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Patients' Online Information-Seeking Behavior Throughout Treatment: The Impact on Medication Beliefs and Medication Adherence

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ABSTRACT

Research on the longitudinal impact of using the internet as an information source on patients' beliefs and medication adherence is scarce. Chronic patients ($N = 107$) from six hospitals were surveyed to longitudinally explore their online information seeking behavior throughout treatment (i.e., before the consultation about their newly prescribed medication in the initiation phase and after six months in the implementation phase) and how this affects their medication beliefs (concerns and necessity) and medication adherence after three weeks (T1) and six months (T2). Most patients (79%) used the internet. Patients who used the internet before the consultation reported to have more concerns about their medication at T1 and T2 compared to those who did not. Moreover, patients who used the internet throughout treatment valued their concerns higher than the necessity after six months (T2). Patients who used the internet after the consultation reported to be more non-adherent after three weeks (T1) compared to those who did not. Because of the longitudinal nature of this study, we were able to pinpoint in which treatment phase patients' online information seeking behavior is particular relevant in affecting patients' beliefs and medication adherence.

Medication non-adherence is a significant public health problem among chronic patients (Zwicker, van den Bemt, Vriezolk, van den Ende, & van Dulmen, 2014). Chronic patients often need maintenance therapy (Billioud et al., 2011; van den Bemt, Zwicker, & van den Ende, 2012) and they are required to manage their medications by themselves. In such a context, medication adherence is influenced not only by patient-related factors (such as demographics and disease characteristics) but also by patients' beliefs about medication and their use of mass media (Horne et al., 2013; Im & Huh, 2017).

The internet has become increasingly important to individuals in their everyday lives (Marton & Wei Choo, 2012) and it is more a rule than an exception that patients Google throughout treatment (Pittet et al., 2014). Online health information is, however, often inaccurate, inappropriate, or not updated (Carpenter et al., 2011; Langille et al., 2010). The potential negative effect of using (inaccurate) online health information on public health-related behaviors has drawn research attention but this is still scarce and inconclusive (Carpenter et al., 2010; Carpenter, Elstad, Blalock, & DeVellis, 2014; Im & Huh, 2017; Sivakumar & Mares, 2016). A reason for these inconclusive results might be that the majority of existing studies are cross-sectional in nature and were thus only able to provide 'snapshots' of patients' online information seeking behavior measured at a single point in

time (Bernstein et al., 2011; Lee, Hoti, Hughes, & Emmerton, 2014; Rutten, Arora, Bakos, Aziz, & Rowland, 2005; Squiers, Finney Rutten, Treiman, Bright, & Hesse, 2005). The interplay between patients' online information seeking behavior throughout treatment, beliefs about medication, and medication adherence therefore warrants more research attention (Im & Huh, 2017). This study aims to longitudinally explore patients' online information seeking behavior throughout treatment (i.e., before a patient education consultation about their newly prescribed medication in the initiation phase of the treatment and six months in the implementation phase of the treatment) and how this online information seeking behavior affects patients' medication beliefs and medication adherence. In addressing this aim, the following research question (RQ) is proposed: How does patients' online information seeking behavior throughout treatment affect patients' beliefs about medication and medication adherence?

To explore this question, the current study focusses on immunosuppressive therapy and biologicals prescribed for patients with Inflammatory Bowel Disease (IBD). This is a complex chronic inflammatory disorder and causes inflammation in the colon. This therapy has proven to be effective, but also entails an increased risk of rare but serious side effects, such as cancer or acute pancreatitis (Johnson et al., 2007). Research showed that if this type of therapy is prescribed, information needs emerge (Bernstein et al., 2011).

These information needs are reflected in the efforts that patients make to actively seek information to gratify their needs (Feathers, Yen, Yun, Strizich, & Swaminath, 2016; Leydon et al., 2000; Rubin, 2002).

