Elaborating Cancer Opinion Leaders’ Communication Behaviors Within Online Health Communities: Network and Content Analyses

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Abstract
This study integrates social network and content analyses to examine the communication behaviors of opinion leaders—such as creating threads and engaging in continuous conversations—in two large cancer-focused online health communities. Guided by the diffusion of innovation theory and the social support literature, we analyzed 951 threads and 10,179 posts and found that a group of opinion leaders (including cancer patients, family caregivers, and cancer survivors) centralized the communities from 2017 to 2018. Opinion leaders’ typical replies to others tended to be a combination of opinion support, emotional support, and network support. Amid their self-created threads, we further identified four themes: cancer history and treatment, health or life condition update, advocacy, and emotional ventilation. Implications for network and content analytics of online cancer communication are discussed.

Keywords
online opinion leader, online health communities, social network analysis (SNA), cancer communication

Extensive studies have examined supportive communication in computer-mediated contexts among individuals facing cancer-related concerns (e.g., Donovan et al., 2014; Rains et al., 2015). With a variety of web-based platforms (e.g., blogs, microblogs, forums, and social networking sites), online health communities (OHCs) present a convenient network for individuals to interact with experientially similar others and exchange social support (Rains & Young, 2009; Zhu & Stephens, 2019). As these online networks continue shaping the ways in which social support are transmitted, exchanged, and/or interpreted, little attention has been paid to how social support is mobilized by opinion leaders online and how these networks are structured. In this article, we identify opinion leaders in two cancer-focused OHCs and examine the role that they play in diffusing supportive messages.

Opinion leaders have been identified as key sources of influence in information diffusion (Katz & Lazarsfeld, 1955; Rogers, 2003). They are typically influential members of a social network from whom others tend to seek advice and information (Huffaker, 2010). Gaining an understanding of opinion leaders’ communication behaviors within OHCs is crucial in studying the diffusion of supportive messages. Toward that end, utilizing two large-scale OHCs, we draw on the diffusion of innovation theory (Rogers, 2003) and the social support literature to (1) theorize and empirically measure opinion leaders’ role in OHCs and (2) unearth their communication behaviors for diffusing supportive messages. In the following sections, we first examine literature on opinion leaders and online social support. Next, we advance several research questions and hypotheses stemming from this body of theory/research, followed by a description of our study methods and findings. Finally, we discuss the theoretical and practical implications of the current investigation for OHCs and computer-mediated support interventions.

OHCs
OHCs have become a major source of social support for people facing health concerns: an estimated 90 million Americans have participated in some type of online support groups/...
communities (Chou et al., 2009; Fox, 2011). Through community building and message diffusion, cancer patients and their advocates can connect with a diverse network of peers facing the same or similar stressors and have access to a wider array of supportive information and services (Bender et al., 2011). Research has found that receiving this support leads to improved physical outcomes, bolstered confidence in treatments, increased optimism and control, and enhanced self-esteem and well-being (Kim et al., 2017).

In an effort to explain and measure why some individuals prefer to obtain social support via online versus traditional offline networks, several researchers built on Granovetter’s strength of weak ties theory (1973) to defining the support connections within computer-mediated contexts as online weak-tie supports (e.g., Wright & Miller, 2010; Wright & Rains, 2013). Typically, online weak ties involve individuals who interact with each other in a limited way through computer-mediated communication, such as exchanging information or finding company (Wright & Miller, 2010). Compared to offline strong ties (e.g., family and friends), online weak ties offer several advantages, including being less judgmental and more objective, offering unique information, and a reduced potential for role conflict (Wright & Miller, 2010). Although this line of research is essential in adding an element of structure to understanding online supportive communication, few studies have (1) examined roles and relationships inherent in the different positions people hold within online networks and (2) measured the actual strength of ties among OHC participants. In this study, we particularly focus on exploring how online opinion leaders might disseminate supportive messages over time and moderate online support dynamics.

**Online Opinion Leaders**

An opinion leader was originally conceptualized as one who could actively interpret the meaning of messages from mass media for lower-end media consumers (Katz & Lazarsfeld, 1955). In the two-step flow model of mass communication, Katz and Lazarsfeld (1955) theorized that opinion leaders enacted as catalysts, communicating media messages, and in the process, exerting power over others. Building on that, Weimann (1994) considered opinion leaders to be those who diffuse information by engaging in various discussion groups with the hope of shaping opinions. In the diffusion of innovation theory, Rogers (2003) advanced the widely cited development of the concept by defining opinion leadership as “the degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency” (p. 27).

More recently, opinion leader research has shifted from personal (egocentric) networks to social (sociometric) networks by focusing on opinion leaders’ level of social embeddedness (i.e., the number of social ties; Weimann et al., 2007). This shift is mostly driven by social network research (Monge & Contractor, 2003), which contributed an entire new dimension of analytical tools and conceptual language. The social network perspective identifies who talks to whom in a community (Wasserman & Faust, 1994). The approach enables researchers to identify who are more central in the network and therefore more influential (Hilbert et al., 2016). While there is no single conventionally accepted definition of online opinion leader, one definition has been used is Huffaker’s (2010) contention that online opinion leaders are those who stoke the fire of online communities by initiating, facilitating, and encouraging communication and social interaction. However, Huffaker’s (2010) conceptualization only focuses on the communicative actions of opinion leaders (e.g., information-giving and information-seeking) yet lacks the explanation of the network and social embeddedness of opinion leaders. To fill the gap, Feng (2016) advanced a novel approach for identifying central users in a topic-driven Twitter network. A few types of central users were identified in 4-day time span, such as conversation starter, influencer, and network builder. However, not all user types are identifiable in the longer term (Adalat et al., 2018).

