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## **BACHELOR THESIS**



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**A systematic network based literature review of effects of online health care**

**Een systematisch netwerk-gebaseerd literatuuronderzoek naar de effecten van online gezondheidszorg**

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## **Abstract**

The shift from traditional health care to online health care has been a topic of interest in numerous studies. This shift may lead to different health. However, research that focusses on the accumulation of findings across papers is scarce. Therefore, this literature review investigated the effects of online health care on the patient by reviewing 24 papers for theoretical perspectives, constructs and relationships related to online healthcare. In total, 38 key constructs were found and in nine categories. Well researched constructs were general health behavior, uses and gratifications, internet use and attitude towards a health service. Finally, different network models were drawn in order to visualize significant relationships between key constructs. The results of the analysis showed that research in the field of online health care is still quite fragmented since most hypothesized relationships were only tested once. Future research should focus on constructs and relationships that were less often analyzed, as well as clarifying causal directions in relationships that were identified in this study.

*Keywords:* online; health care; patient; effect

## **1. Introduction**

In the past years, there has been an ongoing transformation of health care. With the development of the social media era, people in more recent times are actively discussing health issues on social media, sharing experiences and engaging with healthcare professionals, particularly on online platforms such as Facebook, Twitter or Web- based technologies (Yoo, 2012; Boachie, 2017). The rapid and innovative advances in social media offer great opportunities for modifying health behavior and increasing health self-management (Korad & Itani, 2011; Amrita, 2013). Moreover, online platforms and social media sites are considered to be inexpensive methods for engaging in health care and have numerous advantages for the patient of today's online world (Gough, Hunter, Ajao, Jurek, McKeown, Hong & Kee, 2017). Therefore, people increasingly use online facilities for health-related issues.

There is currently a lack of a generic overview that integrates results from various research efforts that discussed online health care. Especially, due to the wide and sometimes contradictory variety of theoretical perspectives and research approaches, it is difficult to draw a general picture of the uses, benefits, and limitations of online health care. Therefore, the purpose of this literature review is to address the relationships among different constructs underlying the field of online health care. The findings provide important implications for theory and practice by providing a better understanding of an emerging field of health care.

## **2. State of the art**

Kaplan and Haenlein (2010) define social media as “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user generated content”. In general terms, they suggest that social media provides opportunities for users to generate, share, receive, and comment on social content among other users through communication (Kaplan & Haenlein, 2010; Kamel Boulos & Wheeler, 2007). However, social media is changing the nature and speed of health care interaction between individuals and organizations. These shifts lead to a wide diversity of studies investigating online health care and its effects.

Generally, prior studies have shown that the use of social media for health care is growing rapidly (Gough et al., 2017; Moorhead, Hazlett, Harrison, Carroll, Irwin, & Hoving, 2013; Wantland et al., 2004; Amrita, 2013). Gough et al. (2017) point out that online health messages

can generate greater engagement and change in behavior and attitude towards online health care. In particular, social media are a powerful tool in online health care and increases patients' opportunities and benefits to engage with their own health care (Moorhead et al., 2013). Overarching benefits were for example increased accessibility, a wider access to health information and/or peer/social/emotional support (for more benefits see Moorhead et al., 2013). The results of a study on the impact of social media on healthcare showed that health information on social media significantly influences one's psychological and behavioral health outcome such as increased participation in health care or a higher intention towards health self-management (Yoo, 2012; Goonawardene, Jiang, Tan, & Jiang, 2012; Wantland et al., 2004). Moreover, Wantland et al., (2004) pointed out that there is an improvement in outcomes for individuals using Web-based interventions to achieve the specified knowledge in a health care domain and/or change their behavior consequently. Examples of these outcomes included increased participation in health care and increased knowledge. These findings are also in line with Amrita (2013), arguing that social media has seen a good influence in the behaviors of the users. Summarized, online health care is shown to have various advantageous outcomes such as behavior changes or a greater knowledge of a specific health domain, which consequently make it more likely for people to practice health care online.

However, using the online domain for health care has also its limitations. For example, the maintenance of user's confidentiality and privacy cannot always be granted (Moorhead et al., 2013). Moreover, considering how easy it is to google one's symptoms, it is not surprising that many people make an attempt at self- diagnosis (Tonsaker, Bartlett & Trpkov, 2014). Patients then often overthink and misinterpret their own health issues based on what they read online. This may lead to false self-diagnosis and uncertainty.

Another study (Bass, Ruzek, Gordon, Fleisher, McKeown-Conn, & Moore, 2006) showed a significant relationship between internet- use and perceived patient-provider relationship. This is in line with a study by Tustin (2010), who showed that the patient- provider interaction plays a significant role in online health care in that dissatisfied patient tend to seek and trust information sources other than their physicians. In turn, Hu and Sundar (2010) studied the relationship between online sources (e.g. patient blogs, health organization websites) and health behavior and found that respondents showed a greater behavioral intention towards online health information attained from websites compared to blogs or homepages. Consequently, this raises the question of the credibility of various online health information.

There is also considerable ambiguity among studies (e.g. Tustin, 2010; Hu & Sundar, 2010). For example, there were contradicting results found in that attitude towards a health service influences internet or not (Tustin, 2010). Specifically, studies found both significant and not significant results with regard to that relationship. It is also not clear yet whether the perceived quality of the source has an effect on the perceived quality of the online information, since a study by Hu and Sundar (2010) revealed deviating findings.

These different studies emphasize the complexity and wide variety of theoretical perspectives and research approaches. However, in revolutionizing online health care, little empirical research has systematically examined the causal relationships between the online environment and the impact of online health care and its effects. Especially, due to the diversity of technology and effects in health care, the different theoretical perspectives and finally, the existence of contradicting results, there is a need for a generic overview. Therefore, the purpose of this literature review is to gain insight into the academic field of online health care and to determine constructs and hypotheses that have been investigated so far. Therefore, a network-based literature review will be conducted in order to draw an inclusive model of the findings from prior studies.

This network analysis will consequently address the following research questions:

- *RQ1: Which theoretical perspectives are central in the research field of empirical based online health care?*
- *RQ2: Which constructs related to online health care can be identified in this research domain and how can the constructs be categorized?*
- *RQ3: Which hypothesized relationships between the constructs have been examined in previous research?*
- *RQ4: Which overall network model can be derived?*

The next section presents more information about a network based literature review. Thereafter, in section 4, the research procedure is explained. Section 5 outlines the results in terms of theoretical perspectives, the constructs that were identified for online health care as well as the relationships between these constructs within the created network. Finally, the last section presents a conclusion, discussion and suggestions for further research.

### **3. A network approach towards literature review**

Due to the growing number of studies investigating different research perspectives, much more information has become available which leads to the difficulty of maintaining an overview of all available research results with regard to online health care. Moreover, the complexity is particularly that most empirical research studies in social science typically test many interrelated hypotheses, rather than a single one (Dooley, 2001). Thus, a systematic way of conducting literature research is needed (Van de Wijngaert, Bouwman & Contractor, 2014).