Patients' online information seeking behavior

Healthcare providers are still patients' preferred, most trusted information source (Närhi, 2007). Nonetheless, many patients use the internet as a source of information in addition to their provider (Feathers et al., 2016). One of the distinctive characteristics of the internet is that it contains information that is often unverified, inaccurate, biased, or misleading and difficult to comprehend (Bernard et al., 2007; Diviani, van den Putte, Meppelink, & van Weert, 2016; Flanagan & Metzger, 2000; Langille et al., 2010; van der Marel et al., 2009). The opportunity to encounter conflicting information also increases when information is obtained from more than one source of information (e.g., a healthcare provider and the internet; Carpenter et al., 2010, 2014). This is likely to confuse patients and may potentially lead to misunderstanding, negative beliefs about medication, and consequently, negative health behaviors such as lower medication adherence (Im & Huh, 2017; Nagler, 2014). This is particularly problematic for patients experiencing difficulties in estimating the credibility of online health information (Carpenter et al., 2014).

A longitudinal study in cancer patients indicated that patients are more active information seekers before their treatment than afterwards (Eheman et al., 2009). In line with these results, Vogel, Bengel, and Helmes (2008) demonstrated that cancer patients' information seeking behavior is particularly high at the start of the treatment, and decreases throughout treatment. Cross-sectional studies on chronic patients' information needs about their treatment confirmed that patients' information needs emerge rapidly in the initiation phase of the treatment. The information needs become less prevalent during the implementation phase, although the majority of the patients has further information needs after 10 days and half of the patients after four weeks (Barber, Parsons, Clifford, Darracott, & Horne, 2004).

Medication adherence and the internet

Medication non-adherence is a major public health problem that has been termed an 'invisible epidemic'. Non-adherence to pharmacotherapy ranges from 13% to 93%, with an average rate of 40% (Sabaté, 2003). Poor adherence compromises the effectiveness of a treatment and results in suboptimal illness control. These deficiencies can result in an increased use of healthcare services (i.e., acute care and hospitalizations), a reduction in patient quality of life, and increased healthcare costs (Sabaté, 2003). In the USA, the cost of non-adherence has been estimated at \$100–\$300 billion annually (Madden et al., 2008).

Medication adherence involves a process in which three phases can be distinguished: the initiation (the patient determines the need for medication and takes the first dose), the implementation or execution phase (the patient's behavior corresponds with the prescribed treatment), and the discontinuation phase (the end of the regimen is marked) (Vrijens et al., 2012). During these different phases, different information needs are expected to emerge (Matsuyama, Kuhn, Molisani, & Wilson-Genderson, 2013; Vogel

et al., 2008). In particular the internet may serve as an easy accessible source to satisfy these information needs (Baumgartner & Hartmann, 2011). How the internet affects adherence might differ per phase. For example, patients in the initiation phase may use the internet to read stories about the efficacy of the medication or about fellow patients' experiences before they decide whether to start taking the medication. In the implementation phase, patients might start evaluating the prescribed treatment online and decide whether they still believe it is necessary to take the medication.

It is increasingly recognized that medication adherence is an important but complex behavior. In total, 200 determinants of medication adherence have been studied but none of them has been consistently related to adherence (Donovan, 1995). Research on the impact of the internet on medication adherence is rare (Im & Huh, 2017). A recent study showed that almost all chronic patients use the internet to make decisions about their medication (Feathers et al., 2016). However, this study did not report the effect of using the internet on medication adherence. One study that did report on the relation between internet use and medication adherence reported that the frequency of exposure to online information was negatively related to medication adherence (Im & Huh, 2017). This study, however, did not measure patients' online information seeking behavior at different moments in treatment. Thus, they were not able to identify the moment in treatment in which patients' online information seeking behavior was influential (i.e., before the treatment in the initiation phase or while using the medication in the implementation phase of the treatment) in affecting adherence.

Patients' medication beliefs and the internet

The significance of positive beliefs toward a desired behavior has been emphasized in theories such as the theory of planned behavior (Ajzen, 1991) and the health belief model (Becker, 1974). Research in medication adherence proposes that the salient beliefs relating to medication adherence can be grouped under two categories: perceptions of personal need for medication and concerns about potential adverse effects (Clifford, Barber, & Horne, 2008; Horne, Cooper, Gellaitry, Date, & Fisher, 2007; Horne, Weinman, & Hankins, 1999). The necessity-concerns framework (NCF) assumes a relationship between two beliefs about medication: patients' necessity beliefs and concerns regarding medication (Clifford et al., 2008; Phillips, Diefenbach, Kronish, Negron, & Horowitz, 2014). According to the NCF, patients' willingness to start and continue to take their medication is influenced by the way they judge their personal need for the treatment relative to the potential adverse consequences of taking it. Thus, patients weigh the costs against the benefits of taking their medication. According to the NCF, patients are more likely to take their medication if their beliefs in the necessity exceed their concerns (Clifford et al., 2008; Phillips et al., 2014).

