Healthcare professionals’ acts of correcting health misinformation on social media

John Robert Bautista, Yan Zhang, Jacek Gwizdka

Keywords: Authentication, Correction, Health misinformation, Nurses, Medical doctors, Social media

ABSTRACT

Background: Health misinformation on social media is a public health concern, and healthcare professionals can help correct it. However, research on how they correct health misinformation on social media is rare. Objective: To develop a conceptual model that demonstrates how healthcare professionals correct health misinformation on social media. Methods: In-depth semi-structured interviews were conducted between January and March 2020 with 30 U.S. healthcare professionals (15 registered nurses and 15 medical doctors). Participants were recruited through purposive and snowball sampling and interviewed via mobile phone calls (using their mobile phone number) or apps (via Zoom or Skype). Interview data were analyzed using a grounded theory approach. Results: This study presents a two-phased conceptual model that shows healthcare professionals’ acts of correcting health misinformation on social media (e.g., Twitter and Facebook). The first phase involves acts of authentication by which healthcare professionals verify health-related social media posts to be true or not. They undergo the process of internal acts of authentication (i.e., checking the author, checking for cues, checking the topic) and, if needed, external acts of authentication (i.e., examining the author and examining the content). When social media posts are deemed to contain health misinformation, they proceed to the second phase – acts of correction. In this phase, they undergo correction preparation (i.e., reflect, reveal, relate, and respect) and correction dissemination (i.e., private priming, public priming, public rebuttal, and private rebuttal). Conclusions: The study proposed a conceptual model that shows how healthcare professionals correct health misinformation on social media. The findings can guide healthcare professionals when identifying and correcting health misinformation on and off social media, and can guide health authorities when developing campaigns against health misinformation.

1. Introduction

Health misinformation refers to a “health-related claim of fact that is currently false due to a lack of scientific evidence” [1, p.E1]. In general, misinformation can have several forms, such as satire and parody, false connection, misleading content, false context, imposter content, manipulated content, and fabricated content [2]. Research indicates how pervasive health misinformation is on social media. For instance, a recent report shows that a majority of COVID-19 misinformation appear on social media platforms, such as Twitter, YouTube, and Facebook [3]. A majority were also identified to be reconfigured misinformation (i.e., those containing misleading content, false context, or manipulated content) and are spread by high-level politicians, celebrities, or other influential people [3]. Health misinformation is also spread by social bots, such as Twitter bots, that propagate vaccine misinformation [4,5]. Considering that false information on social media spread to more people and much faster than authentic information (i.e., information that is true and verified) [6], the United Nations (UN) [7] and World Health Organization (WHO) [8] consider health misinformation to be detrimental to public health, especially to efforts in controlling the spread of COVID-19.

To correct health misinformation, the UN has led an initiative of empowering people to share authentic health information on social media, paving the way for the creation of digital first responders (i.e., people who share authentic health information on social media and those who can potentially correct misinformation) [7]. Considering that
any person who uses social media can become a digital first responder, healthcare professionals serve as role models for others when it comes to correcting health misinformation on social media. This is more relevant as more healthcare professionals establish an online presence with some gaining prominence as social media influencers [9]. Recent news highlights by healthcare professionals to correct health misinformation on social media. For instance, the Wall Street Journal reports that several healthcare professionals in the US use Twitter to spread facts about COVID-19 to combat misinformation on it [10]. Similarly, the MIT Technology Review reports that a new generation of doctors use Twitter, YouTube, and TikTok to combat COVID-19 misinformation [11]. In general, healthcare professionals are leveraging social media to correct health misinformation. However, formal research is needed to understand how they do this.

Scholars have also highlighted the role of healthcare professionals in correcting health misinformation. For instance, Rubin [12] and Trehwey [13] argue that doctors are well-suited to mitigate health misinformation by using their social media presence and clinical expertise to fact-check medical information. Besides, O’Connor and Murphy [14] urge doctors to rebut health misinformation on social media and provide sources with the rebuttal. Likewise, Danielson et al. [15] encourage nurses to advocate for immunization and counter vaccine misinformation. Moreover, given that social correction of health misinformation on social media can reduce beliefs in health misinformation, Swire-Thompson and Lazer [16] encourage all health communicators, particularly healthcare professionals, to perform correction to spread accurate health information and dispel health misinformation on social media.

Despite numerous calls for healthcare professionals to correct health misinformation on social media, research on how they perform such an act is rare. As reflected above, published work on the role of healthcare professionals in correcting health misinformation focuses on recommendations in doing this and is primarily based on opinion (e.g., being on social media to rebut health misinformation, expert fact-checking, and developing a culture of fact-checking) [12-15]. Thus, empirical studies are needed to determine if such recommendations are reflective of how healthcare professionals are correcting health misinformation on social media. Studies are also limited to the effectiveness of government health agencies as sources of correction against health misinformation [17–19]. Although government (e.g., WHO and Centers for Disease Control and Prevention) [17–19] and non-government (e.g., The Cochrane Collaboration and FactCheck.org) [20,21] organizations serve as expert sources of health information, research should also focus on healthcare professionals since they are considered not only as experts but also trustworthy sources of authentic health information [16] who are now leveraging social media to interact with a global community of health information seekers [9]. Hence, understanding how healthcare professionals correct health misinformation on social media can serve as a catalyst in instituting programs aimed at encouraging them to counter health misinformation online and offline. Besides, misinformation-related conceptual models based on empirical data are limited to healthcare professionals’ intention to share medical rumors [22] and how individuals identify misinformation on social media with less emphasis on the process of correction [23-25].

