $\varepsilon_{i,t} = (\varepsilon_{1,i,t}, \varepsilon_{2,i,t}, \varepsilon_{3,i,t})'$ is a three-element vector of errors.

Overall, the findings are largely consistent with what we found through the main test. Yet, there are two noteworthy changes. First, this alternative test marginally proves the prolonging effect ($\beta = 0.22$, p-value < 0.1) of informational support on updating recency we proposed in H1c, which was not found through the main analysis. Second, we also see the reversed sign ($\beta = 0.16$, p-value < 0.01) on the supported relationship between the previous verbal update and the current one. This is likely due to a momentum effect generated from patients' verbal updating behavior. Thus, further investigation on online updating with writing format overtime should be carried on.

Discussion and Conclusion

Key Findings

The function of social support mechanism

Each support category tends to affect only one aspect of goal striving performance. First, *informational support* mainly influences *verbal update* during goal striving process. This type of practical information from online peers can help a goal initiator generate more thought and understanding about the condition as well as the goal striving strategy. Second, *emotional support* mainly affects a patient's updating *recency*. Revealed from the empirical analysis, the more affective information (e.g., caring, concerns, encouragement, etc.) a patient receives, the more time spent by this person offline until the next online update for the goal. Third, *companionship* mainly impacts incremental *progress* on health goals. Companionship is highly possible to be a distracting factor within the overall social support mechanism to slow down a patient's actions for health goal attainment.

The function of self-regulation mechanism

Similar to social support, each aspect of self-regulation does not influence all three outcomes of goal performance. First, a goal initiator's direct *response* to peers mainly impacts the online updating *recency*. It is found that a negative relationship exists between response and recency. Namely, if a patient posts more responses to individual peers during a given time period, this person will be able to spend less time until the next update. Second, *progress rate* can influence two outcome factors – *next progress change* and updating *recency*. It can be seen from the result that a higher incremental progress does not guarantee an accelerated progress in the near future. Rather, there may be a wavy curve caused by temporal incremental progress: a trend in which a faster progress renders a slower one. This phenomenon in the online patient

community, similar to “sophomore slump” (Feldman and Newcomb 1969; Rubin et al. 1990) in education, might be caused by the chronic conditions with which patients frequently experience the intertwined better and worse states on the same health issue (Charmaz 1991). In addition, we also found that a patient with a higher incremental progress during this time will be likely to delay the next goal update. Third, the *current verbal update* mainly affects the *next verbal update* in the next round. The result showed that a patient may not be ready to provide much information on the condition if s/he has reflected on the self-management behavior during the previous update. This finding, also similar to the “sophomore” issue for progress, can be caused by a cognitive mechanism related to self-reflection and self-evaluation in which self-understanding and improvement do not occur at every stage of self-monitoring.

Besides the findings above, the research also reveals another two interesting points as follows. First, positive mood is likely to be a crucial influencer to goal progress, especially for progress. Based on the results in models 1 and 2 in Table 3, the significant effect of informational support at $p < .10$ became insignificant after adding positive mood into the model. Meanwhile, positive mood appeared to be a significant enhancer for incremental progress at $p < .001$. This unexpected shift in significance from informational support to positive mood should be investigated in the future research.

Second, updating *recency* is connected with four different influencers (i.e., emotional support, goal initiator’s response, previous incremental progress, and previous recency), more than the other two outcome performance. Compare with progress and verbal update, updating recency is not the major indicator for goal striving or attainment. It is, however, an important

factor to judge whether an online goal attainment function for patients is well designed or attractive. In this research, the fact that patient's direct response to peers can help pull users back online and continue the goal striving conversation implies that one-on-one talk mode is a useful function for generating potential health goal overachievers.

Research Contributions and Implications

First, this research provides a holistic view on health goal attainment in a social media setting. Applying social cognitive theory as the theoretical background and adopting the "feedback loop" perspective of self-regulation, the authors captured online patients' health goal striving performance from three aspects: (1) incremental progress (i.e., progress rate, or change in progress) represents the extent of improvement, (2) verbal update represents the self-awareness and the ability of self-reflection and self-evaluation, and (3) updating recency represents the length of pause between two consecutive goal updates. Social media provides patients a diverse and flexible environment to manage their chronic conditions. For example, patients are able to update their health states and conditions based on their own schedules and willingness rather than providing health-related information scheduled by a healthcare professional. This kind of flexible patient-centered platform not only allows patients visit based on their needs but also makes evaluating patient outcome, such as goal striving performance, more difficult than conventional approaches. This research adds insights to the literature by providing a new way of measuring goal performance for online chronic condition management.

Second, we conceptualized two important online mechanisms for health goal attainment: social support and self-regulation mechanisms. This research is one of the first to investigate how social media-enabled patient communities affect chronic illness sufferers' goal performance for disease self-management. To this end, we suggest that social support and self-regulation be taken into consideration together due to the "social" nature of those platforms. The combination of these two mechanisms also contributes to "collaborative care management" (Callahan et al. 2006; Unützer et al. 2002; Von Korff et al. 1997) for chronic conditions. This collaborative illness management integrates patients' desire for both health improvement and groupness, generating commons-based peer production (Benkler 2002; Fichman et al. 2011) – in the context of this research, goal performance.

Third, this study also initiates an in-depth empirical approach to reveal different effects from social support and self-regulation systems on online goal management. Health goal striving behavior is not as same as regular health management in that the former is usually with better-defined objectives than the latter. Therefore, we may not be able to conclude that, for example, the effect of social support is always positive on a health goal-related performance. This research suggests that both positive and negative effects can be generated within social support and self-regulation systems. Thus, whether patients are able to push their goals forward is complicated and complex based on the types of support they receive and the self-regulation they perform.

Implications for Practice

First, practitioners such as online patient community managers and healthcare professionals should recognize that social media can be a two-edged sword. This research reveals that informational support tends to help support receivers better understand their situation and thus generate more health and goal-related content in their goal updates. Informational support may also improve the goal progress for some patients. Thus, this type of contents not only helps the support receivers themselves but also potentially benefits update readers. On the other hand, companionship, or regular chatting, can cause incremental progress to drop during a goal striving process. Therefore, professionals who have a close connection with online patients might want to encourage these patients to initiate more disease-related conversation (informational support) and guide patients to moderately engage in casual chatting (companionship) to take better advantage of social media's power for goal striving activities.

Second, online patient social communities should encourage members to overcome the "sophomore slump" phenomenon during goal management process, especially for their progress and verbal update. Although previous progress rate and verbal update can cause a temporal drop in the current incremental progress and verbal update, this does not necessarily mean that self-regulation does not function well. In contract, this phenomenon may be normal for chronic condition sufferers when they pursue health goals. Thus, online communities, if they integrate goal function into the platforms, should send out educational notes for goal initiators throughout the entire goal pursuing process to let them understand that experiencing a small progress or

even a drawback on their goals is common for chronic conditions. After all, keeping moving forward matters the most for any disease self-management activity.

Third, caregivers, physicians, and nurses should pay attention to their patients' mood state. This research reveals an interesting finding: a patient's temporal positive mood (emotion) state has a crucial positive influence on progress rate. Also, this mood state can even cause the effect of informational support to be insignificant. Therefore, positive mood from the patient's own cognition has a remarkable effect, which should not be ignored.

Limitations and Future Research

Nevertheless, this study does have a few limitations. First, the empirical analysis was based on FE-AR (1) regression modeling, but other types of modeling may be also appropriate for this research. For example, a latent growth curve model can also be applied in this research to better understand the factors that influence the rate of progress change. Second, the current analysis included only one control variable, positive mood. We believe that adding more time-variant control variables (e.g., number of followers) can help reduce the omitted variable bias. Third, although the longitudinal data helped us investigate the change in variables overtime, it does not reveal which factors matter for the final accomplishment of a goal (i.e., goal completion or attainment). A survival study is a suitable technique for further investigation on goal attainment. Lastly, since positive mood appeared to be a significant influencer in our analysis, we may also consider using mood as an outcome variable and study the antecedents of mood change in an online patient community.

Conclusion

Given that more and more patients have gone online to seek health information and pursue a variety of health-related goals, little is known about whether online social media platform is the best place for goal striving activities. In this research, we investigated the effect of online social support and online self-regulation mechanisms on health goal striving performance by empirically studying an unequally-space unbalanced panel data set collected from a major online patient community in the U.S. Our finding shows that not all factors within those two mechanisms are created equal. Informational support should be highly promoted among online patients as it is beneficial for goal initiators, while companionship should be communicated at a mild or moderate level due to its negative effect. The results also indicate that a "sophomore slump" problem tends to occur during the loop on progress and verbal update. Online patients should be noticed frequently via certain means (e.g., email, community ads, etc.) so that they will not give up on their goals and the long-term chronic condition self-management when they experience one or more drop along the process. This is one of the first studies to conceptualize both social support and self-regulation to study goal striving activities in the online environment. The longitudinal data set also provides a dynamic and deeper look at the relationships in interest.

