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# Untangling the antecedents of initial trust in Web-based health information: The roles of argument quality, source expertise, and user perceptions of information quality and risk

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ABSTRACT

As the Internet develops as a medium for disseminating health-related information, research on Web-based health information consumption grows increasingly important to academics and practitioners. Building on the current research in this area, our study proposes a model of initial trust formation in Web-based health information, rooted in the elaboration likelihood model (ELM) and Toulmin's model of argumentation. The proposed model theorizes trust as a function of perceived information quality and perceived risk, which are in turn determined by the structural quality of the message (argument quality) and the expertise of the message source (source expertise). Testing of the research model was accomplished via a field experiment involving 300 online users who had searched for health information on the Web. Overall, the results largely support the proposed model, explaining substantial variance in trust and highlighting the important but distinct roles that argument quality, source expertise, and user perceptions of information quality and risk play in determining an individual's decision to trust health information online.



## 1. Introduction

The Web has become an important channel for disseminating information tied to the practice of healthcare. Importantly, Web-based health information can reside within a wide variety of resources online. As its availability grows, so does the population of individuals consuming health information on the Web. According to a recent Harris Poll, the number of people looking for health-related information online is growing steadily, currently accounting for about 88% of the American adults who went online in 2010; that is a 10% increase from the previous year [16]. While the accessibility of Web-based health information can certainly be beneficial to the individual and society as a whole, not all of this information is equally sound and virtuous. Erroneous health information permeates the Web, often coexisting with valuable high-quality health information [12]. Moreover, consumers commonly struggle to discern the quality of Web-based health information [49], increasing the risk of trusting and applying bad health-related information. Given the close association between Web-based health information consumption and general wellbeing, trusting and applying bad health information can carry a variety of potential and sometimes-realized consequences.

Responding to the issues of variable quality of Web-based health information and the consumer's inability to accurately distinguish high- from low-quality, practical efforts have been made toward qualifying this information. Guidelines and checklists have been developed for evaluating health information online and the websites on which they reside (e.g., HONcode, HITI, and DISCERN). In addition, attempts have been made to develop tools for automatically evaluating the quality of specific health information on the Web [42,53]. In essence, these efforts have sought to aid consumers in differentiating quality and forming trust in the right information. While these efforts are noteworthy, they have been made without clear specification of the underlying mechanisms that govern an individual's decision to trust in and apply Web-based health information. A theory-driven understanding of the factors that drive trust formation in this context is essential to developing effective tools and interventions aimed at improving the evaluation and consumption of health information online.

While online trust has been studied widely, the vast majority of work in this area has been tailored to the context of e-commerce transactions. Because the costs of consuming Web-based health information are typically non-monetary and instead tied to health and wellbeing,

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the mechanisms involved in trust formation may be different from those for e-commerce transactions. Moreover, while the research on initial trust formation online has examined the roles of argument and source characteristics [23], as well as the role of information characteristics [34,50], their respective influences have been examined separate from one another. As a result, the overall impact of the findings from these respective streams has been limited to date. Because these factors do not exist in isolation from one another when evaluating health information online, it is important that their roles be clarified in light of the process of initial trust formation. Research is needed that draws together these disjointed streams and explains how the characteristics of the argument, the source, and the information work together to drive initial trust formation on the Web.

In an effort toward building a more complete understanding of the mechanisms underlying initial trust formation in Web-based health information, the current study develops and tests an integrated model, rooted in the elaboration likelihood model [37,38] and Toulmin's model of argumentation [52], which untangles the influencing roles of argument-, source-, and information-based factors. In doing so, this study seeks to extend the knowledge base on trust formation and aid researchers and practitioners interested in developing more robust tools for guiding consumers. In addition, this study seeks to provide enhanced prescription to reputable Web-based health information providers for taking advantage of the conceptual levers involved in communicating online to better distinguish themselves and reach information seekers.

## 2. Theoretical development and research model

### 2.1. Trust in Web-based health information

Trust has been studied widely across several disciplines, with a variety of definitions offered based on respective disciplinary perspectives and assumptions. Among these different definitions a common thread is "willingness to be vulnerable" [46]. Specifically, prior research defines trust as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" [30] (p. 712). Tailored to the context of transacting online, McKnight et al. [32] define trust as "a willingness to depend on a vendor to deliver on commitments" (p. 335). Taken further, the authors distinguish trusting belief—conceptualized as the extent to which one believes that a specific online vendor has attributes that are beneficial to the trustor—from other trust-related constructs. In line with McKnight et al. and recent research adopting their view [22,23], the current study takes the trusting beliefs approach and defines trust in Web-based health information as the extent to which one believes that a specific Web-based health information provider has attributes that are beneficial to the consumer.

Furthermore, this research focuses on initial trust, referring to trust formation in a relationship where the consumer does not yet have credible information about, or affective bondage with, the information provider [32]. Although initial trust forms during the first encounter and within a short amount of time, initial trust can still be very influential and make the individual vulnerable [31]. Provided this conceptualization of trust in Web-based health information, its formation can be understood as a process of persuasion through argumentation, whereby the consumer seeks to alleviate psychological barriers tied to interacting with an unfamiliar object or party. As people often look for relevant health information for their specific situations within a limited amount of time, understanding the factors that influence the formation of initial trust can provide important insights into how people can be directed toward credible health information.

### 2.2. Elaboration likelihood model (ELM)

The elaboration likelihood model (ELM) of persuasion postulates that "important variations in the nature of persuasion are a function of the likelihood that receivers will engage in elaboration of (that is, thinking about) information relevant to the persuasive issue" [36]. ELM theorizes that there are two routes to persuasion. First is the central route, which is governed by "extensive and effortful information processing activity, aimed at scrutinizing and uncovering the central merits of the issue" [39] (p. 42). With the central route, persuasion is the result of careful and thoughtful consideration of the arguments central to the issue. This route highlights how arguments in a persuasive message are comprehended and processed cognitively by the argument recipient.

The second route is referred to as the peripheral route, and is largely dominated by non-issue-relevant concerns, also called persuasion cues. These persuasion cues are not inherent in the message itself but are nonetheless relevant to the situation, often taking the form of rewards, punishments, or social roles. Under the peripheral route, more attention is paid to peripheral factors than the message itself, and active thinking about the merit of the message takes a secondary role in the persuasion outcome.

The chief differentiator between the central and peripheral routes is the extent to which active thinking about, or cognitive elaboration of, the argument(s) takes place. ELM acknowledges that "persuasion can take place at any point along the elaboration continuum" [36] and that active cognitive elaboration produces enduring persuasion outcomes [37]. Moreover, when the message is personally relevant, the likelihood of elaboration is relatively high, and message recipients are more likely to effortfully consider the issue at hand [37].