To contribute to the literature on the role of healthcare professionals in curbing health misinformation and address the abovementioned research gaps, this study aims to develop a conceptual model that describes how healthcare professionals correct health misinformation on social media. Such a model provides a theoretical understanding of the ways and means that healthcare professionals identify and correct health misinformation on social media. Besides, the conceptual model serves as a foundation for future work on testing effective correction methods for specific health topics. Aside from its theoretical value, the study provides insights for healthcare professionals and policymakers to counteract health misinformation on and off social media.

2. Methods

2.1. Research design and data collection

We used a qualitative research approach to obtain rich insights on how healthcare professionals correct health misinformation on social media. This approach is useful when developing a conceptual model [26]. After receiving approval from the institutional review board of The University of Texas at Austin (2019-10-0149), data were collected by interviewing U.S. medical doctors (MDs) and registered nurses (RNs), as they form the largest group of the health workforce in the U.S [27].

Participants were recruited through a combination of purposeful (i.e., should be a social media user and with active RN or MD licensure) and snowball sampling (i.e., potential participants were asked for referrals and accessing one social media profile to another). They were contacted through email or a personal message on Facebook, Twitter, Instagram, or LinkedIn. To ensure a maximum variation sample (i.e., a wide range of data or participants who will represent wide variations of the phenomena under study) [28, p. 135], we recruited participants from various age groups, sex, and practice areas and locations.

JRB conducted semi-structured interviews via mobile phone calls (contacting participant’s mobile phone number) or apps (i.e., Zoom or Skype) between January and March 2020. Participants provided verbal and written consent to audio record the interview. An interview guide was developed by reviewing relevant literature on social media [29,30] and misinformation [1,23,25]. We made minor revisions to the interview guide (e.g., changes to the wording and arrangement of the questions) based on pilot interviews with two healthcare professionals who were not part of the main study (see Table 1 for sample questions). A total of 30 interviews were performed (M = 21.40 min). Participants received a $20 gift voucher as an incentive.

2.2. Data analysis

Data analysis started when JRB transcribed the audio recordings after each interview. This process enabled the identification of potential themes that may need additional exploration in subsequent interviews. All transcripts were imported to MAXQDA 2018 for in-depth qualitative analysis based on Pandit’s [26] approach to grounded theory analysis. Initially, JRB performed an iterative process of open and axial coding. Open coding was performed to break down data into smaller analytical points while axial coding was conducted by grouping open codes to generate connections between categories and subcategories [28]. The codes used in the study were either a priori – predefined based on previous works [23,25] – or those that emerged from the data. Three coders (1 RN, 1 medical student, and 1 information studies graduate student) also independently coded a sample of the transcripts. Results show good interrater reliability (Krippendorff’s alpha = 0.79) [31]. Disagreements among the coders were resolved through discussions. Memos were also written to keep track of emerging insights from the data. After an iterative process of coding and memoing, the research team discussed the resulting themes to identify interrelationships that would be a basis for a

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Interview guide sections and sample questions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section</td>
<td>Sample questions</td>
</tr>
<tr>
<td>Personal and work background</td>
<td>• Asking participants about their age, sex, and job position.</td>
</tr>
<tr>
<td>Use of social media</td>
<td>• Can you tell me what social media platforms you use and for what purpose?</td>
</tr>
<tr>
<td>Authenticating health information</td>
<td>• Imagine that you are browsing your favorite social media platform and you encounter a health-related post. What are the clues that you will look for to see whether it has health misinformation?</td>
</tr>
<tr>
<td>Correcting health misinformation</td>
<td>• Have you corrected someone on social media? How did you go about it?</td>
</tr>
</tbody>
</table>
conceptual model of how healthcare professionals correct health misinformation on social media. Moreover, meetings were convened to identify nuances based on participant characteristics. Upon assessment of the data, the research team found that data saturation has been reached with the current number of participants. This is evidenced by the development of well-established and interrelated categories and the absence of new or relevant data within categories [28]. Thus, additional interviews were not pursued.

2.3. Trustworthiness

We uphold the trustworthiness of this qualitative study by following the principles of credibility, transferability, dependability, and confirmability [32]. First, we ensure credibility by establishing rapport with interviewees to elicit honesty and by utilizing iterative questioning to clarify details and prevent recall bias. Next, we enhance the findings’ transferability using maximum variation sampling by interviewing healthcare professionals from both sexes and different practice areas and locations. Also, we followed our approved protocol throughout the study to uphold dependability. Finally, we uphold confirmability by presenting relevant quotes to support our themes and the percentage of participants who expressed each theme. Quotes are linked to participants’ anonymous ID for reference (e.g., RN1 and MD1).