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Appendix 1A. Coding Book for Content Analysis

Social Support Subcategory	Definition
Informational support	Informational support is provided to the type of assistance that helps define, comprehend, and cope with stressful problems (i.e., health problems in this research).
Advice	Giving guidance and/or making suggestions.
Referral	Offering a source for information or assistance.
Teaching	Passing on instructional and/or educational information.
Examples • I was first put on Femara. However, I had to switch to Tamoxifen as I could not tolerate the side effects of the Femara… • I suggest you look into "Zone." Eat 3 meals daily + 2 snacks, just avoid bad carbs and sugar. • It (losing weight) takes time, determination, and of course dedication, eating healthy and exercise:)	
Emotional support	Emotional support is affective and sentimental in nature and communicates love or caring.
Understanding/empathy	Appreciating and/or identifying with what someone is expressing often, not necessarily, based on having shared a similar experience.
Encouragement	Attempts to inspire hope and courage, to hearten. All prayers.
Affirming/Validation	Acknowledgement and/or positive reinforcement of someone, their ideas, attitude, or actions.
Sympathy	Expressing sorrow for or feeling troubled by another's situation.
Caring/concern	Demonstrating regard for someone's well0being by being very attentive and interested.
Examples 1.I went to bed at 2:30AM and was up at 7 so I know how you feel. Isn't bipolar FUN??? LOL! 2.Hugs!!! 3.Gosh, that's a lot to put on your shoulders, especially when you need direction and advice. 4.You've made the right choice! Just as this journey is different for each of us, so are the decisions we have to make… 5.I just want you to know that don't think it's you ... it's something in him ... please don't take it personally…	
Companionship	Companionship conveys information mainly related to sense of being connected.
Chatting	Conversations that are not about the chronic condition and/or goal.

Humor/teasing	Laughing, sending a joke, personally kidding.
Groupness	Addressing the group, referring to benefits or actions of the group and/or the group's online community.

Examples

1. We have four beautiful kids together. The youngest one starts kindergarten in a week from now. I'm going to cry like a baby!
2. Congratulations to your graduation!
3. Ok… so I saw this in January. But it's a NEW YEAR!!!! So perfect timing!
4. We have to be glad for the prayer warriors out there ... they never stop praying for any of us. You and I and many like us have to remember that. Someone is praying now.

Appendix 1B. Correlation and Collinearity Checks

Table 1B-1. Pearson Correlation Coefficient for Variables

No.	Variable	1	2	3	4	5	6	7	8
1	*logInformational* $_{i,t-1}$	1.00							
2	*logEmotional* $_{i,t-1}$	0.58***	1.00						
3	*logCompanionship* $_{i,t-1}$	0.34***	0.44***	1.00					
4	*logOutgoingMessage* $_{i,t-1}$	0.21***	0.14***	0.07**	1.00				
5	*Progress* $_{i,t-1}$	-0.08**	-0.01	-0.04	-0.07**	1.00			
6	*logVerbalUpdate* $_{i,t-1}$	0.21***	0.26***	0.05*	0.06*	0.04	1.00		
7	*logRecency* $_{i,t-1}$	-0.01	0.02	0.01	0.00	0.10***	0.00	1.00	
8	*HighMood* $_{i,t-1}$	-0.02	-0.03	-0.01	-0.01	-0.04	-0.01	-0.03	1.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1B-2. Collinearity VIF Check for Variables

Variable	VIF	1/VIF
logEmotional $_{i,t-1}$	1.75	0.572711
logInformational $_{i,t-1}$	1.6	0.625618
logCompanionship $_{i,t-1}$	1.26	0.791517
logVerbalUpdate $_{i,t-1}$	1.09	0.917588
logOutgoingMessage $_{i,t-1}$	1.05	0.950565
Progress $_{i,t-1}$	1.03	0.975127
logRecency $_{i,t-1}$	1.01	0.989285
HighMood $_{i,t-1}$	1	0.996724
Mean VIF	1.22	

Essay 2: How Online Patient Communities Influence Health Goal Completion: A Survival Analysis Approach

Introduction

Health goal attainment has long been recognized as an important indicator of patients' health states. Based on a recent poll, 90 per cent of the participants set goals to manage their health, and one in three of them intended to know more on how to attain their health goals (Welltok 2015). With the prevalence of social media-enabled online patient communities, an increasing number of patients, especially chronic illness sufferers, have been engaged in goal striving activities in a variety of such communities. These online platforms appear to be the appropriate venues for patients to self-manage their health conditions. In this paper, we examine the effectiveness of online patient communities (OPC) on patients' self-managed goal attainment.

Online goal attainment process consists of two important components, i.e., social support from online peers and patients' self-reflection (e.g., Song et al. 2017). Most online communities provide functions to support these two components. For example, DailyStrength.org was one of the first patient social platforms providing patients with goal setting functions. SparkPeople.com is another community example that allows patients to monitor their weight-loss goals while communicating with others. Extant literature does not provide a clear view on how social support and self-reflection during the goal attainment progress contribute or impede health goal attainment. It is argued that an improved health state, if achieved in the online social setting,

cannot be separated from online peers' support as well as disease self-management effort (Coulter et al. 2015; Von Korff et al. 1997). Since goal attainment process is not simply equal to health state in that the former involves one's cognition and judgment, it is not appropriate to conclude that social and self facets act as boosters for goal attainment.[1] Thus, we first investigate the general benefits of social support and self-reflection on the possibility of goal attainment (*RQ1*). In addition, we also investigate the moderating role of goal type on the relationship between social support/self-reflection and the likelihood of goal attainment (*RQ2*).

This study is grounded in social cognitive theory (Bandura 1991; Bandura 2001) and considers two aspects for each antecedent of goal attainment. For social support, informational and emotional support are examined for their direct effects. For self-reflection, health-related and leisure-oriented content reported by patients during goal progress updates are examined for their explanatory effects. Since the research focus is on goal attainment, the final point of any given health goal, survival analysis is identified as the most appropriate approach for data analysis. A unique data set is collected from a leading online patient community with social functions and goal settings. This online community offers chronic disease sufferers pre-defined goal type options and progress scales, an updateable journal feature, and a social-friendly comments section for any update. 87 patients with complete goals (censored) and 305 patients with incomplete goals (uncensored) are gathered within the data set. This survival analysis helps us study how the possibility of goal attainment changes with the included social and cognitive factors.

[1] The World Health Organization provides specific scale and valuations of health state, which can be accessed through the link: http://www.who.int/choice/demography/health_valuations/en/

Our empirical analysis reveals several noticeable findings. Firstly, we find that informational support is not an influential antecedent to health goal attainment whereas emotional support is beneficial for achieving health goals. Secondly, the two aspects of patients' self-reflection during goal updates affect goal attainment oppositely. It appears that, compare with leisure content, health-related reflection is the helpful factor for attaining a health goal. Lastly, patients' performance on goal attainment under the received social support and reported self-reflection is influenced by their goal types.

This research contributes to the literature and practice from the following perspectives. First, this study adds new insights in health goal attainment on social media-enabled communication platforms. Second, our study contributes to the literature by revealing the effects of informational/emotional support and self-cognitive endeavor on online goal management. Third, we suggest that patients take advantage of online healthcare communities as their strategic tools for disease self-management.

The rest of the paper is organized as follows. We state the research background in section 2, followed by the literature review and hypothesis development in section 3. In section 4, we introduce the context of the data collection venue, collection strategy, analysis method, and results. Finally, we conclude this study with an in-depth discussion on the key research findings, contributions, implications, and limitations in section 5.

Disease Self-Management and Online Health Goal Attainment

Disease self-management is a patient-centered approach to reduce healthcare cost while improving health status (Lorig et al. 2000). Such illness management is crucial especially for chronic condition sufferers who require long-lasting care and treatments. Many initiatives are conducted for boosting patient capability to gain self-efficacy and to solve self-identified problems. Most of the past research was related to self-management educational program provided by healthcare professionals (e.g., Bodenheimer et al. 2002). Recent studies, however, reveal that social and behavior factors can be important predictors to evaluate risk and worthy for patient healthcare conditions and expenditures (Hibbard et al. 2016). Social media-enabled patient communities provide users with both social and behavior capabilities to manage their health via goal striving functionality. Thus, attaining health goals online is the venue carrying a novel opportunity for research on patient self-management behavior and performance.

Online health goal attainment refers to the act of achieving a self-identified, beneficial health outcome through the assistance of online patient community usage. Examples of such goals are “finish current treatment” for tumor patients, “be emotionally stable” for bipolar patients, “lose weight” for high blood pressure patients, etc. Extant research notes that goal attainment indicates a patient’s health status (Reuben and Tinetti 2012). Past studies on goals are focused on the antecedent role of goals by looking at the presence or absence of them (see Locke and Latham 2002) and the distance from them (e.g., Goes et al. 2016). Due to the important meaning of goal attainment for patients, however, it is crucial to explore and reveal the online factors influencing goal attainment for patient self-management.

Literature and Hypotheses

Social Support and Goal Attainment

Social support refers to "a coping resource from which people may draw when handling stressors" (Thoits 1995, p. 64). In online environment, social support can be exchanged between any individuals with social ties. Social support occurs when two or more individuals exchange resources with the aim of benefiting the recipient side (Shumaker and Brownell 1984). Social support can be viewed as social cognitive means in health practices (Bandura 2004). When online environment is the context of a study, researchers usually conduct the study with three types of social support as follows: informational support, emotional support, and companionship (e.g., Bambina 2007).