Along with personal relevance, Petty et al. [40] have identified argument quality and source expertise as key determinants of persuasion outcomes. In the context of persuasive messaging, an argument is a type of message presentation that is intended to establish the validity of an asserted claim by providing rationale or support for the claim; consequently, argument quality should be defined and assessed in terms of the presence and relationships among rational assertions [5]. Source expertise on the other hand refers to the extent to which the source of a persuasive message is perceived to be capable of making correct assertions [41]. In their experiment designed to test the validity of the two routes of persuasion, Petty et al. [40] found that persuasion was more pronounced when arguments had high quality and the source possessed high levels of expertise. These findings have been replicated in the context of e-commerce by Kim and Benbasat [24], who manipulated argument and source characteristics and found that trust assurance of the expert source combined with quality argumentation produced the highest trusting beliefs for both high-price and low-price conditions. Overall, the theoretical tenets of ELM and findings from past research suggest that, in the context of Web-based health information, argument quality and source expertise should play important roles in influencing information acceptance, as the medical information is often highly specialized and the field demands specialized formal training to become a credentialed provider.

### 2.3. Toulmin's model of argumentation

Although ELM effectively postulates the central influencing role of argument quality in persuasion-based outcomes like trusting behavior, the theory falls short of explicating the actual characteristics of a quality argument. Recognizing this shortcoming, past research in information systems and consumer behavior recommends supplementing ELM with Toulmin's model of argumentation [52], which hones in on the anatomy of high quality arguments [5,24]. Toulmin's model posits that arguments can comprise six structural components—claim, data, warrant, backing, qualifier, and rebuttal. Three of these components—claim, data,

and warrant—are considered essential while the rest are not required in some arguments [52,56]. Because they are fundamental to any argument regardless of situational context, the current study focuses on the first three essential components. Because the presence or absence of these structural elements makes an argument strong or weak [9,43], Toulmin's model has been considered a useful diagnostic device for examining the nature of strong versus weak manipulations of argument quality [5].

Claim refers to any assertion or conclusion put forward for general acceptance. Data refers to any facts or evidence used to support a claim. Warrant refers to any statement that connects specific data to a specific claim by providing rationale as to why the data supports the claim. As an example in the context of Web-based health information, if an individual were seeking advice online related to experiencing the symptoms of headaches and dizziness, an example of claim alone can be a message stating, "Your new pair of glasses is too strong." Then, an example of supporting data might be, "You changed your glasses recently." Finally, an example of warrant might be, "When people wear new glasses that are too strong, they will experience headaches and dizziness." Prior research has validated essential components of Toulmin's model of argumentation in explaining online consumers' trust in e-commerce vendors [22]. Following the theory and past research in the online context, we expect Toulmin's model to be an appropriate fit in the Web-based health information context as well.

### 2.4. Perceived information quality and perceived risk

While prior research has shown that the quality of an argument and the qualification of the source can influence trust-related outcomes on the Web [10,19,22,24], their influences have generally been modeled as direct. Meanwhile, a related stream of research incorporating perceptions of information quality and risk suggests that these perceptions are very closely related to trust-based behavior, and should also be considered in models focused on information-oriented mechanisms of trust [34]. In this context, perceived information quality refers to the extent to which a user views the information provided by a website as current, accurate, relevant, useful, and comprehensive [34,47,51]. Unlike argument quality, which addresses the structural properties of a persuasive message [5,22,40], perceived information quality captures the degree to which the information objects *within* the argument have these characteristics [44]. Judgments of argument structure and judgments of the information objects provided within the argument are made independently [2,6,44], and argument quality is recognized as a distinct antecedent factor influencing perceived information quality [44]. Consistent with this stream, we conceptualize argument quality and perceived information quality as distinct constructs. Moreover, these two constructs are operationalized differently in the current study, as argument quality is directly manipulated by an experimental setting while perceived information quality is reported by the study subjects.

Perceived risk has been defined in the past as a person's perception of uncertainty about the consequences of undertaking an action or activity [8,34]. In the context of the current study, perceived risk refers to the extent to which a user views the consequences of acting on the information provided in a website to be uncertain. Synthesizing ELM, Toulmin's model of argumentation, and the past research on trust, we position perceived information quality and perceived risk as key mediators of the effects that argument quality and source expertise have on initial trust in Web-based health information. The research model guiding this study is presented in Fig. 1.

### 2.5. Research hypothesis development

Information-seeking behavior online has been modeled in the past as a process involving judgments of information quality [44]. Importantly, argument structure is identified within this process as a central factor influencing evaluations of information quality [44]. Consistent with this perspective, Ricco [43] found argument structure to be a determinant of perceived argument strength, which is considered a direct antecedent of users' perceptions of credibility of online word-of-mouth messages [6]. In a health consultation and advice setting where the consequences of trusting and applying bad information can be high, users seek convincing, quality health messaging on the Web. When all of the necessary components of an argument are present, providing supporting elements for a position, consumers are more likely to judge the information provided as relevant, accurate, and useful [43,44]. Framed in the context of the current study, people should hold perceptions of higher information quality when a conclusion (claim) is provided with evidence (data) and logical reason (warrant). Therefore, we hypothesize:

**H1.** Argument quality has a positive effect on perceived information quality.

Because health information is directly tied to human wellbeing, risk is an inherent attribute of accepting and applying health information. According to Cox [8], managing this risk "*is largely concerned with dealing with uncertainty, that is, with information handling*" (p. 10, emphasis in original). In other words, consumers will change their information handling processes to fill in the information gaps when presented with poorly structured messaging. Thus, when health information is well-structured and clearly bound to supporting rationale, consumers

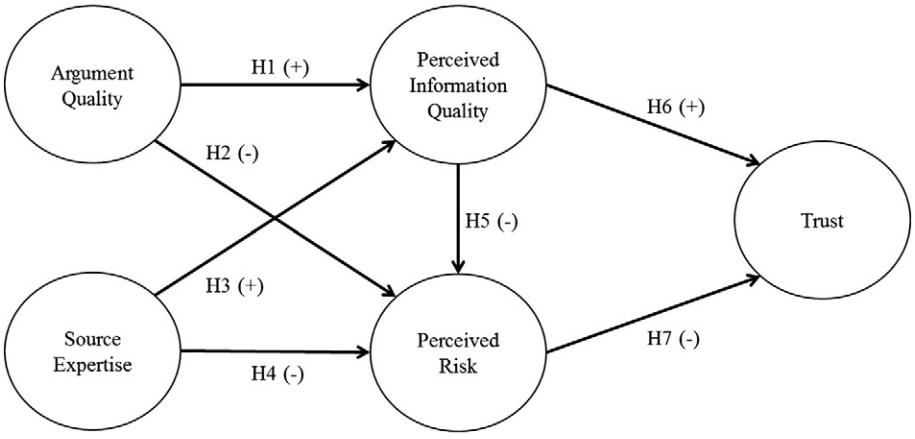


**Fig. 1.** Research model.

should perceive less risk associated with acting on the information. Hinting toward this relationship, Ye and Johnson [56] showed that users of an expert system accepted the system's conclusion more often when presented with warrant-based explanations. Their results suggest that people are more assured when all of the critical elements of argumentation are provided. Based on this reasoning, we hypothesize:

**H2.** Argument quality has a negative effect on perceived risk.

Past research identifies the authority of the information provider as an important criterion when assessing information quality in healthcare-related contexts [10,17,51]. According to ELM [37,38], source expertise should have a significant effect on persuasion, working through the central route by motivating people to pay more attention to the content of the message when it is from an authoritative source. In other words, information consumers will cue on the status of the consultant when forming perceptions of information quality and should view messaging from a reputed consultant as being of higher quality. Therefore, we hypothesize:

**H3.** Source expertise has a positive effect on perceived information quality.

Source expertise should also contribute to reduced risk perceptions. Risk is primarily driven by uncertainty about the potential consequences of acting on information [8]. In essence, risk stems from the existence of multiple alternatives with relatively equal probabilities [48], and risk reduction is a central motive underpinning human communication [4]. When forming initial trust, individuals will attempt to reduce uncertainty during their initial interactions by gathering knowledge about the communicating partner [4]. Building on these notions, a large number of studies have identified source expertise as important for establishing the credibility of online health information [10,17,51]. These studies generally agree that, in an online health-consultation setting, source expertise will influence message credibility, which should also lead to lower perceived risk. Therefore, we hypothesize:

**H4.** Source expertise has a negative effect on perceived risk.

It is reasonable to expect perceived information quality will have a negative impact on perceived risk. Nicolaou and McKnight [34] suggest that by increasing the perceived worth of exchanged information, perceived information quality reduces risk perceptions. High quality information means that the information is more relevant, current, accurate, and complete. When more relevant, current, accurate, and complete information is provided, it should help reduce the uncertainty associated with following the advice from a stranger. Thus, we hypothesize:

**H5.** Perceived information quality has a negative effect on perceived risk.

Higher levels of perceived information quality should be directly associated with higher levels of initial trust. Past research identifies information quality as an important trust-building mechanism in online interactions [21], and a direct determinant of trusting beliefs in exchange relationships [34]. Information that is perceived to be current, accurate, relevant, useful, and complete reflects an information provider that is competent, truthful and credible, engendering trusting beliefs in the information provider [14]. In the online health consultation setting, where information is the primary resource exchanged between parties, perceived information quality should play a central role in determining the trustworthiness of the information provider. Consequently, we hypothesize that:

**H6.** Perceived information quality has a positive effect on trust in the information provider.

The link between perceived risk and trusting beliefs has been confirmed by prior research, but the direction of the relationship between the two variables has been controversial. For example, while acknowledging the opposite direction as a possibility, Nicolaou and McKnight [34] and Kim et al. [25] argue that trust influences the perception of risk. In contrast, other researchers assert that perceived risk is a determinant of trust [11,18,27,35]. Mitchell [33] provides a possible explanation for this seemingly conflicting theorization by pointing out that perceived risk is "a necessary antecedent for trust to be operative and an outcome of trust building is a reduction in the perceived risk of the transaction of relationship" (page 174). In this view, perceived risk is an initial determinant of trust in the information provider, and over time, as the trusting relationship builds, perceived risk reduces. Accordingly, we position perceived risk as an antecedent of trust in the information provider because our study is focused on initial trust, and hypothesize that:

**H7.** Perceived risk has a negative effect on trust in the information provider.

The proposed model enables us to trace the effects argument quality and source expertise have on trust via the user perceptions of information quality and risk. However, it does not answer whether the effects of argument quality and source expertise on trust are fully mediated by those perceptions. Mediators explain how well external events are filtered by internal psychological processes. They provide insights on how or why those observed effects occur [3]. Although prior research (i.e., [23]) has empirically examined the effects of argument and source characteristics on trust, it did not involve any mediators. Furthermore, prior research on trust has identified perceived information quality and perceived risk as key antecedents of trust [11,18,27,34,35], but has not examined these factors as mediators in the process of trust formation.

Meanwhile, the theoretical tenets of uncertainty reduction theory (URT) [4,54] suggest that perceptions of risk and information quality may serve as important mediators between argumentation presented to a communication partner, and how that partner responds. URT posits that the onset of any relationship between two parties, whether in person or online, is characterized by high levels of uncertainty. Thus, when an individual initially communicates with another party, relevant information is processed with the purpose of establishing (and managing) perceptions of uncertainty about the other party. These evaluations of uncertainty are what ultimately influence how the individual reacts to the communication partner [1,4]. Consistent with these theoretical tenets, past work in the context of online communication and purchasing behavior posits that uncertainty-related perceptions fully mediate between online communication and intention to purchase [1].

Translated to the focus of the current study, URT and the past research findings suggest that perceptions of information quality and risk will fully mediate the effects of message processing and source evaluation, on subsequent trust-related outcomes. More specifically, argument quality and source expertise present important evidence which can be used to reduce uncertainty about the situation. Perceived information quality and perceived risk capture certain aspects of uncertainty about the situation—one is information-focused while the other is outcome focused. Once established, these uncertainty-related perceptions should then drive initial trust formation. Thus, remaining consistent with the theoretical tenets of URT and findings from past research, we expect the effects of argument quality and source expertise on trust to be fully mediated by the user perceptions of information quality and risk. Furthermore, we maintain the previously hypothesized relationship between perceived information quality and perceived risk. Taken together, we hypothesize[1]:

[1] The authors thank an anonymous reviewer for helpful comments on setting up the mediational hypotheses.

**Table 1**
Sample characteristics.

| Item | Count | Ratio (%) | Item | Count | Ratio (%) |
|---|---|---|---|---|---|
| Gender | | | Frequency in using the Internet in a week | | |
| Men | 150 | 50.0 | 1 to 3 times | 0 | 0.0 |
| Women | 150 | 50.0 | 3 to 5 times | 15 | 5.0 |
| | | | More than 5 times | 285 | 95.0 |
| Age | | | Internet usage in a day | | |
| 20–24 | 49 | 16.3 | Less than 1 h | 10 | 3.3 |
| 25–29 | 58 | 19.3 | 1 to 3 h | 88 | 29.3 |
| 30–34 | 64 | 21.3 | 3 to 5 h | 95 | 31.7 |
| 35–39 | 47 | 15.7 | More than 5 h | 107 | 35.7 |
| 40–44 | 40 | 13.3 | | | |
| 45 or higher | 42 | 14.0 | | | |
| Occupation | | | Internet searching experience | | |
| Office worker | 131 | 43.7 | None | 0 | 0.0 |
| Technical/sales/service | 43 | 14.3 | Less than 1 year | 0 | 0.0 |
| Self-employed | 21 | 7.0 | 1 year to 3 years | 0 | 0.0 |
| Housewife | 36 | 12.0 | 3 years to 5 years | 5 | 1.7 |
| Student | 51 | 17.0 | More than 5 years | 295 | 98.3 |
| Etc. | 18 | 6.0 | | | |

**H8.** The effect of argument quality on trust in the information provider is fully mediated by the perceived information quality–perceived risk relationship.