For this study, it was chosen for a network based literature review. It is a well-researched method to identify relationships between constructs across a large set of papers (Van de Wijngaert et al., 2014) and combine these results in a general picture. Compared to a single meta-analysis approach, that only focusses on a single or a small set of hypotheses, a network approach can visualize the interrelatedness of hypotheses. In this manner, a hypothesis can be understood as a directed tie between two variables (Van de Wijngaert et al., 2014). By combining the hypotheses from a large set of papers, a network of relationships between variables emerges. The created network maps the concepts and causal relationships across a corpus of different studies. This results in a general overview of the theoretical foundations of a specific research domain. This approach has the advantage of analyzing hypotheses regardless of theoretical models and research in different contexts. Through the accumulation of results from various studies, fragmented knowledge is combined to an overall overview that gives insight into the specific research domain. Finally, using a network approach towards literature review has the potential to help focusing research and formulate new research questions for future research (Van de Wijngaert et al., 2014). Summarized, a network approach ‘combines the strength of a meta-analysis [...] with the visual-analytics offered by network methods’ (Van de Wijngaert et al., 2014, p. 2).

### **4. Research procedure**

The research procedure can be divided into three steps. First, papers were selected based on a specific combination of key words. Second, the chosen papers were coded by using a coding sheet provided by the supervisor of the study. Third, the examined hypothesized relationships were analyzed in order to draw a network. In the following, the three steps will be outlined in greater detail.

#### 4.1 Paper selection

Academic papers from the period 2000 – 2018 in English were collected from Google Scholar. The year 2000 was chosen as a starting point for this literature review because research (Brodie et al., 2000) has shown that since that time a clear shift was recognized in the amount of people using their computers to access online health information.

To specify the domain, at least three of the four defined keywords needed to be met. It is expected that by including the keywords ‘health care’, ‘online’, ‘effect’ and ‘patient’, all relevant articles are selected and cover the representative scope of the domains health care, online, technology, effects and patient. However, alternative terms for the five main keywords were defined so that a cluster per keyword was available (see Table 1). Other terms for ‘health care’ are health services, health communication, health promotion and health support. ‘Online’ refers to electronic, social media, Facebook, Twitter, health communities, digital, internet-based, social networking and computer mediated. ‘Effect’ invokes behavioral change, effectiveness, motivation, intention and results. These three keywords, ‘health care’, ‘online’ and ‘effect’ were content related.

*Table 1: Number of papers accordingly to defined keywords*

	<b>Cluster of keywords</b>
<i>Health care</i>	health services OR health communication OR health promotion OR support
<i>Online</i>	electronic OR social media OR Facebook OR Twitter OR health communities OR digital OR internet- based OR social networking OR computer mediated
<i>Effect</i>	effectiveness OR results OR behavioral change OR motivation OR intention
<i>Hypothesis</i>	hypotheses (plural) OR H1/ H2 etc.
<i>Patient</i>	public OR individuals OR group.

For this study, information about the significance of the relationships between independent and dependent variables was needed and only evidence based studies provide this kind of information. Therefore, only quantitative studies with the keyword studies were extracted for this literature review. However, for papers that did not include explicit hypotheses, it did not necessarily mean that no concepts or relations could be extracted (Terpsiadou & Economides, 2009). In other words, it was just more complex to extract concepts and relations from studies that have not formulated explicit hypotheses. Therefore, ‘hypothesis’, which is similar to

hypotheses (plural) and H1, H2 etc., and ‘patient, which is comparable to public, individuals and group, were related to the quantitative structure of an article.

Three undergraduate students enrolled in Communication and Information Science at Radboud University started the paper selection by finding ten papers each. The process of inclusion and backward search also required the students to continuously exchange in order to specify keywords and criteria for selecting papers. For example, at the outset of the study, ‘social media’ was defined as a keyword. However, this was changed to ‘online’ to broaden search results. Papers with abstracts that showed irrelevancy by not relating to online health care were excluded. Also, papers that did not specify or test hypothesis and/or it was not clear what was exactly tested were not included in the dataset. In total, 24 papers remained (retrieved on 22 March 2018). The information based on the retrieved papers was stored in an Excel file for the following coding procedure.

## **4.2. Coding**

The 24 remaining papers were coded by three students using an Excel coding sheet that was developed specifically for this purpose. Subsequently, the students were trained on the coding scheme and coded two papers for practice.

### *4.2.1. Data gathering*

The papers were coded in several steps and the coded information was stored in an Excel file (based on Van de Wijngaert et al., 2014). The coding sheet included four general tabs: reference, hypotheses, theory and operationalization (see appendix I.). First, in the reference sheet general information about the selected papers was coded: abbreviation of the authors of the article, title, year of publication, APA reference, research method, sample (size), data analysis and model fit. Second, the hypotheses sheet restated the abbreviation of the authors and the title of the study, and coded: direction of the hypothesis discussed, relevant theory, independent and dependent variables, results and significance in terms of beta and p- values. Third, in the theory sheet relevant theory was coded which hypotheses were based on. Fourth, the operationalization sheet included the reference of the article again and outlined how independent variables were operationalized, e.g. which items and scales were used. Additionally, interaction effects were coded. However, they were not taken into account for the final analysis.

In order to prevent subjectivity, the researchers coded independently. After the researchers had coded independently, they discussed the datasets in two sessions and created one new dataset together. During these sessions, the researchers compared the information they filled in the different tabs. When the researchers had different results, they read the particular article again and discussed the specific gap to fill in. Moreover, the new dataset was sorted alphabetically. These steps resulted in one final dataset. Thus, there was no need to calculate the intercoder reliability.

#### *4.2.2. Unification and aggregation*

Unification and aggregation of different concepts into a single one is a significant step in the research process. In particular, for network analysis it is important to avoid getting a too large set of nodes (Van De Wijngaert et al., 2014).

With regard to literature reviews, there are two problems with coding. First, there can be different operationalizations for the same variable names. For example, self-efficiency could be operationalized in questions about intentions to improve health (Oh et al., 2013) or in questions about the degree of confidence with one's health (Yoo, Kim & Lee, 2018) Second, the same operationalization may be used with different variable names (Van de Wijngaert et al., 2014). For example, questions about social support were termed empathic experience (Nambisan, 2011), perceived network support (Oh et al., 2013) or satisfaction with online support (Chung, 2013). Therefore, Bacharach (1989) suggested unifying variables in order to create a consistent basis of constructs. This technique was consequently also applied to this literature review, meaning that different labels for the same phenomena were renamed to one general construct. For instance, one researcher may use 'behavioral intention' as a term whereas another may use 'intention to self-managed health care'. These terms were classified and renamed to 'health behaviour' which is then defined as an action, online or offline taken by a person to maintain, attain, or regain good health and to prevent illness. Furthermore, closely related variables were aggregated in order to minimize the number of different constructs for analysis. For example, 'health behavior' is an aggregation of 'behavioral intention', 'intention to self-managed healthcare' and 'health behavior'.