Research indicates that the costs and the benefits of taking the medication function as possible motivators to engage in information seeking behavior (Eastin & Guinsler, 2006). When patients already have doubts about the necessity of taking the medication or concerns about their medication, there is a risk that inaccurate or inappropriate information might even increase their doubts or concerns (Eastin & Guinsler, 2006). Previous

research showed that exposure to online information negatively affects patients' beliefs (Carter, Moles, White, & Chen, 2013; Im & Huh, 2017; Niederdeppe et al., 2014). Especially patients who used the internet more often reported to have more negative beliefs about their medication as compared to patients who used the internet less often (Im & Huh, 2017). These studies, however, only studied the impact of internet use on beliefs on one time-point and did not specify the phase of the treatment. In addition, the use of the NCF while examining the impact of online information on patients' medication beliefs could further improve our understanding because it provides insight into which belief (i.e., the necessity or concerns) is influenced by patients' online information seeking behavior.

Research questions and hypotheses

In answering the main research question, the following hypotheses and sub questions are developed:

H1: Patients are more likely to use the internet at the start of their treatment (i.e., in the initiation phase) to seek for medical information than while using the medication (i.e., in the implementation phase).

RQ1: How does patients' online information seeking behavior throughout treatment relate to medication adherence in the initiation phase and after six months?

RQ2: Are there differences in medication adherence in the initiation phase and after six months between patients who use the internet before (vs. not before) and patients who use the internet after (vs. not after) the consultation?

H2: Patients who are using the internet throughout their treatment, experience more negative beliefs about medication (i.e., they value the concerns higher than the necessity of taking the medication) in the initiation phase (H2a) and after six months (H2b) than patients who are not using the internet throughout treatment.

RQ3: Are there differences in medication beliefs in the initiation phase and after six months between patients who use the internet before (vs. not before) and patients who use the internet after (vs. not after) the consultation?

Method

Procedure and design

This retrospective cohort study was part of a larger research project aimed at developing and testing a theoretical and evidence-based tailored multimedia intervention to improve medication adherence (Linn, van Weert, Smit, Perry, & van Dijk, 2013). IBD patients were recruited from six hospitals in the Netherlands. The Dutch guidelines advise providers to pay extra attention to medication use and the risks of the treatment, in particular if the patient is starting with immunosuppressive or biological therapy (Initiative on Crohn's and Colitis [ICC], 2015). During a consultation of approximately

30 minutes, a nurse practitioner (NP) informs the patient about the medication, including its possible side effects and instructions on how to take the medication.

To be eligible for the study, patients had to meet the following inclusion criteria: (1) diagnosed with IBD according to classical clinical, endoscopic, radiographic, and/or path histological criteria as determined by an experienced gastroenterologist; (2) starting with immunosuppressive or biological therapy; and (3) being able to read and write in Dutch.

Prior to the consultation with the NP, a written informed consent was obtained from both patients and NPs. Furthermore, at baseline (after the prescription of medication by the doctor, but before the consultation with the NP), patients completed a written questionnaire where they filled out questions about their background characteristics and their internet use (T0). Three weeks and six months after the consultation with the NP, patients were contacted for a telephone interview to collect information on their medication beliefs (T1, T2), self-reported medication adherence (T1, T2), and internet use (T2).

The recruitment flow is depicted in Figure 1. In total, we approached 243 IBD patients diagnosed, 211 patients were considered eligible. In total, 36 of the eligible patients refused to participate in the study (17.1%; reasons are listed in Figure 1). Of the 175 consented eligible patients, we excluded patients who were part of the pilot study ($n = 16$) or patients who did not complete the study because after careful consideration with their doctor they had to stop taking their medication ($n = 47$; 26.8%). In five cases the researchers were not able to reach the patient by phone (2.9%). As a result, the final sample for this study consisted of 107 patients.

The Medical Ethical Committee of the VU Medical Center granted permission for this study, which was supplemented with local feasibility statements of all participating hospitals (trial number NTR2892).