**H9.** The effect of source expertise on trust in the information provider is fully mediated by the perceived information quality–perceived risk relationship.

## 3. Method

### 3.1. Participants

Testing of the hypotheses was conducted via a field experiment. The experiment involved a website, which simulated the provision of health advice, and participants were recruited on a voluntary basis. To be eligible, participants were required to be older than 19 years of age, and have prior experience searching for health information online. Because females and males have been found to react differently to persuasion [15,20], we wanted to ensure that the two gender types were equally represented. After controlling for the gender ratio, a total of 300 applicants who applied for the study participation first were selected. The characteristics of the participants are presented in Table 1.

In addition to demographics, participants were asked about their past experience searching for health information on the Web. All participants indicated that they had experience in acquiring Web-based health information. Moreover, participants reported that the reasons for searching health information on the Web were (from high to low) to (1) identify a name of the disease (79%), (2) gather detailed disease information (71.3%), (3) find curing methods (62.7%), (4) find diagnostic methods (47.7%), and (5) get the latest health issue news or issues (17.3%). In addition, most respondents had searched for health information for themselves (82%) or their families (75.7%).

### 3.2. Procedure

When participants visited the website specifically designed for this study, they were first asked to respond to a pre-test questionnaire, which captured information regarding demographics, Web usage, and experience with Web-based health information. Following the survey, participants were provided with an explanation of the experiment, which was identical across the experimental conditions. Having read the explanation, participants then viewed three experimental Web pages in sequence, each page dealing with a separate health consultation scenario. More specifically, for each experimental condition, three unique Web pages were developed that contained health consultation information specific to that condition. These three health consultation pages differed depending on the experimental conditions while the assigned experimental condition remained static across the three cases. There was a minimum time limit (i.e., 3 min) for viewing each Web page to discourage participants from skipping any page without paying adequate attention. After viewing all of the Web pages, participants were asked to respond to a second questionnaire, which included the measurement items for the constructs in the research model and a measure of personal relevance regarding the symptoms described in the cases.

### 3.3. Experimental conditions

Following past experimental studies that leveraged Toulmin's model of argumentation [22], argument quality was manipulated in this study by including or excluding the essential components of argumentation. Specifically, argument quality was varied by including (1) claim only, (2) claim plus data, and (3) claim plus data and warrant in a health consultation page. Consistent with Petty et al. [40], source expertise was varied along professional status versus non-professional status. Specifically, we created the Web pages through which medical advice was provided either by a medical expert (professional) or a person who had suffered before from the same symptoms (non-professional). By varying argument quality at three levels (claim only, claim plus data, claim plus data and warrant) and source expertise at two levels (non-professional, professional), our experimental design yielded the following fully-crossed six experimental conditions: (1) claim-only with non-professional condition, (2) claim-plus-data with non-professional condition, (3) claim-plus-data-and-warrant with non-professional condition, (4) claim-only with professional condition, (5) claim-plus-data with professional condition, and (6) claim-plus-data-and-warrant with professional condition. The study's participants were stratified into males and females in advance and then were randomly assigned to one of the six conditions from each stratum.

Participants in all of the experimental conditions saw identical Web pages throughout the experiment except for those three consultation pages to which the experimental manipulations were applied. Before those Web pages were developed, we surveyed health advice websites in South Korea to develop three health consultation cases based on the actual cases available from the NAVER's Knowledge Man site, the most popular health consultation site in South Korea. We employed three cases instead of one to strengthen the manipulation and mitigate potential idiosyncratic responses to any particular

type of health issue. The three health consultation topics were headache, stomachache, and fever in order, each of which was handled on a separate Web page. These three topics were deemed desirable because of their commonness.

Each health consultation topic consisted of two components: question and answer. With the question component (common across all conditions), a patient gave a detailed description of the symptoms experienced and inquiry as to why they were occurring. Depending on the experimental condition, the answer component varied while maintaining the same diagnosis. Specifically, the answer component contained three elements: introduction of the consultant, diagnosis, and the suggestion to visit a nearby clinic for examination. All of the Web pages were designed as actual browser-based Web pages, provided through a website titled 'K-Doc'.

Manipulation of argument quality was accomplished via the diagnosis. For the claim-only conditions, the diagnosis only comprised a conclusive message of what caused the symptoms to occur (e.g., I reckon that you have gastritis). For the claim-plus-data conditions, the diagnosis comprised the same conclusive message, preceded by a list of symptoms related to the health condition diagnosed (e.g., with the pain below sternum, in particular the pit side pain or heartburn, indigestion are symptoms of stomach disease. I reckon that you have gastritis.). In the claim-plus-data-and-warrant conditions, in addition to the list of symptoms and the conclusive message, the diagnosis also comprised statements explaining how the data are related to the conclusion (e.g., most of stomach-related symptoms are associated with the secretion of gastric acid. The excessive secretion of gastric acid, inflammations due to stomach acid reflux into the esophagus, or mucosal hypersensitivity cause the symptoms. In addition, the expansion of the stomach after eating foods can stimulate gastric mucosa and cause abdominal pain.).

Manipulation of source expertise was accomplished by providing different information regarding the consultant. In the non-professional conditions, the consultant was described as a person who had suffered before from the identical symptoms. In the professional conditions, the consultant was described as a physician. To improve the credibility, the physician's title, photo, and the website's certification statement were also presented with the consultant introduction statement for the professional conditions.

### 3.4. Measures

Perceived information quality, perceived risk, and trust were measured on 7-point Likert scales. Eight items adapted from Nicolaou and McKnight [34] were used to measure perceived information quality for the currency, accuracy, relevancy, usefulness, and completeness of the information provided by a consultant. Perceived risk and trust were measured using three items adapted from Nicolaou and McKnight for each construct. Further details regarding the measurement items (translated from Korean) used for perceived information quality, perceived risk, and trust are provided in Appendix A. Also, because personal relevancy was found to influence the processing of information in prior research [40], it was assessed with a two-item measure (see Appendix A) on a 2-point (yes, no) scale in order to check whether the randomization achieved its intended effects in ensuring the compatibility of the experimental conditions.

### 3.5. Control and manipulation checks

To counterbalance any systematic differences across the experimental conditions, the participants were randomly assigned to each experimental condition. A series of analysis of variance (ANOVA) tests confirmed that participant characteristics were not significantly different across the experimental conditions in pre-test questionnaire measures of age, Internet usage (frequency, time), Internet searching experience, and prior search of Web-based health information, confirming the equality of experimental conditions at the outset. Also, there were no significant differences across the experimental conditions with respect to personal relevancy to the symptoms described in the consultation cases.

For manipulation checks, the credibility of information was assessed by asking two questions (on 7-point Likert scale) about (1) the health information provided by the website was credible enough to take an action based on it, and (2) the health information provided by the website was credible enough to share it with family and friends. The manipulation of argument quality was effective in producing perceived differences in the credibility of information across the three conditions (3.33 for claim-only, 3.65 for claim-plus-data, 4.01 for claim-plus-data-and-warrant; $F = 7.58$, $p < 0.01$). Similarly, the manipulation of source expertise was effective in producing differences between the two conditions (3.35 for non-professional, 3.96 for professional; $F = 18.53$, $p < 0.001$).