### **4.3. Data analysis**

Data analysis focused on the frequency of theories and constructs found in the literature and which hypotheses were tested among the papers. For this study, a dataset was created including all extracted results and main directed relationships between constructs across the different studies that were retrieved. After the information had been extracted from the studies, general information about the papers was coded (e.g. year of publication). Moreover, theoretical perspectives were analyzed as well as type and frequency of constructs. Then, the Excel coding sheet was transformed into network data. Therefore, an edgelist format was used which defines edges in terms of independent and dependent variables on each line in the dataset. In other words, the edgelist is simply a list, or array, of edges which we will need for the graph.

The next step was to draw a network model in order to analyze and visualize relationships by using the software program Gephi. Gephi is an open-source software for interactive visualization and exploration for all kind of networks and complex systems (Heymann, 2015). Based on the visual representation of the data, the network can be analyzed, using metrics that differentiate network levels, nodes and dyads. Generally, the more often a concept was investigated as an independent or dependent variable, the higher the degree. The higher the degree, the bigger the circle in the network. And the more often a relationship was analyzed, the thicker the line between the various constructs (Lasthuizen & Van de Wijngaert, 2015). In accordance with the results of this study, implications for further research can be derived.

## **5. Results**

In this section, we present the results of this literature review. First, general information about the papers is presented as an introduction. Second, theoretical perspectives are described. Third, the total number of constructs found among the dataset are outlined. Fourth, the relationships between the constructs are analyzed. Finally, the results of the network analysis are elaborated.

In total, 24 papers were selected for this literature review. Most papers were published in the *Journal of Health Communication* (8) and *Computers in Human Behavior* (4). The papers were published between 2007 and 2018, with most papers being published between 2010 and 2011 and in 2013 (see Figure 1).

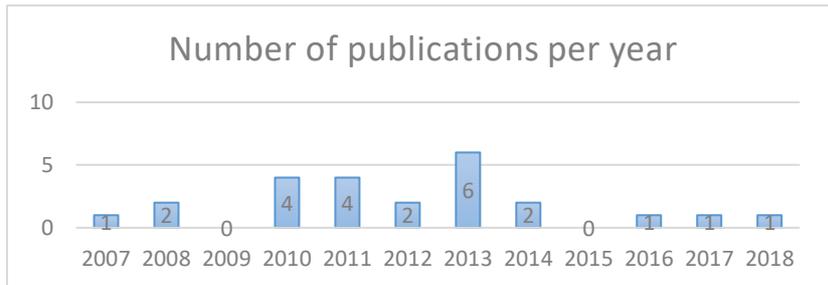


Figure 1: Number of publications per year

Nearly in all papers (21) survey results were analyzed. There was only one paper discussing a literature review (Lau, Siek, Fernandez-Luque, Tange, Chhanabhai, Li & Eysenbach, 2011). Moreover, data analysis was mainly based on methods such regression analysis (11), SEM (5) and path (3). To conclude, among all selected studies, online health care has been investigated in many different contexts which is shown by the diversity of the designs scholars have used in their research. Consequently, the research field of online health care is a topic of growing interest, with more and more publications that may create a complex and diverse research field.

### 5.1 Theoretical perspectives

In order to answer the first research question, this section will outline theoretical perspectives that were central in the selected papers. Table 2 presents the theories that were discussed at least twice in the papers included in this literature review.

Table 2: Overview of theories in selected papers

Theory	Studies	Main proposition
Buffering hypothesis	Lewandowski, Rosenberg, Parks & Siegel, 2011; Oh et al., 2013; Nambisan, 2011	Social support can mitigate the impact that stress and negative events have been demonstrated to have on well-being. The receipt of social support can reduce the impact of negative events by providing a distraction, providing a solution to the problem, and by reducing the perceived importance of the event
Cues-filtered out approach	Lewandowski, Rosenberg, Parks & Siegel, 2011; Hu & Shyam Sundar, 2010	The medium through which individuals communicate affects the quality of interaction. The quality of an interaction is based upon the number of cues—both verbal and non-verbal signals such as tone of voice or hand gestures—that a given media allows. Face-to-face communication offers the maximum amount of cues, and is thus of the highest quality; mediated communication, on the other hand, is laden with fewer cues and thus decreases the quality of interaction

Elaboration likelihood model	Dutta, & Feng, 2007; Hu & Shyam Sundar, 2010	A person's motivation and ability to process a given message determine the level of elaboration likelihood, that is, how much effort one puts into processing the message. When a person's motivation or ability to process a given message is low, the communication effect is more likely to be influenced by heuristic cues such as the source of the message
Motivation theory	Ba & Wang, 2013; Oh et al., 2013; Tanis, 2008	Motivation (opportunity and ability) influences information processing and participation positively
Protection motivation theory (PMT)	Goonawardene et al., 2013; Tanis, 2008	Describes individuals' adaptive or maladaptive coping to a health threat can be resulted from two processes which are threat appraisal process and coping appraisal process.
Uses and Gratifications theory (U&G)	Chen & Lee, 2014; Nabi, Prestin & So, 2013; Ridout, Campbell & Ellis, 2012; Dutta & Feng, 2007; Lee, 2008; Goonawardene et al., 2013; Amrita, 2013; Oh et al., 2013; Tustin, 2010; Hou & Shim, 2010; Tanis, 2008	People will use media when these media gratify their needs (perceived benefits)
Theory of planned behavior	Yoo et al., 2018; Goonawardene et al., 2013	Consumer intention to behave is predicted by attitude, subjective norms and perceived behavioral control

As can be derived from Table 2, most papers combined various theories. Hence, uses and gratifications theory was most frequently used and was combined with theory of planned behavior for example (Goonawardene et al., 2013). Also, the cues filtered out approach was combined with buffering hypothesis theory (Lewandowski, Rosenberg, Parks & Siegel, 2011). The advantage of combining theories in one paper is a well- founded research model that generates a broader insight into the field of online health care. This leads to the conclusion that an eclectic approach is needed which combines findings into one system (e.g. network model) in order to be able to draw general conclusions.

## 5.2. Constructs

The second research question set out to identify which constructs related to online health can be found and how these constructs can be categorized. After aggregation of the variables, a total of 38 constructs were defined. These constructs were divided into nine main categories (see Table 3). An explanation of the constructs can be found in appendix II.

Table 3: Main categories and subcategories after aggregation

	<b>Main categories</b>	<b>Subcategories</b>
1	Belongingness	Homophily, identification with a group, perceived source homophily
2	Health behavior	General health behavior, offline health behavior, online health behavior
3	Health belief	Patient belief
4	Internet use	Health related internet use, internet use
5	Perceived quality of health service	Perceived quality of the online information, perceived quality of the source, perceived quality of the technology system, trust in health system
6	Self-efficacy	Health related self-efficacy, technology related self-efficacy
7	Support	Support (network), support (offline), support (social), support (inter-personal), support (empathy), support (esteem), support (condition-specific), support (appraisal), support (informational, emotional, functional), support (tangible)
8	Use of health service	Attitude towards health service, use of health service (other), uses and gratifications
9	User characteristics	Health status (emotional), health status (general), health status (mental), health status (physical), life satisfaction, personal characteristics, perceived threat, privacy concern, perceived risk

The nine main categories summarize the 38 constructs (subcategories) found in this study. For example, user characteristics include health status (emotional), health status (general) or health status (mental). By putting related constructs into one main category, the network can be divided into groups which could help to create a simplified network. In order to analyze frequency and types of variables, Figure 2 shows four different types of concepts: independent only, mostly independent, mostly dependent and dependent only (Van De Wijngaert, et al., 2014).

