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Health Misinformation During Epidemiological Crises

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Author Note

This proposal is in partial fulfillment of the Williams Honors College and School of Nursing requirements. We have no known conflicts of interest to disclose.

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Abstract

Health misinformation is more prevalent than ever in the modern age and poses serious risks for those who believe it. Medical fallacies can become especially harmful during periods of widespread disease when the misinformed respond in ways that increase threats to public health. The purpose of this systematic review is to describe and critically appraise the evidence about how health misinformation during endemics and pandemics can influence behaviors and responses, as well as the implications of interventions affecting these behaviors. A systematic search of the literature with inclusion/exclusion criteria using CINAHL Plus with Full Text, MEDLINE, and PsychINFO resulted in an analysis of twenty primary sources. In general, researchers have found that health misinformation has been prevalent during the COVID-19 pandemic and endemic outbreaks of Ebola, Zika, and measles. A significant proportion of individuals believe misinformation, and evidence supports that the tendency to believe misinformation is related to predictive factors such as the propensity for conspiracy thinking, decreased literacy skills, increased social media usage, younger age, and fear. Implications of findings for interventions include using social media to promote accurate information, building public trust in the government and healthcare system, and ensuring the public has access to accurate information.

Health Misinformation During Epidemiological Crises

For as long as there have been endemics, there has been fear and falsehoods. Where disease multiplies, so do panic and speculation. The past three years of rampant pandemic COVID-19 mutation and growth have done nothing if not showcase how both disease and information can spread. Health misinformation in all of its various forms came to the forefront of the global conversation and consciousness (Fittler et al., 2021; Hauer & Sood, 2020; Lopez-Garcia et al., 2021; Melki et al., 2021; Snyder et al., 2021; Worrall et al., 2020**)**. Health misinformation, defined as false or misleading health-related claims that aren't supported by scientific research but rather word of mouth or anecdotal evidence (Suarez, 2021) have become increasingly present in daily life. These claims are a serious concern that pose a health risk to all individuals who have decided to believe these misguiding sources of data. In the modern information age where millions of opinions are one click away on social media platforms such as Facebook and Instagram, various internet websites, and online or social media influencers, it can be exceedingly difficult for individuals to parse through what information is evidence-based and scientific. In times of healthcare crises—epidemics and pandemics—this misinformation becomes even more deadly.

Regardless of whether the disease in question is Ebola, Zika, measles, coronavirus, or the multitude of other options throughout medical history, the public's frenzied response to its spread can be counted on. As fear grows, so does conjecture. The misinformation that circulates as a response is a problem with serious public health consequences. It can perpetuate the spread of illnesses, cause preventable and unnecessary hospitalizations and deaths, negatively affect healthcare professionals, and create mistrust between the public and the healthcare system (Bagherpour, 2020; Melki et al., 2021). That mistrust may then cause further misinformation and

scientifically unfounded home remedies, and so it becomes a vicious and never-ending cycle between scientists, government administration, public health agencies, healthcare teams, and the public. Misinformation about the spread and treatment of illnesses can put the health of individuals at risk. Further, healthcare professionals may then face the significant brunt of the results of epidemic misinformation, as they are the ones who have to care for those who have self-treated in inappropriate ways, or neglected to protect themselves in evidence-supported ways.

The purpose of this systemic literature review is to describe and critically appraise the evidence about how health misinformation can influence behaviors or responses to epidemics and pandemics, as well as the effectiveness of interventions to affect those behaviors and responses. This Honors project systematic review was conducted to answer the following questions:

1. How does the prevalence of health misinformation differ between sources?
2. What proportion of the public believes health misinformation?
3. What factors contribute to individuals believing and trusting false information?
4. How can current research findings guide interventions to curb the spread and application of health misinformation?