In this study, building on previous research, we define online opinion leaders as influencers who (1) create, receive, and disseminate online information through network connections and central positions and (2) act as information bridges and active engagers. We argue that compared with non-leaders, online opinion leaders possess significantly higher levels of network connectivity and are influential in developing shared attitudes and cognitions among members of online communities. Indeed, researchers have found that online communities tend to be successful when an online opinion leader is present in centralized networks, setting agendas, moderating interactions, and keeping the group on track with its goals (Valente, 2010).

Furthermore, with the ubiquitous use of personal computers and mobile devices, online opinion leaders are better equipped to offer advice by providing information and opinions more efficiently (Turcotte et al., 2015). It is logical to presume that online opinion leaders would be an important factor in the diffusion of supportive messages and would hold great potential for acting as “effective weak ties” (Wright & Rains, 2013, p. 321) when interacting with others. However, there is limited understanding of online opinion leaders’ role within the online network of a cancer support community. To fill in this gap, the following research questions were first advanced:

**RQ1**: To what extent is an online cancer support community centralized by a certain number of users?

**RQ2**: Can a central group of online opinion leaders be identified and differentiated from the rest of the users?

In addition to the network attributes of online opinion leaders, it is also necessary to unravel their identities—such
as cancer patients, survivors, family caregivers, and/or health care professionals—to better understand the nature of their influence. For the purpose of this article, we defined online opinion leaders’ identities as follows: Cancer patients are people who are currently diagnosed with cancer and are seeking reliable information and support from similar others. Cancer survivors are those who have recovered or survived from cancer and are looking for gaining insights from others or hoping to connect with others who are struggling with cancer. Family/friend caregivers are people who are responsible for taking care of their loved ones affected by cancer and are looking for support or to exchange information. Health care professionals are those who provide preventive, curative, promotional or rehabilitative health care services in a systematic way to cancer patients. Opinion leaders may take on and showcase multiple identities (e.g., being caregivers and health care professionals) during online interactions. As suggested by Stewart and Abidi (2012), distinguishing the identities of online opinion leaders is a crucial step for navigating the actual meaning underlying different strength of ties as well as the degree of communication between participants of an online support community. Therefore, we posed the following research question:

RQ3: What are the identities of opinion leaders in an online cancer support community (e.g., patients, survivors, family caregivers, and/or health care professionals)?

Online Replies as Social Support

Broadly speaking, online social support can be defined as support gained through online interactions and exchanged with people who are, for the most part, unseen and unknown. OHCs provide a convenient platform for users—including online opinion leaders—to take one or both of the following two forms of participation: (1) contributing an original post that initiates a topic discussion and (2) responding to others’ posts. These replies serve as a direct indicator of social support, reflecting the functional nature of the network tie (Song et al., 2011). Through receiving replies, OHC users can gather supportive attention, information, and care from others.

To date, the majority of content analyses examining the nature of online supportive messages have drawn upon Cutrona and Suhr’s (1992) social support behavior code (SSBC) or a commensurate coding scheme to examine the prevalence of five types of support messages: informational, emotional, esteem, network, and/or tangible (for extended review, see Rains et al., 2015). Informational support provides facts, guidance, or advice, while emotional support involves expressions of empathy, concern, caring, love, and trust. Esteem support shows expressions of confidence, encouragement, and affirmations of an individual’s strengths.

Network support conveys a sense of belongingness and includes attempts to expand support seekers’ connections or reinforces existing connections, and tangible support involves offers of financial assistance, services, or material goods. In a recent meta-analytic review over published content analyses of online support communities, Rains and colleagues (2015) found that informational and emotional support messages were the most prevalent, while esteem and network support appeared less frequently.

Replies to an original post from other online users can indicate attention, engagement, and responsiveness to the post (Himmelboim, 2008). Seen in this light, social networks based on post-reply relationships offer a fruitful venue for studying the interactive and reciprocal nature of communication in OHCs. Given online opinion leaders’ active role in instigating and facilitating communication, we proposed the following research question:

RQ4: What kind(s) of supportive messages are embedded in opinion leaders’ replies to others?

Of particular relevance to this study of OHCs, it is important to note that previous conceptualizations of informational support failed to separate three distinguishable factors—fact, opinion, and personal experience—that collectively constitute informational support messages (Stewart & Abidi, 2012). More specifically, a fact is something that can be proven true or false, such as medical trial findings, drug instructions, treatment options, and hospital information. An opinion is based on a belief or a feeling that is not always true and cannot be proven (e.g., an expression of a patient’s feelings on a treatment). Personal experience refers to anecdotes that rely heavily or entirely on individual testimonies, which usually cannot be verified due to cognitive bias (Gibson & Zillman, 1994). To build on this more extensive explication of informational support and fully understand supportive messages embedded in opinion leaders’ replies to others, we posed the following research question:

RQ5: Given the difference between fact, opinions, and personal experiences, what are the prevalent combinations of different supportive messages embedded in opinion leaders’ replies to others?