3. Results and discussion

3.1. Participants’ characteristics

We invited 212 potential participants, and 30 of them (14 % response rate) agreed to participate (i.e., 15 MDs and 15 RNs). Despite the low response rate and sample size, the current sample is relatively enough for a qualitative study since rich insights can be obtained after interviewing 20 participants [33]. Table 2 shows a summary of the participants’ characteristics. While the sex distribution for MDs is relatively equal, there are more females among RNs. This is somewhat expected since nursing is a female-dominated occupation [34]. In terms of age, the majority are middle-aged adults and the median age for MDs and RNs is 42 and 41, respectively. The median years of practice for both RNs and MDs is 15. The participants’ practice areas are diverse. Major specializations included pediatrics (n = 5), pediatric nursing (n = 4) or public health nursing (n = 3). The participants come from 16 U.S. states. Most of the participants (RN = 80 %; MD = 100 %) can be considered as micro-influencers for having at least 1,000 Twitter followers [35]; however, the median values for followers and follower-followee ratio are higher for MDs than RNs.

3.2. Use of social media

In this study, social media are “Internet-based channels that allow users to opportunistically interact and selectively self-present, either in real-time or asynchronously, with both broad and narrow audiences who derive value from user-generated content and the perception of interaction with others” [36 p.50]. Fig. 1 shows the social media platforms used by the participants. Results show that most participants were using Twitter and Facebook. They describe Twitter as their de facto professional social media platform that they frequently use to network with colleagues as well as to receive and share health-related information. On the other hand, Facebook is used for both personal (e.g., connecting with family and friends) and professional (e.g., connecting with colleagues and joining professional group pages) reasons. Several participants (MD4, MD10, MD12, and RN8) created their professional Facebook accounts to differentiate it from their personal accounts. Several participants also use Instagram (primarily for personal use) and LinkedIn (strictly for professional use).

A few participants noted that they use other social media platforms, such as YouTube, Snapchat, and Pinterest, primarily for personal reasons. A few MDs use Doximity [37] – a social media platform specific to medical professionals. Five MDs use TikTok for personal use, with three (i.e., MD1, MD4, and MD6) uploading health-related videos on it.

3.3. Acts of correcting health misinformation on social media

Fig. 2 shows the conceptual model of healthcare professionals’ acts of correcting health misinformation on social media. It has two phases. The first phase involves acts of authentication. Within this phase, healthcare professionals undergo the process of internal and/or external acts of authentication. The second phase involves acts of correction. In this phase, healthcare professionals undergo correction preparation and dissemination.

3.3.1. Phase 1: acts of authentication

Before correcting health misinformation, healthcare professionals assess whether a social media post contains health misinformation that needs to be corrected. To do this, they initially engage in acts of authentication which are actions performed to determine if a social media post is authentic (i.e., one that is true and verified). We derive the term acts of authentication from Tandoc et al.’s [25] audiences’ acts of authentication conceptual framework. In this phase, healthcare professionals engage up to two processes to authenticate health information.
and detect health misinformation on social media: internal acts of authentication (i.e., authenticating a social media post using one’s knowledge and skills), and if needed, external acts of authentication (i.e., authenticating a social media post using other sources aside from one’s knowledge and skills).

3.3.1. Internal acts of authentication. The first process of acts of authentication involves internal acts of authentication. It is defined as acts that healthcare professionals perform to authenticate a social media post using one’s knowledge and skills. For example, two participants stated:

“I recognize if it is [health] misinformation if it’s a topic that I know. I might know. I know the science and I know that that’s [health] misinformation.” (RN14)

“…I will look at the words they are posting and is this something that is consistent with my medical training or is this something that I know to be false.” (MD3)

Some examples of internal acts of authentication include checking the author, checking for cues, and checking the topic. These internal acts are often used in combination.

Checking the author (RN = 40%; MD = 67%). Participants check the
author of a social media post to approximate the post’s credibility (i.e., credible information is likely to be posted by credible entities). For example, health information posted by legitimate healthcare organizations (e.g., WHO, Centers for Disease Control and Prevention, National Institutes of Health, American Heart Association, etc.) are credible. However, if it is posted by individuals, participants tend to look for cues to assess the author’s credibility. For instance, RN9 and MD3 inspect an author’s social media name to see if it provides hints of clinical background or expertise (e.g., presence of MD or RN titles in the profile name). Moreover, MD12 prefers that the author’s social media account has “a checkmark for verified accounts on certain platforms” (e.g., Twitter and Facebook).

Healthcare professionals also specified authors who share health misinformation on social media (see Fig. 3). The sources tended to be random people who they do not know and anti-vaxxers. Some participants noted that even experts can be susceptible to share health misinformation on social media, albeit in an unintentional manner:

“Sometimes it is unintentional... experts who are talking about certain things but accidentally put something down that is not accurate, is incorrect, or has not been updated.” (MD1)

Checking for cues. Participants tend to look for cues within the message part of the post to assess if it contains health misinformation (see Table 3). For most participants, those that do not cite references are likely to contain health misinformation (RN = 40 %; MD = 27 %). However, others noted that the presence of a reference is not a guarantee since some may provide dubious URL links (RN = 20 %). On the other hand, health misinformation posts can also be written in a sensationalized manner (MD = 20 %) or that it pretends to be authoritative by using expert language (RN = 7%; MD = 33 %). Moreover, others have noted that a conspiratorial tone (MD = 13 %), an appearance like an advertisement (RN = 20 %; MD = 20 %), and gross grammar mistakes (RN = 13 %) are indicative of health misinformation.