Methods

Search Strategies

Twenty primary sources of research were selected from health and nursing research databases, including CINAHL Plus with Full Text, MEDLINE, and PsychINFO. Inclusion criteria consisted of: published in peer-reviewed journals, published within the last five years, primary sources, and relevancy to the systematic review questions. Exclusion criteria included:

non-research publications, non-peer-reviewed articles, and published greater than five years ago. The references of several well-written systematic reviews were initially reviewed to find current, high-quality primary sources. The search was comprised of various key search words such as health misinformation, disinformation, fake news, pandemic, epidemic, outbreak, COVID, COVID-19, coronavirus, Zika, Ebola, panic, emotional responses, physiological responses, nurses, and social media. To narrow the search results and focus retrieved publications, all database searches were conducted using some form of the term "health misinformation" in order to filter out other epidemiology research that does not pertain to our topic of misinformation.

Description of Selection Process

Publications deemed relevant initially were then systematically and critically evaluated for biases, conflicts of interest, ethical considerations, validity, and limitations that did not meet inclusion and exclusion criteria. The PRISMA flowchart (Appendix A), was used for the search and selection process. The results of the studies were also appraised to determine whether the scientific findings adequately backed up and supported the claims made by the study researchers and authors. Selection bias was minimalized by including studies regardless of the Honors project authors' personal beliefs or values. Even though many different articles were appraised, the research findings were congruent in its conclusions. Therefore, the findings presented in this systematic review are consistent.

Review of Literature

Description of Collection

The majority of researchers used descriptive designs (Chun-Hai Fund et al., 2016; Fittler et al., 2021; Geldsetzer, 2020; Hauer & Sood, 2020; Klofstad et al., 2019; Lopez-Garcia et al., 2021; Luo et al., 2021; Melki et al., 2021; Safarnejad et al., 2020; Sell et al., 2020; Singh et al.,

2020; Synder et al., 2021; Vinck et al., 2019; Winters et al., 2018; Worrall et al., 2020; Zhuang et al., 2020) while others used quasi-experimental designs (Bode & Vraga, 2018; Chua & Banerjee, 2018; Scherer et al., 2021) There was also one case study (Warren & Wen, 2016). The studies generated levels of evidence ranging from II to VI. Researchers of several of the studies analyzed data from web-based surveys or social media content. Non-digital research settings included the United States, Nepal, Sierra Leone, Hungary, United Kingdom, Spain, the Dominican Republic of the Congo, China, Canada, Lebanon, and Ireland. The sample of publications covered the health misinformation topic from a wide variety of geographical regions to get a better understanding not only from a national perspective but from an international perspective as well. Research sample sizes ranged from two participants in a case study to 60 in quantitative studies and up to the investigation of 435,700 tweets in a qualitative content analysis study. Data collection methods across studies consisted of both online and physical surveys, questionnaires, and personal interviews. Analyses included both quantitative and qualitative content analyses.

Several gaps in knowledge were noted across studies. One such being what specific primary interventions can affect individuals' beliefs in health misinformation in the first place. In addition, since all current studies on this topic are focused on adults, the effects of misinformation on children and adolescents are still unknown and have yet to be studied. Further research is needed to bridge these gaps in knowledge.

Integrated Review of the Literature

Studies were grouped based on their relevance to a respective research question. Those that discuss the prevalence of health misinformation are included in section one. Studies related to the proportion of misinformation trusting individuals are highlighted in section two. Section three examines the studies that consider individual predictive factors associated with the trust or

denial of health misinformation. Section four provides suggested interventions that may be helpful in curbing the spread and application of health misinformation by the public. Many studies pertain to more than one research question, and are therefore discussed in multiple sections.