## 4. Results

We employed a combinatory approach for the analysis of the psychometric properties, experimental effects, and hypothesized paths in the model. Specifically, we used ANOVA and Tukey's multiple comparison test to examine experimental effects, and partial least squares (PLS) to assess the psychometric properties of the measures and the causal paths in the proposed model. While ANOVA is a traditional method commonly used to test between-group differences and experimental effects, it is not designed for path analysis or any analysis of psychometric properties of measures.

PLS is a component-based structural equation modeling approach [13,55] that has received wide acceptance recently for theoretical model testing. PLS allows measurement and structural models to be assessed simultaneously while placing minimal demands on sample size and distributional assumptions [7,13,55]. Although PLS is useful for measurement property analysis and model testing, it is not as flexible as ANOVA with conducting multiple comparison tests or testing the relative efficacy of experimental conditions when multiple experimental conditions are involved. Thus, the two approaches can be considered complementary, providing deeper insights on the phenomenon under study when used together.

### 4.1. Experimental group means

Table 2 reports the mean scores and standard deviations for perceived information quality, perceived risk, and trust, grouped by experimental conditions. Among the six conditions, the claim-plus-data-and-warrant with professional condition showed the highest level of perceived information quality and trust, and the lowest level of perceived risk. A mean analysis showed that the argument quality

**Table 2**
Descriptive statistics of measured constructs by experimental condition.

| Experimental condition | n | Statistic | Perceived information quality | Perceived risk | Trust |
|---|---|---|---|---|---|
| Claim-only with non-professional | 50 | *M* | 2.79 | 4.92 | 2.85 |
| | | *SD* | 1.18 | 1.22 | 1.37 |
| Claim-plus-data with non-professional | 50 | *M* | 3.18 | 4.76 | 3.67 |
| | | *SD* | 1.21 | 1.19 | 1.20 |
| Claim-plus-data-and-warrant with non-professional | 50 | *M* | 3.87 | 4.69 | 4.12 |
| | | *SD* | 1.03 | 0.97 | 1.00 |
| Claim-only with professional | 50 | *M* | 3.38 | 4.37 | 3.41 |
| | | *SD* | 1.25 | 0.93 | 1.39 |
| Claim-plus-data with professional | 50 | *M* | 3.84 | 4.47 | 3.79 |
| | | *SD* | 1.29 | 1.06 | 1.40 |
| Claim-plus-data-and-warrant with professional | 50 | *M* | 4.52 | 4.05 | 4.79 |
| | | *SD* | 0.75 | 0.88 | 0.95 |

Note. $N = 300$.

manipulation was successful in influencing perceived information quality (3.08 for claim-only, 3.51 for claim-plus-data, 4.19 for claim-plus-data-and-warrant), perceived risk (4.64 for claim-only, 4.61 for claim-plus-data, 4.37 for claim-plus-data-and-warrant), and trust (3.13 for claim-only, 3.73 for claim-plus-data, 4.46 for claim-plus-data-and-warrant). It also showed that the source expertise manipulation was successful in influencing perceived information quality (3.28 for non-professional, 3.91 for professional), perceived risk (4.79 for non-professional, 4.30 for professional), and trust (3.55 for non-professional, 4.00 for professional).

### 4.2. Psychometric properties of measures

We used SmartPLS 2.0 [45] to examine the psychometric properties of the constructs in the model. Specifically, the measurement model was examined for internal consistency reliability and convergent discriminant validity [7,57]. Internal consistency reliability is similar to Cronbach's alpha and the value of 0.7 or higher is considered adequate. Convergent and discriminant validity was assessed by examining (1) the square root of the average variance extracted (AVE) by a construct from its indicators and (2) standardized loadings and crossloadings. For adequate convergent and discriminant validity, it is recommended the square root of the AVE to be at least 0.707 and to exceed that construct's correlation with other constructs [7] for the first criterion, and the loadings of the items to be at least 0.707 and to be higher than their crossloadings (i.e., the items to load more highly on constructs they are intended to measure than on other constructs) for the second criterion [57].

Table 3 presents the internal consistency reliabilities, square roots of AVE, and correlations among the study constructs. Table 4 presents the factor structure matrix of loadings and crossloadings. All the numbers in the two tables were directly obtained from SmartPLS while specifying all the measurement items as reflective indicators of the latent constructs. The experimental variable of argument quality was coded as 0 for the claim-only condition, 1 for the claim-plus-data condition, and 2 for the claim-plus-data-and-warrant, and the experimental variable of source expertise was coded as 0 for non-professional and 1 for professional.

As shown in Table 3, the internal consistency reliabilities were all higher than 0.90, exceeding the reliability criteria. Further, Tables 3 and 4 collectively provide strong support for convergent and discriminant validity. As evidence, (1) the square root of the average variance extracted for each construct (Table 3 diagonal elements) was greater than 0.707 and greater than the correlation between that construct and other constructs, without exception, and (2) the factor structure matrix (Table 4) shows that all items exhibit high loadings on their respective constructs (all items load at 0.82 or higher) and no items load higher on constructs they were not intended to measure, without exception. Overall, the self-report measurement items exhibit sufficiently strong psychometric properties to support valid testing of the proposed model.

**Table 3**
Reliabilities, square roots of AVE, and correlations among measured constructs.

| Construct | ICR | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1. Argument quality | 1.00 | **1.00** | | | | |
| 2. Source expertise | 1.00 | 0.00 | **1.00** | | | |
| 3. Perceived information quality | 0.97 | 0.36 | 0.26 | **0.88** | | |
| 4. Perceived risk | 0.92 | −0.11 | −0.23 | −0.48 | **0.89** | |
| 5. Trust | 0.94 | 0.39 | 0.18 | 0.82 | −0.52 | **0.92** |

Note. ICR = internal consistency reliability. Diagonal elements (bold) are the square roots of average variance extracted (AVE) by latent constructs from their indicators. Off-diagonal elements are correlations between latent constructs.