Checking the topic. Participants noted several health misinformation topics that they encountered on social media (see Fig. 4 for topics that were mentioned by at least three participants). Although there is a consensus among participants that health misinformation is “kind of global throughout all the social media platforms” (MD13), most of them recalled encountering these topics frequently on Facebook and Twitter and occasionally on Instagram and LinkedIn. For example, all participants encountered health misinformation about vaccines. Since the interviews were conducted when COVID-19 is spreading globally, participants also recalled encountering misinformation about COVID-19, particularly on its causative agent, transmission, signs and symptoms, and treatment.

Table 3 Health misinformation cues in the message.

<table>
<thead>
<tr>
<th>Health misinformation cue</th>
<th>Description</th>
<th>Representative quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appears like an advertisement</td>
<td>RN = 20 % MD = 20 %</td>
<td>“That to me is someone who seems to say almost like the pop-up ads you may find when you surf the web or it says, ‘plastic surgeon says to do this to make your skin look younger.’ That is a commercial that is trying to sell something. When something looks like that on social media – it’s an advertising for something – which is we would traditionally call like that as snake oil, in other words, it’s a product with an unproven claim and not regulated by the FDA.” (MD2)</td>
</tr>
<tr>
<td>Conspiratorial tone</td>
<td>MD = 13 %</td>
<td>“I think the individual who is appearing to sound as if they discovered something that the medical profession has been hiding from the general public. That’s a clue that they’re almost going off on some type of a delusion and they are looking for people to collude with the delusion.” (MD2)</td>
</tr>
<tr>
<td>Gross grammar mistakes</td>
<td>RN = 13 %</td>
<td>“I look at things like grammar and jargon and technical terms in a post. If there’s a bunch of misspellings or the person writes below a certain grade level, I usually don’t pay any attention to it and don’t take it as fact or don’t believe it as truthful.” (RN11)</td>
</tr>
<tr>
<td>No cited reference</td>
<td>RN = 40 % MD = 27 %</td>
<td>“I think to truly substantiate your point as evidence-based, it’s very very helpful to either cite a source or link to it directly. If there is no link at all and it’s just someone’s statement, it’s quite difficult to substantiate that.” (MD11)</td>
</tr>
<tr>
<td>Presence of dubious URL link</td>
<td>RN = 20 %</td>
<td>“If it is from the CDC, it’s probably fine. If it’s from nationalnews.com and mercola.com, then I know that’s not going to be accurate.” (RN15)</td>
</tr>
<tr>
<td>Pretending to be authoritative</td>
<td>RN = 7 % MD = 33 %</td>
<td>“I think non-experts use expert-like language at times and it can be confusing to people.” (MD10)</td>
</tr>
<tr>
<td>Sensationalized media</td>
<td>MD = 20 %</td>
<td>“I think all social media share one characteristic: they try to capture attention by using the most outrageous headline or most outrageous lead.” (MD8)</td>
</tr>
</tbody>
</table>

Table 3. Sources of health misinformation.

<table>
<thead>
<tr>
<th>Random people</th>
<th>Anti-vaxxers</th>
<th>Family</th>
<th>Friends</th>
<th>Anonymous profiles</th>
<th>Imposters</th>
<th>Colleagues</th>
<th>Influencers</th>
<th>Media outlets</th>
<th>Moms group</th>
<th>Experts</th>
<th>Celebrities</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. 3. Sources of health misinformation.
Table 4
Representative quotes for external acts of authentication.

<table>
<thead>
<tr>
<th>External acts of authentication</th>
<th>Description</th>
<th>Representative quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examining the author</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Background checking</td>
<td></td>
<td>Gathering information on the Internet to assess the credibility of the author (e.g., employers and affiliations).</td>
</tr>
<tr>
<td>Checking past posts</td>
<td></td>
<td>Visiting the author’s social media page(s) to check for past posts and see whether there is a history of posting misinformation.</td>
</tr>
<tr>
<td>Examining the content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clicking the link</td>
<td></td>
<td>&quot;What the background is of the person or organization? What their affiliations are? And if it's being reposted by people who I trust, is it coming from a news agency, health agency or expert in that field?&quot; (RN13)</td>
</tr>
<tr>
<td>Crossmatching</td>
<td></td>
<td>&quot;I’ll look at other information about the account and also look about what other things are being posted on that account. If sometimes there’s a post that are somewhat neutral but if you look at their historical posting, you can tell that they sometimes people may put something more neutral and then start streaming very much more firm disinformation post.” (MD6)</td>
</tr>
</tbody>
</table>

Fig. 4. Health topics with health misinformation on social media.

for information) rather than incidental (i.e., passive reliance on institutional sources or authenticating by chance). There are two categories by which external acts of authentication occur. First, examining the author by means of background checking and checking their past posts. Second, examining the content of the post by clicking the link and crossmatching. Table 4 provides representative quotes for external acts of authentication. Like internal acts of authentication, these external acts are often used in combination to arrive at a decision whether a social media post contains health misinformation (e.g., examining the author only may not guarantee that the post does not contain health misinformation so it is also important to examine the content).