Section 1: Prevalence of Health Misinformation Between Sources

Misinformation during times of epidemiological crises has been found to be consistently evident and affects decisions about what people believe they need to do in order to promote health (Fittler et al., 2021; Fung et al., 2016; Geldsetzer, 2020; Lopez-Garcia et al., 2021; Singh et al., 2020). Some have even called these surges of health misinformation a pandemic in itself—an "infodemic" (Fittler et al., 2021; Lopez-Garcia et al., 2021). Unsurprisingly, electronic media, including the internet, social media platforms (e.g. Twitter or Facebook), and text messaging, has been found to be the biggest contributor to the prevalence and spread of epidemiologic misinformation (Lopez-Garcia et al., 2021; Safarnejad et al., 2020; Winters et al., 2018). For example, Sell et al. (2020) found that out of merely 3,639 tweets related to the Ebola virus, 10% of those Tweets contained false or partially false information. In a study on COVID-19 conducted in Hungary (Fittler et al., 2021), 100% of the top 10 Google search results for "Ivermectin" were linked to illegal drug retailers, and considering 85% of individuals do not scroll past the first Google page, the implications of these findings are serious. Although to a lesser degree than electronic media, health misinformation was also found to be prevalent within other sources of information as well (Melki et al., 2021; Scherer et al., 2021; Winters et al., 2018). In a study conducted by Winters et al. (2018), print media, as well as communication via government and community leaders, were found to be the next greatest sources of misinformation after electronic media. Overall, the degree of prevalence and availability of

health misinformation to the general public is noteworthy, especially in relation to the next discussion about the proportion of trusting behavior.

Section 2: Proportion of Trusting Behavior Related to Health Misinformation

Researchers have clearly established that health misinformation is prevalent during public health crises (Fittler et al., 2021; Lopez-Garcia et al., 2021; Sell et al., 2020), but others set out to determine what proportion of the public was actually trusting this inaccurate messaging. Vinck et al. (2019) found that one in four adults in the Dominican Republic of the Congo believed Ebola did not exist, and this was largely due to receiving information from inaccurate sources. In a US sample of 777 adults, 20% of adults believed at least one Zika conspiracy (Klofstad et al., 2019), and in a different study of 3000 adults, over 23% believed COVID-19 was developed by the government or a terrorist organization as a bioweapon (Geldsetzer, 2020). Also in the same study, participants were asked how many people they thought would die from the coronavirus by the end of 2020, and an astonishing 61% of the U.S. participants and 71.7% of UK participants responded with less than 500 deaths (Geldsetzer, 2020). Researchers also discovered that a larger proportion of people tended to trust health misinformation especially about preventative measures—perhaps due to fear. For example, in one Nepalese sample of 871 where 70% of participants believed limiting their consumption of meat would prevent the spread of COVID-19 (Geldsetzer, 2020; Singh et al., 2020). Similarly, over 25% of 3,000 American participants believed avoiding Chinese restaurants would also reduce the risk of contracting coronavirus, a belief that appears to be purely founded on racial bias and association (Geldsetzer, 2020). Clearly, health misinformation is not just accessible by the public, but it is being believed and adopted by a large enough percentage of the population to evoke concern from professionals about its impact on public health.

Section 3: Predictive Factors of Likelihood to Trust Health Misinformation

Researchers have examined predictive factors associated with individuals' susceptibility to believe health misinformation (Bode & Vraga, 2018; Chua & Banerjee, 2018; Klofstad et al., 2019; Luo et al., 2021; Singh et al., 2020; Scherer et al., 2021; Vinck et al., 2019; Winters et al., 2018; Worrall et al., 2020). For example, those who spend more time on social media and who are not exposed to multiple different sources of information were found to be more likely to consider misinformation to be accurate and influential (Melki et al., 2021; Scherer et al., 2021; Winters et al., 2018). A higher tendency for conspiracy thinking about other aspects of life was also a strong predictor of belief in health misinformation as well as the rejection of scientific information (Bode & Vraga, 2018; Klofstad et al., 2019). Lack of trust in the government or lack of trust in the healthcare system were other predictors across multiple studies and indicative of increased susceptibility to believe health misinformation, decreased use of preventative measures, and even poorer health outcomes due to individuals not seeking formal medical care (Melki et al., 2021; Scherer et al., 2021; Vinck et al. 2019). In addition, fear was found to be significant in the conversation of health misinformation – researchers have noted that those exposed to social media messages instilling fear were not only more likely to trust the misinformation but were also more likely to share and spread the inaccuracies (Chua & Banerjee, 2018; Luo et al., 2021).