Finally, previous research suggested that online opinion leaders may not only engage in a range of conversations by responding to others’ posts but also set agendas by creating themes pertaining to a particular topic (Stewart & Abidi, 2012). Thus, to understand online opinion leaders’ communication activities, it was important to account for topics and themes with which opinion leaders are inclined to start. Hence, the following research question is posed:

RQ6: What are the salient themes among opinion leaders’ self-created threads?
Methods

Data set and Data Collection

The research data were retrieved from two forum-based OHCs, including The Cancer Forum (OHC1; http://www.cancerforums.net) and Cancer Survivors Network (OHC2; http://forums.lungevity.org/). In this study, we utilized the data from the lung cancer section of both communities for two reasons: first, the lung cancer sections were the most active sections of the two communities which had collectively generated over 3,600 threads and 35,000 posts since 2003. Second, according to the American Cancer Society (2020), lung cancer accounts for about 25% of all cancer deaths and is by far the leading cause of cancer death among both men and women. Each year, more people die of lung cancer than of colon, breast, and prostate cancers combined.

After receiving approval from the websites and our own institution’s institutional review board (IRB), we extracted data using a web crawler (specifically designed and implemented for this study). The crawling procedure consists of three parts: controller (used for distributing works), parser (downloading web pages and filtering redundancy), and (3) resource library (storing data). Overall, 951 threads (512 threads from OHC1 and 439 from OHC2) and 10,179 posts (7,011 from OHC1 and 3,168 from OHC2) from 2017 to 2018 were extracted. All forum posts were organized in threaded discussions comprised of the initial posts plus a chain of replies, which would be visible to any registered users when signing in the forum with a username and password. All identifying information was removed from the posts, and usernames were changed to alphanumeric aliases.

Social Network Analysis

In order to identify opinion leaders, we used social network analysis (SNA), which represents communication in terms of nodes (i.e., actors/members) and edges (i.e., communication ties; Monge & Contractor, 2003). SNA provides a tool to examine the actual strength of ties within an online community as well as the degree of communication among users (Wasserman & Faust, 1994). In this study, an undirected 1-mode network was created among users, in which a tie between two users indicated they had communicated on a thread, and the value of the tie was the number of threads on which they have both communicated. We utilized network analytical packages NodeXL and UCINET to visualize and analyze retrieved data.

To answer RQ1, we used centralization and core-periphery modeling to reveal the two network structures, respectively. Centralization refers to the overall cohesion or integration of a network structure that may be more or less centralized around one actor or a set of actors (Monge & Contractor, 2003). Furthermore, the core-periphery model describes and attempts to explain the structural relationship between a densely connected core and a loosely connected periphery (Borgatti & Everett, 1999). The core-periphery structure is determined by fitting conversation networks to a mathematical model. A fit of .5 or greater indicates a decent core-periphery structure (Warmbrodt et al., 2008).

Online opinion leaders depend on network connections (i.e., how much one is connected in the network via “in-degree” and “out-degree” links) and central positions (i.e., a user’s central role in the network) to bridge information and influence others. Therefore, to answer RQ2, utilized centrality measures—including degree centrality, closeness centrality, and betweenness centrality (Monge & Contractor, 2003)—identify online opinion leaders. Specifically, degree centrality measures the number of ties an individual node has; closeness centrality measures how quickly a single node can reach all other nodes; and betweenness centrality measures a node central to the network if they are often used as a path between two other actors (Xu et al., 2015). Following the suggestion of Borgatti and Everett (1999), we also measured the coreness value to examine how central one user is to the network. All four measures were normalized to a (0, 1) scale for simpler interpretation (Hanneman & Riddle, 2005). Both a high-degree centrality and a high-coreness value indicate central positions, and accordingly, dominance in the networks (Freeman, 1979).

Content Analysis

To answer RQ3, RQ4, and RQ5, we employed a three-step content analysis. After identifying opinion leaders in the network, Step 1 classified their identities (i.e., cancer patients, cancer survivor, family/friend caregivers, and health care professionals) based on self-provided profile, such as biography, location, interests, occupation, and signature. Step 2 extended the original social support scheme (Cutrona & Suhr, 1992) to investigate different types of social support provided by opinion leaders. Finally, given that there lacked a theoretical framework to assess the content of opinion leaders’ self-initiated threads, Step 3 applied a grounded theory to explore major themes of those threads. Below, we detailed the code development process and coding procedures. Two authors and one graduate student were involved in the coding process.

Code Development. After identifying opinion leaders in both networks, we further uncovered their identities (RQ3) based on self-provided profile, such as biography, location, interests, occupation, and signature. For RQ4 and RQ5, we were interested in disentangling informational support into three distinguishable aspects: factual information support, opinion support, and personal support. To answer these questions, we developed a coding scheme to analyze opinion leaders’ replies to others within the two networks. First, a pilot coding of a random subsample of 5% of opinion leaders’ posts (N=561) was performed to verify and modify the original
coding scheme. This initial step extended the original social support scheme to include seven different aspects of supportive messages: (1) factual information support refers to replies that entailed research findings, instructions on drug use, treatment options, hospital information, and general information about cancer-related events; (2) opinion support refers to replies that expressed personal opinions on cancer-related issues; (3) personal story support refers to replies that revealed personal testimonies and experiences regarding cancer diagnose and treatment; (4) emotional support refers to replies that conveyed expressions of empathy, concern, caring, love, and trust; (5) network support refers to replies that communicated a sense of belongingness (e.g., greeting, welcoming, referencing to other group members, and seeking more information in a reciprocal manner); (6) esteem support refers to replies that expressed confidence, encouragement, and affirmations of an individual’s strengths; and finally, (7) tangible support includes offerings of financial assistance or material goods.

