



Cross-Culture Online Knowledge Validation and the Exclusive Practice of Stem Cell Therapy

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ABSTRACT

Increasingly, people are turning to the internet to access health information despite reports that sites vary in terms of their quality, especially when the health practice is emerging or exclusive, such as stem cell and umbilical cord blood therapy. Given the controversy, patients have to depend on available sources to validate their knowledge prior to going for these practices as treatments. This study explores how the internet supports the spread of stem cell therapy practices, viewing it from a knowledge validation theoretical perspective. The study posits hypotheses differentiating digital and human sources, trust in the media source, and exploratory and verification sources on knowledge validation for exclusive practices. Primary survey data was collected from the US and Kuwait. Key findings suggest that knowledge verification and trust in the internet influences knowledge conversion and the practice decision of patients for less practice-oriented knowledge, and this effect is higher for Kuwait than USA, and more so for stem cell than umbilical cord blood practice.

KEYWORDS

Culture, Exclusive Practices, Health Information Seeking, Health Information Source, Knowledge Conversion, Knowledge Verification, Stem Cell, Trust

INTRODUCTION

Deceitful information and advertisements on the Internet for stem cell therapy practices are misleading, with several businesses engaged in direct-to-consumer marketing of non-approved stem cell treatments (Knoepfler & Turner, 2018). Patients believe and undergo the advertised therapies, resulting in adverse consequences. Examples include three women blinded by unproven treatments (Kuriyan et al., 2017), or halt in the inexorable loss of vision (Mandai et al., 2017), or ending up with new tumors from the treatments (Berkowitz et al., 2016).

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Undoubtedly, the Internet is a significant source that aids in the spread of stem cell therapy practices. However, to what extent the Internet influences the validation of knowledge around stem cell therapies for patients, remains a puzzle equivocally crucial for practice and research. This study tries to unravel this puzzle, viewing it from a knowledge validation theoretical perspective. Knowledge validation is an evaluation process of relevant facts about a medical practice or procedure. It may involve activities that intend to reach the structural correctness of the intended knowledge base (i.e., verification), or activities that intend to show the capability of the knowledge base to reach correct conclusions (i.e., evaluation) (Durcikova & Gray, 2009). Knowledge validation is essential when the reliability and credibility of the sources are questionable, and lack of access to relevant and truthful knowledge (ter Hoeven, Stohl, Leonardi, & Stohl, 2019). This is important as the Internet is emerging as the first step information source for health (Daraz et al., 2019) and increasing dependence as an information source (18% in 2016 to 20% in 2017) or a primary knowledge avenue (62% in 2016 to 67% in 2017) (Gottfried & Shearer, 2016; Shearer & Gottfried, 2017).

Extant information systems research has conceptualized that knowledge validation involves a knowledge conversion process, consisting of a series of indirect and direct interactions (Massey & Montoya-Weiss, 2006). Internet and social media, as channels, are helpful in this process that enables the interactions (Carlson & Zmud, 1999). Individuals use the interactions to derive useful knowledge from a source, either at a single instance or across time with varied experiences (Massey & Montoya-Weiss, 2006). Studies also note that irrespective of the knowledge provided by the Internet, trust in such media as a knowledge source and subsequent validation process is a vital puzzle (Daraz et al., 2019; Hou & Shim, 2010). The credibility of contributed online information is questionable (Archak, Ghose, & Ipeiritos, 2011; T. Lu, Xu, & Wallace, 2018), with a push on reality to make the information attractive (Berger & Milkman, 2012). Most search results are driven by keyword-based matches, ranks of websites, and advertisement potential; and thus, they have built-in biases to provide pushed knowledge than facts (Olteanu, Castillo, Diaz, & Kiciman, 2019). Although the internet is emerging as the prominent media for a health information source, replacing traditional providers as a source is dubious (Daraz et al., 2019). Whether or not users are able to attain useful knowledge from the Internet that can be translated into a decision to practice the treatment is not yet clear (Grimm et al., 2019; Marsh et al., 2016). Research has also shown the differentiated impact of cultures on the internet search process (Thoumrungroje, 2018; Tian, Deng, Zhang, & Salmador, 2018). A pertinent question in the context of the Internet as a health information source is does the information provided about practices is useful? If so, to what extent? Do the information search processes translate to valuable knowledge or helpful for knowledge validation? Furthermore, does it lead to a decision to practice the treatment? Do different cultures translate the information search process differently in terms of knowledge conversion of health information?

The study asks the research question: How internet-based knowledge validation and trust influence knowledge conversion, and in turn practice decision, for two exclusive health practices (EHP): stem cell and umbilical cord therapies, in two normative contexts: Kuwait and the United States (US)? EHP are relatively new practices without widespread validated outcomes available to establish the efficacy of the practice, and yet to form a successful and all-embracing clinical guideline to ascertain a practice-to-outcome approach (Ali & Al-Mulla, 2012; Seay et al., 2017). The stem cell therapy and umbilical cord blood are EHP, that use the regenerative properties of body cells to potentially treat diseases for which currently there are no sustainable cures (Vaquero et al., 2018).

Notwithstanding several plausible clinical trials, there are ethical and policy level controversies with the current evidence of efficacy of stem cell and umbilical cord blood therapies (King & Perrin, 2014). Stem cell therapy has significant clinical potential, yet, currently, only a few stem cell therapies are ready for actual clinical applications (Guzzo & O'Sullivan, 2016). This reality has not stopped the rise of clinics worldwide, advertising a wide range of unproven stem cell-based interventions (Dresser, 2010). Many of these clinics have some online presence on the internet and use direct-to-consumer marketing, despite the lack of approval by regulatory organizations (Paarlberg, 2005).

Given the exaggerated media coverage, and inadequate practice-level information about the two EHP- stem cell and umbilical cord blood therapies, patients have to depend on available sources to validate their knowledge before undergoing the treatments (T. Lu et al., 2018). Thus, it is intriguing whether the type of channel source (digital or offline), trust in the channel source, and the culture impact the knowledge conversion process of gathering, validating information, and practice decision on these therapies—that is the focus of this study. Anchoring to the existing theoretical framework and research on the role of channels and media in the knowledge conversion process, the study posits hypotheses differentiating digital and human sources, trust in the media source, culture, and exploratory and verification sources, on knowledge validation and practice decision for EHP. Primary survey data was collected from the US and Kuwait. Two-stage least squares regression methods are used. Findings suggest that knowledge verification using the internet influences knowledge conversion of patients as compared to offline sources, for less practice-oriented knowledge, and this effect is higher for Kuwait than the US, and more so for stem cell than umbilical cord blood practice (e.g., less EHP). Trust in the source of health information moderates this relationship. In addition, knowledge conversion mediates the relationship on practice decisions.

LITERATURE REVIEW

EHP originate from clinical trials, these practices are yet to form a successful and all-embracing clinical guideline to ascertain a practice-to-outcome approach (FDA, 2018; Saad, Paoletti, Burzykowski, & Buyse, 2017). Examples of such practices would be artificial heart, fetal tissue transplantation, gene therapy, and stem cell therapy. New therapies or procedures need to be tested and validated before establishing them as a widespread practice. Because of the significant consequential impact, clinical trials have to follow stringent guidelines and protocols established by regulatory agencies, such as the National Institutes of Health and the FDA (FDA, 2017) making the trials costly and lengthy (Sundberg et al., 2017).

Cost and time factors lead researchers to often release the interim results of trials through publications or reports than waiting for completely validated and established results that apply to a broader population (Sundberg et al., 2017). Such interpretations lead to EHP that are not validated yet practiced using the limited information and interpretation coming out of ongoing clinical trials (Glasgow, 2005).

These practices need to be followed with caution. Nevertheless, some of these results are adopted by opportunistic practitioners and clinicians, with dubious effects to earn money (Murdoch, Zarzeczny, & Caulfield, 2018). Patients are attracted by false advertisements to avail of these practices (Murdoch et al., 2018; von Tigerstrom, 2017). Whether patients rely on the internet or other sources to verify the efficacy of these falsely advertised EHP potentials, remains a wide gap for healthcare practice and academics equivocally.

Stem cell and umbilical cord therapies are EHP that use regenerative properties of human body cells, to produce both copies of themselves and more specialized cells for potential adult therapeutic applications (Vaquero et al., 2018). Early growth of the commercial market for unproven stem cell-based started from Asia and is currently spreading worldwide. Governing stem cell therapies is still at its infancy (Cossu et al., 2018; George, 2011). Although international efforts to regulate stem cell practices are emerging, however, these guidelines are not yet conclusive (Murdoch et al., 2018).