There are also several demographic characteristics that play a role in individuals trusting health misinformation. Age was found to be a significant factor, with younger individuals being more likely to trust misinformation and older adults being less likely to rate misinformation as accurate or influential (Klofstad et al., 2019; Scherer et al., 2021). Individuals with a higher household income were found to be more critical of health misinformation and had a higher

likelihood of rejecting it (Scherer et al., 2021). In addition, less education and decreased literacy skills have been associated with increased susceptibility to trust misinformation and lack of overall health knowledge. Interestingly, more education and higher literacy skills were identified as protective factors against the influences of misinformation (Melki et al., 2021; Scherer et al., 2021; Singh et al., 2020; Worrall et al., 2020). All in all, these findings of predictive and protective factors about trusting health misinformation are significant and may be particularly important in the conversation of targeted interventions.

Section: 4 Implications for Interventions Affecting Health Misinformation

Findings from all twenty studies have implications for the use of certain interventions in curbing health misinformation by ensuring that people have access to accurate information from trusted sources (Fung et al., 2016; Hauer & Sood, 2020; Singh et al., 2020) and the necessary tools to distinguish between misinformation and accurate information (Bode & Vraga, 2018; Chua & Banerjee, 2018; Melki et al., 2021). Firstly, knowing which populations are vulnerable to misinformation may be an important step in tailoring or gearing interventions towards particular populations that are more likely to be influenced by false information (Klofstad et al., 2019; Scherer et al., 2021). In addition, understanding how the public responds emotionally to health threats can enable experts to design interventions and eventually campaigns that may decrease fear and panic (Luo et al., 2021; Zhuang et al., 2020). Although social media is a significant contributor to the spread of misinformation (Hauer & Sood, 2020; Melki et al., 2021; Safarnejad et al., 2020; Warren & Wen, 2016), research suggests that social media may also be an effective way to communicate accurate health information to large audiences (Singh et al., 2020; Warren & Wen, 2016) through partnerships with social media companies (Sell et al., 2020), algorithm changes (Bode & Vraga, 2018), responsible users and literacy training (Bode &

Vraga, 2018; Melki et al., 2021), and government campaigning (Hauer & Sood, 2020). Further, trust is a major component of belief in health misinformation and poor health outcomes, so building individual and community trust in governments and healthcare systems could be key to enabling the public to adopt accurate information as opposed to misinformation (Chua & Banerjee, 2018; Melki et al., 2021; Vinck et al., 2019). Since education has been found to be the most effective way to increase the public's health knowledge, experts also need to ensure that individuals have access to scientifically accurate information at a universally readable level (Fung et al., 2016; Singh et al., 2020; Worrall et al., 2020). A recent National Bureau of Economic Research study showed significantly higher rates of COVID-19 cases and deaths in areas of the United States where television programs downplayed the seriousness of the virus and shed doubt on precautionary measures, and this highlights the necessity of accurate and digestible health messaging (Bagherpour, 2020).In conclusion, although more specific research still needs to be done about interventions to combat health misinformation, current evidence about misinformation is strongly and consistently suggestive of certain effective measures that may help construct interventions to curb an "infodemic."

Limitations

Across all studies, several limitations stand out. All are dealing with historical time periods during outbreaks of Ebola, Zika, measles, or COVID-19. During each study, there were specific global and environmental factors at play that influenced the collection of data, such as the primary location of the Zika virus being in South American countries whereas Ebola is a virus typically concentrated in Africa (Klofstad et al., 2019; Vinck et al., 2019). Further, technological, scientific, and sociopolitical factors differed across these outbreaks to time as well as to geographic areas. For example, responses to misinformation from the COVID-19 pandemic