Examining the author. Participants searched the Internet to examine whether the author is reputable to be a source of health information. One of the ways to do this is to perform background checking (RN = 27%; MD = 20%) which is to search for additional online information about the author. The goal is to determine if that entity is credible, particularly whether a conflict of interest exists. Another means of examining the author is through checking past posts (RN = 20% MD = 13%). For some participants, this is necessary since this provides a hint of their tendency to spread health misinformation. In general, authors who post health misinformation in the past are likely to post one in the future.

Examining the content. Participants also examine the content of the post to see whether the content is consistent with what the literature is saying. One of the ways to do this is by clicking the link (RN = 27%; MD = 20%) to obtain more details of that post. This is assuming that the post contains a URL link. The goal is to determine if the link leads to a credible source and if the information in the link is consistent with the social media post (i.e., is the post’s message congruent with the provided link?). In some instances that a health-related social media post does not have a link or participants are unfamiliar with the topic, they tend to perform crossmatching (RN = 40%; MD = 7%) to see if the information in the post is congruent with the content of reputable sources (e.g., journal articles, news sources, or gov websites).

3.3.2. Phase 2: acts of correction

After authenticating a health-related social media post and deeming it to contain misinformation, if they are motivated to correct it for personal (e.g., not wanting relatives to be exposed to or share health misinformation) and/or professional reasons (e.g., to do good to the public as a healthcare professional), they would enter the next phase which is acts of correction. In this phase, healthcare professionals engage in two processes to correct health misinformation: correction preparation followed by correction dissemination.
3.3.2.1. Correction preparation. Healthcare professionals adhere to several principles, often used in combination, to prepare messages aiming at correcting health misinformation on social media. These principles include 4Rs: (1) reflect, (2) reveal, (3) relate, and (4) respect. In general, the principle of reflect guides the principles of reveal, relate, and respect. Table 5 provides representative quotes for the 4R’s of correction preparation.

Reflect (RN = 33%; MD = 40%). Several participants noted that they reflect to understand why social media users post health misinformation before writing the corrective message. Such reflections enable them to validate their thoughts and feelings in relation to other people’s concerns toward a health issue that has misinformation (see MD14 in Table 3). For some participants, being mindful of the context of why health misinformation is posted can help improve the persuasiveness of the corrective message that they are crafting (see MD15 in Table 3). Such reasons provide a justification for why reflect precedes the other principles of the 4Rs. Nonetheless, one participant noted that healthcare professionals should also acknowledge that while some people do not have the intent to spread health misinformation, some deliberately spread it, which makes it challenging to prepare corrective messages that can undo the manipulation (see MD9 in Table 5).

Reveal (RN = 67%; MD = 80%). When writing the corrective message, participants emphasized that it is important for it to explicitly reveal facts and support it with reputable references. They believe that doing this increases the credibility and social utility of the corrective message (see RN10 and MD9 in Table 5). While revealing facts and references are expected for any corrective message, some participants noted that healthcare professionals should also be transparent in sharing health information. For instance, in the context of vaccines, while the benefits outweigh the risks, it is still important to mention such risks for the sake of transparency (see MD4 in Table 5).

Relate (RN = 13%; MD = 7%). Aside from revealing facts within the corrective message, participants noted that such a message should be written using plain language with little to no jargon so that “the public can relate” (MD14). For some participants, while posting a link to a journal article can serve as a reference to support a fact, stories from reliable newspapers can be used as an alternative for the public (see RN5 in Table 5). To some extent, others noted that it is important to recognize that a substantial number of people may not have sufficient health literacy to process health information. That is why it is important to write corrective messages using plain language (see RN15 in Table 5).

Respect (RN = 53%; MD = 27%). Overall, healthcare professionals are expected to act professionally whether it is communicating with colleagues, patients, or the public regardless of online or offline. As such, participants noted that although some social media users may be harsh or aggressive in the way that they spread health misinformation, healthcare professionals should still observe the principle of respect when writing corrective messages. Besides, participants noted that shaming people and being too aggressive when correcting people is counterproductive (see RN8 and MD1 in Table 5).

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
<th>Representative quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflect</td>
<td>Understanding why social media users post health misinformation.</td>
<td>“Try to be compassionate. Do not dismiss the patient and try to understand their post. We need compassion when dealing with misinformation because not everyone has the intent of spreading misinformation.” (MD14) “It’s good to validate the thoughts or the concerns of the person in some ways. Even when somebody’s posting something that’s like ‘you all should be freaked out about the coronavirus [COVID-19]’ because it has a 10% case fatality rate or something. I think it’s really good to be like ‘OK so what’s behind that post?’ and try to acknowledge it.” And then use that as sort of a platform to then go to the correction gently. So, I think it’s a little bit of a feedback sandwich.” (MD15) “You have to create a cause for spread of disinformation and you basically have to treat it like an information war like a propaganda war and not ‘I hope these people just lack information or are ignorant.’ They are not ignorant. They are specifically being manipulated and knowing how to undo that manipulation is much more challenging than just providing correct information.” (MD9) “What do I do is I copy a link from CDC or an open access peer reviewed journal publication, and I post that as I state something like ‘as a nurse it’s important for me to present accurate information. Here’s an accurate information about vaccine preventable diseases’ or ‘here’s the benefit of MMR in preventing these ulcers.’ As a nurse, it’s important for me to make sure that correct information is in the public domain or something along those lines.” (RN10) “When I am correcting people like him, basically, I call up an enormous amount of literature to defend my positions and I think it’s really important for experts to show that it’s not just a matter of opinion but there’s a significant amount of data that stands behind medical decision making in the recommendations that we make. And so, I think if you’re gonna do this online you have to be able to do that and really do that, otherwise you’re just another person.” (MD9) “I think a lot of people get tired of just being told here the benefits, here the benefits, here the benefits... and that’s one of the big drivers of the anti-vaccine community is like ‘what are the risks? You’re not telling us the risks.’ Yes, there are risks to every medical intervention but here are the risks compared to the benefit. That seems to go a really long way and I get messages on social media all the time of people saying that it helped them. I get people in my clinic” (continued on next page)</td>
</tr>
</tbody>
</table>
who say that they came in to see me specifically because of things that I had shared online.” (MD4)