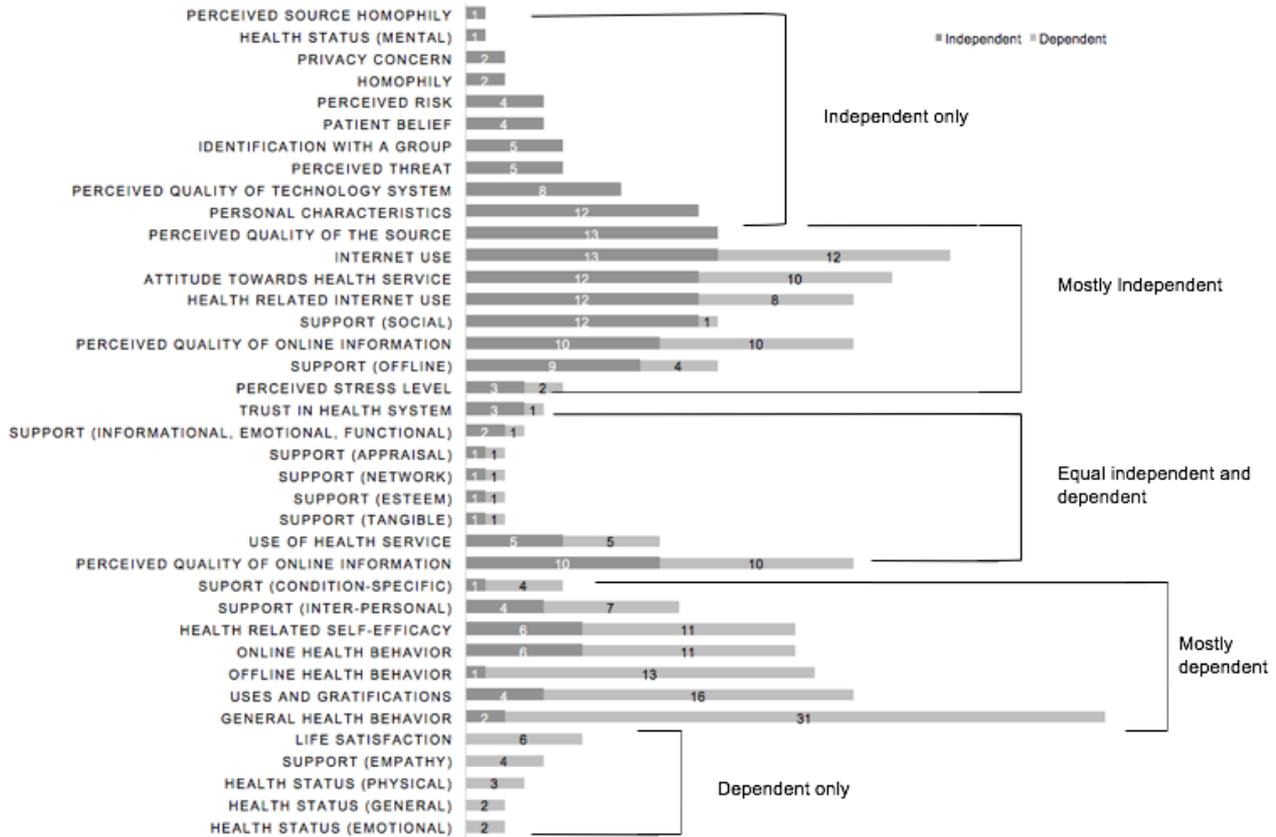


Figure 2: Concepts used as predictor or effect variable

By analyzing Figure 2, we gain insight into which concepts have been tested among the hypothesis and their frequency. Additionally, the figure shows which concepts are used as independent or dependent variables to explain other concepts. Based on figure 2, general health behavior (31) and uses and gratifications (16) were often researched concepts, specifically as dependent factor. Perceived quality of the source (13), internet use (13) and attitude towards a health service (12) were often analyzed as predictive factors. To conclude, many constructs can be defined as both predictors and as effects of online health behavior. However, those constructs that have often been analyzed play an important role in the field of online health care. With regard to the results of this study, it may be anticipated that frequently researched constructs are found in more hypotheses than less frequently researched constructs. In the next section, the relationships between the various constructs are discussed in greater detail.

### 5.3. Relationships between constructs

In order to answer the third research question, the hypothesized relationships between the constructs were investigated. In total 168 hypotheses were extracted from 24 papers for this literature review. Even though interaction relationships were coded, they were no part of further

analysis since all the interaction relationships between moderator and independent variables were different.

Of the 168 hypotheses, two hypotheses were not empirically tested, three hypotheses were partially significant, 46 hypotheses were not significant, and 117 hypotheses were significant. After comparing the 168 hypotheses in terms of predictor and effect variables, we got a total of 102 unique relationships. Of these unique directed relationships, 77 were significant, 33 were not significant, three hypotheses were partially significant and two hypotheses were not tested. We showed that various papers tested the same relationships between constructs, revealing different results. Therefore, we got a total of 115 main effects. However, most hypothesized relationships were analyzed only once (65,7%) with 39,9% significant results. Table 4 presents the number and percentage of relationships between the constructs, their times analyzed and their significance (based on Lasthuizen & Van de Wijngaert, 2015).

*Table 4: Number and percentage of relationships between constructs, times analyzed and significance*

Times analysed	Number of unique relationships	Percentage of unique relationships	Number of relationships	Percentage significant
1x	67	65,7 %	67	39,9 %
2x	22	21,6 %	44	26,2 %
3x	5	4,9 %	15	9 %
4-5x	5	4,9 %	21	12,5 %
6-9x	3	4,9 %	21	12,5 %
<b>Total hypotheses</b>	<b>102</b>	<b>100%</b>	<b>168</b>	<b>100%</b>
Total significant	77	67 %	117	69,6 %
Total partially significant	3	2,6 %	3	1,8 %
Total not significant	33	28,7 %	46	27,4 %
Total not tested	2	1,7 %	2	1,2 %
<b>Total results</b>	<b>115</b>	<b>100 %</b>	<b>168</b>	<b>100%</b>

Based on the Excel sheet, it was further found that relationships that were often analyzed were attitude towards health service → internet use (8), perceived quality of the source → perceived quality of the online information (7), personal characteristics → offline health behavior (6) and identification with a group → general health behavior (5). We conclude that most relationships were tested only once and led to a total of 115 main effects. Furthermore, less than the half of

hypotheses were significant, especially when they were tested only once. In the next section, we will further elaborate on the relationships that were tested by using network analysis.

### 5.3. Network model

In order to answer the fourth research question, the main directed relationships between the constructs were exported from Excel to Gephi (Bastian, Heymanns & Jacomy, 2009). Once the data has been imported to Gephi, relationships were tested by using network analysis.