**Table 4**
Factor structure matrix of loadings and cross-loadings.

| Scale items | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Argument quality | **1.00** | 0.00 | 0.36 | −0.11 | 0.39 |
| 2. Source expertise | 0.00 | **1.00** | 0.26 | −0.23 | 0.18 |
| 3. Perceived information quality (PIQ) | | | | | |
| PIQ1 | 0.31 | 0.18 | **0.85** | −0.37 | 0.67 |
| PIQ2 | 0.30 | 0.23 | **0.88** | −0.41 | 0.66 |
| PIQ3 | 0.33 | 0.27 | **0.91** | −0.44 | 0.72 |
| PIQ4 | 0.33 | 0.29 | **0.90** | −0.47 | 0.75 |
| PIQ5 | 0.28 | 0.21 | **0.88** | −0.43 | 0.74 |
| PIQ6 | 0.33 | 0.19 | **0.91** | −0.44 | 0.76 |
| PIQ7 | 0.36 | 0.20 | **0.91** | −0.40 | 0.76 |
| PIQ8 | 0.31 | 0.23 | **0.82** | −0.41 | 0.71 |
| 4. Perceived risk (RISK) | | | | | |
| RISK1 | 0.01 | −0.20 | −0.35 | **0.84** | −0.41 |
| RISK2 | −0.11 | −0.20 | −0.46 | **0.92** | −0.49 |
| RISK3 | −0.16 | −0.22 | −0.46 | **0.91** | −0.49 |
| 5. Trust (TR) | | | | | |
| TR1 | 0.26 | 0.22 | 0.78 | 0.54 | **0.92** |
| TR2 | 0.44 | −0.01 | 0.71 | 0.41 | **0.91** |
| TR3 | 0.39 | 0.27 | 0.76 | 0.47 | **0.92** |

Note. Items should load high (>0.707) on their respective constructs (bold) and no item should load higher on constructs other than the one it was intended to measure. The measurement items of PIQ, RISK, and TR used in the survey are shown in Appendix A.

### 4.3. Experimental effects

Table 5 presents the results of argument quality (claim-only, claim-plus-data, claim-plus-data-and-warrant) × source expertise (non-professional, professional) ANOVA run for perceived information quality and perceived risk, each as a dependent variable separately. Supporting H1, argument quality had a significant positive effect on perceived information quality ($F = 24.52$, $p < 0.001$). Given the multiple levels of the argument quality manipulation, we ran the Tukey's HSD test, which is the most widely used procedure for testing all pairwise contrasts [26], to identify the exact sources of the observed significant effect of H1. The Tukey's HDS test requires equal sample size across the experimental conditions, which was the case in this study. The Tukey's test found that all the comparisons between the argument quality conditions were significant (claim-only vs. claim-plus-data: mean difference of 0.43, $p < 0.05$; claim-plus-data vs. claim-plus-data-and-warrant: mean difference of 0.69, $p < 0.001$; claim-only vs. claim-plus-data-and-warrant: mean difference of 1.11, $p < 0.001$). In contrast to H2, argument quality didn't have a significant negative effect on perceived risk ($F = 1.99$, *ns*). Supporting H3, source expertise had a significant positive effect on perceived information quality ($F = 23.60$, $p < 0.001$). Supporting H4, source expertise had a significant negative effect on perceived risk ($F = 16.74$, $p < 0.001$). In addition, a separate run of ANOVA showed that both argument quality and source expertise had significant effects on trust ($F = 28.17$, $p < 0.001$ for argument quality; $F = 8.45$, $p < 0.01$ for source expertise). The interaction term (argument quality × source expertise) was not significant in any of these ANOVA tests.

**Table 5**
Results of the ANOVA for perceived information quality and perceived risk (*** $p < 0.001$).

| Source of variation | *SS* | *df* | *MS* | *F* |
|---|---|---|---|---|
| *Perceived information quality* | | | | |
| Argument quality | 63.01 | 2 | 31.51 | 24.52*** |
| Source expertise | 30.32 | 1 | 30.32 | 23.59*** |
| Error | 377.83 | 294 | 1.29 | |
| Total | 4343.95 | 300 | | |
| *Perceived risk* | | | | |
| Argument quality | 4.38 | 2 | 2.19 | 1.99 |
| Source expertise | 18.42 | 1 | 18.42 | 16.74*** |
| Error | 323.57 | 294 | 1.10 | |
| Total | 6540.56 | 300 | | |

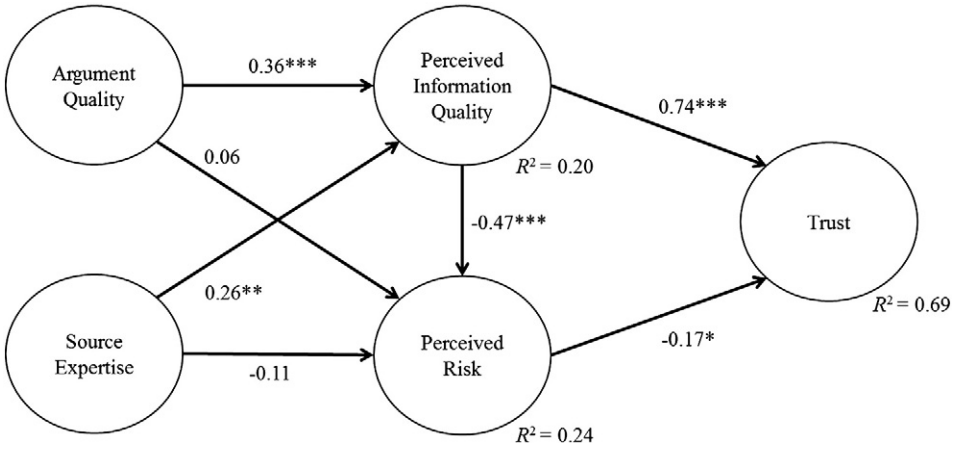


**Fig. 2.** PLS test of research model. * $p<0.05$; ** $p<0.01$; *** $p<0.001$.

*4.4. Path analysis of the proposed model and hypotheses*

In PLS, structural model testing involves examining path coefficients (similar to standardized beta weights in a regression analysis) and their significance levels. We used bootstrapping (with 200 resamples) to assess the statistical significance of path coefficients. Fig. 2 summarizes the results of PLS structural model testing. Supporting Hypothesis 5, perceived information quality had a significant negative effect on perceived risk ($\beta = -0.47$, $p<0.001$). Supporting Hypothesis 6, perceived information quality had a significant positive effect on trust ($\beta = 0.74$, $p<0.001$). Finally, supporting Hypothesis 7, perceived risk had a significant negative effect on trust ($\beta = 0.17$, $p<0.05$).

All of the significant effects previously tested using ANOVA remained the same except for the effect of source expertise on perceived risk (H4). Because of the presence of the path from perceived information quality to perceived risk, the previously significant effect of source expertise on perceived risk became non-significant. In the absence of the path from perceived information quality to perceived risk, the path was significant ($\beta = -0.23$, $p<0.01$), echoing the result of ANOVA (see Table 5). Taken together along with H4 and H3, the results indicate that the significant effect of source expertise on perceived risk is fully mediated through perceived information quality [3].

Furthermore, to assess whether perceived information quality and perceived risk fully mediate the effect of argument quality on trust (Hypothesis 8) and the effect of source expertise on trust (Hypothesis 9), we followed the three-step testing procedures specified by Baron and Kenny [3]: (1) significant relationships exist between the independent variable and the dependent variable, (2) significant relationships exist between the independent variable and the hypothesized mediators, and (3) in the presence of the significant relationships between the mediators and the dependent variable, the previously significant relationship between the independent variable and the dependent variable is no longer significant or the strength of the relationships decreases significantly.