Informational Support. Informational support refers to the type of assistance that helps define, comprehend, and cope with stressful problems (i.e., health conditions in this research) (Cohen and Wills 1985; Thoits 2011). Online informational support contains three subcategories: advice, referrals, and teaching (Bambina 2007). According to social judgment theory (Sherif and Hovland 1961), one might expect that people put more weight on the opinions closer to their own while discounting those distant ideas (Perloff 2010; Yaniv 2004). In regard to combating a health goal, the support receiver (i.e., the goal initiator) is likely to receive practical, health-oriented information from those who have the same health issue, if not the exactly same goal. It can be expected that the support receiver will take such information seriously. Research also

shows that conformity in opinions is important in people's decision-making process. For patients, similarly, peers' informational support is based off of peers' understanding and/or experience on a given medical condition, which is likely to be helpful for the goal initiator. In addition, prior research has suggested that informational support is given to a patient to reduce the uncertainty s/he is facing to and guide the patient's action (Huang et al. 2014) and thus should be beneficial for those intending to boost their health states (Yan and Tan 2014). Thus, we anticipate the goal attainment possibility to be positively influenced by a high volume of received informational support from online community peers. Based on these arguments, we propose the first hypothesis:

H1. Online informational support is positively related to the possibility of goal attainment for online patient community users.

Emotional Support. Emotional support is affective and sentimental in nature and communicates love or caring (Yan and Tan 2014). It is represented by understanding/empathy, encouragement, affirmation/validation, sympathy, and caring/concern (Bambina 2007). Although it does not contain any constructive advice or suggestion, emotional support can help patients reduce their negative feeling due to any issues or reaffirm their self-efficacy due to a noticeable progress. This type of social support acts like stimulant directly affecting patients' mood state and emotion. In other words, emotional support can make patients feel emotionally better. As a result, patients are more likely to keep striving on their goals with less tendency to give up if

they can receive more emotional support. Research has shown that better mood state helps patients achieve a better health state (Pressman and Cohen 2005). Thus, this social cognitive aspect of the use of online patient communities is likely to increase users' chance to finish their health goals. Therefore, we propose the second hypothesis as follows:

H2. Online emotional support is positively related to the possibility of goal attainment for online patient community users.

Self-Reflection and Goal Attainment

In order to improve health goal progress and eventually achieve the goal, self-regulation is recognized as a crucial cognitive process for patients. Self-regulation is defined as the "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman 2000, p. 14). Self-regulation is represented as a feedback loop (Miller et al. 1986; Scheier and Carver 1985) in which patients periodically and constantly compare what they are/have been experiencing to what they intend to experience. This comparing mechanism, powered by self-striving activities, helps patients moving closer toward the point of health goal completion. If the endeavor is not satisfied by the person's comparator mechanism, the feedback loop may be broken and the health goal might be left incomplete. For those self-initiated goals posted by patients in their online communities, the self-monitored and self-reflected content is a critical aspect indicating whether an online patient let the striving endeavor moving further along.

Since self-monitor and reflection in online patient communities is within social environment, it is common for patients to post both health-related content and leisure-oriented content for the purpose of interaction. Patient-generated-content (PGC) focusing on health condition and goal striving experience can be considered as a high-concentrated reflection for health goal attainment, and PGC focusing on leisure topics, on the other hand, can be considered as a low-concentrated reflection for health goal attainment. Thus, the more high-concentrated reflection content posted along the goal striving journey, the more likely a patient can rise up the possibility of health goal attainment. Otherwise, the patient is likely to decrease the rate toward health goal attainment. This argument supports the following hypothesis:

H3. The self-reflection focusing on health-related content can help the patient increase the possibility of goal attainment (H3a), whereas the self-reflection emphasizing leisure-oriented content decreases this possibility (H3b).

The Moderating Role of Goal Types

In this study, we also consider the likelihood of health goal attainment to vary per different goal type. This is because that a goal type not only reflects the nature of the associated health condition but also indicates the level of difficulty a health goal may be achieved. In other words, a better planned, more manageable health goal may be easier to attain under the influence of social and cognitive factors. To explain this, we use the following case as an example. Given two individuals who receive social support and conduct self-reflection in a community, the one

with a type of mental disorder may take more time or has lower likelihood to attain a goal called "be mentally stable" than the other one with cancer to attain a goal called "complete my current chemotherapy treatment." Thus, we present our last hypothesis as follows:

H4. Patients' effectiveness on the possibility of goal attainment due to the received social support and generated self-reflection varies by goal type.

Methodology

Research Context

Our research context is a large online patient community launched in 2006. Before our data collection, the website had more than 400,000 members participating in over 500 health support groups. All the support groups were predefined by the website rather than generating by the users. Thus, each online support group has a clear focus on a specific disease or medical concern. The prior focus of the website is on chronic illnesses (e.g., mental disorder, cancer, diabetes, etc.). The website also has support groups for severe family and relationship issues (e.g., abuse, divorce, etc.) and major life style topics (e.g., diets and weight maintenance). An individual can voluntarily choose to become a registered member of this patient community, and all the available functionality (e.g., forum, support groups, social function, goal monitor, etc.) is free of charge. After filling out the illness profile page, a patient (user) will be assigned to all the related support groups. Online patients can also choose among showing the entire personal page

to the public, showing selected content to the public, or showing personal content to online friends only.

Figure 2-1. Goal Progress Diagram and Goal Update Journals on Patient Goal Page

To use the goal function and track the progress, a patient should first either choose a goal type from a predefined goal list provided by the website or create one based on the health issue. The website provided the most representative goal types based on the focuses of the health support groups; thus, most of the members would select one of the predefined goals. The progress on the goal is set at 0% if there is no additional update. Afterward, the members shall start monitoring and tracking their goal progresses. Figure 2-1 demonstrates the goal progress diagram, and the goal-related journals, which contain self-reflection and social support contents.

Data Collection

For patients with online chronic disease, it usually took them a few months to two years to complete a health goal.2 Thus, we collected two years of patient goal activities since December 2007 when the website launched the health goal management function.

We chose 13 support groups (see Appendix 2A) to collect data for the reasons as follows. (1) Group members tended to read other people's goal updates rather than managing their own initiatives. Thus, we needed groups with enough members engaging in their goal management activity. (2) Since the research focus is on health goals, we did not include family and relationship related support groups (e.g., parenting, divorce, etc.).

We employed a web crawler to collect data from this patient community. The complete information about the selected groups and the associated goal types along with the goal

[2] We conducted a simply distribution analysis on goal start and end time. We found that the goal initiators usually needed up to two years on average to complete a health goal.

completion rate are shown in Appendix 2A. We selected the most popular health goal within each support group as the focus goal. For example, “Lose Weight” was the most popular goal in “High Blood Pressure” and “Diets & Weight Maintenance” groups; it is also relevant to members’ health in these two groups. Thus, we selected “Lose Weight” as the focus goal in these two groups. Similarly, other four types of goals were selected from the other groups. It is possible that one patient had more than one health condition and joined more than one group among these 13 groups. Thus, duplicate information was eliminated before we finalized the data set. Applying our criteria and the time window, a total of 392 online patients were included in the panel data set. 87 patients managed to complete their goals within the research window, while the rest 305 left their goals unfinished.

Variables

Dependent variable

The dependent variable is the hazard rate measuring the probability that a patient will experience goal attainment at time *t*. It is an unobserved variable. We use *GoalDurition* to represent the time spent from the goal start date to the end date. If a patient experienced health goal attainment (i.e., the event is censored), then the end date is the goal end date. Otherwise, the end date is the last day of the research window.

Independent variables

(1) *Informational* represents the number of times online friends provide informational support to a patient. (2) *Emotional* represents the number of times online friends give emotional support to the patient. (3) *HealthUpdate* is the number of health-related content posted in patient's health goal update entries. (4) *LeisureUpdate* is the number of leisure-oriented content posted in the health goal update entries.

Control variables

(1) *Tenure* indicates the length in time since a patient became the member of the online community and is measured by days. (2) *NumberOfUpdate* shows the total number of goal updates a patient posted until the goal attainment is censored or the end of the research window. (3) *HealthResponse* captures the number of patient's health-related response to online peers in comment section. (4) *LeisureResponse* captures the number of patient's leisure-oriented response to online peers in comment section.

Content Analysis

This research adopted Bambina's (2007) research on online social support. A complete version of Bambina's definitions and coding scheme for informational and emotional support is shown in Table 2-1. We conducted a directed content analysis (Hsieh and Shannon 2005) to code social support categories from the collected online records by goal update. A total of 2570 records (goal updates) required to be coded. The coding started with a clear definition on each

category. Then, two coders were involved to code the text, and the reliability of the content analysis was checked for confirming the results. We discuss the coding process in detail in this section.