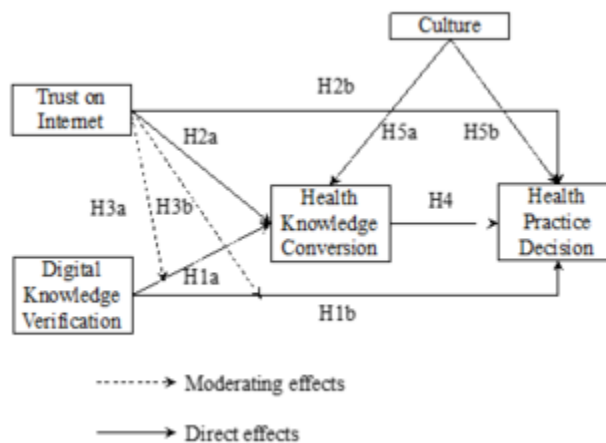
Until more international standardization has occurred, the focus for online and health information systems in the realm of new technologies such as stem cell therapy should probably be on filtering and consolidation of accurate information to patients. An online search for stem cell practice using Google reveals unreliable information, mainly driven by advertisements (Murdoch et al., 2018). Thus, online information on stem cell practices may be confusing and overwhelming. Interpretation of the information may lead to invalidated applications of the information presented. Therefore, the issue examined in this study, how far information on the Internet can be used to validate patients' knowledge

compared to offline knowledge is a valid concern. Also, comparative evidence of such effect across different cultural settings although a difficult task, no doubt, but an important one.

Hypotheses

Conceptually, this study argues that online sources have a significant impact on validating and deciding to take on the EHP - the stem cell and umbilical cord practices. Furthermore, the study also argues for the crucial role of trust in the source of information and the importance of the culture as a differentiating factor. The theoretical underpinning for this validation is posited to be the existing discussions around the knowledge conversion process (Massey & Montoya-Weiss, 2006), media

Figure 1. Research model



richness theory (Carlson & Zmud, 1999), and trust in the information source (Sillence, Briggs, Harris, & Fishwick, 2007). The research model is shown in Figure 1 and the theoretical arguments are further explained to posit testable hypotheses.

Knowledge conversion is the process by which individuals are affected by the experience of another, which may be embodied in the mind of another or a knowledge artifact (Argote et al., 2003; Massey & Montoya-Weiss, 2006; Paulin & Suneson, 2015). Knowledge artifacts are intermediary mechanisms used to capture and provide experience to others. The success of knowledge conversion hinges on both developing understanding, and the ability to use knowledge in some local context (Åkerman, 2015; Casillas, Barbero, & Sapienza, 2015). Knowledge conversion process occurs through a sequence of interactions over time that takes two forms: (1) indirect knowledge conversion: independent interaction by individuals with a knowledge artifact, and (2) direct knowledge conversion: communication between participants and may be complemented by using knowledge artifacts (Massey & Montoya-Weiss, 2006).

Media richness theory (MRT) suggests that communication media differs in their ability to facilitate understanding of information cues and reduce uncertainties (Daft & Lengel, 1986; Suh, 1999). MRT suggests that individuals' learning is a function of the characteristics of the channel (i.e., media richness) and the learning task (i.e., uncertainty). Media richness refers to a channel's ability to transfer information, that is determined by its capacity for immediate feedback, the multiple cues and senses involved, language variety, and personalization (Lengel & Daft, 1988). The richness of media or the utility of the media characterizes a channel's ability to communicate multiple information and promote personal decision-making within that channel (Maity & Dass, 2014). MRT suggests that the

more ambiguous the task, the more complex the channel needs to be for successful communication (Kock, 2005). Each information channel possesses inherent characteristics that comprise its richness and utility; however, individual experience, perceived usefulness, and ease of use also influence the richness factor (Anandarajan, Zaman, Dai, & Arinze, 2010). Furthermore, richness and utility are influenced by socially constructed knowledge through learning from others (Liu, Tan, & Sutanto, 2018).

Existing literature has shown that the higher media utility and richness, the easier it is to convey information, thus facilitating better communication, learning and decision making because the information receiver can rapidly and correctly understand the other party (Tseng, Cheng, Li, & Teng, 2017). With the advancement of digital content, health information online is always available for users, the information is always updated, even customized, and users are able to attain immediate feedback online (Huo, Zhang, & Ma, 2018). On the other hand, physicians and offline channels of health information such as books, family and friends are not always available and have limited time. Furthermore, with the development of communication technology, there are many ways to share information (Lozoya et al., 2018). Information is presented digitally in many ways through pictures, videos, specialized applications, personalized notification, among others. Therefore, digital health information which is richer in content and represented with multiple patterns might leave people clearer perceptions and deeper impressions than the health knowledge from official offline channels that are not as rich (Lipowski & Bondos, 2018; Nisar, Prabhakar, & Strakova, 2019). Therefore, health knowledge conveyed offline as compared to digital knowledge potentially has lower media richness (Huo et al., 2018). Furthermore, the richer the media, the deeper the resulting cognition and understanding, and the more precise the perception of knowledge quality becomes. The richness and perceived utility of the media and intellectual capital affects the knowledge conversion process (Attar, Kang, & Sohaib, 2019; Massey & Montoya-Weiss, 2006; van Woerkom & Sanders, 2010).

With the exaggerated media coverage and insufficient practice-level information on EHP, users have to depend on available information sources to validate their knowledge before deciding to partake in such treatments. Knowledge validation is an evaluation and verification process of relevant facts about a medical practice or procedure. It may involve activities that intend to reach the structural correctness of the intended knowledge base (i.e., verification), or activities that anticipate demonstrating the ability of the knowledge base to conclude properly (i.e., evaluation) (Durcikova & Gray, 2009). Knowledge validation is essential when the reliability and credibility of the sources are questionable, and when there is a lack of access to relevant and truthful knowledge (ter Hoeven et al., 2019) – such as EHP. Knowledge verification of digital media allows for both indirect and direct knowledge conversion. Indirect knowledge conversion through reading online health information, and direct knowledge conversion by the ability to communicate with health professionals online.

Based on the above discussion, this study argues that digital media provides richer health content that will translate to higher knowledge quality and conversion, and ultimately deciding on partaking the treatment. Thus, we hypothesize:

Hypothesis 1a: Digital Media based knowledge verification is positively associated with health knowledge conversion.

Hypothesis 1b: Digital Media based knowledge verification is positively associated with practice decision.

With higher exclusivity of the practice, there may be fewer opportunities to attain information. Knowledge seekers and sources may hit a wall to validate or converse. Out of stem cell and umbilical practices, the exclusivity of knowledge may differ, thus, the study expects that the impact of knowledge validation on knowledge conversion may differ—however, prediction of a degree of which is difficult, without measuring the exclusivity intensity of these practices. Thus, the study explores how the knowledge validation to conversation relationship differs across these practices, without stating any specific hypothesis.

Studies have suggested that the Internet is the main source of information, especially when the information is about sensitive illnesses (M. Berger, Wagner, & Baker, 2005; Klein & Wilson, 2002). Individuals trust online sources for health information and advice (Sillence et al., 2007). However, this trust may be misplaced. Several recent studies have evaluated the content of health websites and have concluded that the quality of health information is poor (Arif & Ghezzi, 2018; Daraz et al., 2019; Ernst et al., 2019).

The MRT suggests that media channel perceptions are developed based on different user experiences (Carlson & Zmud, 1999). Through the knowledge conversion process, individual and shared experiences affect the perceived utility of media (Massey & Montoya-Weiss, 2006). Using the Internet for health-related purposes may be informative as users find relevant information. Yet, for others, seeking health information online may be confusing, and overwhelming (Jiang & Beaudoin, 2016). With such negative Internet experience, the impact of online health information seeking on perceived health information might be weakened (Kim, Lustria, Burke, & Kwon, 2007). In contrast, positive Internet experiences increase the ability to take advantage of the resources found online (Chang & Chen, 2008). For example, when online users seek predominant health information, less difficulty is encountered in processing health information (Josefsson, 2006). However, when the information is more exclusive and difficult to find, the perceived health information might be weakened (Qiu et al., 2017). Information overload on the Internet and limited attention contribute to the degradation of the Internet experience (Qiu et al., 2017). Therefore, the more a user trusts the Internet as a source, the more positive a user's experience will be, and thus, the more knowledge the user will gain (Gefen, Karahanna, & Straub, 2003) and the higher the intention to transact (McKnight, Choudhury, & Kacmar, 2002). MRT suggests that the more ambiguous the task, the more complex the channel needs to be for successful learning (Kock, 2005). Therefore, the richer media- or digital media- is utilized for ambiguous tasks (Nisar et al., 2019) such as information on EHP. Extending the focus beyond information seeking to seek exclusive health information on the Internet, the study expects to observe a similar pattern of association between trust in online sources and knowledge conversion and in turn, practice decision. Thus:

Hypothesis 2a: Individual's trust in the digital medium drives them to leverage from digital sources for knowledge conversion.