To assess opinion leaders’ self-initiated threads (RQ6), we employed the grounded theory approach (Glaser & Strauss, 1967) to fully position communication behaviors within its social context and to capture the concepts and ideas that are naturally emerged. In this study, the OHC served as an ideal large social context, and the emerged supportive communication behaviors were opinion leaders’ self-created threads.

**Coding Procedures and Inter-Coder Reliability.** In Step 1, prior to the beginning of the coding process, three coders first did a 2-hr team training. The training consisted of instructions on how to use codebook and familiarity with all the factors assessed in the study. We coded the 16 profiles and discussed to solve coding discrepancies regarding opinion leaders’ identities. The overall reliability Krippendorff’s alpha was .95.

In Step 2, we met in a series of team meetings to code support types from 7,967 responses that the opinion leaders provided to others’ posts (RQ4). All documented discrepancies were resolved through discussion and consensus. This procedure reduced the bias when a more assertive coder can be more persuasive than others and create confounding (Weber, 1985). The three coders established reliability by coding a random subsample of 561 posts. The Krippendorff’s alphas were: factual information support ($\alpha = .93$), opinion support ($\alpha = .87$), personal story support ($\alpha = .81$), emotional support ($\alpha = .91$), network support ($\alpha = .88$), and esteem support ($\alpha = .90$).

In Step 3, we analyzed opinion leaders’ self-created threads ($N=222$) following the constructivist grounded theory (Glaser & Strauss, 1967), where data collection and analysis occurred iteratively. We met in a series of team meetings to code, identify, and discuss the emerging themes. The initial phrase of analysis generated more than 40 open codes. In the ensuing step, we began to “separate, sort, and synthesize . . . data through qualitative coding” followed by a constant comparison (Glaser & Strauss, 1967), where each category was organized based on its theoretical and practical similarity to the other categories. The conceptual categories were generated inductively and followed Owen’s (1984) criteria of recurrence, repetition, and forcefulness.

**Results**

**Identifying Opinion Leaders (RQ1, RQ2, and RQ3)**

We used core-periphery analysis to determine if the two networks were centralized by certain number of opinion leaders (RQ1). The final fitness scores of the conversation network to core-peripheral model were .86 (OHC1) and .79 (OHC2) (all above the .50 threshold), which suggests both networks exhibited a core-peripheral structure and the opinion leaders had strong connections with many other users. Isolated users were dropped from the analysis because their coreness value could not be calculated. Table 1 presents the result of the core-periphery analysis, while Figure 1 visualizes the entire network structures of OHC1 and OHC2.

**Table 1. Communication Densities Stratified by the Core-Periphery Structure in the Online Community.**

| I-Mode network                  | Core     | Periphery |
|---------------------------------|----------|-----------|
| Core of OHC1 (9 members)        | 7.404    | 1.308     |
| Core of OHC2 (6 members)        | 8.593    | 1.670     |
| Periphery of OHC1 (2,011 members) | 1.417 | 0.277     |
| Periphery of OHC2 (1,977 members) | 1.308 | 0.131     |

Note. OHC = online health communities. In OHC1, we identified nine opinion leaders based on the centrality measures (i.e., degree centrality, closeness centrality, and betweenness centrality) and the coreness value (RQ2). In OHC2, we identified six opinion leaders using the same measurement. Table 2 presents the outcomes of centrality measures and the coreness values of the identified opinion leaders. First, the max normalized degrees of the two network were .79 (OHC1) and .68 (OHC2), respectively, which means that one user had responded to nearly 80% of the threads within OHC1 and one user had responded to nearly 70% of the threads within OHC2. The means of the post degrees were .44 (max: .79, min: .09) and .51 (max: .72, min: .11), respectively, indicating that users were not all contributing to all threads. This was a positive finding that shows both networks were centralized by certain number of opinion leaders.

**Figure 1.** Identifying Opinion Leaders (RQ1, RQ2, and RQ3).
showing that there were certain users enacting as communication conduits for the network. Finally, the means of the coreness value were .15 (max: .65, min: .04) and .32 (max: .71, min: .16), respectively, indicating a small group of users centered of both networks. Furthermore, Table 3 summarizes the characteristics of those opinion leaders.

**Opinion Leaders' Replies as Social Support (RQ4)**

The results indicated that seven types of supportive messages were embedded in opinion leaders’ replies to others. Each of them is subsequently illustrated with exemplars.

**Factual Information Support.** Cancer-related factual information was present in 41% \((n=3,266)\) of replies. Opinion leaders provided basic cancer-related facts such as staging, symptom, prognosis, standard treatment options, and cutting-edge experimental options. A typical reply contains facts associated with different stages of lung cancer. For example, one user asked the cancer condition of his father; an opinion leader responded: “if your Dad’s cancer has spread to the bones you are correct in saying he is stage 4. While stage 4 lung cancer cannot be cured, it can be managed and held back for quite a while.”

It is worth noting that opinion leaders tended to follow up with more questions to ensure that the factual information they provided were appropriate for the condition. These replies oftentimes contained questions about diagnoses, test results, and symptoms. For example, after reading a caregiver’s post expressing uncertainties on his father upcoming surgery, one opinion leader asked,

> Will the surgeon be using VATS? Will the sample be tested for cancer while your dad is in the operating room? Will it be a wedge resection? Will the surgeon remove the upper right lobe if the nodule is cancerous?