Table 2-1. Coding Schemefor Informational and Emotional Support Adopted from Bambina (2007)

Support Category	Support Subcategory
Informational Support	Advice Referral Teaching
Emotional Support	Understanding/Empathy Encouragement Affirmation/Validation Sympathy Caring/Concern

We followed Krippendorf's (2004) and Landis and Koch's (1977) suggestions on categorical content analysis in this research. First, a meeting was hold between two researchers (as coders) to understand and discuss the concept and definitions together. A coding book (Appendix 2B was generated during the meeting. Second, we conducted a pilot coding. 30 patients' goals, or 197 records, were randomly selected from the data set to test whether the pilot coding result exceeds the threshold kapppa value of 0.7 (Krippendorff 2004; Landis and Koch 1977). The kappa value of 0.7 indicates that the agreed understanding between coders is significantly higher than what can be concluded by chance. The coders conducted two rounds of independent coding until they reached the threshold kappa value of 0.7. During the third round,

each coder coded other 40 patients' goals (248 records), and the result exceeded the kappa value of 0.7. This pilot coding confirmed that the coding book is robust. Third, two coders separately coded the rest of the data set (2125 records). Last, all the codes were documented in the panel data set for the data analysis.

Survival Analysis

Since the research focus is the final success on health goals (i.e., health goal attainment), survival analysis and hazard ratio is the appropriate approach. We used a semi-parametric model, Cox proportional hazard regression, to analysis the health goal attainment data as all the predictors in the model are continuous variables (Cox 1992). The model is specified as follows:

$$\lambda(t|X_i) = \lambda_0(t)\exp(X_i'\beta) \quad (1)$$

In this model, $\lambda_0(t)$ is a baseline hazard function that describes the risk for patients with $X_i = 0$, who serves as a reference cell. $\exp(X_i'\beta)$ is the relative risk, a proportionate increase or reduction in risk, associated with the set of characteristics X_i. The model for this research with all the X_i and control variables is shown as follows:

$$\lambda(t|X_i) = \lambda_0(t)\exp\begin{pmatrix}\beta_1 logInformational_i \\ +\beta_2 logEmotional_i \\ +\beta_3 logVerbalUpdate_i \\ +\beta_4 logLeisureUpdate_i \\ +controls\end{pmatrix}, \quad (2)$$

where $controls$ represents all the control variables in the research.

We conducted the Schoenfeld and scaled Schoenfeld residuals plots individually to check the proportionality assumption on each independent variable. The p-value of larger than 0.05 for each term indicates that all of the terms should be kept in the model. We plotted the Cox-Snell residuals to check the goodness of fit. The plot indicate that the model fits well.

Results

The Cox proportional hazard regression results are reported in Table 2. Model 1 includes only control variables. It shows that two control variables, *Tenure* and *NumberOfUpdate*, are significantly associated with the hazard rate of health goal attainment, but the effects are negative. Model 2 includes the main effects along with the control variables. The results show that all the main effects are significantly related to the dependent variable in this study except informational support.

In H1, we proposed that informational support boosts the chance of goal attainment for online patient community users. As shown in Table 2-2, the coefficient for *logInformational* is negative and not significant. Thus, we did not find support for H1. In H2, we posited that emotional support increases the possibility of goal attainment for online patient community users. As shown in the results, the coefficient of *logEmotional* is positive and significant (hazard ratio = 1.911, $p < 0.001$), thus supporting H2. It suggests that patients with one unit increase in *logEmotional* is associated with 91.1% increase in the hazard rates. In H3a-b, we hypothesized that health-related self-reflection content increases the possibility of goal attainment (H3a) whereas leisure-oriented self-reflection content decreases the possibility (H3b). The results show

that the hazard ratios for H3a and H3b are 1.918 ($p<0.001$) and 0.680 ($p<0.01$) respectively. Thus, H3a-b are also supported.

Table 2-2. Estimated Coefficients of Cox Proportional Hazard Model on the Possibility of Goal Attainment

Variable	Model 1	Model 2
logTenure	**-1.834*** **	**-1.856*** **
	(0.242)	(0.248)
logNumberOfUpdate	**-0.460***	**-1.264*** **
	(0.228)	(0.284)
logHealthResponse	-0.140	-0.486
	(0.406)	(0.425)
logLeisureResponse	-0.245	-0.138
	(0.476)	(0.496)
logInformational		-0.412
		(0.217)
logEmotional		**0.647*** **
		(0.155)
logHealthUpdate		**0.651*** **
		(0.189)
logLeisureUpdate		**-0.385****
		(0.134)
Number of parameters	392	392
Log-likelihood	-375.0	-347.4
Chi-squared	98.50	153.8

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

The moderating effect of goal types was proposed in H4. The survival functions by goal type show at any point in time that goals are associated with different survival rate (See Figure 2-2). Test for equality of survival functions among the groups suggests the observed differences are significant ($p<0.01$). Patients with well-planned goals, such as Beat HCV and Complete

Cancer Treatment, are more likely to attain their goals than patients with goals involving higher uncertainties. Thus, H4 is supported.

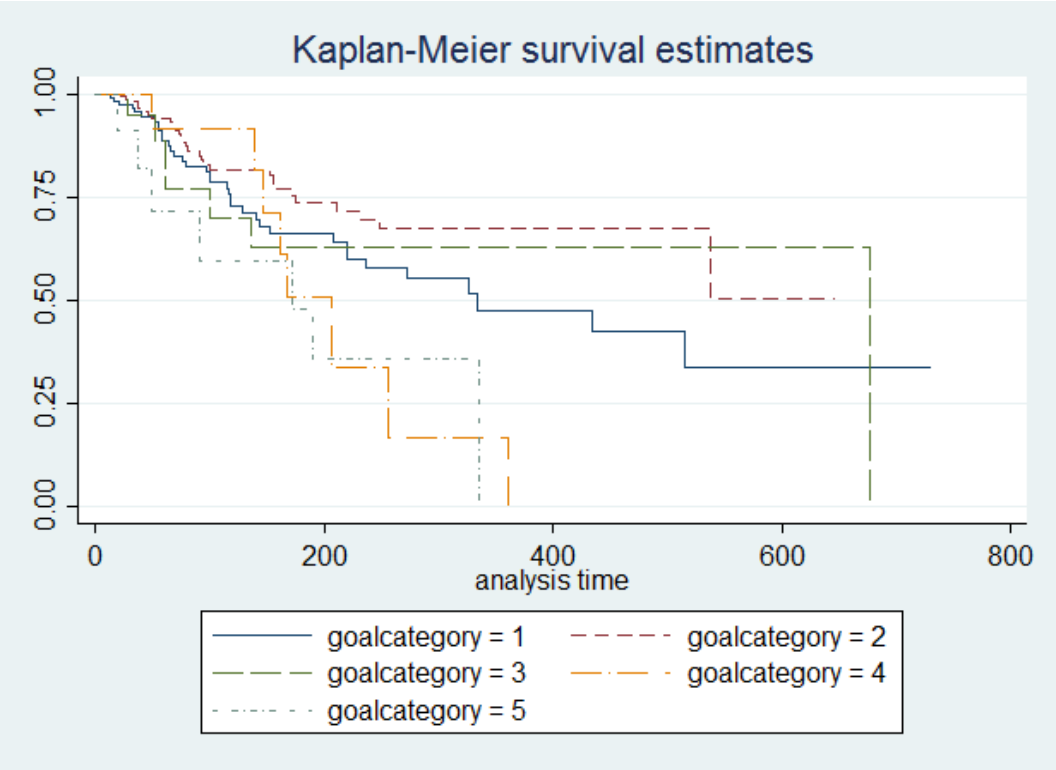

Figure 2-2. Kaplan-Meier Survival Estimates by Goal Types (1-Improve Mental Disorder; 2-Lose Weight; 3-Manage Diabetes; 4-Beat HCV; 5-Complete Cancer Treatment)

Discussion and Conclusion

Disease self-management has entered a new age when healthcare social media communities become increasingly important in patients' daily life. Patients are more engaged in

managing their health through setting and monitoring goals with the presence of online peers and friends. Besides the convenience of interacting with peers 24/7, social media-enabled health goal striving activity also challenges our knowledge on the effectiveness of the communication patterns in regard to health goal attainment. Applied the Cox proportional hazard regression model in this research, we studied the relationships between social support, self-reflection, and the possibility of goal attainment from a social cognitive theory perspective. In this section, we discuss the key findings, research contributions, practical implications, limitations and suggestions for future research.

Findings

This research has several key findings. First, the main effects of informational and emotional support appear to be different on the possibility of health goal attainment. If a patient does not provide any self-reflection with either health-related or leisure-oriented content during goal updates (i.e., no health or leisure update in model 2), this person's possibility to finish the goal will not be changed with the amount of the received informational support increases. However, this possibility increases with the increase of the received emotional support. Thus, practical health information from non-professional peers does not help the purpose of health goal setting (i.e., health goal attainment); rather, emotion or intuition-driven information from others increases the chance for patients' success on their health goal management.

Second, patients' self-reflective updates on health-related experience and leisure events also affect health goal attainment in different directions. If a patient does not receive any social

support (i.e., no informational or emotional support in model 2), s/he will have a higher chance to attain the health goal by providing health-related self-reflection. The possibility will be decreased if the patient focuses on sharing leisure activities and daily life.

Third, this study confirms the moderating effect of goal type on the relationship between the preceding four antecedents and the possibility of health goal attainment. The results suggest that the level of manageability of a goal is positively related to the link.