“I put it at a layperson’s level. I don’t post the actual study from the journal necessarily, but I read and post the story from a reliable newspaper and they look at the story too.” (RN5)

“I think it needs to be put very plainly. From a public health perspective, health literacy in general is not great in the United States. The average American has like a 4th grade functional reading level, so it’s very important to put things plainly. It’s important to put it in very easy to understand terms and to do so directly.” (RN15)

“I think that the answer is always be kind and always be respectful. Always. We need to be kind to each other. We need to be respectful. I think that taking it from a lens of trying to help increases understanding of each other is important. Shaming each other, not the right way to go.” (RN8)

“I try to do it respectfully because I know that a lot of people are very deep set in their ways and have already convinced themselves that something is correct. Sometimes, people believe so strongly in things that you really can’t convince them otherwise. I think that being too aggressive can be counterproductive.” (MD1)

3.3.2.2. Correction dissemination. After preparing corrective messages, participants describe means that they have disseminated corrections on social media. First, the means that they disseminate it can be public (e.g., post can be seen by anyone) or private (e.g., post can only be seen by followers or through a direct message). Besides, consistent with the types of correction found by Walter and Murphy [38], participants also expressed that the correction can either be a direct contradiction to a health misinformation post (i.e., rebuttal) or forewarning to health misinformation (i.e., priming). Hence, we found that healthcare professionals use four strategies to disseminate correction on social media: (1) public priming, (2) private priming, (3) public rebuttal, and (4) private rebuttal. Table 6 provides a summary of these strategies including examples and representative quotes.

Public priming. This refers to publicly posting or sharing credible or evidence-based health information as a means of priming against health misinformation. An example of this is when healthcare professionals publicly tweet about COVID-19 facts and attach a CDC link with it after encountering misinformation. About 33 % of MDs and 47 % of RNs have engaged in public priming. Interestingly, participants consider it part of their duty to share accurate information with the public as a means of “drowning” health misinformation. By doing so, they can become a “silent advocate of posting correct information and therefore indirectly dissuading people from posting incorrect information” (RNS). Besides, some mentioned that they cannot “police everybody and correct all the bad information” (MD3), hence the preference for public priming.

Private priming. This refers to privately posting or sharing credible or evidence-based health information as a means of priming against health misinformation. An example of this is posting a protected tweet (i.e., for followers only, cannot be retweeted, and will not appear in third-party search engines) about COVID-19 facts and attaching a CDC link with

Table 5 (continued)

Table 6

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
<th>Example</th>
<th>Representative quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publicly posting or sharing credible or evidence-based health information as a means of priming against health misinformation.</td>
<td>Publicly tweeting about COVID-19 facts with a CDC link.</td>
<td>‘I think it probably starts with sharing good information. I don’t know if we can police everybody and correct all the bad information but I think we really need to stand up as healthcare professionals and make sure that we are sharing good information so that people can come to us and know what’s right basically.” (MD3)</td>
<td></td>
</tr>
<tr>
<td>Privately posting or sharing credible or evidence-based health information as a means of priming against health misinformation.</td>
<td>Tweeting a protected tweet (for followers only) about COVID-19 facts with a CDC link.</td>
<td>‘I use Facebook just as a personal platform to stay in touch with friends and family, and I mostly thought post health related information on my Facebook. Things that are related to public health that I’m passionate about, news stories about health issues and sometimes science things that are of interest to me. Just stuff that I read in news, nothing super scientific. Everything I post is general knowledge stuff from the news. Nothing like a Journal or...’ (RN7)</td>
<td></td>
</tr>
</tbody>
</table>

(continued on next page)
### Table 6 (continued)