Measurements

Personal factors

Participants were asked to indicate their age, gender, education, diagnosis (whether they were diagnosed with Crohn's disease or

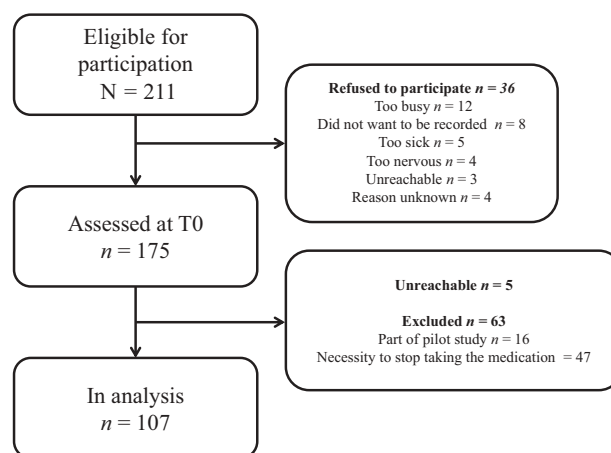


Figure 1. Flowchart inclusion of patients.

Ulcerative Colitis), and time since diagnosis. Level of education was categorized afterward into low, moderate, and high.

Online information seeking behavior

Based on a previous study (Muusses, van Weert, van Dulmen, & Jansen, 2012), internet use was surveyed by asking patients whether they used the internet to seek for information about their maintenance therapy between the moment their doctor prescribed the medication and the consultation with the NP (T0) and whether they had used the internet to seek for information about their maintenance therapy after their consultation with the NP (T2). Patients were asked to rate how often they had used the internet for information about their maintenance therapy ranging from 0 = 'never used' to 5 = 'used 5 or more times'. To compare users with non-users before and after the consultation with the NP, we recoded this scale with 0 representing a non-user, and the other categories representing a user.

Beliefs about medication

To measure patients' evaluation of their perceived necessity and concerns regarding medication, the Beliefs About Medicine Questionnaire (BMQ) was used (Horne et al., 1999). The BMQ has been validated and used in a variety of illness populations (Horne et al., 2013) including IBD (Linn, van Weert, van Dijk, Horne, & Smit, 2016). The BMQ-specific consists of two subscales: beliefs about the necessity of taking medication (e.g., 'my life would be impossible without medication') (5-items; $\alpha = .80$ [T1] and $.86$ [T2]) and concerns about taking medication (e.g., "having to take the medication worries me") (5-items; $\alpha = .73$ [T1] and $.72$ [T2]). Each item was given a value between one to five, one being 'strongly disagree' and 5 being 'strongly agree'. A necessity-concerns differential (NCD) was calculated per patient by subtracting his/her concerns score from his/her necessity score, resulting in a range from -20 to 20 . The NCD provides a numerical assessment of how the patient judge their perceived need for treatment, relative to their concerns. Positive scores indicate that necessity was valued higher than concerns and negative scores indicate that concerns were rated higher than perceived need (Clifford et al., 2008; Horne et al., 1999; Menckeborg et al., 2008).

Medication adherence

Self-reported medication adherence to their immunosuppressive or biological therapy was measured with the 5-item Medication Adherence Report Scale (MARS) ($\alpha = .61$ [T1] and $.61$ [T2]) (Horne & Weinman, 2002). The MARS has been used in a variety of illness populations including IBD (Linn et al., 2016). Examples of scale items include: "Some people forget to take their medicines. How often does this happen to you while you are using your immunosuppressive or biological therapy?" and "Some people miss out a dose of their medication or adjust it to suit their own needs. How often do you do this with your immunosuppressive or biological therapy?" with item responses scored on a five-point scale where 0 = 'never' and 4 = 'always'. Scores were added up resulting in a score of 0–20. A lower score indicates higher self-reported medication adherence.

Analysis

Descriptive statistics were used to describe the sample characteristics. In order to gain insights into the extent to which chronic patients seek online information throughout their treatment, we created three different variables 1 = patients who used the internet (vs. non-users), 2 = patients who used the internet before consultation (vs. not used it before) and 3 = patients who used the internet after consultation (vs. not used it after).