Implications for Research and Practice

A couple of research contributions are made from the study. First, this study adds new insights for health goal attainment on social media-enabled communication platforms. We conducted a survival study on the possibility of health goal attainment with the presence of online social support and self-reflection. The design of the study allowed us to involve both environmental (peer support) and cognitive (self-reflection) factors in patients' behavior on goals. To the best of our knowledge, this is one of the first research investigating goal attainment in the social media setting. Second, although extant studies recognize the crucial effect of social support on patients' health (e.g., Yan and Tan 2014), it is unclear whether social support is beneficial for patients' self-striving behaviors (e.g., health goal attainment). Our study contributes to the literature by revealing the different effects of informational and emotional support on patients' goal attainment likelihood. More specifically, informational support, by itself, may not play a notable role in patients' goal attainment. Emotional support, on the other hand, acts beneficial in the relationship with health goal attainment possibility. This means that

positive emotion and intuition may be more crucial than informational support duirng health goal management behavior since the former support is likely to increase patients' confidence on reaching their goals.

In addition, the study also provides some important implications for practice. First, we suggest that online patients set their goals in a more specific manner as a well-thought, manageable objective is likely to help patients benefits more from social/cognitive influencers toward goal attainment. Second, although setting health goals, especially chronic condition goals, does not always lead to the winning of a battle with a disease, being able to finish a goal has significant meaning to patients' disease management. Therefore, offline patients should be encouraged by their caregivers to go online and strive their goals with the presence of social influence.

Limitations and Future Research

Finally, we acknowledge the limitations of this study and point out some directions for the future research. First, other comparisons may be conducted through more grouping methods, such as female vs. male and mental vs. physical conditions, for other potential insights. Second, we collected data from the active condition groups on goal striving activities. However, the less active groups may carry their unique characteristics that were not uncovered by our data set. Since additional desirable data are truly hard to obtain, more robustness checks may be conducted to help verify the results of the survival analysis. Finally, more control variables can

be included to help reduce the omitted variable bias. Examples of such variables are number of support givers, number of strong ties and weak ties, etc.

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Appendix 2A. Detail about the Selected Goals and Illness Groups

Goal Type	Support Group	Total Group Members	Total Members with The Goal	Total Completed Goals	Completion Rate
Lose Weight	High Blood Pressure	1464	163	13	8%
	Diets & Weight Maintenance	12202	3085	199	6%
Manage Diabetes	Diabetes Type I	1488	89	5	6%
	Diabetes Type II	3928	218	16	7%
Beat HCV	Hepatitis C	3693	122	39	32%
Complete Cancer Treatment	Teens with Cancer	122	11	2	18%
	Breast Cancer	1323	44	5	11%
	Colon Cancer	763	33	4	12%
	Lung Cancer	865	17	1	6%
	Brain/CNS Tumors	851	17	2	12%
Improve Mental Disorder	Bipolar Disorder-Teen	1506	92	9	10%
	Bipolar Disorder-adult	21615	1325	91	7%
	physical & Emotional Abuse	11340	672	61	9%
5 Goal Types	*13 Support Groups*	*61160*	*5888*	*447*	*8%*

Appendix 2B. Coding Book for Content Analysis

Social Support Subcategory	Definition
Informational support	Informational support is provided to the type of assistance that helps define, comprehend, and cope with stressful problems (i.e., health problems in this research).
Advice	Giving guidance and/or making suggestions.
Referral	Offering a source for information or assistance.
Teaching	Passing on instructional and/or educational information.
Examples • I was first put on Femara. However, I had to switch to Tamoxifen as I could not tolerate the side effects of the Femara… • I suggest you look into "Zone." Eat 3 meals daily + 2 snacks, just avoid bad carbs and sugar. • It (losing weight) takes time, determination, and of course dedication, eating healthy and exercise)	
Emotional support	Emotional support is affective and sentimental in nature and communicates love or caring.
Understanding/empathy	Appreciating and/or identifying with what someone is expressing often, not necessarily, based on having shared a similar experience.
Encouragement	Attempts to inspire hope and courage, to hearten. All prayers.
Affirming/Validation	Acknowledgement and/or positive reinforcement of someone, their ideas, attitude, or actions.
Sympathy	Expressing sorrow for or feeling troubled by another's situation.
Caring/concern	Demonstrating regard for someone's well0being by being very attentive and interested.
Examples • I went to bed at 2:30AM and was up at 7 so I know how you feel. Isn't bipolar FUN??? LOL! • Hugs!!! • Gosh, that's a lot to put on your shoulders, especially when you need direction and advice. • You've made the right choice! Just as this journey is different for each of us, so are the decisions we have to make… • I just want you to know that don't think it's you ... it's something in him ... please don't take it personally…	

Essay 3: Doctors' Received Benefits from Extra-Business Activities on Social Media-Enabled Hospitalized Communities: An Empirical Investigation

Introduction

In congruence with widespread adoption of cell phone and Internet technologies across numerous societies, many developing countries have initiated telehealth, or e-health (e.g., online health, m-health, etc.), programs aimed to solve a series of healthcare problems (e.g., healthcare availability, quality, and financing) due to their resource-constrained health markets. According to an investigation conducted by the World Health Organization (WHO), the top three reasons to launch technology-enabled healthcare programs in low- and middle-income countries are extending geographic access, data management, and facilitating communications (Lewis et al. 2012). During the past decade, for example, program implementers, donors, and policy-makers in China have been developing innovative telehealth and telemedicine programs aimed at integrating social media with medical services (i.e., social media-enabled hospitalized communities) for doctors and patients as a means to eliminate many geographic and financial barriers. In this research, we focus on doctors' adoption of such online hospitalized communities in China and shed light on doctors' social communication with patients and its impact on their online medical practice.

Based on social exchange theory (Blau 1964), one can benefit socioemotional reward and economic reward in a social exchange relationship with others. In a medical relationship, doctors are able to receive both respect (socioemotional) (e.g., Edwards et al. 2002; Kmietovicz 2002;

Roland and Dudley 2015) and financial benefit (economic) (e.g., Roland and Dudley 2015) by interacting with patients. We expect the online doctor-patient social interaction to contribute to doctors' received respect and financial benefit. Extant research has revealed the positive impact of online doctor-patient communication for patients but lacks important evidence from the doctors' perspective. Based on a recent survey with patients in China, more than half were hesitant to use online hospitalized communities due to their limited familiarity toward the online doctors and the associated medical facilities (Accenture 2016). To the contrary, a majority of the surveyed also expressed that outpatient-oriented services (e.g., appointment making, and remote medical consultation) were essential elements desired from online medical communities (Accenture 2016). It can be anticipated that the unfamiliarity is likely to negatively influence doctors' online medical practice which is reflected in their received respect and financial reward.

On social media platforms, medical professionals can conduct extra-business activities, as opposed to point-of-care services, to develop social ties with patients. The extra-business activities enable doctors to convey caring to their patients, which can engender a positive affective engagement in the medical relationship (Adler 2002). Past research suggests that the recruitment of sociophysiologic components (i.e., the interplay of social and physical functions) in the doctor-patient relationship promotes reciprocal results in the behavior and experience for both parties (Adler 2007). In correlation with social exchange theory, literature on doctor-patient relationship indicates that a caring relationship is helpful for doctors on both humane and economic grounds (Adler 2002). Therefore, our first goal in this study is to uncover the association between doctors' extra-business activities and their received respect and financial

benefit via the adoption of online hospitalized communities in China (*RQ1*). In addition, emerging business research suggests that socioemotional wealth may contribute to economic wealth (Duran 2016; Martin et al. 2016). However, the knowledge on these two concepts has not been established from the literature in this research domain. Therefore, we explore the relationship between these two aspects by connecting online doctors' received respect and financial benefits in social media-enabled hospitalized communities. More specifically, our second goal in this study is to answer: How does doctors' received respect mediate the nexus between online extra-business activities and doctors' financial benefit (*RQ2*)?

To answer the preceding research questions, we collected doctor-level data from a leading social media-enabled hospitalized community in China, which has been actively engaging in Internet healthcare since 2006. Our findings reveal that online doctors' activeness on the extra-business activities is positively associated with their received respect and financial benefit through the social and medical interaction with online patients. In addition, we find that the socioemotional aspect, received respect, gained by practicing remote medicine can promote the economic aspect, financial benefit, for those doctors on the website. This indicates a positive mediation effect of doctors' received respect on the link between their extra-business activities and received financial benefit.

This research contributes to literature and practice in several ways. First, this study provides a clear understanding on doctors' use of Internet hospitalized communities in the backdrop of a developing country. Second, this research helps add to the foundation for interdisciplinary study between social media and healthcare by suggesting a positive nexus

between doctor-patient social interactions and doctors' professional benefits via the innovative e-health programs. Third, our investigation reveals a crucial function of socioemotional reward—the positive mediator—for medical professionals practicing online health. For practice, this study suggests that social media-enabled hospitalized communities are an effective means for medical professionals to establish or maintain their medical practices. Additionally, we recommend that doctors using online healthcare platforms maintain a positive professional image among their patients as this virtue may bring them with more medical service requests, which may prepare them better for future healthcare formats.