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
<th>Example</th>
<th>Representative quotes</th>
</tr>
</thead>
</table>
| **Public rebuttal**| Responding to a health misinformation post by publicly pointing out the misinformation and sending credible or evidence-based health information as a rebuttal. | Replying to a vaccine misinformation post on Facebook by rebutting the misinformation and providing a link to the CDC. | something like that.” (RN5)  
“...big responsibility is 'hey I’ve run into some sites that have said things like this and things like this, be sure to be on a look out and make sure if the information is giving you is the correct information' to the people who follow me on social media or to my family members or friends who I know in person.” (RN1)  
“Depending on the context of what they said, I might respond to them in a public way and say 'hey you know that’s not necessarily true' or 'you know, here’s what these sources say.” (RN11)  
“I try to present facts like when there is a statement like ‘measles does not kill people’. Then I will present facts from the CDC that shows how many people die from measles. I try to correct it using facts. I might start to initiate a conversation. But when they start to get nasty, then I’ll just ignore or block them after that. It’s a public conversation [on Twitter].” (MD7)  
“Twitter is different. I’ve almost never corrected someone via DM [direct message] that I can remember. I try to do it publicly because, again, the point is not so much it needs to be inflammatory, it’s to correct someone’s misinformation for their and others’ benefit.” (MD11)  
“On social media, it depends on how motivated I am to respond. If I see it on my Twitter feed, I may not engage with it. But if it’s on Facebook and it’s someone that I know, then I will engage with it because I feel like they need to know whatever the truth is behind it. So, I keep my Facebook to family members, friends and colleagues.” (RN6)  
“I might pull them to the side and engage with them in a direct message in a DM or something like that where it’s not publicly saying. That’s on a case-by-case basis.” (RN11)  
“If I see that they’re trying to make an effort to understand, then I will ask them to direct message me through Twitter. And then, of those a few folks, I either emailed... like we shared an email and I emailed them or we got on a phone call.” (MD8) |
| **Private rebuttal**| Responding to a health misinformation post by privately pointing out the misinformation and sending credible or evidence-based health information as a rebuttal. | The rebuttal and link to the CDC is sent as a personal/direct message to a family member who posted vaccine misinformation on Facebook. | it. Only 13% of RNs have engaged in private priming and none among the MDs. Considering its limited reach, private priming aims to expose close ties (e.g., family and friends) to correct information so that they will not spread health misinformation.  
**Public rebuttal.** This refers to responding to a health misinformation post by publicly pointing out the misinformation and sending credible or evidence-based health information as a rebuttal. An example of this is replying to a vaccine misinformation post on Facebook by rebutting the misinformation and providing a link to the CDC to support the rebuttal. About 80% of MDs and 47% of RNs have engaged in public rebuttal. Engaging in public rebuttal, although contributes to social learning of health issues (see MD11 in Table 6), predisposes healthcare professionals to heated arguments leading to harassment, especially for controversial topics like vaccination or gun control (see MD7 in Table 6 for example).  
**Private rebuttal.** This refers to responding to a health misinformation post by privately pointing out the misinformation and sending credible or evidence-based health information as a rebuttal. An example of this is sending the rebuttal and link to CDC as a personal/direct message on Facebook to a family member who posted vaccine misinformation. About 33% of MDs and 60% of RNs have engaged in private rebuttal. Private rebuttal is often performed when the social media platform allows for personal messages to be sent. That is why this is usually performed when correcting health misinformation disseminated by close ties (e.g., family, friends, or known social media contacts). |

4. Discussion

Health misinformation is a public health concern, and healthcare professionals can correct health misinformation on social media [10–16]. However, a key gap in the literature is how they perform the correction activity. To address this gap, we developed a conceptual model that illustrates how healthcare professionals, such as RNs and MDs, correct health misinformation on social media. In general, the conceptual model shows that when correcting health misinformation on social media, healthcare professionals engage in acts of authentication (i.e., internal and external acts of authentication) followed by acts of correction (i.e., correction preparation and correction dissemination).

Consistent with Tandoc et al. [25], acts of authentication involve
This study extended Tandoc et al.’s [25] audiences’ acts of authentication conceptual framework by specifying that acts of authentication are followed by acts of correction (i.e., correction preparation and correction dissemination). In other words, after authenticating that a health-related social media post contains misinformation, by virtue of personal and/or professional reasons, healthcare professionals would correct it by preparing the corrective message based on the 4Rs (i.e., reflect, reveal, relate, and respect) and deciding the strategy by which the correction will be disseminated (i.e., private priming, public priming, private rebuttal, and public rebuttal). Although previous work highlights the need for healthcare professionals to provide an accurate (providing facts that has a credible source; under the 4R principle of reveal) and easily understandable (under the 4R principle of relate) health information to correct health misinformation [13,14,16], our findings suggest that it is also important for healthcare professionals to reflect on the circumstances on why such misinformation is spreading (under the 4R principle of reflect) and to be respectful when correcting people (under the principle of respect). In general, this study serves as a call for healthcare professionals to not only provide evidence-based and easily understandable corrections but also to be mindful and respectful when correcting health misinformation.

Our results also show various means by which corrections are disseminated by healthcare professionals. Consistent with Walter and Murphy [38], corrections were delivered through rebuttals or priming. However, what is interesting is the participants’ choice of either privately or publicly disseminating the correction based on the author of misinformation (e.g., private responses for personal contacts and public responses for unknown contacts). Although providing a rebuttal to health misinformation is an effective means of correction [38,40], our findings suggest that it may predispose healthcare professionals to harassment, especially to public rebuttal of health misinformation on sensitive health topics like vaccination. In situations where healthcare professionals are not comfortable with performing rebuttals, our study suggests that priming can be an alternative means of disseminating correction. While rebuttals are much effective in correcting misinformation, research shows that priming can still correct misinformation [38,41]. Regardless of using rebuttal or priming as a means of correcting health misinformation, our findings echo previous work [42,43] where social media users can drown misinformation by rebutting it or sharing accurate information to prime others against misinformation.