Hypothesis 2b: Individual's trust in the –digital medium drives them to leverage from digital sources for practice decisions.

The infinite amount of information offered by the Internet makes searching for information on usually time-consuming and thus reducing the media utility of the channel (Eysenbach & Jadad, 2001). Internet users frequently experience confusion caused by the mass amount of poorly organized information available with variable quality and relevance (Eysenbach & Jadad, 2001; Qiu et al., 2017). Also, health information online has been produced at a higher reading level than the estimated average reading level of an average patient (Meghan, Paul, Hussein, Cross, & Della Valle, 2017). Expectedly patients will experience even more confusion, trying to find and comprehend the intended information (Swar, Hameed, & Reyhach, 2017). With higher exclusivity of the practice, it may be even more confusing and more difficult to find and process the information. Therefore, the degree of exclusivity might differ in the relationship between trust and knowledge conversion. Again, how trust in the Internet and knowledge conversion relationship differs across the two EHP: stem cells and umbilical cord blood is explored, without stating any specific hypothesis. Nevertheless, the interaction of trust in the Internet and knowledge verification should influence the knowledge conversion and in turn, practice decision.

Access to reliable information is linked to reduced anxiety and trust (Sohaib & Kang, 2017). Studies have shown that educating patients with reliable information is effective in preventing and reducing anxiety (Garcia, 2014). While the Internet may cause information overload anxiety (Reinecke

et al., 2017; Swar et al., 2017), it can also lead to reduced anxiety when the information is reliable and understandable (Alnafea, Fedele, Porter, & Ni Riordain, 2017). In line with MRT, when a user trusts the Internet the user will be able to attain a better experience and a more reliable and understandable experience (Sbaffi & Rowley, 2017) as well as the decision to conduct a transaction (Sohaib, Kang, & Nurunnabi, 2019). Following through with MRT, studies have shown that when a user trusts the media channel, the user will gain more knowledge as compared to when the user has had a bad experience with the channel (Lipowski & Bondos, 2018; Tseng et al., 2017). Therefore, the study hypothesizes that the more a user trusts the digital source, the more knowledge will be validated and thus the higher the knowledge converted.

Hypothesis 3a: Trust moderates the relationship between digital media, knowledge verification, and their impact on knowledge conversion.

Hypothesis 3b: Trust moderates the relationship between digital media, knowledge verification, and their impact on practice decisions.

Patient choices need to be based on good information. The more knowledge a patient has, the more confident the patient will be in making an informative decision (Frieden, 2017). Decision-making on health treatments should be guided by informative knowledge (Nguyen, Mosadeghi, & Almario, 2017). According to MRT users will receive more information through richer media, and this information tends to be easier to interpret, assimilate, and involves lower cognitive costs (Maity, Dass, & Kumar, 2018). The Knowledge-to-Action framework (Graham et al., 2006) emphasizes crucial steps toward selecting and implementing health interventions and decisions (Gagné & Boulet, 2018). The framework is composed of two main components (1) Knowledge creation and (2) Action. Various studies in the health care field (Bjørk et al., 2013; Hua et al., 2012; Stacey et al., 2009) have shown the importance of knowledge creation before taking action. Thus, the study hypothesizes that knowledge conversion is a mediator for the relationship between knowledge verification, trust, and their impact on practice decisions.

Hypothesis 4: The impact of knowledge verification and trust on practice decision is mediated by knowledge conversion.

The US and Kuwait have different cultural contexts. National culture is a collective mindset that distinguishes members of one nation from another, differentiated by value dimensions such as individualism, power distance, and uncertainty avoidance—that are relevant to the context of knowledge exploration and validations concepts used in this study (Hofstede, 2003; Triandis, 2018). Extant research has used the value dimensions to explain the use of the Internet for knowledge seeking significantly improves across time (Lane, Khuntia, Parthasarathy, & Hazarika, 2017). Prior research has alluded to these factors to explore the usage of technology and digital media to impact communication and coordination (de Mooij, 2017; Gonzalez-Loureiro, Sousa, & Pinto, 2017; Thoumrungroje, 2018), website design and trust among various cultures (Cyr, 2013), and in uncertainty avoidance (Sohaib, Kang, & Miliszewska, 2019).

This study argues that individuals in Kuwait and the US, driven by individual values, will leverage differently from the knowledge validation to the conversion process using the Internet. For instance, Kuwait is reflected as a collectivistic value-driven culture with Hofstede Individualism score of 25, whereas the US has a 91 score. Individualism refers to the degree of interdependence, and lower scores reflect that ties between people are strong. Being collective denotes that individuals in Kuwait are integrated into strong cohesive groups, with loyalty and commitments to the group. Individuals in collective cultures will base their self-understanding on the reactions of others around them (Triandis, 2018; Yun, Mohan, & Zhao, 2017), in contrast to people in the US who will base

their self-understanding on their own independent actions regardless of what others think (Triandis, 2018; Zeffane, 2017).

Based on collectivistic culture, Kuwaiti Internet users are more likely to learn from online verification because they believe that such information is more likely to be associated with their societal pre-existing beliefs (Lucas, 2006). Individualistic cultures search for new information rather than verify the information at hand (Bhagat, Kedia, Harveston, & Triandis, 2002). Furthermore, collectivistic societies are more influenced by media as compared to individualistic societies (Singh, 2006). This is even more fitting when the type of knowledge is novel and exclusive. This arguably is the rationale to expect that individuals in Kuwait will have a stronger validation process of knowledge conversion in the stem cell and umbilical cord blood practice as compared to individuals in the US.

In a similar vein, Kuwait scores high in power distance trait, as compared to the US (score of 90 versus 40). Power distance in a given society indicates the differences in the intellectual spread of people. Cultures with large power distance tend to be hierarchical, while those with small power distance tend to value equality. In low power distance cultures where equality and independence are highly valued, people depend less on others and are more likely to use commercial sources for information (Stump & Gong, 2017). In contrast, in high power distance cultures, people rely on personal sources of recommendation and favor peer interaction rather than commercial sources (Stump & Gong, 2017). Consumers in larger power distance cultures will display a higher propensity to be influenced by digital media and communications than those in smaller power distance cultures (Singh, 2006). Expectedly, in cultures with high power distance, people will be more influenced by the information they are provided, and thus their validation process of knowledge conversion will be higher than cultures with low power distance.

Uncertainty avoidance reflects on the ambiguous situations in a culture. Societies feel endangered by these situations, and thus, create principles that try to avoid these. A high score means the society prefers to avoid uncertainty, and a low score means the society tolerates ambiguity. Kuwait scores 80 on this dimension (versus 46 for the US) and thus prefers avoiding uncertainty. Kuwait is a culture that is highly intolerant of ambiguity, and to minimize the anxiety associated with the uncertainty, the society will exploit knowledge to confirm information.

Kuwait is a collectivist society with higher power distance and uncertainty avoidance traits than the US. Given the differences between the two cultures, the study expects that the impact of knowledge validation and trust on knowledge conversion and practice decisions may differ. In particular:

Hypothesis 5a: Users residing in Kuwait will have a higher knowledge conversion impact than users residing in the US.

Hypothesis 5b: Users residing in Kuwait will have a higher practice decision impact than users residing in the US.

RESEARCH METHODS

The dataset comes from primary survey data, which was developed and tested on two distinct populations, Kuwait and the US. These two countries are exemplars of collectivist and individualistic cultures, respectively in 2017. Offline and online surveys were conducted. A pilot-test was conducted on a sample of 18 in Kuwait and the US for both offline and online surveys. The refinement process was minor and mainly focused on the wording of the items. The final survey questionnaire is provided in Table 1.