First, the statistics settings were adjusted to limit the network to the significant unique relationships only. Second, Force Atlas was selected as the algorithm to lay out the network. Additionally, the Expansion layout algorithm was adjusted in order to scale up the network and make it appear sparser (Gephi, 2018). Figure 3 shows the network of the significant unique relationships and clusters of constructs.

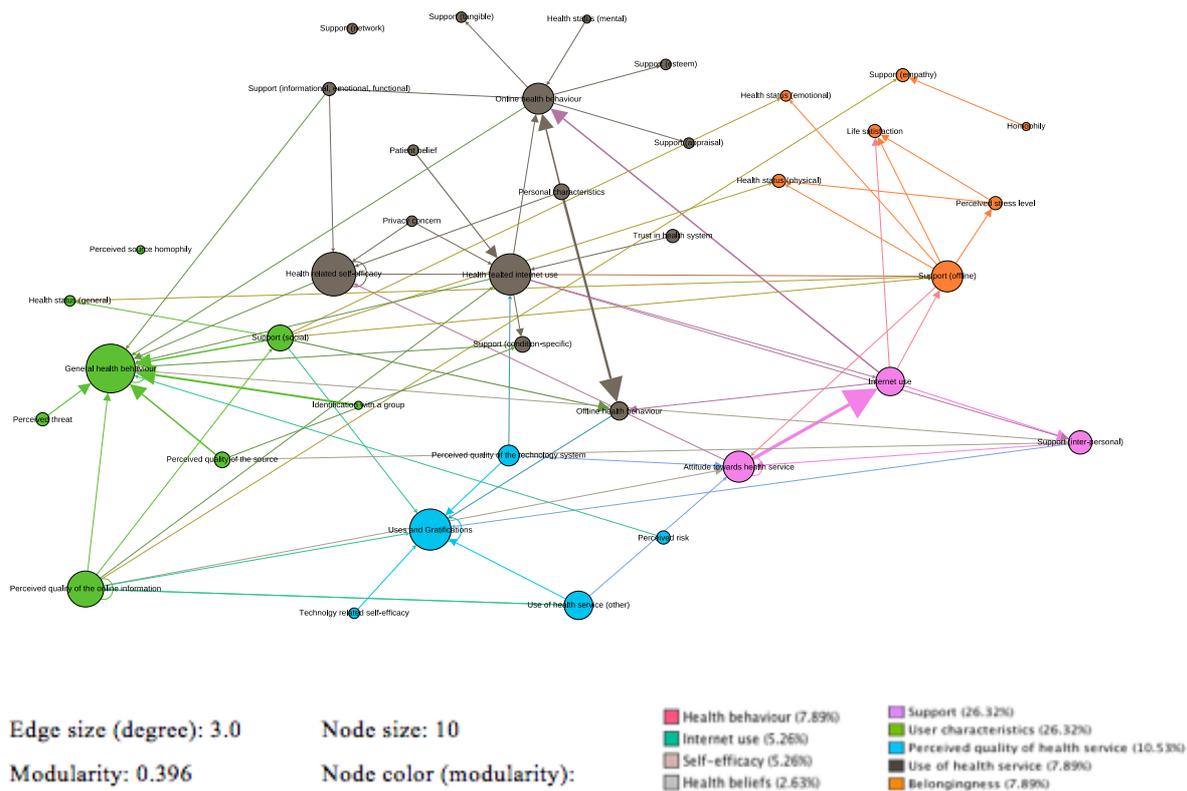


Figure 3: Network of significant unique relationships and clusters of constructs

Constructs are visualized by circles, also called nodes. The relationships between the constructs are presented by edges. Generally speaking, the more often a concept was investigated as an independent or dependent variable, the higher the degree. The degree of a node is the number

of relation (edge) it has, independently if it is an in or an out relation. The degree is thus the sum of edges for a node (Totet, 2013). The higher the degree, the bigger the node in the network. The more often a relationship was analysed, the thicker the edge between the constructs (Lasthuizen & Van de Wijngaert, 2015). Moreover, when implementing the modularity algorithm, the network shows different constructs within their modularity classes. Modularity measures the strength of division of a network into clusters that help to compartmentalize the network (Blondel, Guillaume & Lefebvre, n.d.). Lastly, the thickness of the arrows represents the number of times the relationships were analyzed and were significant (Lasthuizen & Van de Wijngaert, 2015). Thus, the thicker the edge, the more often is was the relationship significant

The results of the visual network analysis show a quite dense network. There are many connections between the constructs as well as bigger and smaller nodes. Bigger nodes such as general health behavior, uses and gratifications and health related internet use represent constructs that were researched more often. Smaller nodes, such as network support or patient belief were not often examined among the studies. By implementing the modularity algorithm, five clusters were analyzed in the network, each differing in size and number of constructs. These clusters are colored in brown (39,5%), green (21,1%), orange (18,5%), blue (13,2%) and purple (7,9%). Based on these findings, it can be summarized that constructs related to self-efficacy, online health behavior and health related internet use make up the biggest part of the network (39,5%). Hence, all clusters have also relationships to each other. For example, the purple cluster reflecting factors relating to internet use is connected to the brown cluster including factors that relate to online health behavior. An overview of the constructs belonging to each cluster can be found in the appendix (III).

In terms of the thickness of the arrows, attitude towards health service, for example, was shown to have a strong significant relationship with internet use. Further analysis revealed that online health behavior influences various types of support, for example tangible support or esteem support. On the other hand, online health behavior is influenced by the mental health status of a person. From the results of the network analysis, it is clear that attitude towards health service presents a significant role in the network with a strong relationship with internet use. If the attitude is positive, internet use is likely to be higher. Moreover, general health behavior has the highest number of significant relationships and is influenced by many different constructs, such as social support, perceived quality of the source, perceived quality of the online information, perceived threat or with factors from other subgroups such as health related self-

efficacy or perceived risk. Other constructs function only as linking pin, such as social support is a linking pin between general health behavior and offline health behavior. Another finding is that uses and gratifications does not influence many other constructs, hence, it is influenced by a large set of factors such as the use of health service and perceived quality of the technology system. Furthermore, triads of relationships were found in the network. For example, internet use on interpersonal support, interpersonal support on attitude towards health service, and attitude towards health service on internet use. Summarized, most constructs are related to other constructs, except for network support and perceived source homophily.

#### **5.4. Core constructs**

Core constructs can be identified by analyzing the degrees of a construct - the more often the concept was investigated as an independent and dependent, the higher the degree (Lasthuizen & Van de Wijngaert, 2015). As already pointed out earlier from Figure 2, various core constructs could be defined. To obtain more insight into the significance of these constructs, degree centrality was analyzed. The results of degree centrality are consistent with the earlier defined core constructs and provided additional insight into the times that a construct was analyzed. In addition, the network revealed bidirectional relationships which are shown by arrows that visualize that variables were used as an independent variable in the one study, and as dependent variable in another study. These bidirectional relationships will be discussed in terms of in-degrees and out-degrees in the next section.