The paper is organized as follows. In section 2, we introduce the online healthcare reform that has occurred in China and detail unique social aspects of doctors' online communication with patients. Then, we provide the theoretical background and discuss our hypothesis development in section 3. The design of the data collection, the empirical analysis, and its results are presented in the following section 4. In the final section, we conclude this study with the discussion on research findings, implications, limitations, and future directions.

Healthcare Reform and Social Media-Enabled Hospitalized Communities in China

Social Media-Enabled Hospitalized Communities

Recently, China has undergone a rapid technological healthcare evolution. Existing research and reports refer to the advancement of healthcare as "Internet healthcare" (Gong 2016), "electronic medical care," or "online medical services" (Accenture 2016). This evolution is enabled by the Internet and multiple network features (e.g., cloud computing, bigdata, social

networking, mobile Internet, Internet of things, etc.), aimed to connect medical professionals with patients to deliver such medical services as patient education, healthcare information inquiries, electronic health records (EHR), and telemedicine (e.g., online medical consultations and remote diagnosis and treatment). Examples of such initiatives and the observed advantages have been documented in recent studies (e.g., Tu et al. 2015; Xu 2016). The ultimate goal of online medical services is to realize smart healthcare.

Social media-enabled hospitalized communities are one of the key elements within the wide spectrum of smart healthcare that promote positive doctor-patient interactions. Online hospitalized communities have the potential to benefit a number of doctors who are heavily burdened by the growing demands of medical service required from outpatients. First, doctors' work pressure due to outpatients' inquiries is expected to be alleviated by more balanced doctor-patient relationship. Traditionally, a significant number of patients have queued up at hospital registration offices in order to see doctors in China (ChinaEconomicReview 2009), which can partially contribute to an intense doctor-patient relationship during periods of overload (Wu et al. 2014). Remote medical consultations due to the adoption of online hospitalized communities can save patients otherwise significant amount of waiting time in a hospital. This may promote patients' overall medical experience and thus increase doctor-patient relationship from which doctors may benefit in the long term. Second, doctors can access patient consultation history records during any given conversation with a patient via online hospitalized communities. This is likely to increase doctors' productivity and treatment results. Third, the use of such communities may help doctors to effectively use their small time slots to deliver in-time services to their

patients. Moreover, social functions are embedded in these online communities, equipping doctors with a higher level of sociability to develop relationship with and gain trust from more patients. Generally, these community-enabled convenience and merits are likely to benefit doctors from both social and economic perspectives. Thus, there is much potential to conduct rigorous exploitations and investigations on medical professionals' benefits through the remote interaction with their patients on online hospitalized communities. However, the extant research in the context of online hospitalized communities has not provided adequate evidence on the effectiveness of the adoption of such communities and doctors' received benefits. In this research, we investigate doctors' social activities (i.e., extra-business activities) and their impact on doctors' received benefits in a social media-enabled hospitalized community in China.

Online Extra-Business Activities

Prior research on healthcare has acknowledged doctors' social media use beyond the medical consultation boundary (Von Muhlen and Ohno-Machado 2012). However, most of the studies in this stream were focused on traditional social media such as Twitter, Facebook, and LinkedIn (e.g., Antheunis et al. 2013; Guseh et al. 2009). When it comes to social media-enabled hospitalized communities, no longer does the social part stand by itself and cause potential privacy concerns as noted by Von Muhlen and Ohno-Machado (2012). Rather, the social function embedded in the online hospitalized communities may facilitate doctors' effort to strength their professional career. In this research, we construct doctors' social behaviors enabled by online hospitalized communities as *extra-business activities*. The extra-business function is

one of the key embedded features offered to doctors to digitally and remotely connect with their patients in a non-consultation manner.

We view online doctors' medical services as *point-of-care* activities with their patients, which are usually dyadic in nature. By contrast, extra-business activities allow doctors to post constructive and/or informative information to educate patients, make announcements to let patients be aware of future changes and schedule for medical services, post greetings to patients to celebrate holidays and events, and categorize those online patients based on different types (e.g., types of health condition) to better manage them. These activities allow doctors to conduct one-to-many interactions with patients, which extends the traditional hospital functions to a higher level of sociability.

Theory and Hypotheses

Social Exchange Theory, Extra-Business Activities, and Doctors' Received Benefit

Social exchange theory (Blau 1964) posits that individuals engage in social interaction based on an expectation that such interaction can cause certain types of social reward. Approval, status, and respect are examples of the social reward (Blau 1964). Foa and Foa (1980; 1974) further present six types of exchange resources (i.e., rewards): love, status, information, money, goods, and services. In Cropanzano and Mitchell's (2005) review, they summarize two general forms of outcomes – socioemotional and economic – that can be engendered through exchanging behaviors between any two parties. *Socioemotional outcomes* refers to the rewards that satisfy one's social and esteem needs and are often symbolic in nature (Cropanzano and Mitchell 2005;

Mitchell et al. 2012). *Economic outcomes* are the rewards that satisfy one's financial needs and are usually tangible in nature (Cropanzano and Mitchell 2005; Shore et al. 2006).

Due to the widely applicable nature of social exchange theory in human interactions, researchers have extended this theory to online social environments (e.g., Chen 2013; Köhler et al. 2011; Matook et al. 2015; Tiwana and Bush 2001). Among the extant healthcare studies, the majority focuses on the effectiveness of online communities and patients' benefits, such as patient empowerment (e.g., Johnston et al. 2013), and hospitals' social media use for connecting patients (e.g., Huang and Dunbar 2013). A limit number of studies, however, have investigated how social exchange can benefit online doctors. The ever-evolving social media-enabled doctor-patient communities integrated with hospital functions (e.g., remote consultations, patient management, etc.) create an appropriate venue for healthcare professionals to explore novel paths to maintain and/or establish their medical career by serving their patients remotely. We expect that the adoption of such online communities is rewarding for medical professionals through social exchange activities with their patients.

In this research, we shed light on doctors' received benefits on social media-enabled hospitalized communities through two facets: doctors' received respect (i.e., a socioemotional reward) and their financial benefit (i.e., an economic reward). *Respect* is defined as paying attention to and taking seriously another person (Dillon 1992). People may feel disrespect when they are ignored, neglected, disregarded, or dismissed by others (Laschinger and Finegan 2005). Prior research has revealed the importance of respect for patients (e.g., Dickert and Kass 2009) and the generation of respect for nurse management (e.g., Laschinger and Finegan 2005).

However, little emphasis has been placed from the perspective of doctor's received respect. *Financial benefit* is the income a doctor receives by conducting medical consultations with patients via an online hospitalized community. The community-enabled medical consultations may take on such forms as web-based consultations, web-enabled phone consultations, video conferencing consultations, etc. Financial benefit is a crucial element in business settings, such as marketing (Palmatier et al. 2007), information technology adoption (Williams et al. 2012), and management (e.g., Barling et al. 1996; Barnett 2007), to name a few. However, the financial benefit for medical professionals in their doctor-patient interactions has not been fully investigated in the past research.

Extra-Business Activities, Respect, and Financial Benefit

Based on social exchange theory, if an actor (i.e., an online doctor in this study) initiates positive actions, the targets (i.e., the online patients in this study) tend to reciprocate those positive actions with positive responses (Cropanzano et al. 2017). This reciprocity relationship between the actor and the targets is viewed as a high-quality social exchange relationship. We expect this high-quality social exchange relationship to promote doctors' received respect (socioemotional aspect) and financial gain (economic aspect) via the use of an online hospitalized community.

First, social exchange theory anticipates that a positive initiation may elicit the increased socioemotional reward for the actor (or the "affective commitment" from the target) (Cropanzano et al. 2017). This view point has been verified through the positive relationship

between managerial support and employees' affective commitment in organizational literature (e.g., Bishop and Scott 2000; Bishop et al. 2000; Van Knippenberg and Sleebos 2006; Wayne et al. 1997). We argue that such a positive, reciprocal relationship exists between medical professionals and patients as well. In particular, when a doctor utilizes the social functions in an online hospitalized community to devote effort on extra-business activities, s/he should expect to gain more respect from the affected patients. Patients in a traditional medical relationship usually judge their doctors based on the effectiveness of medical-related processes (e.g., consultation, treatment procedures, etc.). Other patients may also judge their doctors for the bedside manner during a medial encounter. However, social media-enabled hospitalized communities allow doctors to demonstrate their nonconsultation-oriented, multidimensional characteristics to their patients. For example, doctors who desire to educate others beyond primary care patient integration can take advantage of the online platform to post informative articles for patient eduction. Online doctors can also post many notifications and holiday wishes to express their caring and friendship. These efforts are likely to make patients feel appreciated and evoke the sense of respect from them. Thus, we propose the first hypothesis:

H1. Active extra-business activities are positively associated with doctors' received respect in social media-enabled hospitalized communities.