The survey in Kuwait was conducted over two months from May 2017 to July 2017, and the sample is composed of 506 responses. The survey in the US was conducted over 2 months from October 2017 to December 2017 and the sample is composed of 215 responses. The survey items were based on existing validated scales. Around 63% of the overall sample were female (Appendix displays detailed descriptive statistics on the respondent's demographics and characteristics). While only 1% of the

Table 1. Description of variables

Variable	Description
Dependent Variables	
PD_UMB	Practice decision to undergo a treatment using umbilical cord blood therapy. Question: Would you store the cord blood of your newborn? Yes___, No___, Not sure___. The variable was coded as 1 if the response is Yes, and 0 otherwise.
PD_STEM	Practice decision to undergo a treatment using stem cell therapy. Question: Have you visited websites of centers offering stem cell therapies? Yes___, No___. The variable was coded as 1 if the response is Yes, and 0 otherwise.
KC_STEM	Knowledge conversion from a general level of knowledge to more specific practice knowledge regarding stem cell therapy. KC_STEM = Practice level detailed knowledge of stem cell therapy (PK_STEM) – General knowledge of stem cell therapy (GK_STEM). Questions: Select the appropriate answer: 1. Stem cells can cure neurological disorders like Alzheimer’s and Parkinson’s diseases. Yes___, No___, I do not know___. 2. Stem cells can cure diabetes. Yes___, No___, I do not know___. 3. Stem cells can cure spinal cord injuries and paralysis. Yes___, No___, I do not know___. 4. Stem cells can cure heart diseases. Yes___, No___, I do not know___. 5. Stem cells can cure cancer. Yes___, No___, I do not know___. 6. Stem cells can stop the process of aging. Yes___, No___, I do not know___. 7. Stem cells are involved in bone marrow transplants. Yes___, No___, I do not know___. 8. Stem cells can cure infertility. Yes___, No___, I do not know___. 9. Stem cell therapies are very safe. Yes___, No___, I do not know___. 10. Have you heard about Stem cell medical Centers in the US? Yes___, No___, I do not know___. 11. Have you heard about any stem cell research being performed in the US? Yes___, No___, I do not know___. 12. Have you come across any stem cell awareness campaigns in the US? Yes___, No___, I do not know___. 13. Have you heard of medical centers that treat patients with stem cells outside of the US? Yes___, No___, I do not know___. 14. The stem cell centers you heard of where in which countries? Fill in the blank _____ Yes___, No___, I do not know___. Coding: The score for practice knowledge was coded by taking the responses to the survey items 10-14, where 1 indicates “Yes”, and 0 otherwise; The score for general knowledge was coded by taking the responses to the survey items 1-9, where 1 indicates “Yes”, and 0 otherwise For each group of coded responses (i.e. general, practice), items were tested for reliability with Cronbach’s alpha. Then a single generated scale was constructed for general and practice knowledge, respectively. The two scaled variables, which were mean-centered around zero, were then differenced (practice knowledge – general knowledge) to represent knowledge conversion.
KC_UMB	Knowledge conversion from a general level of knowledge to more specific practice knowledge regarding umbilical cord therapy. KC_UMB = Practice level detailed knowledge of umbilical cord therapy (PK_UMB) – General knowledge of umbilical cord therapy (GK_UMB). Questions: Select the appropriate answer: 1. Umbilical cord blood can cure leukemia. Yes___, No___, I do not know___. 2. Umbilical cord blood can cure neurodegenerative diseases such as Parkinson’s and Alzheimer’s. Yes___, No___, I do not know___. 3. Umbilical cord blood can cure diabetes. Yes___, No___, I do not know___. 4. Umbilical cord blood can cure paralysis. Yes___, No___, I do not know___. 5. The amount of umbilical cord blood collected after birth is sufficient to treat adults. Yes___, No___, I do not know___. 6. Umbilical cord blood can treat the baby from any genetic diseases he might carry. Yes___, No___, I do not know___. 7. The stored umbilical cord blood is sufficient to cure diseases that might affect the baby later in adulthood. Yes___, No___, I do not know___. 8. Have you heard of umbilical cord blood banking? Yes___, No___, I do not know___. 9. Is the cord blood banking service provided in the US? Yes___, No___, I do not know___. 10. Have you come across any umbilical cord blood campaigns? Yes___, No___, I do not know___. Coding: The score for practice knowledge was coded by taking the responses to the survey items 8-10, where 1 indicates “Yes”, and 0 otherwise; The score for general knowledge was coded by taking the responses to the survey items 1-7, where 1 indicates “Yes”, and 0 otherwise For each group of coded responses (i.e. general, practice), items were tested for reliability with Cronbach’s alpha. Then a single generated scale was constructed for general and practice knowledge, respectively. The two scaled variables, which were mean-centered around zero, were then differenced (practice knowledge – general knowledge) to represent knowledge conversion.

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Table 1. Continued

Variable	Description
Independent Variables	
DIGITAL_VER	Digital media-based knowledge verification. Confirmatory verification of knowledge using digital sources (e.g., internet and social media) for a health condition or disease. Questions: After seeing a doctor I also check the following for more information (Choose all that apply): Internet websites __, Social Media (Twitter, Facebook, Instagram, etc.) __, Books __, Friends and family (non-specialists) __, None __. Coding: The design variables (i.e. eight-items checklist) were transformed into seven dummy variables, where checked responses to each item were coded as 1, or 0 otherwise. Factor analysis was then conducted, and a factor with high loading scores on “Internet Website” and “Social Media” was chosen to represent digital media-based knowledge verification.
DIGITAL_TRUST	Trust in the digital media (e.g., internet and social media) for public health information. Questions: From a scale of 1-5 (1: Strongly Disagree; 2: Disagree; 3: Neither Agree nor Disagree; 4: Agree; 5: Strongly Agree), please answer the following: 1. In general, most people can be trusted. 2. In general, I am very careful dealing with people. 3. In general, most people try to be fair. 4. Most people in the healthcare system will try to take advantage of you if they get a chance. 5. I am confident in hospital doctors. 6. I am confident in the health information I find on the internet. 7. I believe that the doctors’ interest is in the care of the patient above the interest of his own financial benefit. The items were tested for reliability with Cronbach’s alpha, and then a single variable with mean-centered and standardized values was constructed.
Variables Used as Controls and for Additional Analyses	
DIGITAL_EVL	Digital media-based knowledge evaluation. The extent to which digital media was used as an exploratory search about a health condition or disease. Questions: Before seeing a doctor I check the following for more information (Choose all that apply): Internet websites __, Social Media (Twitter, Facebook, Instagram, etc.) __, Books __, Friends and family (non-specialists) __, None __. Coding: The design variables (i.e. eight-items checklist) were transformed into seven dummy variables, where checked responses to each item were coded as 1, or 0 otherwise. Factor analysis was then conducted, and a factor with high loading scores on “Internet Website” and “Social Media” was chosen to represent digital media-based knowledge evaluation.
DIGITAL	Use of digital media sources (e.g., internet and social media) as a health information source. Questions: 1- In general, your primary source of health and medical information is: Internet websites __, Doctors and Specialists __, Friends and family (non-specialists), Books __, TV __, Newspapers and magazines __, Social media (Twitter, Facebook, Instagram, etc.) __. 2- If you had a health-related question, whom would you ask first? Internet websites __, Doctors and Specialists __, Friends and family (non-specialists), Books __, TV __, Newspapers and magazines __, Social media (Twitter, Facebook, Instagram, etc.) __. Coding: The variable was coded by taking the responses to the following survey items 1-2. “Internet websites” and “Social Media” were coded as 1, and 0 otherwise. The two items were tested for reliability with Cronbach’s alpha, and then a single generated scale was constructed.
HUMAN_EVL	Human-based knowledge evaluation. The extent to which human source was used as an exploratory search about a health condition or disease. Question: Before seeing a doctor I check the following for more information (Choose all that apply): Internet websites __, Social Media (Twitter, Facebook, Instagram, etc.) __, Books __, Friends and family (non-specialists) __, None __. Coding: The design variables (i.e. eight-items checklist) were transformed into seven dummy variables, where checked responses to each item were coded as 1, or 0 otherwise. Factor analysis was then conducted, and a factor with high loading scores on “Friends and Family” was chosen to represent human knowledge evaluation.
HUMAN_VER	Human-based knowledge verification. Confirmatory verification of knowledge using human sources (e.g., doctor, friends, and family) for health condition or disease. Question: After seeing a doctor I also check the following for more information (Choose all that apply): Internet websites __, Social Media (Twitter, Facebook, Instagram, etc.) __, Books __, Friends and family (non-specialists) __, None __. Coding: The design variables (i.e. eight-items checklist) were transformed into seven dummy variables, where checked responses to each item were coded as 1, or 0 otherwise. Factor analysis was then conducted, and a factor with high loading scores on “Friends and Family” was chosen to represent human knowledge verification.
CULTURE	Place of residence, Kuwait (Culture = 1) or US (Culture =0).