**Opinion Support.** Cancer-related opinions were present in 82% \((n=6,532)\) of replies. Opinion leaders tended to offer suggestions for medication and treatment, health care providers, and solutions for handling side effects. Their opinions varied depending on how evidence was interpreted. For example, one user questioned her doctor’s treatment plan which triggered an opinion leader’s reply: “you should try another doc or see if anyone cancels so you can get their spot. Try not to wait. Be your own advocate.”

![Figure 1. Communication network of OHC1 and OHC2. Note. OHC = online health communities.](image-url)

![Table 2. Centrality Measures for Identified Opinion Leaders.](image-url)

| Name | Post centrality | Closeness | Betweenness | Coreness |
|------|-----------------|-----------|-------------|----------|
| OL1  | 0.77            | 0.77      | 0.44        | 0.78     |
| OL2  | 0.61            | 0.89      | 0.47        | 0.85     |
| OL3  | 0.59            | 0.72      | 0.41        | 0.61     |
| OL4  | 0.63            | 0.77      | 0.40        | 0.60     |
| OL5  | 0.79            | 0.90      | 0.52        | 0.83     |
| OL6  | 0.74            | 0.74      | 0.50        | 0.77     |
| OL7  | 0.75            | 0.75      | 0.49        | 0.66     |
| OL8  | 0.77            | 0.81      | 0.50        | 0.85     |
| OL9  | 0.64            | 0.79      | 0.41        | 0.65     |
| OL10 | 0.69            | 0.85      | 0.40        | 0.72     |
| OL11 | 0.47            | 0.61      | 0.52        | 0.77     |
| OL12 | 0.51            | 0.60      | 0.50        | 0.71     |
| OL13 | 0.49            | 0.83      | 0.49        | 0.62     |
| OL14 | 0.61            | 0.77      | 0.50        | 0.71     |
| OL15 | 0.54            | 0.66      | 0.41        | 0.79     |

Note. OL1–OL9 were identified from OHC1, and OL10–OL15 were identified from OHC2. OHC = online health communities.
Personal Story Support. Personal stories occurred in 55% (n=4,381) of replies. Opinion leaders shared their own story or others’ experiences that might resonate with support seekers’ experiences. For example, one person asked if anyone was familiar with Clexane because he had to do a daily abdominal shot of Clexane for a month. One opinion leader replied: “I experienced exactly the same thing. After 10 days I ran out of locations. Looks as though you’ve got the experts on your shots.”

Emotional Support. Emotional support was present in 79% (n=6,293) of replies. Opinion leaders tended to voice their compassion and concerns for support seekers’ sufferings, misfortunes, and predicaments by acknowledging and contextualizing the distressed other’s feelings and perspective. For example, one opinion leader replied to a thread of a support seeker’s wife who was diagnosed with cancer: “I am so sorry about your wife’s diagnosis. I went through similar storms and I am always here for you.”

Network Support. Network support occurred in 34% (n=2,708) of replies. These replies conveyed a sense of belongingness, welcome, and inclusivity, and reinforced the connection with support seekers. The results suggested that opinion leaders consolidated different posts depicting similar conditions that could be helpful to others. For instance, one opinion leader stated: “We have had a couple of recent posts regarding this new therapy recently approved by the FDA for treatment of LC. It does show a lot of promise and that is a good thing.” This type of replies was typically embedded in opinion leaders’ comments beginning with “I am sorry to have to welcome you here” and “welcome to the forum but sorry you have the need to seek us out,” while concluding with “keep us posted,” “let us know how it goes,” and “we’re here to listen any time you feel the need to talk.”

Esteem Support. Esteem support was present in 28% (n=2,230) of replies. Opinion leaders tended to encourage support seekers to have confidence in themselves. For example, one opinion leader said, “I know the statistics are grim but remember we are not statistics.” They also gave their best wishes to others, expressed confidence in the treatment, or offered positive sentiments and compliments: “You are very strong and I wish you love and light moving forward. I hope you are feeling better today.”

Tangible Support. Replies that involved offers of physical or monetary assistance occurred in 1.6% (n=127) of replies. For example, one opinion leader offered free housing and meals in the replies to a patient user who was newly diagnosed with lung cancer, and said “whenever you came down here, feel free to stay in my place and we could have food together and chat.”

Prevalent Combinations of Supportive Messages (RQ5)

RQ5 addresses the matter of how opinion leaders’ replies to others might vary in support types. Consistent with procedures in Donovan et al. (2014), we conducted a series of dependent proportion tests with Bonferroni correction and

Table 3. Characteristics of Identified Opinion Leaders.

| Name | Total started thread | Total replies to others | Categorization | Age | Gender | Length of account ownership (years) |
|------|----------------------|-------------------------|----------------|-----|--------|-------------------------------------|
| OL1  | 34                   | 721                     | Cancer patient | 59  | Male   | 4                                   |
| OL2  | 157                  | 945                     | Cancer patient | 59  | Male   | 7                                   |
| OL3  | 30                   | 640                     | Cancer patient | 72  | Male   | 2                                   |
| OL4  | 71                   | 521                     | Cancer patient | 42  | Female | 2                                   |
| OL5  | 16                   | 766                     | Cancer patient | 57  | Male   | 7                                   |
| OL6  | 43                   | 641                     | Caregiver      | 67  | Female | 2                                   |
| OL7  | 13                   | 868                     | Caregiver      | 60  | Female | 5                                   |
| OL8  | 122                  | 1,139                   | Caregiver      | 58  | Female | 8                                   |
| OL9  | 36                   | 643                     | Cancer survivor| 46  | Male   | 3                                   |
| OL10 | 83                   | 922                     | Cancer patient | 42  | Female | 2                                   |
| OL11 | 44                   | 449                     | Cancer patient | 67  | Female | 4                                   |
| OL12 | 52                   | 387                     | Cancer patient | 70  | Male   | 1                                   |
| OL13 | 15                   | 461                     | Cancer patient | 61  | Female | 3                                   |
| OL14 | 18                   | 474                     | Caregiver      | 55  | Female | 5                                   |
| OL15 | 23                   | 601                     | Caregiver      | 52  | Female | 5                                   |