in the modern technological age involved more ordering of medications online, whereas the Ebola outbreak did not necessarily include this technological factor (Fittler et al., 2021). Therefore, it cannot be certain whether findings from studies about one outbreak can be generalized to other similar outbreaks, or even whether information from a certain time during an outbreak can be applied to the same outbreak but at a different time (Fittler et al., 2021; Klofstad et al., 2019; Lopez-Garcia et al., 2021; Melki et al., 2021; Safarnejad et al., 2020; Winters et al., 2018; Worrall et al., 2020). Similarly, there is a temporary component to studies that focused on the analysis of online and social media content, because this information is constantly changing, and what is being pushed by algorithms into the general public's eye is extremely time period dependent (Bode & Vraga, 2018; Fittler et al., 2021; Fung et al., 2016; Hauer & Sood, 2020; Lopez-Garcia et al., 2021; Safarnejad et al., 2020; Sell et al., 2020; Worrall et al., 2020; Zhuang et al., 2020). Considering the time-sensitive nature of the studies and findings, many of the studies were also retrospective in design.

Another limitation is that although the diverse settings of these studies help to provide a bigger picture about this topic, they may also confine our ability to generalize findings to other specific countries or geographical regions. For example, findings from studies conducted in the United States may differ from similar studies conducted in Nepal simply due to cultural and societal factors. Numerous population studies were conducted using the internet or phone, which may pose a problem to the reliability of the findings, especially in areas where access to these resources is uncommon (Melki et al., 2021; Singh et al., 2020) or in studies that recruited participants through a website requiring an account (Geldsetzer, 2020; Scherer et al., 2021). Studies involving participants' self-reported data may also be inaccurate since self-reported behavior is not always indicative of actual behavior (Geldsetzer, 2020; Klofstad et al., 2019;

Melki et al., 2021; Singh et al., 2020; Vinck et al., 2019; Winters et al., 2018). One study also contained a monetary reward of $1.50 for completing the research survey, and while minimal in value, the possibility of it influencing the participants or their response cannot be eliminated (Geldsetzer, 2020). All in all, these limitations are important to consider when assessing the validity and reliability of the findings presented in this systematic review.

Synthesis of the Evidence

Misinformation is spread through various sources with electronic media being the biggest contributing factor (Lopez-Garcia et al., 2021; Safarnejad et al., 2020; Winters et al., 2018). The spread of health misinformation is concerning due to the fact that it is believed by a large percentage of the population. The predictors of the public's likelihood to trust misinformation greatly increased for those who spend more time on social media, lack trust in the government, or are fearful (Chua & Banerjee, 2018; Luo et al., 2021; Melki et al., 2021; Scherer et al., 2021; Vinck et al. 2019; Winters et al., 2018). Protective factors against health misinformation included higher income, higher education level, and increased literacy skills (Klofstad et al., 2019; Melki et al., 2021; Scherer et al., 2021; Singh et al., 2020; Worrall et al., 2020). Current research suggests that there are interventions available to curb the spread of misinformation. These interventions include ensuring public access to accurate information, recognizing vulnerable populations, and understanding the emotional responses of the public in order to design campaigns that decrease fear (Fung et al., 2016; Hauer & Sood, 2020; Klofstad et al., 2019; Luo et al., 2021; Scherer et al., 2021; Singh et al., 2020; Zhuang et al., 2020).

Recommendations

The spread of health misinformation could be curbed in clinical practice. Healthcare providers can perform health research and relay current, reliable information to patients who lack

protective factors (Klofstad et al., 2019; Melki et al., 2021; Scherer et al., 2021; Singh et al., 2020; Worrall et al., 2020). Governmental institutions may be able to decrease health information by designing campaigns that reduce fear (Fung et al., 2016; Hauer & Sood, 2020; Klofstad et al., 2019; Luo et al., 2021; Scherer et al., 2021; Singh et al., 2020; Zhuang et al., 2020). In future studies, researchers should appraise these interventions for effectiveness in mitigating the spread of misinformation.