##### *5.4.1. In-degrees*

In-degrees represent dependent variables or effects that were most often explained. Therefore, a network analysis focusing on the in-degrees in the network was conducted (see appendix IV.) which shows the significant in-degrees in the network. Based on the network, general health behavior, uses and gratifications, attitude towards health behavior, health related self-efficacy, health related internet use were most frequently researched dependent variables (in-degree >5).

##### *5.4.2. Out-degrees*

Out-degrees visualize the independent variables from a study. After running a network analysis showing only the out-degrees, it was found that online health behavior, health related internet use, social support, internet use, offline support and perceived quality of the online information were most frequently researched independent variables (out-degree>5) (see appendix V.)

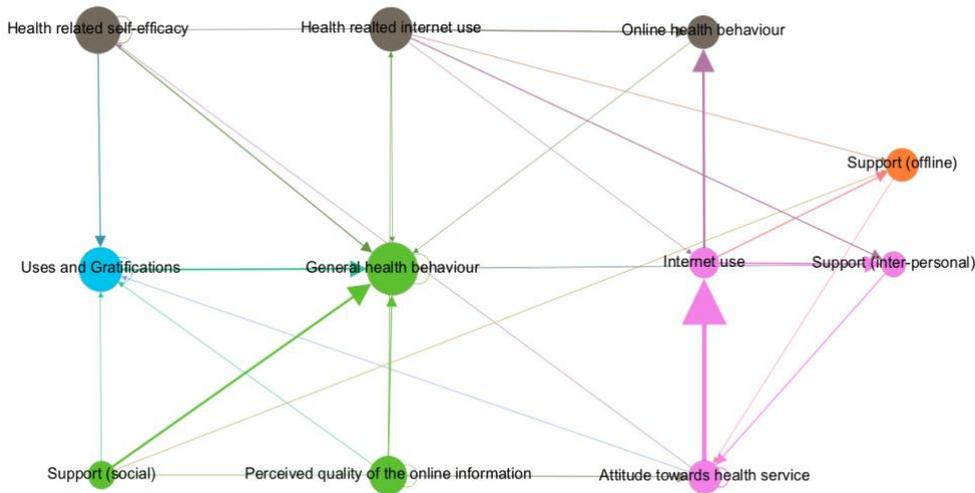
The analysis of in- and out-degrees shows that many constructs may be a predictor or an effect of online health care. This is also in line with the correlation design of many studies included in this literature review since it is not possible to be conclusive about causality. To conclude, it was shown that general health behavior was examined most often (17 times), followed by health related self-efficacy (15 times), perceived quality of the online information (12 times) and social support (8 times).

#### *5.4.3 Aggregation*

After aggregating the variables in nine main categories, a network model was created that showed relationships that were tested only once. The size of the nodes was based on weighted degree which means the bigger the node the more often is it tested. The color of the nodes was based on in-degree which means that dependent variables are darker than independent variables. The derived network can be found in the appendix (VI). Based on the network (VI), it can be concluded that the different main categories influence each other. Particularly, health behavior was found to be influenced by many other categories, for example by support, belongingness, use of health service or internet use. Furthermore, based on the node size, it could be concluded that internet use has been investigated often too. There was also a strong relationship between the use of the health service (e.g. attitude towards health service or uses and gratifications) and internet use. The interaction between the nine main categories highlights the complex composition of online health care and its effects that are dependent on a mix of constructs.

#### **5.5. Core network model**

In order to simplify the complex network model in Figure 3, a network model based on the defined core constructs and significant relationships was designed using Gephi. In total, 11 constructs and their relationships between each other were found to be significant at least five times. These findings build the core network model and a conceptual framework for the research field of online health care. Consequently, Figure 4 shows the network of the at least five times analyzed significant relationships.



Node color (modularity) (see appendix III.) Node size: 10

Figure 4: Network of significant unique relationships studied at least five times

General health behavior is a frequently tested dependent construct in the network and is influenced by a large set of explanatory constructs, such as uses and gratifications, online health behavior or health related self-efficacy. The central position of general health behavior reflects its importance in the research field of online health care as a frequently analyzed dependent variable. The right-handed side of the model shows one cluster group including internet use, attitude towards health service and interpersonal support. These three constructs also form a triad: internet use on interpersonal support, interpersonal support on attitude towards health service and attitude towards health service on internet use. Moreover, interpersonal support seems to be a linking pin between health related internet use and attitude towards health service. This may be due the fact, that the better the interpersonal support during health related internet use, the better the attitude towards the health service. Another finding is that the perceived quality of online information has often been analyzed to have an effect on health related internet use, general health behavior and social support. Uses and gratifications in turn, is mainly influenced by other constructs rather than having an effect on other constructs.

To conclude, general health behavior has a central role in the network. The latter construct and uses and gratifications are most influenced by other constructs rather than having an effect on other constructs. Furthermore, most constructs were examined together influencing other constructs, such as attitude towards the health service. Contrary, relationships influencing general health behavior were more direct, whereas these constructs also influence each other.

## 5.6 Overall model of online health care

Based on the findings, an overall network model was drawn, which can be found in Figure 5.

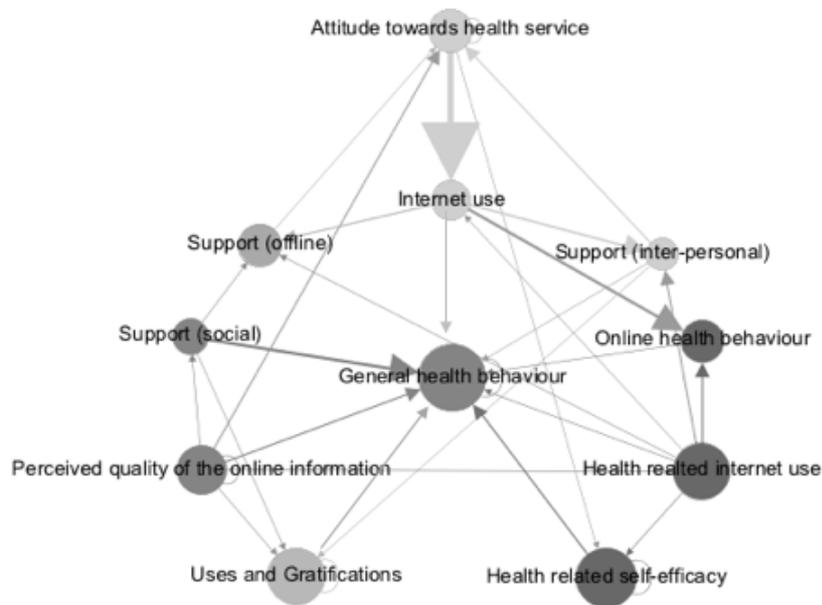


Figure 5: Overall model of online health care

As derived from Figure 5, general health behavior is influenced by a large set of other constructs around it, whereas the relationships with thicker arrows visualize relationships that were often analyzed and significant. Moreover, darker nodes visualize constructs that have often been tested as a dependent variable. At the top, attitude towards health service and internet use found to be the most often analyzed and significant relationship influencing the whole network model. Contrary, other relationships are less often analyzed and significant, for example the relationship between health related internet use and health related self- efficacy. However, most constructs do have a relationship to other constructs which results in a dense, fully connected network of a star typology. There are also constructs that explain other constructs in the same category. This is visualized by the circles around a construct. For instance, uses and gratifications constructs also explain other uses and gratifications constructs.