Note. OL1–OL9 were identified from OHC1, and OL10–OL15 were identified from OHC2. OHC = online health communities.
compared the proportions of replies that contained each support type and combinations of them. More specifically, we compared (1) replies with only opinion support against the other six types of supportive messages and (2) combinations of two, three, four, and five types of supportive messages in sequence against each other. Tangible support was excluded in the analyses because it appeared significantly less frequently than the other six categories.

Among discrete types of supportive message, opinion support occurred in more replies than others. In the test of two-way combinations, “opinion support+emotional support” tended to occur in greater proportion to all other types. In the test of three-way combinations, “opinion support+emotional support+network support” appeared in a significantly higher proportion of replies than all other types. In the test of four-way combinations, “opinion support+personal story support+emotional support+network support” was the most common type of reply. Finally, in the test of five-way combinations, the general trend was: “factual information support+opinion support+personal story support+emotional support+network support.” Across all of the comparisons, the most frequent combination is “opinion support+emotional support+network support.” Tables 4 to 8 present results of the above comparisons.

**Table 4. Proportions of Replies Containing Different Types of Supportive Messages (Single Type).**

| Proportion | Types of supportive messages | O | F | PS | E | N | ES |
|------------|------------------------------|---|---|----|---|----|----|
|            |                              |   |   |    |   |    |    |
|            | O = opinion support; F = factual information support; PS = personal story support; E = esteem support; N = network support; ES = emotional support. |   |   |    |   |    |    |
|            | p-values of proportions that share superscript letters are significantly different at p < .05. |   |   |    |   |    |    |

**Table 5. Proportions of Replies Containing Different Types of Supportive Messages (Two-Way Combination).**

| Proportion | Types of supportive messages | O + F | O + ES | O + PS | O + N | O + E | F + PS | F + N | N + ES |
|------------|------------------------------|------|-------|-------|-------|-------|-------|-------|-------|
|            |                              |      |       |       |       |       |       |       |       |
|            | O = opinion support; F = factual information support; ES = emotional support; PS = personal story support; N = network support; E = esteem support. |      |       |       |       |       |       |       |       |
|            | p-values of proportions that share superscript letters are significantly different at p < .05. |      |       |       |       |       |       |       |       |

**Table 6. Proportions of Replies Containing Different Types of Supportive Messages (Three-Way Combination).**

| Proportion | Types of supportive messages | O + F + PS | O + PS + ES | O + PS + N | O + F + N | O + N + ES | E + F + PS | PS + F + N | F + N + ES |
|------------|------------------------------|-----------|------------|------------|-----------|------------|-----------|-----------|-----------|
|            | O = opinion support; F = factual information support; PS = personal story support; ES = emotional support; N = network support; E = esteem support. |         |            |            |           |            |           |           |           |
|            | p-values of proportions that share superscript letters are significantly different at p < .05. |         |            |            |           |            |           |           |           |

**Opinion Leaders’ Self-Created Threads (RQ6)**

We found four main themes emerged from opinion leaders’ self-created threads. Each of them is subsequently illustrated with excerpts below. Potentially identifiable information were replaced with “XX.”

**Theme 1: Cancer History and Treatment.** Opinion leaders created threads as a general introduction to talk about the details of their background and treatment history. For example, one opinion leader stated he was diagnosed with stage III non-small cell lung cancer (NSCLC) at the age 51, and recently, the doctor found a single tumor in the lower part of his left upper lobe. Likewise, another opinion leader mentioned, “Clear 6month scan at the end of April. Next scan early November.” In addition, opinion leaders actively exchanged information on new research findings and triggered questions on technical details. For instance, one opinion leader heard from a doctor that visualization could help the success of treatment, so he created a thread to address the effect.

**Theme 2: Health or Life Condition Update.** Opinion leaders started threads to update their health condition and kept up with other users through life events. For example, one opinion leader mentioned she still had “a lot of aches and pains,” but in the same thread, she also updated on other life events: “Once or twice a week I’m doing an hour long Clubbin Cardio class with my wife. I’m not very coordinated but I’m having fun. It helps that I’m one of the only men in the class.” Similarly, another opinion leader stated, “My daughter had two tickets for XX court today and were officially ladies of the day in our floppy hats!”

**Theme 3: Advocacy.** Through self-created threads, opinion leaders were likely to use their well-established connections along with their knowledge to promote activities and events that could help others. As one opinion leader suggested:
“I’ve done several of these events and find them to be quite rewarding. If there is one in your area, whether you are survivor or caregiver, I hope you consider attending.” Similarly, another opinion leader initiated a thread entitled “Thoughts of Support” after witnessing several forum users lost their loved ones. In the thread, she suggested other community members to give their “prayers of comfort and support” to those who recently lost loved ones.