Chi-square tests were performed to check whether the groups differed in terms of gender and education and to explore whether patients were more likely to use the internet at start of their treatment than while using the medication. In addition, analysis of variance (ANOVA) was conducted to check whether the groups differed in terms of age. For testing the effects of using the internet before and/or after the consultation on medication beliefs (H2) and medication adherence (RQ), separate ANOVAs were conducted with medication beliefs (NCD), patients' score of their concerns, patients' score of their necessity, and medication adherence as dependent variables, and the variables representing different internet users as factors. Additional Bonferroni tests were conducted to check for differences within groups. Since this retrospective cohort study was part of a larger research project and patients received a multimedia intervention, we controlled for allocation to the intervention group. Because being part of the intervention or the control group did not alter the main effects on patient beliefs about medication and medication adherence, the unadjusted effects are reported.

Results

Participants

A total of 107 respondents was included in the analysis. The mean age of this sample was 42.3 years ($SD = 15.3$) and 40.2% is male. On average, respondents were diagnosed with IBD for 12.2 years ($SD = 10.4$) and most of them were diagnosed with Crohn's disease (69.2%). The majority of the sample was highly or moderately educated (79.3%). Results showed that there was no difference in gender $\chi^2 = 2.91$, $p = .589$ or in diagnosis $\chi^2 = 0.63$, $p = .731$ between users and non-users. Patients with higher education used the internet more often as compared to patients with lower education ($\chi^2 = 13.78$, $p = .001$).

Patients' online information seeking behavior

We expected that patients were more likely to use the internet at the start of their treatment (i.e., in the initiation phase) to seek for medical information than while using the medication (i.e., in the implementation phase) (H1). In total, 102 patients completed the questionnaire on internet use. Of these patients, 17 patients never used the internet (16.7%) and 85 patients reported to have used the internet (83.3%). Of these internet users, 31 used the internet only to prepare themselves (36.5%), 11 started after the consultation with their online information seeking behavior (12.9%), and 43 used the internet before and after (50.6%). Results showed that patients were not significantly more likely to use the internet in the

initiation phase than while using the medication ($\chi^2 = 2.89$, $p = .089$). H1 was therefore not supported.

Online information seeking behavior and the impact on self-reported medication adherence and medication beliefs

We explored how patients' online information seeking behavior throughout treatment was related to medication adherence (RQ1). We first tested whether there was a significant difference on medication adherence between patients who used the internet throughout treatment and patients who did not. Results showed that there was no significant difference in adherence in the initiation phase $F(3, 93) = .94$, $p = .335$ or after six months $F(3, 96) = .00$, $p = .971$ between patients who used the internet throughout treatment and patients who did not. We then explored whether there were differences in medication adherence in the initiation phase and after six months between patients who used the internet before the consultation (vs. not before) and patients who used the internet after (vs. not after) the consultation (RQ2). Results indicated that there was no significant difference in adherence in the initiation phase $F(3,93) = 0.00$, $p = .957$ or after six months $F(3, 96) = 0.00$, $p = .996$ between patients who used the internet before and patients who did not use the internet before. There was a significant difference in adherence in the initiation phase between patients who used the internet after the consultation and patients who did not use the internet after the consultation. Patients who used the internet after the consultation, were more non-adherent after three weeks $F(3, 93) = 4.93$, $p = .029$ as compared to patients who did not use the internet after the consultation. No significant difference was found after six months $F(3,96) = 0.20$, $p = .665$.

Hypotheses 2 predicted that patients who used the internet throughout their treatment experience, experience more negative beliefs about medication (i.e., they value the concerns higher than the necessity of taking the medication) in the initiation phase (H2a) and after six months (H2b) than patients who did not use the internet throughout treatment. There was no main effect of internet use throughout treatment on the NCD at T1 $F(3, 93) = 0.58$, $p = .450$. There was, however, a main effect at T2 $F(3, 95) = 5.19$, $p = .025$, indicating that if patients used the internet throughout treatment, they valued the concerns over the necessity of taking the medication compared with patients who did not. Thus, H2a was not supported and H2b was supported.