Second, in line with social exchange theory, we expect that doctors' effort on extra-business activities with patients should also contribute to the amount of received financial benefit

in online hospitalized communities. Doctors' social-oriented efforts are likely to keep their patients in the circle in which patients can benefit from reading informative articles and receiving doctors' up-to-date schedules. These patients may also value the doctors' effort on delivering thoughtful or festive notes online. Any kind of extra-business output from the doctors is likely to help patients feel the sense of caring from the doctors. Patients tend to visit doctors who care their patients rather than treating people for the sake of the work. As such, online doctors' extra-business endeavor might elicit more requests for point-of-care business from existing patients and even new patients in a hospitalized community. Past research on social media marketing suggests that seller generated content that has a clear target of receivers will positively impact on buyers' purchasing behavior (Goh et al. 2013). For the relationship between doctor and patient, therefore, we propose our second hypothesis as follows:

H2. Active extra-business activities are positively associated with doctors' received financial benefit in social media-enabled hospitalized communities.

Respect and Financial Benefit

Prior research has suggested that socioemotional reward may be able to engender financial wealth for a social interaction with business nature (Duran 2016; Martin et al. 2016). A doctor's received respect in healthcare is similar to a firm's image and reputation in marketing. Both of them carry the socioemotional meaning, are developed overtime, reflect the impression from the other side of the table. In regard to the relationship between brand image and reputation

and purchase behavior, researchers have long affirmed that the former plays an essential role on the production of the latter (e.g., Bian and Moutinho 2011; Esch et al. 2006; Gardner and Levy 1955; Hsieh et al. 2004). This important link is also shown to be influenced and supported via social platforms (Coulter et al. 2012). In healthcare, when patients respect a doctor or notice a doctor respected by many, they tend to believe that this person possesses many virtues. For example, a respected doctor is likely to be perceived as one caring about the patients, having high work ethics, practicing quality medical services, etc. Patients, therefore, are likely to make medical appointments with this type of doctors. We expect this to be the case in social media-enabled hospitalized communities as well. If a doctor receives higher level of respect from his/her patients based on the evidence shown in an online community with hospital functions, the doctor may be able to receive more business for medical services which leads to more financial rewards. Therefore, we hypothesize the following relationship:

H3. Doctors' received respect is positively associated with their received financial benefit in social media-enabled hospitalized communities.

The Mediating Effect of Respect

In the aforementioned hypothesis H3, we compared doctors' received respect from patients with firms' brand image and reputation. This comparison can be carried on for the explanation of the mediation effect of received respect. In business domain, past research shows that building image and reputation can mediate the promotion of positive consumer behaviors.

For example, it is well noted that one's established image plays a mediating role in generating customers' retention (Nguyen and LeBlanc 1998). Taking the online settings as the background, extant research has also revealed the crucial role of image in between the relationship communication and relationship commitment (Balaji et al. 2016). These findings suggest that, in healthcare, doctor's received respect, similar to image and reputation, may act as a mediator in the relationship between doctors' extra-business activities (relationship communication) and their received financial reward (patients' commitment in the relationship).

According to the preceding literature and hypotheses discussed, we conceptualize our research model elucidated in Figure 3-1.

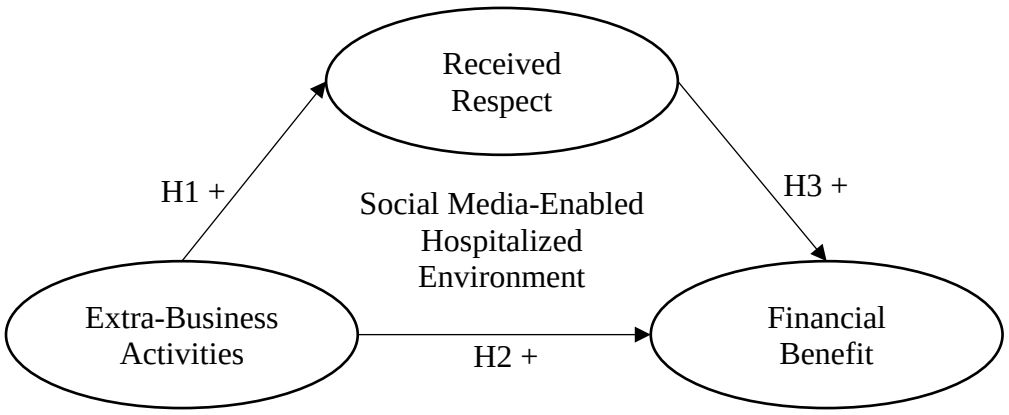

Figure 3-1. Research Model

Methodology

To address our research questions – How do doctors' online extra-business activities promote doctors' received respect and financial benefit? and How does doctors' received respect mediate the link between online extra-business activities and doctors' financial benefit? – we examine a sample of doctors with their extra-business activities and healthcare practice that we observed on a leading social media-enabled hospitalized community in China. In this section, we describe the context of the online community, data collection strategy, involved variables, data analysis, and results.

Study Setting

This leading social media-enable hospitalized community was established in 2006 in China. As of the end of 2016, this online community maintained approximately 140,000 doctors throughout the nation. It integrates socialized community with hospital functions to provide a "smart Internet hospital" solution for doctors and patients nationwide to connect with each other regarding medical consultations, treatments, and other general communications on healthcare. To interact with patients, doctors should first register as members on the website and then active the online hospital functions (i.e., web consultation and phone consultation) and patient-oriented, extra-business function (i.e., categorizing patients into different groups and posting information to the focused patients). With these functions, doctors can post medical information on their pages to education and engage patients, create a number of focused groups to categorize patients, and provide both unpaid and paid medical services per patients' requests. Accordingly, patients

are able to send “thank-you” letters via available online functions to show gratitude to their respected doctors.

Notes: the abbreviation “D/P” means “Doctor/Patient;” “Phone Service” indicates the paid phone medical consultation established through the website; “Web Service” represents the paid web medical consultation on the site.

Figure 3-2. Medical Services Section in Doctors’ Online Pages

Figure 3-2 demonstrates how a typical medical services page looks like on a doctor’s webpage, while Figure 3-3 shows a doctor’s patient-oriented groups and posts. In addition, doctors can deactivate those hospitalized functions to promote their career online at a minimum level. Given our interest in doctors’ received respect and financial benefit and the high activeness

of the doctor-patient interactions on this website, we chose to focus intensively on doctors' extra-business activities on this website as related to their received respect and financial benefit.

Figure 3-3. A Doctor's Extra-Business Activity Page on This Website

Data Collection

We selected doctors with infertility specialty for collecting data based on the following reasoning. First, infertility conditions usually require long-term continuous treatments. Thus, the communications between doctors and patients are meaningful for treating the related illnesses.

Second, the doctor-patient activities regarding infertility conditions, compare with other diseases, are particular lively on this website. As a result, high variations on user behaviors are enabled for data analysis.

The sample of this research contains of 68 infertility specialists who opened the online portals for medical services (i.e., online hospital services) and extra-business activities in a period of one year from March 14th, 2016 to March 13th, 2017. Data were collected via a commercialized web crawler on a post basis, which engenders 133,565 patient posts (consisting of unpaid and paid consultations, "thank-you" letters, and other review posts), 10 doctors' patient-oriented posts, and 333 doctor-generated groups of focused patients. Detailed information about the data set is shown in Table 3-1.

Table 3-1. Detailed Information about the Data Set

Information type	**Count**
Number of doctors	68
Doctor posts (i.e., patient-oriented posts)	10
Created patient groups	333
Patients' medical posts	133,565
- Paid web consultations	3020
- Paid phone consultations	827
- "Thank-you" letters	1213

Variables

Dependent variable

Our first dependent variable is a doctor's received financial benefit, *Financial*. We measured it by the sum of patient paid web and phone consultations, i.e.,

$Financial_i = NumberOfPaidWeb_i + NumberOfPaidPhone_i$, where the subscript i denotes an individual doctor. The second dependent variable is a doctor's received respect denoted by *Respect*, which is measured by the number of "Thank-you" letters a doctor received from patients.

Independent variables

The independent variable is *Extra_Business*, which captures a doctor's extra-business activities cratering to his/her online patients. There are two types of information available on the website to represent a doctor's extra-business activities – (1) creating a number of groups to categorize patients and (2) posting medical topics in patient groups. Thus, we captured two count variables – *NumberOfGroups* and *NumberOfDoctorPosts* – and used the sum value of them to denote *Extra_Business*, i.e.,

$Extra\_Business_i = NumberOfGroups_i + NumberOfDoctorPosts_i$, where the subscript *i* denotes an individual doctor.

Control variables

We included four control variables in this research. (1) We controlled doctors' medical experience with a binary variable *Chief*, which indicate whether a doctor's professional title is equal/above or below Associate Chief Physician. Chief equals to 1 if a doctor's title is equal/above Associate Chief Physician, and 0 otherwise. (2) We controlled doctor's experience on this website with a continuous variable *Tenure*. (3) Patients' activities within their doctors'

patient groups were also included. We used *PatientPosts* to capture patients' posting activity in patient groups. (4) Lastly, we used *Response* to denote the number of responses on the posts in patient groups to capture the activeness of participation on the posted topics. The descriptive statistics are reported in Appendix 3A.

Data Analysis Method

We applied the ordinary least squares (OLS) regression with robust standard errors and the Huber-White sandwich estimators. This method deals with a collection of minor problems such as the failure to meet assumptions of normality and heteroscedasticity and observations with large residuals. Thus, we were able to maintain smaller standard errors for the model coefficients.