continued on following page

Table 1. Continued

Variable	Description
DOCTOR	<p>Use of doctor as a source of health information.</p> <p>Questions:</p> <p>1- In general, your primary source of health and medical information is: Internet websites___, Doctors and Specialists___, Friends and family (non-specialists), Books___, TV___, Newspapers and magazines___, Social media(Twitter, Facebook, Instagram, etc.)___.</p> <p>2- If you had a health-related question, whom would you ask first? Internet websites___, Doctors and Specialists___, Friends and family (non-specialists), Books___, TV___, Newspapers and magazines___, Social media (Twitter, Facebook, Instagram, etc.)___.</p> <p>Coding: The variable was coded by taking the responses to the survey items 1-2. “Doctors and Specialists” were coded as 1, and 0 otherwise. The two items were tested for reliability with Cronbach’s alpha, and then a single generated scale was constructed.</p>
INT_FREQ	<p>Frequency use of the Internet.</p> <p>Question: How often do you use the Internet? Every day___, 2-3 times a week___, Once a week___, Once in 2-3 weeks, Once a month___, Once in 3 months___, Less than a few times a year___, Never___.</p> <p>Coding: The score for the variable was coded by taking the responses to the question. Where the checked responses to the ordered category choice sets (i.e. seven) were transformed into corresponding numerical values. The ordered categories where responses were low were combined, resulting in three intervals.</p>
SM_FREQ	<p>Frequency use of Social Media.</p> <p>Question: How often do you use social media? 3 hours a day or more___, 1-2 hours a day___, 30 mins a day___, Once a day___, Few times a week___, Few times a month___, Once a month or less___, Never___.</p> <p>Coding: The score for the variable was coded by taking the responses to the question. Where the checked responses to the ordered category choice sets (i.e. eight) were transformed into corresponding numerical values. The ordered categories where responses were low were combined, resulting in four intervals.</p>
AGE	<p>Age.</p> <p>Question: Age: Less than 18___, 18-24___, 25-30___, 31-35___, 36-40___, 41-45___, 46-50___, 51-60___, 61-70___.</p> <p>Coding: The variable was coded by taking the responses to the question, where the checked responses to the ordered category choice sets (i.e. eight) were transformed into corresponding numerical values.</p>
GENDER	<p>Gender.</p> <p>Question: Gender: Female___, Male___.</p> <p>Coding: The variable was coded by Female = 1 and Male = 0.</p>
EDUCATION	<p>Education level.</p> <p>Question: Education: Less than High School___, High school graduate___, Associate Degree___, Bachelor’s degree___, Master’s degree___, PhD___.</p> <p>Coding: The variable was coded by taking the responses to the question, where the checked responses to the ordered category choice sets (i.e. six) were transformed into corresponding numerical values.</p>
INCOME	<p>Household income level.</p> <p>Question: Annual household income: Less than \$20,000___, \$20,000 - \$49,000___, \$50,000 - \$74,999___, \$75,000 - \$149,999___, \$150,000-\$249,999___, \$250,000 or higher___.</p> <p>Coding: The variable was coded by taking the responses to the question. Where the checked responses to the ordered category choice sets (i.e. six) were transformed into corresponding numerical values. For the survey administered in Kuwait, US dollar intervals were converted to equivalent Kuwaiti monetary figures accordingly.</p>

sample is 18 years of age or less, 48% of the sample fall within the 18-24 year age group, 21% fall in the 25-30 age group, 10% in the 31-35 age group, and the rest of the sample is above 35 years of age. Around 60% of the sample have at least a Bachelor education level, 14% have Associate, 14% have high school and 10% of the sample have Masters or Ph.D. In terms of income level around 28% of the sample make less than \$20,000 annually, 22% make \$20,000-\$49,000, and the rest of the sample make \$50,000 or more. About 96% of the sample use the Internet on a daily basis and around 52% of the sample use social media for 3 hours a day or more. One interesting phenomenon observed is the greater reliance on the online information source for health-related information. For instance, of the survey participants who answered a survey question about the primary sources of health and medical information, 43% reported consulting a doctor or specialists, whereas 67% used the internet or social media. Although we had some concerns about the health background of the respondents, the fact that almost all the sample use the Internet on a daily basis and most of the sample uses the digital channels as a primary source of health information suggests that this sample was appropriate to examine knowledge conversion from the Internet and digital sources. Table 2 displays the descriptive statistics and the pairwise correlations amongst the variables.

Table 2. Summary statistics and pairwise correlations amongst variables

	Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	KC_UMB	0.00	1.50	-3.86	3.21	1.00																		
2	KC_STEM	0.02	1.44	-3.63	4.41	0.44	1.00																	
3	PK_UMB	0.00	1	-2.78	3.75	-0.70	-0.19	1.00																
4	PK_STEM	0.00	1	-2.92	3.55	-0.17	-0.70	0.24	1.00															
5	GK_UMB	0.00	1	-1.52	2.35	0.70	0.25	0.02	0.00	1.00														
6	GK_STEM	0.00	1	-1.35	4.84	0.27	0.70	-0.03	0.02	0.35	1.00													
7	HUMAN_VER	0.00	0.75	-0.90	2.38	-0.02	0.02	0.05	-0.05	-0.08	0.00	1.00												
8	DIGITAL_VER	0.00	0.94	-1.87	1.09	0.15	0.14	-0.07	-0.07	0.10	0.11	-0.03	1.00											
9	HUMAN_EXP	0.00	0.82	-1.53	2.22	0.00	-0.02	0.03	0.00	-0.05	-0.02	0.35	-0.11	1.00										
10	DIGITAL_EVL	0.01	0.95	-2.11	0.72	0.03	0.02	0.03	0.04	0.04	0.09	-0.17	0.40	0.00	1.00									
11	DOCTOR	0.43	0.50	0.00	1.00	0.06	0.01	0.04	-0.03	0.02	-0.02	0.09	-0.10	0.03	-0.15	1.00								
12	DIGITAL	0.67	0.47	0.00	1.00	-0.01	0.02	0.01	0.06	-0.01	0.06	-0.09	0.14	-0.03	0.13	-0.74	1.00							
13	DIGITAL_TRUST	0.00	0.50	-1.20	1.85	-0.01	0.02	0.05	0.02	-0.06	0.05	0.10	-0.06	0.05	-0.04	0.07	-0.05	1.00						
14	INT_FREQ	2.95	0.26	1.00	3.00	0.01	0.00	-0.01	0.02	0.05	0.06	0.06	-0.09	0.14	-0.01	0.00	0.02	-0.06	1.00					
15	SM_FREQ	3.30	0.84	1.00	4.00	-0.05	-0.01	-0.03	-0.02	0.00	-0.09	0.02	0.03	-0.06	-0.02	0.01	0.04	0.02	-0.16	1.00				
16	AGE	2.47	1.89	0.00	8.00	0.09	0.00	-0.06	-0.03	0.07	-0.03	-0.07	-0.01	-0.04	-0.08	-0.01	-0.05	-0.06	-0.28	-0.18	1.00			
17	EDUCATION	3.25	1.02	0.00	6.00	0.19	0.07	-0.12	-0.02	0.15	0.08	-0.17	0.00	-0.18	-0.05	-0.16	-0.09	-0.14	0.13	0.07	0.15	1.00		
18	GENDER	1.27	0.45	1.00	2.00	-0.04	-0.03	0.01	0.02	-0.05	-0.02	0.03	-0.06	0.00	-0.04	0.13	0.01	0.11	0.01	-0.20	0.07	-0.09	1.00	
19	INC	2.24	2.24	0.00	7.00	-0.03	0.03	0.07	0.01	0.03	0.05	-0.03	0.04	-0.06	0.06	0.00	-0.01	-0.05	-0.03	-0.15	0.42	0.16	0.26	1.00

The main dependent variable to explore patients' medical practice decisions was operationalized with a questionnaire asking subjects whether they would consider undertaking a medical treatment procedure. The variable was operationalized using several questions written by a panel of stem cell specialists for each practice. General knowledge refers to the extent to which subjects possess general knowledge about the stem or umbilical cord as a potential treatment to improve one's health condition. Practice knowledge refers to the extent to which subjects are aware of facilities or places to receive stem and umbilical cord treatments to improve health conditions. The internal consistency of the items was tested using Cronbach's alpha, and the standardized score was generated for practice and general knowledge, respectively. Knowledge conversion is then derived by calculating the difference between the two scores.