Theme 4: Emotional Ventilation. Opinion leaders also created threads to vent emotions. For example, one opinion leader said: “My hope is that we all have a great 2012. Because this last year sucked. Though it was the most productive and greatest learning year of my life.” Identified as patient caregiver, an opinion leader conveyed her emotions about missing her mom:

This will be the first Christmas without my dear mom and I miss her terribly . . . My life has changed and the hole in my heart will forever be there but I am my mother daughter and that will never change.

Discussion

Recognizing that the extant research of OHCs has primarily focused on reporting content generated by users in general (e.g., Bender et al., 2011; Rains et al., 2015), this study sought to explain the diffusion of supportive messages by examining opinion leaders’ role across online interactions over a 1-year period. Specifically, we advanced the conceptualization of online opinion leaders and formalized interactions between users—including opinion leaders—of two cancer-focused OHCs by explicitly representing them in network structures. We found that a total of 15 online opinion leaders—nine from OHC1 and six from OHC2—with various identities centralized the two communities, respectively. In addition, this study identified salient themes among opinion leaders’ self-created threads and compared numerous types of supportive message embedded in opinion leaders’ replies to others. The results provided evidence for how supportive messages spread throughout OHC networks. The next two sections further discuss the theoretical and practical implications of this study.

Table 7. Proportions of Replies Containing Different Types of Supportive Messages (Four-Way Combination).

| Proportion | Types of supportive messages | $O + F + P + S + E$ | $O + F + P + S + N$ | $O + F + P + S + E$ | $O + P + S + E + E$ |
|------------|------------------------------|---------------------|---------------------|---------------------|---------------------|
| .21$^{a,b,d}$ | .19$^{a,b,c,d}$ | .20$^{a,b,c}$ | .07$^c$ | .11$^d$ |

Note. O = opinion support; F = factual information support; PS = personal story support; E = esteem support; N = network support; ES = emotional support. $p$-values of proportions that share superscript letters are significantly different at $p < .05$.

Table 8. Proportions of Replies Containing Different Types of Supportive Messages (Five-Way Combination).

| Proportion | Types of supportive messages | $O + F + P + S + E + N$ | $O + F + P + S + E + N + E$ | $O + P + S + E + N + N$ |
|------------|------------------------------|---------------------|---------------------|---------------------|
| .09$^a$ | .29$^{a,b}$ | .05$^b$ |

Note. O = opinion; F = factual information support; PS = personal story support; E = esteem support; N = network support; ES = emotional support. $p$-values of proportions that share superscript letters are significantly different at $p < .05$.

Theoretical Implications

Despite the recent rapid changes in information and communication technologies, such as the rise of social networking sites, this study illustrates how the fundamental premise of the diffusion of innovation theory—that is, a relatively small number of central figures exercising disproportionate influence on the flow of information—still stands. The results showed that both networks exhibited a core-peripheral structure. Consistent with our conceptualization, the findings indicated that not everyone is equally connected with others in OHCs, and those online opinion leaders play influential roles in the flow of supportive messages by attracting numerous incoming and outgoing connections in the network. In other words, they create, receive, and disseminate supportive messages through central network positions. This network approach provides (1) a complementary perspective to previous studies that employed content analysis techniques to describe messages on OHCs, and (2) a visualization of relational connections in online weak-tie networks that may not be present in offline networks (Hilbert et al., 2016).

Furthermore, by integrating the diffusion of innovation theory and the social support literature, this study also addresses the calls to apply multilevel and network perspectives to support mobilization within online support communities (Wright, 2016). Consistent with Rogers’ (2003) argument, we found that online opinion leaders were often located at the core of the social network and had frequent...
interactions with others in the community. They contributed to the majority of replies to others’ posts and disseminated supportive messages by spreading factual information, offering suggestions, and showing emotional support. These communicative efforts served as the bridge of information, the broker of relationships, the important power that drives subsequent community activities, and the catalyst in people’s behavioral and health outcomes (Valente, 2010). As such, it is reasonable to believe health is embedded in the content and network structure of online relational life. Opinion leaders’ online participatory actions, both self-created threads and replies to others, may exert impacts on the attitudes, intentions, and behaviors of other users.

Our findings also shed lights on the self-identities of opinion leaders: among 15 opinion leaders identified in this research, 10 were cancer patients (including one survivor). Cancer patients occupied a larger proportion of opinion leaders, as they resonated more with each other on symptoms, treatments, and challenges (Kim et al., 2017). In addition, five opinions leaders were family/friend caregivers, which highlights patients’ families and friends actively engage in the coping process and form powerful groups with patients (Bender et al., 2011). This finding extends previous theorizing of social networks from structural indices—including size (e.g., the number of network members) and density (the extent to which network members are connected to one another)—to members’ self-concept and role identity salience (Walker & Lynn, 2013). The diffusion and mobilization of online social support depends not only on opinion leaders’ social and emotional attachment to communities but also on self-categorization differences.

In addition, the seven types of supportive messages embedded in opinion leaders’ replies to others also enrich the social support literature, particularly associated with the typology of perceived and/or received social support. Instead of simply considering informational support as a whole, this study provides a more nuanced understanding of informational support by demonstrating that informational support consists of three facets: facts, opinions, and personal stories. Specifically, we found that opinion leaders tended to provide more opinion-focused supportive messages related to cancer prevention, early detection, treatment, and survivorship. Such classification permits exploring the nature and consequences of different support messages within OHCs and provides an analytical scheme for future research in this area. Furthermore, it is worth underscoring that the most frequent combination of supportive communication in opinion leaders’ messages was a mixture of opinion, emotional, and network support. This finding adds to our knowledge about normative communication in OHCs (cf. Donovan et al., 2014), for example, suggesting that it is common and perhaps preferable to accomplish multiple purposes with a single message and that it is a priority to inform via opinions as well as reassure people that they are cared about and welcome. This raises several interesting theoretical possibilities and opportunities for further research into communication in OHCs, for instance, about the extent to which opinion leaders knowingly or strategically set the tone of the community, and whether other members communicatively converge (e.g., Giles & Ogay, 2007). Recent research indicates that OHC messages, and thus the community itself, can vary in terms of how positively or negatively toned the posts tend to be (Haik et al., 2019). Opinion leaders surely play a role in such trends, perhaps by explicitly managing the community guidelines, or implicitly by the sheer frequency of their messaging.