PLS results supported all three of the Baron and Kenny's [3] criteria for the mediational effects for both argument quality and source expertise, as summarized in Fig. 3. First, argument quality and source expertise each had a significant effect on trust ($\beta = 0.41$, $p<0.001$ for argument quality; $\beta = 0.27$, $p<0.05$ for source expertise). Second, argument quality had a significant effect on perceived information quality ($\beta = 0.36$, $p<0.001$) while it had a non-significant effect on perceived risk ($\beta = 0.08$, *ns*) in the presence of the significant path from perceived information quality to perceived risk ($\beta = -0.51$, $p<0.001$), collectively indicating that the mediation follows the argument quality–perceived information–perceived risk link. Similarly, source expertise had a significant effect on perceived information quality ($\beta = 0.26$, $p<0.01$) while it had a non-significant effect on perceived risk ($\beta = -0.12$, *ns*) in the presence of the significant path from perceived information quality to perceived risk ($\beta = -0.45$, $p<0.001$), again collectively indicating that the mediation follows the source expertise–perceived information–perceived risk link. Third, for argument quality, when argument quality, perceived information quality, and perceived risk were all entered as independent variables, the previous significant effect of argument quality on trust dropped to nonsignificance ($\beta = 0.12$, *ns*), indicating full mediation. Similarly, for source expertise, when source expertise, perceived information quality, and perceived risk were all entered as independent variables, the previous significant effect of source expertise on trust dropped to nonsignificance ($\beta = -0.05$, *ns*), again indicating full mediation. The results provide consistent empirical evidence that perceived information quality and perceived risk fully mediate the effect of argument quality on trust and the effect of source expertise on trust, in support of Hypothesis 8 and Hypothesis 9.

## 5. Discussion

This study extends the knowledge base on Web-based health information consumption by developing and empirically testing a theory-grounded model of trust in online health information. The model was successful in illuminating the mechanisms that drive individuals' decision to trust in health information on the Web and linking the antecedent factors of argument quality and source expertise to online trust in health information. All the hypothesized paths were found significant except Hypothesis 2 and the model accounted for substantial variance in trust ($R^2 = 0.69$). As theorized, argument quality was a significant determinant of perceived information quality while source expertise was a significant determinant of both perceived information quality and perceived risk. In the presence of perceived information quality, the significant effect of source expertise on perceived risk was no longer true, suggesting that the effect of source expertise on perceived risk is fully mediated by perceived information quality. Both perceived information quality and perceived risk were found significantly related to trust in health information, fully mediating the effects of argument quality and source expertise on trust. These findings significantly extend prior research on online trust and health information by providing an integrative theory-grounded explanation of how trust in Web-based health information is formed. While online trust formation has been a topic of much focus in the context of evaluating online vendors and buying tangible products online, this topic has received much less attention in the context of consuming Web-based health information. To the best of our knowledge, the proposed model represents the first explication of the mechanisms

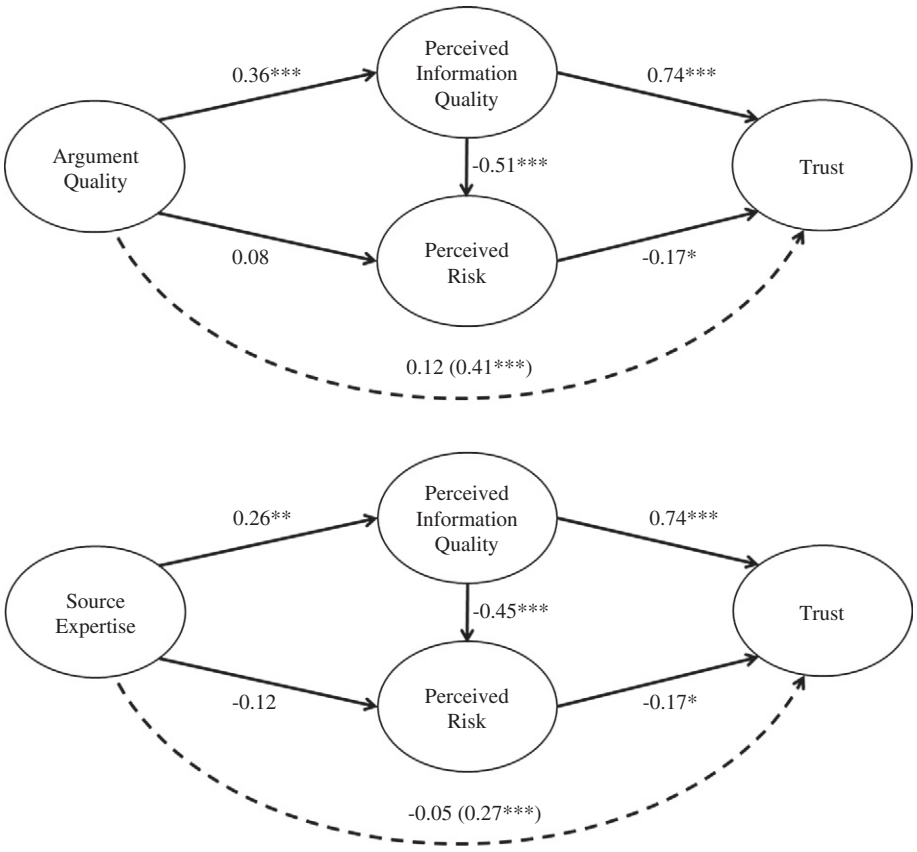


**Fig. 3.** Mediational analysis results. $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$. Values in parentheses represent the direct effect of the independent variable on trust prior to controlling its indirect effects through perceived information quality and perceived risk. Dashed lines indicate that the significant direct effect of the independent variable became nonsignificant after controlling for perceived information quality and perceived risk.

involved in online trust formation from the integrative theoretical perspectives derived from the synthesis of ELM [37,38] and Toulmin's model of argumentation [52].

The results of this study bring to light the important mechanisms involved in an individual's decision of whether or not to trust Web-based health information. The study's results highlight the central role of perceived information quality in developing trust in Web-based health information. In the context of buying goods and/or services online, prior research on trust formation generally models message and source characteristics as direct antecedents of trust [22,23]. Extending this work to the domain of Web-based health information, where the costs associated with consumption are health-related as opposed to monetary in nature, this study finds that perceived information quality plays a significant intermediate role between message/messenger characteristics and trust when the "product" is online health-related information. Thus, rather than directly influencing trust in this context, argument quality and source expertise can serve as important anchors individuals use to first establish judgment of the quality of the information in question. Information quality perceptions then impact trust through two important and distinct routes. Specifically, in addition to *directly* influencing trust in Web-based health information, information quality *indirectly* drives trust by reducing the perceived risk of accepting and applying specific information. Future research on trust and consumption of Web-based health information should take note of these findings and incorporate perceived information quality into future models explaining trust formation in this context. Furthermore, future research is invited for the identification of other important antecedents of perceived quality of Web-based health information. While this study highlights message and source characteristics, it is likely that characteristics of the consumer (e.g., personality) and characteristics of the topic (e.g., severity of the health concern) influence perceptions regarding information quality.