## 6. Conclusion and discussion

This section presents a general conclusion and highlights the most significant results per research question. The first research question focused on identifying theoretical perspectives in the research field of online health care. The analysis showed that there were many different

theories used among the papers included in this literature review. A theory that has frequently been used in various papers was uses and gratifications theory, which proposes that people will use media when these media gratify their needs (Katz, Blumler & Gurevitch, 1974). Moreover, several theories have been combined in order to show essence and generate a broader insight into the field of online health care. This is especially necessary considering that most theories only explain a little part of reality (Lasthuizen & Van de Wijngaert, 2015). However, even though there were many theories retrieved among the papers, most theories were only used once (or twice).

The second research question set out to identify and categorize constructs related to online health care. Based on aggregation and unification of the variables, a set of 38 constructs was identified. These were again categorized in nine main categories which influenced also other main categories. The categories were: (1) Belongingness, (2) Health behavior, (3) Health belief, (4) Internet use, (5) Perceived quality of health service, (6) Self- efficacy, (7) Support, (8) Use of health service and (9) User characteristics. Considering that health behavior was influenced by many other constructs such as support, belongingness or internet use, one may realize the dependency of health behavior on other constructs. Consequently, the complexity of the effects of online health behavior arises. The network of main categories showed an eclectic model in which constructs influence each other and create effects of online health care.

The third research question investigated the hypothesized relationships between the constructs that have been examined in previous research. In total 168 hypotheses were extracted from the papers. In total, there were 102 unique directed hypotheses. From these unique directed relationships, 77 hypotheses were significant. Moreover, it was shown that many constructs have been analyzed as both predictor and effect of online health care. The analysis also showed that research is quite fragmented since most hypothesized relationships were only tested once (65,7%).

In order to answer the fourth research question, network analysis was conducted. The results of the visual network analysis showed a quite dense network with many relationships between constructs. We differentiated five cluster groups that influence each other. Finally, most constructs were found to be placed around the most frequently tested dependent variable general health behavior. Based on the overall network model in Figure 5, it can be concluded that general health behavior is influenced by a large set of other constructs around it. Since attitude towards health service and internet use found to be the most often analyzed and significant

relationship influencing the whole network model, it can be assumed that the better the attitude towards a health service is, the more the internet will be used. Moreover, the network adjusts a star typology since the structure of the network is full connected and arranged around the core constructs general health behavior.

Summarized, these findings highlight the diversity and complexity of constructs that influence general health behavior when using online media for health care. The analysis provides a better understanding of the emerging field of online health care. It showed the central constructs and relationships that act as a common and linking research focus among different papers. Moreover, the results confirm the strong impact of social media on health care and the extent of behavioral changes as a result of using social media for health care.

Finally, social media offers opportunities for modifying health behavior. Thus, it may be assumed that the better various constructs score, the better the effects in online health behavior. Of course, this also creates challenges for the social media domain in order to successfully influence general health behavior.

## **7. Further research**

The findings from this study suggest the following opportunities for future research: First, future work should focus on constructs that were less often analyzed. Such a construct is for example perceived threat since this variable represents a potential threat of online health care, potentially resulting that people do not feel confident using social media for health care. Second, relationships that were less often analyzed should be addressed in future research. For instance, the relationship between perceived quality of the online information and online health behavior is worth mentioning, since it could be assumed that a higher perceived quality of the online information could influence online health behavior positively. Third, hypotheses that were tested only once require more research in future. Since the relationship between the use of health services and the perceived quality of the online information has been investigated only once and the results only reveal a partially significant result, it would be interesting to elaborate more on this relationship. It is also recommended to define new hypotheses that are built on the aggregated constructs from this study. We also propose that further research takes theoretical perspectives into account that are common in the field of online health care. By doing to, research is getting less fragmented when testing new hypotheses.

Moreover, this work has revealed that a large number of studies did not report correctly or consistently. For example, Ba and Wang (2013) or Chung (2013) failed to mention the model fit even though it was required for the type of study they did. Other studies failed to indicate beta-values (Amrita, 2013; Oh, Lauckner, Boehmer, Fewins-Bliss, & Li, 2013). In the overall picture, many studies also failed to write conform general writing norms for research papers. This creates the need for awareness among researchers to familiarize themselves again with specific writing guides and styles. Furthermore, a limitation of this study is that the literature mainly includes surveys, whereas observations are rarely used. Future studies should thus focus on active online health care and health behavior. Even though this method implies a longer period of data-collection, more objective data will be gained in terms of how people search and navigate social media for health care purposes. These insights will offer new key variables for successful online health care. Especially, in the light of the increasing significance of social media, research focusing on network analysis will offer the opportunity to track how the influence of online health care on health behavior will change in the future and increase patient activation.





Perceived quality of the source	Source of health information, perceived source expertise, selecting source, original source, source credibility, perceived appropriateness of source placement	Expert, layperson, knowledge
Internet use	eHealth literacy, internet health information seeking, online health information seeking, HRSS seeking on Facebook, internet use for health information, internet use for health information acquisition, uses and gratification motives, experience-based health information, media capability, health care social media, use the internet for health-related activities, internet health information seeking on perceptions of health status, online social networking activities, non-health related instrumental internet use, Facebook interaction, technology use, Facebook use, emotional appeals, non-health topic information seeking, reliance on the internet, paid services	Use of the internet, reason, getting information, exchanging information, seeking out people, getting answers, functions, number of Facebook friends
Attitude towards health service	Satisfaction with medical care, attitude towards website, empathic experience, satisfaction with care, attitude toward the host HCO, attitude toward the services offered by the host HCO, perceptions regarding the service quality of the HCO	Liking information, appealing website,
Health related internet use	eHealth literacy, internet health information seeking, online health information seeking, HRSS seeking on Facebook, internet use for health information, internet use for health information acquisition, uses and gratification motives, experience-based health information, media capability, health care social media, use the internet for health-related activities, use of Internet for health-related activities, internet health information seeking on perceptions of health status,	Use of the internet, reason, getting information, exchanging information, seeking out people, getting answers, functions, number of Facebook friends