Timeline of Project Completion

For this Honors project, we enrolled in senior honors project independent study in our senior year at the University of Akron. Our project was started during the fall of 2021 and further development of our review of literature section, critical appraisal of studies, the advancement of recommendations about clinical practice, and education, is currently in progress based on discussions with our project sponsor. This systematic review will be completed by the end of the 2023 spring semester. Our sponsor is Dr. Laura Distelhorst, who is a faculty member at The University of Akron School of Nursing. Our readers are Dr. Lisa Hart, who is also a nursing faculty member at The University of Akron, and Jodi Wentz, a skilled writer and librarian.

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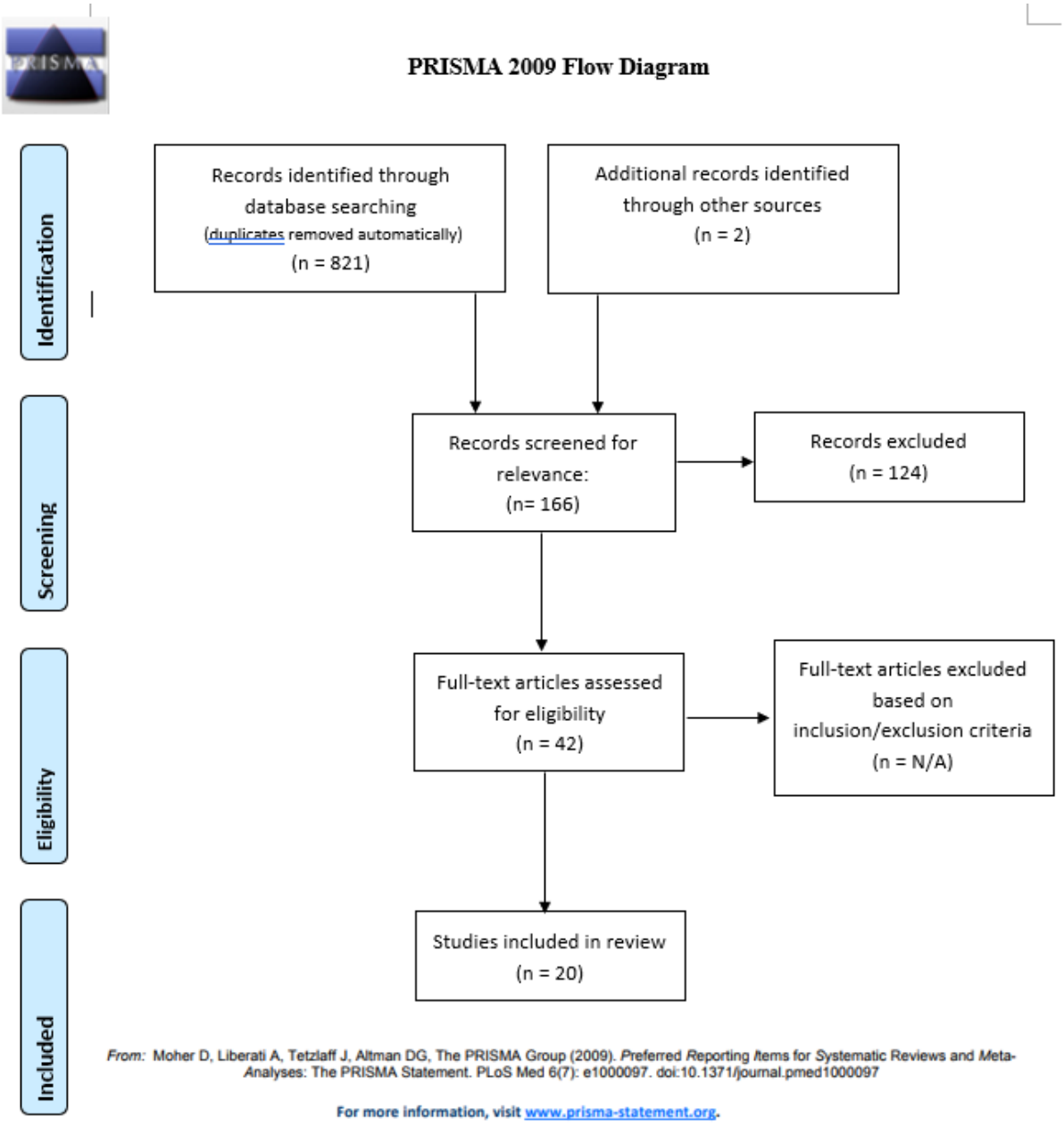
Appendix A