The main variable of interest is the health information source; more specifically, knowledge acquired from a Digital Source (DIGITAL), such as the internet or social media. Intended use of health information source for knowledge validation is also considered, which comprise of knowledge evaluation and knowledge verification, the latter of which this study focuses on knowledge verification (DIGITAL_VER) as a key variable of interest in the model. The operationalization of these variables was accomplished by two questionnaires with multiple checklists of seven items. Subjects answered where they obtain health-related information, prior and post-doctor visits, respectively. Each selected checklist item was coded as a dummy variable, totaling six dummy variables. Factor analysis was used to reduce the dimensionality of the variables, and factors with the highest loading scores that represent human and digital sources were selected for inclusion in the model. Thus, four variables along the dimensions of health information source (i.e., human, digital) and knowledge purpose (i.e., evaluation vs. verification) are included in the model specification.

Trust in public health information for both direct and moderating effects of health information source on knowledge conversion and subsequent practice decision is then examined. More specifically, trust in the internet (TRUST_DIGITAL) as a public health information source. Last, cultural differences (individualistic culture versus collectivistic culture) are contrasted and operationalized (CULTURE) by a single questionnaire asking subjects about their place of residence – US or Kuwait.

In addition to these key variables of interest, several control variables are included to account for counterfactual explanations for knowledge conversion. Health information acquired from humans such as family or friends. In addition, whether or not the user has consulted doctors for health information, whether or not the user has used the internet or social media for health information. A user's trust score in public health and health practitioners. Frequency of internet use and frequency of social media use. Lastly, demographic variables such as age group, education level, gender, and income level are also controlled.

The empirical model specifies the knowledge conversion and practice decision of exclusive practices in health care as key dependent variables. Knowledge conversion and practice decision for two levels of EHP is operationalized, with stem cells and umbilical cord as a baseline and more EHP, respectively. Formal specification of the general model is as follows.

Knowledge Conversion Model

$$(KC_UMB, KC_STEM)_i = \beta_0 + \beta_1 DIGITAL_VER_i + \beta_2 DIGITAL_TRUST_i + \beta_3 DIGITAL_VER_i \times TRUST + \beta_4 CULTURE_i + \beta_c Controls_i + \varepsilon_i \quad (1)$$

Practice Decision Model

$$(D_UMB, D_STEM)_i = \beta_0 + \beta_1 DIGITAL_VER_i + \beta_2 DIGITAL_TRUST_i + \beta_3 DIGITAL_VER_i \times TRUST + \beta_4 CULTURE_i + \beta_c Controls_i + \beta_{10} KC_HAT_i + \varepsilon_i \quad (2)$$

where *Controls* are control variables, the general use of the Internet (INT_FREQ), the general use of social media (SM_FREQ), and several demographic variables including educational level (ED), age group (AGE), income (INCOME), and gender of the survey respondents (GENDER).

Seemingly unrelated regression (SUR) is used to estimate the β coefficients of the key parameters and employ robust standard errors to test the hypotheses. Last, ε are disturbances associated with each observation. The practice decision model uses the predicted values of knowledge conversion from the first stage model (KC_HAT).

Table 3. Key estimation results and support for hypotheses

Variables	Knowledge Conversion				Practice Decision				Hypothesis Supported
	(1)		(2)		(1)		(2)		
	KC_UMB	KC_STEM	KC_UMB	KC_STEM	D_UMB	D_STEM	D_UMB	D_STEM	
Knowledge Conversion (KC_STEM, KC_UMB)					0.546*** (0.04)	0.317*** (0.04)	0.544*** (0.04)	0.314*** (0.04)	H4 supported
Digital Source (DIGITAL)	0.092* (0.05)	0.103** (0.05)			-0.062 (0.05)	-0.011 (0.06)			H1a supported H1b not supported
Digital Knowledge Verification (DIGITAL_VER)			0.210*** (0.06)	0.193*** (0.06)			-0.035 (0.07)	0.015 (0.07)	H1a supported H1b not supported
Trust on Internet (DIGITAL_TRUST)	-0.003 (0.05)	0.049 (0.05)	0.009 (0.05)	0.055 (0.05)	-0.037 (0.06)	-0.003 (0.06)	-0.036 (0.06)	-0.002 (0.06)	H2 not supported
Digital Source x Trust (DIGITAL x DIGITAL_TRUST)	0.030 (0.05)	0.106** (0.05)			0.048 (0.05)	-0.044 (0.06)			H3a supported H3b not supported
Digital Verification x Trust (DIGITAL_VER x DIGITAL_TRUST)			0.060 (0.06)	0.093* (0.06)			0.041 (0.06)	-0.007 (0.07)	H3a supported H3b not supported
Culture (CULTURE)	0.015 (0.14)	0.541*** (0.14)	0.055 (0.14)	0.667*** (0.14)	0.220 (0.15)	0.431** (0.17)	0.201 (0.16)	0.474*** (0.17)	H5a supported. H5b supported.
R-squared/Chi-sq.	0.08	0.02	0.10	0.03	227.08***		228.43***		
Controls	YES								
Observations	721				707				

Note: Robust standard errors in parentheses. Wald test was used to compare coefficients across two equations. Variable abbreviations in brackets represent dependent variables used in SUR. Variable abbreviations in parentheses represent independent variables. *** p<0.01, ** p<0.05, * p<0.1.

RESULTS

Table 3 displays the key results from two specification models. The medical practice decision is preceded by knowledge conversion. For each stage, two specifications operationalize knowledge validation from a digital source, which can further be decomposed into knowledge evaluation and verification, as a single composite variable for the first model, and as two independent variables for the second model, respectively. With the specification, the study compares and contrasts two related but different medical practices – i.e., umbilical cord and stem cells.

The first set of findings are relevant to the use of digital sources for knowledge verification on knowledge conversion and practice decision. The use of digital sources for health information has positive and significant coefficients across the two models on knowledge conversion. For a unit increase

in the digital source (DIGITAL), individuals gain an approximately 0.1 unit increase in knowledge conversion. The digital knowledge conversion variables are standardized, and the interpretation of a unit change implies a unit change in the standard deviation. However, the digital source does not affect the practice decision.

An alternative specification for the digital source use for health information decomposes the digital source use from general to more specific; that is, the use of digital sources for knowledge verification, renders similar results. Our findings show that for those patients who use digital sources primarily to verify the information they have acquired, the effects positively influence knowledge verification. The coefficients on digital knowledge verification (DIGITAL_VER) is positive and statistically significant for both umbilical cords (i.e., $\beta=0.210$, $p\text{-level}<0.01$), and stem cells (i.e., $\beta=0.193$, $p\text{-level}<0.01$). However, digital knowledge verification does not affect the practice decision. Thus, the results from both specifications confirm that hypothesis H1a is supported, but H1b is not supported.

The second set of findings are relevant to the role of trust in the Internet, and how it affects patients' knowledge conversion and practice decision. Our findings show that the direct effect of trust in the Internet as a public source of health information (TRUST) does not influence knowledge conversion or practice decision. Thus, hypothesis H2 is not supported. However, our findings show that trust in the Internet positively moderates digital sources across both models. While the effect is positive for both umbilical cord and stem cells, the effect is statistically significant only for the stem cells (i.e., $\beta=0.106$, $p\text{-level}<0.01$). The result shows that the moderating effect of trust does not affect practice decisions. Thus, hypothesis H3a is supported, but H3b is not supported.

Lastly, we test for the mediating effect of knowledge conversion on the practice decision. Our findings show that the coefficients for both umbilical practice decision (D_UMB) (i.e. $\beta=0.544$, $p\text{-level}<0.01$) and stem cell practice decision (D_STEM) (i.e., $\beta=0.314$, $p\text{-level}<0.01$) are positive and statistically significant. Thus, hypothesis H4 is supported. Sobel tests were conducted and found that that the mediation effect of knowledge conversion is partial, with less than 60% mediation effect influencing the practice decision.