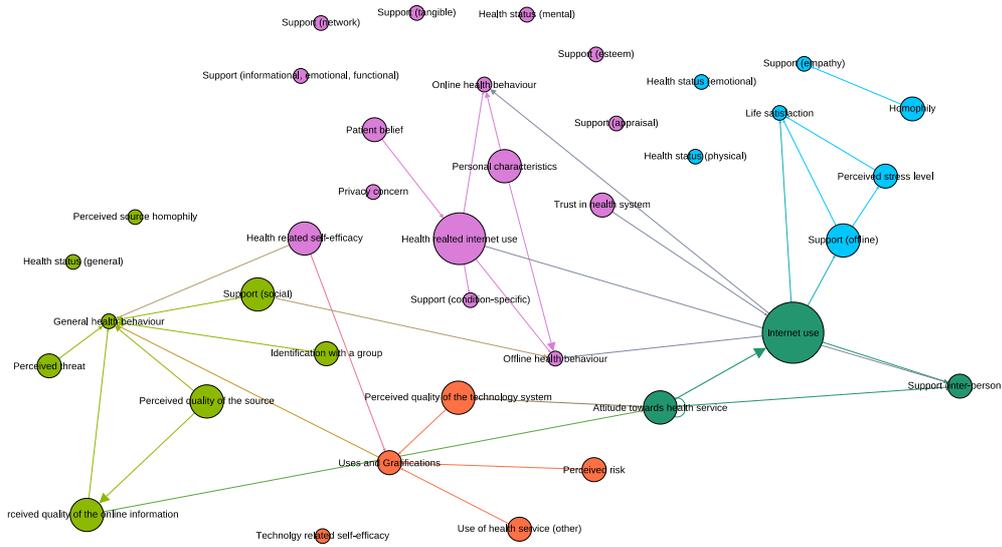
	online health information seeking, online social networking activities, non-health related instrumental internet use, Facebook interaction, technology use, Facebook use, emotional appeals, non-health topic information seeking, reliance on the internet, paid services	
Support (social)	Contacts we develop and the subsequent changes, crowd around us (e.g. social influence), number of Facebook friends, awareness of individuals around us, close to us, or similarity to us, and the impact of their activities, opinions, experiences and beliefs upon our circumstances (i.e., social contagion), recommendations from those we know, as well as others we do not know, delivered via different forms of social media in different contexts (e.g. Social recommendation), support network of a user, satisfaction with offline social support, social support, perceived social support, impact of social support  relationship between Internet health information seeking and perceived social support	Relying on people, support network, impact of support, making decisions, interaction
Perceived quality of the online information	Perceived information completeness, user's online health information seeking experiences, user's online health information seeking experience, pragmatic experience, effective information seeking, channel beliefs, perceived credibility of health information, perceived credibility of health information; behavioral intention, credible health information; high behavioral intention, credibility, stigmatized	Credible, relevant, reliable, in a timely manner, free information, trust, qualified, expert, knowledgeable, trustworthy, honest, thorough - complete - comprehensive - extensive - sufficient- contains all the necessary elements
Support (offline)	Perceived social support, disruption	Being present, cues

Perceived stress level	Perceived stress	Nervous, stressed
Trust in health system	Preference for involvement in decision-making, patient trust, trust in online health information, trust in online health	Responsibility, relative trust
Support (informational, emotional, functional)	Perceived emotional support, types of informational, functional and emotional support we receive due to changes in our social network (i.e., social support).	Support, feelings
Support (appraisal)	Perceived appraisal support	Objective feedback, feeling comfortable
Support (network)	Perceived network support	Friends
Support (esteem)	Perceived esteem support	Confidence (making healthy decisions)
Support (tangible)	Perceived tangible support	Buy me medicine, provide help
Use of health service	Perceived responsiveness in an HCO-provided online patient community, information selection, perceived level of gatekeeping	Responses
Support (condition-specific)	Condition-specific support	Recognizing health problem, recommendation, advise
Support (inter-personal)	Depth of relationship in OSGs, sociability experience, sociability experience, inter-personal support, buffering	Significant relationships, used-social/unsocial, polite/impolite, inviting/not inviting, unfriendly/friendly, and unpleasant/pleasant
Health related self-efficacy	Empowerment, restricted self-efficacy, intention to self-managed healthcare, health self- efficacy	Understanding, cope with illness, help yourself, confident, improving health, meet goals
Online health behavior	Participation, informational eHealth behaviors, participatory eHealth behaviors, HRSS Seeking on Facebook	Duration, Facebook use, intensity, messages, visiting forums
Offline health behavior	User's fitness activity accomplishments, amount of exercising, frequency of contact with health professionals for health	Frequency, need to know about health issues, being

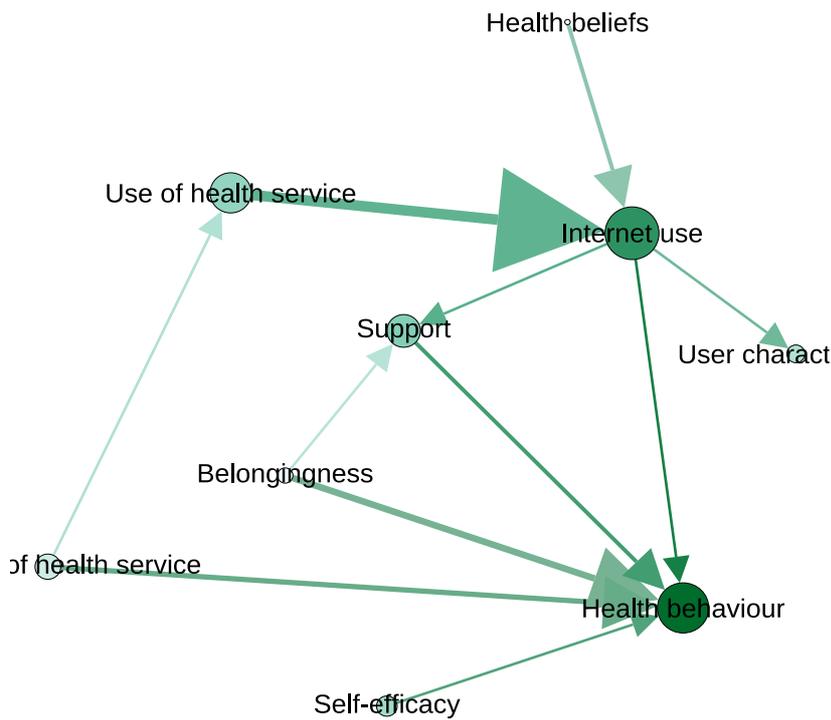
	information, frequency of physician visits for ailment treatment, health information orientation	critical informed about health issues
Use and Gratifications	effect of internet use for health information acquisition, information transmission, information acquisition, preference for social interaction in OSGS, participation in online health groups	Duration, reasons
General health behavior	Activation, positive relationship between empowerment and intention towards self-managed healthcare, behavioral intention, medical decision making preferences, health behavior changes and change in social networks, health behavior, preventive orientation	Responsibility, active role, confidence, taking actions, health conditions, lifestyle changes
Life satisfaction	Life satisfaction	/
Support (empathy)	Perceived empathy	Empathy
Health status (physical)	Physical status, physical health status	Health status, physical
Health status (general)	General health status	Health status, general
Health status (emotional)	Emotional health status	Health status, emotional
Perceived quality of the technology system	Knowledge-based health information, usability, usability experience, uses and gratification motives, informal subjective norms on social media	Posting/ comments, disease/symptom, nutrition/exercise explanation, prevention guide/cure method, seek information, informative, inclusive, supportive, convenience
Personal characteristics	Gender, class, race, health concern	Gender, class, race, personal health



V. Significant out-degrees in the network



VI. Aggregation of variables (Van de Wijngaert, 2018)



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