**Practical Implications**

As demonstrated in the data, identifying opinion leaders within two OHCs is a crucial step in the design of OHCs and health interventions. The results suggest that diffusion of supportive message is not a single event; it is a communication process in which continuous support mobilization involving opinion leaders is essential to evoke change. Particularly, better understanding the broader patterns of online opinion leaders’ support expressions and leadership styles would offer valuable insights about the design process of future interventions. It may be possible to improve the efficacy of online support-focused interventions by considering (1) what opinion leaders communicate, (2) who they are in terms of personal characteristics, and (3) how they exert influence on support seekers by behaving as effective weak ties.

Second, we found that opinion support is the most prevalent support types, which can be used in future research that investigates how opinion leaders’ communication patterns regulate support dynamics and more importantly, how other users react to their messages. Furthermore, according to the optimal matching model, matching the five types of social support (i.e., informational, emotional, esteem, network, and tangible support) with the dimensions of a stressor (i.e., desirability, controllability, life domain, and duration of consequences) produces the most positive outcomes (Cutrona & Russell, 1990). Future studies are encouraged to examine opinion leaders’ support provision in tandem with support seekers’ needs. In addition, as newcomers to online communities are more likely to continue participating if they receive a response to their initial post (Huffaker, 2010), opinion leaders’ prevalent pattern of supportive messages can play an important role in motivating participants and influencing the long-term sustainability of OHCs.

Third, health care professionals were absent from our data, which resonates with the question asking how health care professionals can proactively engage in information diffusion using OHCs (Ventola, 2014). Considering that patients tend to rely on health care professionals as reliable sources and trusted arbiter for seeking information about cancer (Chou et al., 2009), more health care professionals could strategically act as opinion leaders in disseminating supportive messages while aligning their communication behaviors with certain principles (Antheunis et al., 2013). Alternatively, as a
less time-intensive means of providing their patients with survivorship resources, health care professionals could point patients toward OHCs with active membership and supportive opinion leaders. Manuscripts such as the present investigation equip health care providers with better information about the communicative activities of OHCs, which can then inform providers’ recommendations to patients about what to expect from involvement in such communities.

**Limitations and Directions for Future Research**

This research has several limitations as well as directions for future research. In studying the networks of our data set, we only selected one type of node (i.e., individual) and one type of relation (i.e., social exchange of information). However, communication networks are multidimensional, which consist of different types of actors (e.g., individuals, documents, and organizations) and relations (e.g., reciprocity and transitivity) that are embedded in the same network (Shumate & Contractor, 2013). Future studies are encouraged to examine online cancer support networks through multiple nodes and relations.

Indeed, we only examined one subsection (i.e., the lung cancer) of two large online cancer networks, so our findings might not be directly generalized to other OHCs. Researchers should include broader samples by comparing various types of OHCs to investigate the differences between opinion leaders’ communication behaviors. In addition, the actions or inactions of other groups of users in the online community should not be overlooked. For example, research has found that lurkers, who do not actively participate in information exchange, reported the same amount of empowerment as posters (Han et al., 2014). Thus, it is meaningful to further compare the difference between active posters and passive lurkers to help identify the uniqueness of user patterns for precise interventions. Furthermore, scholars of supportive communication agree that even messages that are designed to be helpful are not always received as such (e.g., Goldsmith, 2004). Future studies should examine community members’ evaluations of the quality of opinion leaders’ messages.

While this study identified several communication themes and functions of opinion leaders, we are uncertain about their intentions of being an active agency. One important reason is as more people are using OHCs, the emergence of opinion leaders has become a prevailing approach of marketing for pharmaceutical companies to fulfill their needs, such as promoting new drugs (Ko & Godley, 2014). As such, more research should further investigate marketing factors underlying the communication activities of online opinion leaders. Furthermore, opinion leaders are information gatherers. They gather information from personal source, mass media, and other sources (Weimann, 1994). However, simply exposing someone to information does not guarantee learning or retention of the information. Therefore, future studies need to investigate what factors motivate or influence opinion leaders to acquire information and to share the information with others, and more importantly: how general users perceive opinion leaders’ impact on them. Investigating whether opinion leaders offer optimal support messages is a promising next step for this line of study.

In conclusion, the essential role that opinion leaders can play in influencing a significant number of people seeking support online makes it essential for scholars to develop a complete understanding of online support processes. This study contributed to the literature by (1) theoretically, proposing and examining a nuanced understanding of informational support (facts, opinions, and personal stories), (2) methodologically, identifying opinion leaders through their digital traces, and (3) practically, articulating patterns of their supportive messages (i.e., self-created threads and replies to others). Together, it helps understand the complexity of the role online opinion leaders play in OHCs thereby addressing calls from communication researchers to focus on the multidimensional use of health information technology.

**Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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