PRISMA



Appendix B

Table of Evidence

Title & APA formatted reference	Purpose statement. Research question[2].	Clinical Practice Setting, Sampling methods, Sample size[3].	Design. Level of Evidence.[4]	Findings, Conclusion[5]	Practice & Research Implications[6]	Critical Appraisal. Strengths and limitations[7]
1 **Effect of Infodemic Regarding the Illegal Sale of Medications on the Internet: Evaluation of Demand and Online Availability of Ivermectin during the COVID-19 Pandemic** (Fittler et al., 2021)	Purpose Statement: "**To provide evidence regarding increased demand, online availability and consumer accessibility of ivermectin, an anthelmintic agent, without substantiated indications in reference to SARS-CoV-2 (pg. 1)"** Research question: **What is the "connection between infodemic and its consequences on the illicit online pharmacy market? (pg. 1)"**	Setting: **Hungary** Sampling method: **Search engine result assessment** Sample size: **18 news articles** **First 30 search results to "buy ivermectin online"** **120 SER links (92 links offered ivermectin for retail use**	Design: **Descriptive analysis** Level of Evidence: **VI**	**85% of individuals don't scroll past first Google page. Number of Google searches for Ivermectin correlated with COVID surges/waves. Illegal med retailers equaled 73.3% of search results in March 2021. 100% of Top 10 links were to illegal retailers in Feb and March 2021. 55.5% of online med vendors offered Rx only products w/out a prescription.**	**Infodemic led to panic buying of ivermectin. Retailers taking advantage of the pandemic. Increase demand for the drug led people to pursue illegal means of obtaining it. The article provides several interventions to manage this misinformation.**	Strengths: **Since national and international search trends were analyzed, findings can likely be to pertain to places other than Hungary. Similar findings can also be generalized to other popularized meds (hydroxychloroquine, etc.)** Limitations: **Quality of products offered by retailers not evaluated. Study only covers a 4-month timeframe.**

2 **Using Social Media to Communicate Sustainable Preventive Measures and Curtail Misinformation** (Hauer & Sood, 2020)	Purpose statement: "**Understand how effective social media communication strategies can be crafted to promote sustainable preventive measures and curtail wide-spread misinformation (pg. 1)."** Research question: **"To identify a set of best practices for effective social media messaging to promote sustainable protective measures and curtail misinformation (pg.2)."**	Setting: **Internet/social media** Sample method: **Analytical review** Sample size: **Review of documents from 4 health organizations. Review of suggestions from 4 communication organizations. Review of info from community organizations.**	Design: **Descriptive, observational** LOE: **VI**	**7 effective strategies to curtail misinformation and promote preventative measures. See article.**	**Social media messages need to be written to promote preventative measures and decrease risk behavior. We need facts from trusted organizations. Engage celebrities with large social media platforms. Messaging needs to be clear and simple for lay audiences.**	Strengths: **Can be used to understand international social media communication. Not focused on just the US.** Limitations: **Unable to review recommendations from all trusted organizations. Did not test if social media campaigns/TikTok videos helped curtail misinfo.**