Next, we tested whether there were differences in beliefs about medication in the initiation phase and after six months between patients who used the internet before (vs. not before) and patients who used the internet after (vs. not after) the consultation (RQ3). Results showed no significant difference between patients who used the internet before the consultation and patients who did not use the internet before on the NCD $F(3, 93) = 0.57$, $p = .454$ in the initiation phase. There was, however, a significant difference after six months $F(3, 95) = 4.34$, $p = .040$, indicating that patients who used the internet before the consultation, valued the concerns higher than the necessity after six months as compared to patients who did not use the internet before the consultation. When looking more closely at the NCD, explorative analysis showed a significant difference on the subscale concerns about medication. Patients who used the internet to prepare themselves for the consultation reported significantly more concerns in the initiation phase ($M = 14.22$; $SD = 3.91$) than patients who did not use the internet to prepare themselves ($M = 12.41$; $SD = 3.27$) $F(3, 93) = 6.23$, $p = .014$. This effect was also evident after six months. Patients who used the internet before the consultation ($M = 14.51$; $SD = 4.11$) reported significantly more concerns after six months than patients who did not use the internet before the consultation ($M = 11.92$; $SD = 3.34$) $F(3, 96) = 11.84$, $p = .001$. There was no significant difference between patients who only used the internet after the consultation and patients who did not use the internet after the consultation on the NCD in the initiation phase $F(3, 93) = 0.11$, $p = .918$ or after six months $F(3,95) = 1.92$, $p = .169$ (see Table 1).

Discussion

This study aimed to longitudinally explore patients' online information seeking behavior throughout their treatment and how this online information seeking behavior is related to medication beliefs and medication adherence. Most patients used the internet as a form of preparation for their consultation with their healthcare provider. Fewer patients started using the internet only after the consultation and a minority reported that they had never used the internet. Our study demonstrated that patients who used the internet before the consultation (vs. not before) had more concerns in the initiation phase and after six months. In addition, patients who used the internet throughout treatment valued their concerns higher than the necessity after six months. Patients who used the internet after the consultation (i.e., at the implementation phase of the treatment) reported to be

Table 1. Differences in users and non-users.

	Non-users	Users throughout treatment (before and/or after)	Internet use before consultation	Internet use after consultation
Adherence ^a T1 ^b	M = 0.17 SD = 0.53	M = 0.55 SD = 1.32	M = 0.54 SD = 1.36	M = 0.80 SD = 1.60
Adherence ^a T2 ^c	M = 0.94 SD = 1.03	M = 0.84 SD = 1.61	M = 0.89 SD = 1.66	M = 0.92 SD = 1.90
NCD ^d T1 ^a	M = 6.17 SD = 3.96	M = 4.89 SD = 4.76	M = 4.66 SD = 4.67	M = 5.02 SD = 5.11
NCD ^d T2 ^c	M = 7.50 SD = 4.73	M = 4.38 SD = 5.58	M = 4.04 SD = 5.53	M = 4.12 SD = 6.07

^aA lower score indicates higher self-reported medication adherence

^bT1 = measured after three weeks

^cT2 = measured after six months

^dHigher, positive scores indicate that necessity was valued higher than concerns and lower, negative scores indicate that concerns were rated higher than perceived need

less adherent after three weeks as compared to patients who did not use the internet after the consultation, but not after six months. By using the NCF we were able to gain more insight into specific beliefs that were affected by patients' online information seeking behavior. This framework has been extensively used in research involving medication adherence and can guide health communication researchers in pinpointing important adherence determinants, such as patients' beliefs about medication, and intervention targets such as informing patients about the importance of taking the medication accurately in achieving optimal illness control.

Almost three out of four patients reported having used the internet before their consultation. Previous studies reporting percentages of patients using the internet as a preparation for their consultation reported mixed results, depending on which patient group was surveyed. The highest percentages reported in the literature were among chronically ill patients (Caiata-Zufferey, Abraham, Sommerhalder, & Schulz, 2010), which is in line with the results of the current study. It seems that chronic patients in particular are often using the internet to prepare themselves for their consultation. The use of internet has changed the patient-provider relationship and providers face new challenges in their communication with their informed patients. How healthcare providers respond to this impacts patient-related outcomes such as satisfaction with the communication. For example, previous research shows that patients are more satisfied if the provider takes the online information seriously (Bylund et al., 2007).