Table 4. Robustness checks

Variables	Knowledge Conversion		Practice Decision	
	KC_UMB	KC_STEM	D_UMB	D_STEM
Practice Knowledge (PK_STEM, PK_UMB)			1.633*** (0.11)	0.875*** (0.08)
Digital Knowledge Verification (DIGITAL_VER)	0.107** (0.04)	0.091** (0.04)	-0.061 (0.09)	-0.027 (0.08)
Trust on Internet (TRUST)	0.003 (0.04)	0.048 (0.04)	-0.019 (0.08)	-0.049 (0.07)
Digital Verification x Trust (DIGITAL_VER x TRUST)	0.079** (0.04)	0.090** (0.04)	-0.043 (0.08)	-0.056 (0.08)
Culture (CULTURE)	0.077 (0.10)	0.310*** (0.10)	0.234 (0.22)	0.746*** (0.20)
R-squared/Chi-sq.	0.06	0.04	331.80***	
Controls	YES			
General Knowledge Control	YES			
Observations	721		707	

* $p<0.10$, ** $p<0.05$, *** $p<0.01$; +Variables in brackets represent equations estimated.

Table 4 shows a similar result using an alternate specification of knowledge conversion, where practice knowledge with general knowledge as control was used to proxy knowledge conversion. Last, whether the differences in both exclusivities of practices and use of the digital source for verifying

Table 5. Comparison of digital verification: the U.S. vs. Kuwait*

Variables	Knowledge Conversion		Practice Decision	
	KC_UMB	KC_STEM	D_UMB	D_STEM
Digital Knowledge Verification (DIGITAL_VER)	5.88***	3.07*	0.00	0.64
Digital Verification x Trust (DIGITAL_VER x TRUST)	3.71*	3.66*	0.50	0.35

*p<0.10, **p<0.05, ***p<0.01; †Wald-test was employed to compare coefficients across subsamples drawn for U.S. and Kuwait.
Chi-square statistics with statistical significance is displayed for knowledge conversion and practice decision.

health information acquired from medical experts influence knowledge conversion was tested.

As shown in Table 5, Wald-test was used to jointly test that the coefficients of digital knowledge verification and culture against the null hypothesis. The chi-square test statistics from Knowledge Conversion for both umbilical cord and stem cells support that digital verification and the moderating effect of trust on digital verification effects are different across Kuwait and the U.S. However, for Practice Decision, the difference across culture is not statistically significant. For Knowledge Conversion, subjects residing in Kuwait are more likely to exhibit higher knowledge conversion (i.e., 0.310, p-level <0.01). For Practice Decision, subjects residing in Kuwait are more likely to undergo medical treatment for stem cells (i.e., 0.746, p-level <0.01), supporting hypotheses 5a, and 5b.

DISCUSSION

This study explores how the Internet is a factor in supporting the spread of stem cell therapy practices, viewing it from a knowledge validation theoretical perspective. The findings of this study provide interesting insights. The study finds that digital media as compared to offline media leads to higher levels of knowledge conversion in EHP and practice decisions. Knowledge verification in digital media leads to higher knowledge conversion and the decision to partake in practice.

Furthermore, trust in digital sources moderates the knowledge validation relationship, but only for less EHP. The relationships leading to knowledge conversion and practice decision are stronger for more collectivistic cultures, and cultures that are higher in power distance and uncertainty avoidance (e.g., Kuwait). These findings indicate that not only does the source of knowledge impact knowledge conversion, but also the knowledge validation process, the type of practice, and the culture impacts knowledge conversion and ultimately, the practice decision.

The finding that digital media leads to higher knowledge conversion and practice decision indicates the predominantly emerging role of the internet for health decision making as well as for deciding to partake in practice. Recent literature (Fox & Duggan, 2013; Ma & Atkin, 2017) asserts the developing role of the internet on health decision making. However, empirical validation has been sparse (Chen, Li, Liang, & Tsai, 2018). In supporting the internet knowledge derived for health decision-making, not only this study informs literature; but it also provides insights on how the internet enables health empowerment to patients, in at least in two ways.

First, given the brick and mortar institutionalized healthcare practice prevalent in most countries, seeking health decisions or treatment is difficult and costly. Furthermore, stories of unsafe drugs and medical errors have led patients to want to know more about their medical conditions and treatment

options (Tan & Goonawardene, 2017). Patients now want medical information to be backed up by sound evidence (Calvillo, Román, & Roa, 2015). In that realm, the internet has aided patients to become more proactive in making health-related decisions, reshaping the healthcare industry to become a more “patient-centric” industry.

Second, even if with the best health access, EHP may carry a stigma or reluctance to explore. For example, seeking information about HIV, or STD or plastic surgery is not a norm in many societies. That leads to satiation where the patients are reluctant to seek health, even if at an advanced stage of progression for some private diseases (Geana et al., 2017). The finding that the Internet can shape patients to explore health is informative in this sense, as enumerated in existing research (Permwonguswa, Khuntia, Yim, Gregg, & Kathuria, 2017).

Another important finding is the moderating role of trust. Although digital media and knowledge verification are positively associated with knowledge conversion and practice decisions, the effect is enhanced when the individual trusts the Internet. When the type of information is more general than more exclusive, this finding shows that while the Internet can be a useful source for general or more established health practices, it might be confusing for newer or more EHP and therefore individuals would prefer attaining their knowledge from a human than the Internet.

This study also explores the digital knowledge verification relationship in different cultures. The relationship is more strongly supported for more collectivistic cultures, and cultures that are higher in power distance and uncertainty avoidance. This finding highlights the importance of culture in terms of the knowledge validation process for health information. The nature of the culture profoundly influences how a citizen of that culture searches and validates her information. In a collectivistic culture like Kuwait, physicians have absolute authority to decide on the treatment, and patients must trust their doctors (Tan & Goonawardene, 2017). Patients in the collective culture seem to attain more knowledge conversion than patients in an individualistic culture. Such patients might feel a stronger need to validate their knowledge due to the hierarchal nature of the physician-patient relationship.

Implications

Knowledge validation and conversion concepts, although they have been suggested conceptually in existing literature, this study operationalizes and validates these concepts in a specific context. The practice concern of knowledge validation for exclusive treatments is a highly concerning aspect, and the role of the internet is underexplored. Within this realm, this study makes a significant contribution. To our knowledge, there is not a single study that addresses a theoretical tenet of ‘exclusive knowledge validation’ and that, to our knowledge is a significant contribution and direction for theory; and is a novel contribution to the information systems literature.

Beyond the new overarching concept of digital media knowledge validation framing, the study contributes to research in a couple of ways. First, the findings provide a deeper understanding of information systems artifacts in the health exclusive practice industry. The study suggests that the context of digital media validation has a critical role. Second, the study highlights the important role of trust in the media in terms of knowledge conversion and practice decision. Third, identifying how national culture interplays to influence knowledge conversion is a highlight of this study. These implications not only lead to unraveling the nuances associated with digital media knowledge validation but also extend concepts such as why certain types of cultures can have higher knowledge conversion than others.

In terms of managerial implications, health care providers should now be aware of the Internet informed patient. Thus, health care providers should help patients sort through the information derived from the Internet information offered by patients and guide them to reliable and accurate health websites (T. Lu et al., 2018; X. Lu, Zhang, Wu, Shang, & Liu, 2018). Healthcare organizations should utilize the power and impact of the Internet to their advantage by providing valuable digital information that can assist patients and link them to credible health-related digital information.

Furthermore, health knowledge websites now have a very strong role in the knowledge conversion of patients. Thus, these websites need to ensure that the information provided is easy to interpret and accurate (Maity et al., 2018).

Study Limitations

This study examines how patients validate their knowledge in the knowledge conversion process at a point in time. However, the patient might go back and forth in the learning process, and the validation method and source may change over time. This is a limitation of the study. Future studies could examine how a patient's learning behavior changes over time. Also, using the random sampling process of the public in both the US and Kuwait may include less familiar respondents to the study context. Thus, the generalization of the sample to a uniform national culture characteristic is a limitation of this study. A future study may focus on patients of such EHP and examine their knowledge validation and conversion directly.

CONCLUSION

In conclusion, this study is the first to propose a knowledge validation framing for health information in the EHP context. The concept of knowledge validation framing is explored using trust and type of EHP to provide a richer investigation of the knowledge conversion process and ultimately practice decision. Furthermore, knowledge validation interactions with the information source and trust in information sources draw further insights into the knowledge conversion process. The findings provide important insights that can be used by researchers to investigate different aspects of knowledge conversion further and by health policy management practitioners to develop strategies to increase the reliability of the available information.