Aside from proposing a conceptual model that contributes to a theoretical understanding of how healthcare professionals correct health misinformation on social media, the study has several practical contributions. First, the conceptual model can guide healthcare professionals to better spot misinformation and execute corrections. Specifically, the model provides several misinformation cues to watch out for (see Table 3) including strategies that might enhance the persuasiveness (see Table 5) and dissemination (see Table 6) of the correction. Second, the findings can be a basis for policies or programs that empower healthcare professionals and the public to correct health misinformation on and off social media. For example, the UN, as part of its digital first responder initiative [3], can advocate for the use of the 4Rs (i.e., reflect, reveal, relate, and respect) as a guideline for healthcare professionals and the public when correcting health misinformation on social media. Third, the conceptual model can be used to inform clinical communications curriculum, especially those developed in helping healthcare professionals to better respond to health misinformation. For instance, 4Rs can also be integrated with the communications training of healthcare professionals especially when responding to health misinformation during patient encounters. Finally, although the literature leans on public rebuttal as a means of correcting health misinformation [12-17], the findings provide other means of disseminating corrections to health misinformation (i.e., private rebuttal, public priming, and private priming). Thus, health campaigns aimed at combatting health misinformation can focus on emphasizing both rebuttal and priming as strategies to correct health misinformation so that people have the option to choose a method that they are comfortable with (e.g., those that are not comfortable with public rebuttal because of the potential harassment it can lead to can instead do public priming). Overall, the goal would be to encourage more people to correct health misinformation regardless of the dissemination method.

4.1. Strengths, limitations, and future research directions

This study has several strengths. First, compared with previous work on the role of healthcare professionals in correcting health misinformation [12-15], this is one of the first attempts to empirically examine how healthcare professionals correct health misinformation on social media. Not only does the study show how it is done through a conceptual model, but it also shows how healthcare professionals are correcting health misinformation using a variety of dissemination strategies (i.e., public rebuttal, private rebuttal, public priming, and private priming). Second, the study contributes to misinformation research by providing a conceptual model on how healthcare providers correct health misinformation on social media. It is important to note that existing frameworks or models were limited to data derived from the public [24,25,39] and public relations practitioners [23].

Despite the strengths of the study, we recognize several limitations that can serve as future research directions. First, the healthcare professionals interviewed were limited to RNs and MDs. Although they represent most of the U.S. healthcare workforce [27], future research can also include other healthcare professionals (e.g., dentists, pharmacists, physical therapists, etc.) for additional insights. Second, the conceptual model was based on interview data from RNs and MDs working in the U.S. Thus, it may not accurately describe how healthcare professionals correct health misinformation outside the U.S. Future research can use this study as a guide to explore such phenomenon among healthcare professionals in other countries. Third, although the sample size is relatively adequate for a qualitative study [33], future research can increase the sample size by interviewing additional healthcare professionals (e.g., RNs, MDs, and other allied health professionals) to further enhance the transferability of the findings. Finally, considering that most of the participants are Twitter and Facebook users, the conceptual model might be reflective of how they correct health misinformation on those platforms. Future research can explore whether the model can be applied to other platforms, with different technical affordances, such as Instagram and TikTok.

5. Conclusion

Health misinformation on social media is a public health concern, and healthcare professionals can help correct it. In this study, we developed a conceptual model that shows how U.S. healthcare professionals correct health misinformation on social media through acts of authentication followed by acts of correction. Theoretically, the study contributes to misinformation research by proposing a conceptual model that shows the process by which healthcare professionals correct health
misinformation on social media. Practically, the findings can help healthcare professionals when identifying and correcting health misinformation on and off social media. Moreover, the findings can guide health authorities when developing campaigns against health misinformation.

Author contributions

JRB secured funding for this work. JRB, YZ, and JG designed the interview guide and study. JRB collected the data under the supervision of YZ and JG. JRB, YZ, and JG participated in the data analysis and interpretation of findings. JRB drafted the manuscript. All authors contributed to refining all sections and critically editing the paper.

Funding and acknowledgments

This work is supported by the Bullard Research Fellowship awarded to JRB by the School of Information, The University of Texas at Austin. We would like to express our gratitude to the 30 U.S. healthcare professionals who agreed to be interviewed for this study despite the worsening COVID-19 pandemic at the time of data collection.

What was already known about the topic?

- Health misinformation on social media is a public health concern.
- Health scholars and practitioners are urging healthcare professionals to correct health misinformation on social media.
- There is limited research on how healthcare professionals correct health misinformation on social media.

What this study added to our knowledge?

- We present a conceptual model of how healthcare professionals correct health misinformation on social media by performing acts of authentication and correction.
- Healthcare professionals correct health misinformation on social media by performing acts of authentication and correction.
- The findings can guide healthcare professionals when identifying and correcting health misinformation on and off social media.

Declaration of Competing Interest

None declared.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ijmedinf.2021.104375.

References