There are several reasons why patients turn to the internet before their consultation with their provider. For example, patients go online to increase their knowledge so that they can become more active in their own care (Dowsett et al., 2000) or to cope with concerns they have (Dutta-Bergman, 2004; Eastin & Guinsler, 2006). Because of the longitudinal nature of this study, we can conclude that patients who use the internet before their consultation (i.e., in the initiation phase of the treatment), experience more concerns as compared to patients who did not use the internet before the consultation, both in the short (after three weeks) and in the long term (after six months). As most patients used the internet as a form of preparation for their consultation with their provider, this result is worrying. Although no data was available on the content of the websites visited, exposure to inaccurate online information might be an explanation for patients' high concerns (te Poel, Baumgartner, Hartmann, & Tanis, 2016). Thus, patients may benefit from assistance in identifying the most appropriate strategies for dealing with inaccurate information (Elstad, Carpenter, Devellis, & Blalock, 2012). It is therefore vital that providers discuss patients' online information seeking behavior. A provider can, for example, explicitly explore if the patient went online before the consultation and which websites were consulted. We did not analyze if and how providers explored patients' use of online sources. A typology has been developed on the different communication strategies that healthcare providers can apply when discussing online health information (Caiata-Zufferey & Schulz, 2012) and can guide interventions and research in this area.

Previous research already demonstrated that patients use the internet to make decisions about their treatment (Feathers et al., 2016) and that the frequency of patients' online seeking behavior is positively related to non-adherence (Im & Huh, 2017). Our study contributes to this research line by demonstrating that the moment in treatment in which patients seek online information is an important factor to consider. Reasons why patients turn to the internet after a consultation with their provider are unfulfilled information needs (Tustin, 2010), unclear information (Barber et al., 2004), justification of a treatment decision, or the evaluation of the medical advice (Caiata-Zufferey et al., 2010; Weaver, Thompson, Weaver, & Hopkins, 2009). Our results indicate that patients' internet searches after their consultation (i.e., in the implementation phase of the treatment) negatively affect medication adherence in the short term (after three weeks) but not after six months. This might indicate that patients are more non-adherent in the initiation phase of the treatment but are becoming more adherent after six months. For patients who are not willing to take the medication, additional online information post-visit may have helped them to justify the treatment decision (Caiata-Zufferey et al., 2010; Weaver et al., 2009).

In our study we did not distinguish between different online sections. Sections such as medical libraries, blogs, or discussion groups are expected to differ in content. Sections containing medical information about disease and treatment are expected to mainly provide information and might affect patients' beliefs differently compared to sections such as a discussion fora in which patients share their experiences (Sanders, Linn, Araujo, Vliegthart, & van Weert, 2017). Future research examining the impact of the internet on medication beliefs and adherence is strongly encouraged to differentiate between these different sections.

A limitation of this study is that we used a self-reported measurement to assess medication adherence. Self-reported measurements are affected by favorable bias and forgetfulness on the part of the patient, especially in health-related issues such as medication adherence (Wetzels, Nelemans, Schouten, van Wijk, & Prins, 2006). It must, however, be noted that self-reported medication adherence significantly correlates with more objective measurements of medication adherence such as electronic monitoring (Hugen et al., 2002). Nevertheless, our results should be interpreted with caution and future research should include more objective measurements of medication adherence such as electronic monitoring.

We decided to compare internet users with non-users before and after their consultation. Some patients might have used the internet for hours on multiple occasions to gain information and others may have used it more briefly. As our sample size was rather small, we could not take the variability within this scale into account. As previously shown by Im and Huh (2017), the intensity with which patients use the internet is a factor that should be considered when studying the effects of patients' online information seeking behavior on medication beliefs and medication adherence. Future research should take the variability of this online information seeking behavior into account.

The potential negative effect of inaccurate online health information on public health-related behaviors has drawn research attention but is still scarce and inconclusive. Our study made an attempt to fill this research gap by providing a better understanding of which moment in treatment the internet affects medication adherence and medication beliefs (i.e., at the initiation phase or implementation phase). It also provided more insight into differences in beliefs about medication and medication adherence between patients who use the internet only before or after consultation with their provider. Moreover, the use of the NCF while examining the impact of online information on patients' medication beliefs enables health communication researchers to gain more insight into which belief (i.e., the necessity or concerns) is more salient.

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