Relative to perceived information quality, perceived risk was found to be less potent in determining the degree of trust in online health information. In Nicolaou and McKnight's study [34], which examined the role of information quality in an inter-organizational electronic data exchange setting, the effect of perceived information quality on trust was found to be significant with the path coefficient of 0.45. In Lee et al.'s study [28], which examined the role of perceived risk in a mobile banking usage setting, perceived risk had a strong negative effect on trust with the path coefficient of 0.8. Those studies agree with our findings that perceived information quality and perceived risk are each an important determinant of trust, as we have found. Given that these studies did not assess the effects of perceived information quality and perceived risk on trust simultaneously, it is impossible to make direct comparisons with our study findings, but the combined results suggest that the relative strengths perceived information quality and perceived risk have on trust might be different from e-commerce settings to online health information settings. It is interesting to contrast and compare the relative effects of the two variables in trust formation as the route from information quality to trust represents a mechanism for positive, trust building whereas the route from perceived risk to trust represents a mechanism for negative, trust reduction. While there are arguments about whether the opposite end of trust is distrust or not [29], the presented model acknowledges the two opposing forces that drive the formation of trust, and the current findings highlight the need to examine the relative effects of perceived information quality and perceived risk on trust in other domains.

It is noteworthy that argument quality (i.e., information content attribute) and source expertise (i.e., information source attribute) influence trust via the same paths even though they initially seem to work differently. Using ANOVA, we found that argument quality had a significant effect only on perceived information quality while source expertise had significant effects on both perceived information quality and perceived risk. However, using PLS, we further found that, in the presence of perceived information quality, source expertise no longer had a significant effect on perceived risk. The PLS test of the proposed model shows that both argument quality and source expertise consistently influence perceived risk only through their effects on perceived information quality. This empirical finding is in clear support of the Cox's [8] argument that risk handling is closely related to information handling. In his qualitative analysis of how people handle risk, Cox observed that his subjects sought reliable information, from authoritative impersonal sources or other experienced people, as a way of coping with and mitigating risk. Our study findings agree with this tendency of seeking quality information for risk reduction, and go further by showing that other external factors such as argument quality or source expertise cannot reduce risk without altering the perception of information quality. A number of studies have examined message (information content) and messenger (information source) characteristics with regard to health information trust [10,17,19,51]. Our study contributes to this stream of research by establishing the key mechanisms and causal links through which those message and messenger factors operate for trust formation.

The findings from this study hold important implications for practitioners as well. First, the results suggest that when delivering important health related information via the Web, information providers should be cognizant of the effects that message structure and content ultimately have on consumers' trust. In line with past findings in the e-commerce context [22], this study finds that effective Web-based health messaging requires careful packaging. Diagnosis and/or prescription alone may not help the intended audience despite its accuracy, as perceptions of low information quality may lead it to never be accepted and applied. To maximize the likelihood that important health information is received and applied, providers should thoughtfully bundle health-related claims with supporting data and warrant. In doing so, information providers can reduce the perceived risk associated with applying the information and, in turn, engender trust in the message. The second major implication of the research for practice relates to the important, albeit indirect, influence of source expertise on trust. In conjunction with effective message packaging, Web-based health information providers can increase the impact of their information by qualifying themselves as credible messengers. Providing clear credentials is one way to legitimize the provider of the message, and increase the likelihood that intended recipients will trust and ultimately act upon the information. In the same way that third-party certifications can help establish the credibility and security of many online retailers [24], a similar approach focused on legitimizing the Web-based health information provider should increase the effectiveness of the provided information by enhancing consumers' trust in it.

There are limitations of the present study that should be noted when interpreting its findings. For one, this study focused on a limited set of health conditions and health-related claims. In addition, most participants in this study held substantial Internet search experience. While these features of the study were intended to control for outside factors, the results should be generalized to other health conditions and user demographics with caution. Further work is needed to understand how well the model generalizes to those people with limited Internet experience. A second limitation of this research relates to the manipulation checks used in the experiment. Specifically, our manipulation check questions for argument quality and source expertise required the participants to rate the credibility of information, which was checked for differences between different manipulations of argument quality and source expertise. Credibility of information may be the outcome of argument quality and source expertise combined. Future experimental research in this area should consider asking participants to rate argument quality and source expertise separately. A final limitation of this study relates to its sole focus on initial trust. While initial trust is recognized as having substantial influence on trusting behavior, past research argues that trust forms over time and the influence of factors on trust can change as experience is gained [58]. Therefore, the results of this study should be interpreted within the scope of initial trust formation. A fruitful avenue for future research might be to test our proposed model in a longitudinal setting.

## 6. Conclusion

The Web is quickly becoming a primary resource for the acquisition of health information. More importantly, however, health information seekers are often challenged with distinguishing good from bad information online, presenting unique challenges to reputable information providers, and necessitating further investigation into the mechanisms underlying trust formation within this context. In response, this research provides a theory-grounded, integrated model of trust formation in Web-based health information. This research found that characteristics of the message and of the messenger play important, albeit indirect, roles in forming trust in health information online. Moreover, the results provide strong support for the mediating role of perceived information quality between message/messenger characteristics and trust. We recommend that future research on trust in Web-based health information leverage our findings and incorporate perceived information quality as a mediating influence in trust formation. Overall, this study paves the way for a more unified approach to studying online trust in the health information context by integrating ELM, Toulmin's model of argumentation, and the extant body of research on online trust. Furthermore, this study guides academics as well as practitioners toward more effective health messaging online by highlighting the key mechanisms involved in an individual's initial decision to trust in Web-based health information.

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## Appendix A. Measurement scales

Perceived information quality (PIQ)

PIQ1. This website provides newest health information. (currency)
PIQ2. The diagnosis of the consultation is based on newest health information. (currency)
PIQ3. This website provides accurate health information. (accuracy)
PIQ4. The consultation is based on accurate health information. (accuracy)
PIQ5. This website provides health information that the questioner is seeking for. (relevancy)
PIQ6. This website provides useful health information to the questioner. (usefulness)
PIQ7. This website provides sufficient health information regarding the symptoms of the questioner. (completeness)
PIQ7. There is no deficiency in provided health information for the questioner's symptoms. (completeness).

Perceived risk (RISK)

RISK1. How risky do you feel it would be to make a decision based on the health information provided by this website?
RISK2. How risky do you feel it would be to accept and apply the provided health information to your life?

RISK3. How risky do you feel it would be to accept and apply the provided health information to the lives of others important to you?

Trust (TR)

TR1. The consultant is trustworthy.
TR2. The consultant is sincere and truthful.
TR3. The consultant is knowledgeable about the diseases.

Personal relevancy

I have suffered from the same symptoms covered in this website.
My family members or friends have suffered the same symptoms covered in this website.

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