Since our research questions includes the direct effect of online extra-business activities on doctors' received respect and financial benefit and the mediating effect of received respect between online extra-business activities and received financial benefit, we have two dependent variables to which two equations should be applied. The equation for the received respect (*Respect*) is

$$logRespect_i = \beta_{10} + \beta_{11} logExtra\_Business_i + \beta_{12} Controls_i + \varepsilon_i, \quad (1)$$

and the equation for the received financial benefit (*Financial*) is

$$logEcoTrust_i = \beta_{20} + \beta_{21} logExtra_{Business_i} + \beta_{22} logRespect_i + \beta_{23} Controls_i + \varepsilon_i, \quad (2)$$

where $Controls_i = Chief_i + Tenure_i + logPatientPosts_i + logResponse_i$, and ε_i is the error term in these two equations. There are two steps involved in the model analysis. Firstly, we only

included the control variables for each equation. Secondly, we included *Extra_Business* along with control variables for the *Respect* model and *Extra_Business* and *Respect* for the *Financial* model.

The Pearson Correlation results (see Appendix 3B) show that all the correlation coefficients are smaller than 0.82, indicating that high correlation is not a concern in the data set. The collinearity results (see Appendix 3C) show that the individual VIF of variables are below 10 and the overall VIF is below 6, which suggests that collinearity is not an issue in the study. The results are presented in the following section.

Results

In H1, we proposed that online extra-business activities are positively related to received respect for doctors applying social media-enabled online hospitals. This relationship is supported by the significant coefficient ($\beta = 0.58$, p-value < 0.001) of *logExtra_Business* in Table 3-2, equation 2. In H2, we hypothesized that online extra-business activities help with the received financial benefit for doctors adopting social media-enabled online hospitals. This hypothesis is marginally supported by the significant coefficient ($\beta = 0.229$, p-value < 0.1) of *logExtra_Business* in equation 4. In H3, we proposed that the received respect is positively associated with the received financial benefit for doctors using social media-enabled online hospitals. This hypothesis is supported by the significant coefficient ($\beta = 0.421$, p-value < 0.001) of *logRespect* in equation 4. A summary of the hypothesis testing results is reported in Table 3-3.

Table 3-2. OLS Coefficient Estimates with Robust Standard Errors

DV	*logRespect*		*log Financial*	
Equation	1	2	3	4
Control variables				
Chief = 1	0.199	0.349**	0.224*	0.199*
	(0.127)	(0.118)	(0.111)	(0.094)
Tenure	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
logPatientPosts	0.440***	0.312***	-0.207	-0.443**
	(0.084)	(0.087)	(0.127)	(0.153)
logResponse	-0.405***	-0.179	0.291	0.550*
	(0.104)	(0.123)	(0.183)	(0.224)
Independent variables				
logExtra_Business	-	**0.580*** **	-	**0.229+**
		(0.123)		(0.128)
logRespect	-	-	-	**0.421*** **
				(0.103)
Constant	0.493***	0.000	0.441**	0.039
	(0.114)	(0.134)	(0.130)	(0.158)
R^2	0.065	0.307	0.060	0.396
Observation	68	68	68	68

Notes: the values in parentheses are standard deviations; + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table 3-3. Results of Hypothesis Test

Hypothesis	Result
H1: Extra-business activities (+)→ received respect	Supported
H2: Extra-business activities (+)→ financial benefit	Supported
H3: Received respect (+)→financial benefit	Supported

To test the mediating role of *Respect*, we also conducted a mediation analysis. Since the assumption of normality for indirect effect is difficult to maintain in finite samples (Preacher and Hayes 2008), we involved numerous resampling (5000 times) through bootstrapping technique. This method is especially useful for small sample size. The result is presented in Table 3-4. Zero

does not fall between the reported 95% confidence interval (i.e., between 0.1 and 0.454 at significant level of 0.01), indicating a significant mediating effect. Therefore, a significant effect of *Extra_Business* was demonstrated on the mediator, *Respect*, which in turn significantly influenced *Financial*.

Table 3-4. Bootstrapping Results for Mediation Analysis

Predictor (X)	Mediator (M)	Outcome (Y)	Bias Corrected and Accelerated 95% CI	Significance of Bootstrapping for Indirect Effects
logExtra_Business	logRespect	logFinancial	(0.100, 0.454)	$p = 0.006 < 0.01$

Robustness Check

To check the robustness of the results, we analyzed the data set by using seemingly unrelated regression (SUR) with a small-sample adjustment as the data set had a small sample size (i.e., 68 doctors). We conducted the Breusch-Pagan test to verify the appropriateness of the SUR over OLS regression. No statistically significant evidence was found to reject the null hypothesis that the residuals from equations (1) and (2) in Table 5 were independent (p-value = 0.275). Although SUR is not a preferred method over OLS, it shows (see Table 3-5) the same results as what we found in the main analysis. Therefore, we are confident about our findings through the preceding analysis.

Table 3-5. Coefficient Estimates of Seemingly Unrelated Regression

DV	*logRespect*	*logFinancial*
Equation	1	2
Control variables		
Chief = 1	0.349**	0.199+
	(0.120)	(0.110)
Tenure	-0.000	-0.000
	(0.000)	(0.000)
logPatientPosts	0.312	-0.443+
	(0.278)	(0.242)
logResponse	-0.179	0.550*
	(0.320)	(0.278)
Independent variables		
logExtra_Business	**0.580*** **	**0.229+**
	(0.124)	(0.125)
logRespect	-	**0.421*** **
		(0.110)
Constant	0.000	0.039
	(0.183)	(0.158)
R^2	0.307	0.400
Observation	68	68

Notes: the values in parentheses are standard deviations; + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Discussion

Online hospitalized doctor-patient communities empowered by social media are novel initiatives in healthcare industry globally. The dearth of understanding on this new online healthcare environment necessitates investigations on the effectiveness of this environment and doctors' received benefits. In this research, we uncover insights on the relationship among doctors' online extra-business activities, received respect, and received economic measure of financial benefit by addressing two questions: (1) How do online extra-business activities influence doctors' received respect and financial benefit? and (2) How does doctors' received

respect mediate the relationship between online extra-business activities and doctors' received financial benefit? In this section, we discuss the important findings of this study, contributions for research, implications for practice, and limitations.

Key Findings

First, our findings demonstrate that online extra-business activities not only provide a directly positive impact on doctors' received financial benefit but also make an indirect contribution on financial benefit through their received respect from online patients. Second, we find the causal relationship between the online extra-business activities and the received respect and the relationship between the received respect and the received financial benefit by verifying the mediational effect of the received respect.

Implications for Research and Practice

This research contributes to the literature in several aspects. First, it is one of the first studies to investigate the beneficial effectiveness of online hospitalized communities from doctor perspective. Second, this research explains the underlining mechanism of the causal relationship between doctors' online extra-business activities and their received respect/financial benefit. Third, it also uncovers the positive influence of doctors' received respect and financial benefit, which echoes the emerging research cue of the relationship between socioemotional and economic wealth/rewards in the prior studies (Duran 2016). In addition, new insight about the

positive mediating role of doctors' received socioemotional reward is verified in the online social setting.

There are also practical implications we made through this study. First, we suggest that doctors acquire online platforms, especially social media-empowered ones, to manage their patients. Second, since received respect can help explain the positive relationship between the online extra-business activities and received financial benefit, we recommend that doctors maintain and/or boost the respect that is expressed explicitly by their patients in online healthcare communities.

Limitations and Future Research

Finally, we acknowledge the limitations of this research and provide directions for the future study. First, the sample size of this study is comparatively small. Although we use random sampling method to reduce the selection bias, potential bias may still exist due to the small sample size. Thus, we intend to include more doctors in the data analysis during the follow-up work. Second, other more advanced analytical techniques may be applied for richer findings. Suitable analytical techniques for this study are logit regression, panel data fixed-effects analysis, and difference-in-differences modeling.

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Appendix 3A. Descriptive Statistics

	count	mean	s. d.	min	max
logDoctorPosts	68	0.630	0.303	0.533	2.047
logGroups	68	0.609	0.378	0.336	1.845
logPatientPosts	68	0.638	0.271	0.580	1.890
logResponse	68	0.648	0.236	0.608	2.225
Chief	68	0.765	0.427	0.000	1.000
Tenure	68	1167.956	879.743	0.000	2911.000

Appendix 3B. Pearson's Correlation Coefficients for Explanatory Variables

		1	2	3	4	5	6
1	*logDoctorPosts*	1.00					
2	*logGroups*	0.29*	1.00				
3	*logPatientPosts*	-0.07	-0.03	1.00			
4	*logResponse*	-0.06	-0.10	0.80***	1.00		
5	*Chief*	-0.00	-0.24*	0.12	0.09	1.00	
6	*Tenure*	0.22	-0.02	0.28*	0.28*	0.40***	1.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 3C. Multicollinearity Results

Variable	VIF	1/VIF
logDoctorPosts	1.18	0.848625
logGroups	1.19	0.839556
Chief	1.28	0.779260
Tenure	1.39	0.719118
logPatientPosts	2.82	0.354378
logResponse	2.82	0.354618
Mean VIF	1.78	