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APPENDIX

Table 6. Age group of respondents

Age Group	% of Responses	US	Kuwait
0 – Less than 18	1.92%	0.00%	2.77%
1 – 18-24	48.76%	71.17%	38.93%
2 – 25-30	21.84%	19.37%	22.92%
3 – 31-35	10.16%	5.41%	12.25%
4 – 36-40	5.49%	2.70%	6.72%
5 – 41-45	3.30%	1.35%	4.15%
6 – 46-50	4.26%	0.00%	6.13%
7 – 51-60	3.71%	0.00%	5.34%
8 – 61-70	0.55%	0.00%	0.79%

Table 7. Gender of respondents

Gender	% of Responses	US	Kuwait
1 – Female	63.86%	45.22%	72.33%
2 – Male	36.14%	54.78%	27.67%

Table 8. Education level of respondents

Education Level	% of Responses	US	Kuwait
0 – Less than High School	1.09%	0.00%	1.58%
1 – High School	14.03%	31.58%	6.13%
2 – Associates	14.44%	26.75%	8.89%
3 – Bachelor	60.22%	39.91%	69.37%
4 – Masters	6.40%	0.88%	8.89%
5 – PhD	3.81%	0.88%	5.14%

Table 9. Income category level of respondents

Income Category	% of Responses	US	Kuwait
1 – Less than \$20,000	28.19%	23.04%	30.89%
2 – \$20,000 - \$49,000	22.94%	30.00%	19.22%
3 – \$50,000 - \$74,999	26.54%	20.43%	29.75%
4 – \$75,000 - \$149,999	15.89%	18.70%	14.42%
5 – \$150,000-\$249,999	3.60%	3.48%	3.66%
6 – \$250,000 or higher	2.85%	4.35%	2.06%

Table 10. Internet use frequency of respondents

Internet Use Frequency	% of Responses	US	Kuwait
1 - Once a week or less*	1.08%	0.43%	1.38%
2 - 2-3 times a week	2.57%	1.29%	3.16%
3 - Everyday	96.34%	98.28%	95.45%

*The responses to the following Internet Use Frequency categories – Once a week or less, Once in 2-3 weeks, Once a month, Once in 3 months, Less than a few times a year, and Never – were combined.

Table 11. Social media use frequency of respondents

Social Media Use Frequency	% of Responses	US	Kuwait
1 - Once a day or less*	2.57%	4.74%	1.58%
2 - 30 minutes a day	17.07%	23.28%	14.23%
3 - 1-2 hours a day	28.05%	35.78%	24.51%
4 - 3 hours a day or more	52.30%	36.21%	59.68%

*The responses to the following Social Media Use Frequency categories – Once a day, Few times a week, Few times a month, Once a month or less, and Never – were combined.

Table 12. Primary source of health information of respondents

Primary Source	% of Responses	US	Kuwait
Books	3.8%	2.4%	4.4%
Doctors and Specialists	43.9%	43.9%	43.9%
Friends or Family	8.2%	19.4%	3.1%
Internet/Social Media	66.9%	72.0%	64.6%
Other	2.7%	3.5%	2.3%

Table 13. Key estimation results of the main model

Variables	Knowledge Conversion				Practice Decision			
	(1)		(2)		(1)		(2)	
	KC_UMB	KC_STEM	KC_UMB	KC_STEM	D_UMB	D_STEM	D_UMB	D_STEM
Knowledge Conversion (KC_STEM, KC_UMB)					0.546*** (0.04)	0.317*** (0.04)	0.544*** (0.04)	0.314*** (0.04)
Digital Source (DIGITAL)	0.092* (0.05)	0.103** (0.05)			-0.062 (0.05)	-0.011 (0.06)		
Digital Knowledge Verification (DIGITAL_VER)			0.210*** (0.06)	0.193*** (0.06)			-0.035 (0.07)	0.015 (0.07)
Trust on Internet (DIGITAL_TRUST)	-0.003 (0.05)	0.049 (0.05)	0.009 (0.05)	0.055 (0.05)	-0.037 (0.06)	-0.003 (0.06)	-0.036 (0.06)	-0.002 (0.06)
Digital Source x Trust (DIGITAL x DIGITAL_TRUST)	0.030 (0.05)	0.106** (0.05)			0.048 (0.05)	-0.044 (0.06)		
Digital Verification x Trust (DIGITAL_VER x DIGITAL_TRUST)			0.060 (0.06)	0.093* (0.06)			0.041 (0.06)	-0.007 (0.07)
Culture (CULTURE)	0.015 (0.14)	0.541*** (0.14)	0.055 (0.14)	0.667*** (0.14)	0.220 (0.15)	0.431** (0.17)	0.201 (0.16)	0.474*** (0.17)
Digital Knowledge Evaluation (DIGITAL_EVL)			0.47 (0.06)	-0.011 (0.06)			0.093 (0.07)	0.051 (0.07)
Frequency of Internet Use (INT_FREQ)	0.050 (0.07)	-0.058 (0.08)	0.039 (0.07)	-0.059 (0.07)	-0.041 (0.08)	-0.148* (0.08)	-0.044 (0.11)	-0.153* (0.08)
Frequency of Social Media Use (SM_FREQ)	0.052 (0.07)	-0.63 (0.08)	0.046 (0.07)	-0.064 (0.07)	-0.035 (0.08)	-0.159* (0.08)	-0.036 (0.08)	-0.163** (0.08)
Age Group (AGE)	0.42 (0.04)	-0.027 (0.04)	0.44 (0.04)	-0.025 (0.04)	-0.58 (0.04)	0.010 (0.04)	-0.57 (0.04)	0.009 (0.04)
Gender (GENDER)	0.106 (0.11)	-0.139 (0.12)	0.161 (0.11)	-0.101 (0.12)	0.004 (0.12)	0.095 (0.14)	0.015 (0.13)	0.106 (0.14)
Education Level (EDUCATION)	0.168*** (0.06)	0.105* (0.06)	0.159*** (0.06)	0.101* (0.06)	0.030 (0.07)	-0.010 (0.07)	0.029 (0.07)	-0.015 (0.07)
Household Income Level (INCOME)	-0.060 (0.50)	0.053 (0.05)	-0.073 (0.05)	0.043 (0.05)	0.082 (0.05)	0.021 (0.06)	0.078 (0.05)	0.019 (0.06)
R-squared/Chi-sq.	0.08	0.02	0.10	0.03	227.08***		228.43***	
Observations	721				707			

Note: Robust standard errors in parentheses. Wald test was used to compare coefficients across two equations. Variable abbreviations in brackets represent dependent variables used in SUR. Variable abbreviations in parentheses represent independent variables. *** p<0.01, ** p<0.05, * p<0.1.

Table 14. Robustness checks

Variables	Knowledge Conversion		Practice Decision	
	KC_UMB	KC_STEM	D_UMB	D_STEM
Practice Knowledge (PK_STEM, PK_UMB)			1.633*** (0.11)	0.875*** (0.08)
Digital Knowledge Verification (DIGITAL_VER)	0.107** (0.04)	0.091** (0.04)	-0.061 (0.09)	-0.027 (0.08)
Trust on Internet (TRUST)	0.003 (0.04)	0.048 (0.04)	-0.019 (0.08)	-0.049 (0.07)
Digital Verification x Trust (DIGITAL_VER x TRUST)	0.079** (0.04)	0.090** (0.04)	-0.043 (0.08)	-0.056 (0.08)
Culture (CULTURE)	0.077 (0.10)	0.310*** (0.10)	0.234 (0.22)	0.746*** (0.20)
Digital Knowledge Evaluation (DIGITAL_EVL)	0.057 (0.04)	0.050 (0.04)	0.079 (0.09)	0.047 (0.08)
Frequency of Internet Use (INT_FREQ)	0.024 (0.05)	-0.053 (0.05)	-0.084 (0.11)	-0.183** (0.09)
Frequency of Social Media Use (SM_FREQ)	0.029 (0.05)	-0.054 (0.05)	-0.064 (0.11)	-0.166* (0.09)
Age Group (AGE)	0.014 (0.03)	-0.031 (0.03)	-0.068 (0.05)	0.018 (0.05)
Gender (GENDER)	0.023 (0.08)	-0.077 (0.08)	0.057 (0.17)	0.185 (0.15)
Education Level (EDUCATION)	0.093** (0.04)	0.111*** (0.04)	0.072 (0.09)	-0.093 (0.08)
Household Income Level (INCOME)	0.013 (0.03)	0.041 (0.03)	-0.048 (0.07)	0.042 (0.06)
R-squared/Chi-sq.	0.06	0.04	331.80***	
Observations	721		707	

*p<0.10, **p<0.05, ***p<0.01; +Variables in brackets represent equations estimated.

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