3 **What drives people to believe in Zika conspiracy theories**? (Klofstad et al., 2019)	Purpose statement: **"To demonstrate the role of predispositions, specifically underlying conspiracy thinking, in the acceptance of conspiratorial and unscientific beliefs (pg. 1)."** Research question: **"To what extent are the public concerned about the virus, and to what extent have the public adopted Zika conspiracy theories? (pg. 1)"**	Setting: **US** Sample method: **Convenience sampling** Sample size: **433 females, 344 males**	Design: **Observational, descriptive, survey** LOE: **VI**	**20% of respondents believe at least one Zika conspiracy, 7% believe more than one.** **Conspiracy thinking strong predictor of belief in conspir theories. Age is also related - younger people more likely to believe Zika conspir theories.**	**To curb the spread of health conspir need to focus on those with inc levels of conspir thinking.**	Strengths: **Study accounts for political partisanship, level of education, sex, age, level of mistrust in the government, religion, access to health insurance, and acess to info on Zika** Limitations: **Study is observational. Does not directly measure exposure to online Zika conspir theories, and how they affect beliefs. Has a historical component that may not be relevant anymore**.
4 **Knowledge and Perception Towards Universal Safety Precautions During Early Phase of the COVID-19 Outbreak in Nepal** (Singh et al., 2020)	Purpose statement: **"To assess the knowledge and perception of COVID-19 and relevant universal safety measures among the Nepalese population (pg. 1116)"** Research question**:**	Setting: **Nepal, web-based survey** Sample method: **Convenient non-probability self-select** Sample size: **871**	Design: **Web-based cross-sectional survey** LOE: **VI**	**18% thought COVID only affected older adults and no survival after infection. 70% thought limiting consumption of poultry and meat would prevent spread. Gap in knowledge in relation to social distancing and quarantine. 18% disagree/not sure coughing into elbow is good practice.**	**Educ plays a huge role in knowledge and perception. COVID knowledge may be poor among the general population (uneduc and without access to internet). Social media may be a way to spread**	Strengths: **Study accounted for socio-demographic info.** Limitations: **Half of Nepalese people do not have access to the web. Low literacy. All participants had some levels of formal educ.**

	What is the "level of knowledge and perception of the universal safety precaution among the Nepalese population during this global health crisis? (pg. 1117)"				**public health info and demystify COVID.**	
5 **Knowledge and Perceptions of COVID-19 Among the General Public in the United States and the United Kingdom: A Cross-sectional Online Survey** (Geldsetzer, 2020)	Purpose statement: **"To assess knowledge and perceptions about COVID-19 among a convenience sample of the general public in the United States and United Kingdom (pg. 157)."** Research question: **What is the knowledge and perception of about COVID-19 among the general public in the US and UK, and how can data be used to set priorities in information campaigns on COVID-19 by public health authorities and the media?**	Setting: **UK and US** Sample Method: **Convenience, online questionnaire** Sample size: **3,000 US participants and 3,000 UK participants.**	Design: **Cross-sectional survey** LOE: **VI**	**See data chart.**	**Findings could be used to prioritize information for COVID campaigns. Need to ensure people focus on effective prevention measures.**	Strengths: **Participants were filtered based on age, sex, and ethinicity to represent the US and UK populations based on the last census.** Limitations: **Participants had to have an account with Prolific. Participants were paid $1.50 to take the survey. Could have looked up the answers.**

6 **Risk Communication and Ebola-Specific Knowledge and Behavior during 2014–2015 Outbreak, Sierra Leone** (Winters et al., 2018)	Purpose statement: **"Assess the effect of information sources on Ebolaspecific knowledge and behavior during the 2014–2015 Ebola virus disease outbreak in Sierra Leone (pg. 336)"** Research question: **"What roles did different types of information sources play in influencing knowledge and behavior during the EVD outbreak? (pg. 337)"**	Setting: **Sierra Leone** Sample Method: **Random sampling, survey** Sample Size: **10,509**	Design: **Descriptive, cross-sectional?** LOE: **VI**	**All sources of info except print media assoc with misconceptions and risk behavior. Electronic media and community sources are most strongly associated with misconceptions. Higher knowledge and protective behavior correlated with times of increased transmission rates. Misconceptions declined during the peak. Exposure to different types of media sources correlates with inc knowledge and protective behaviors. Electronic media has highest assoc with knowledge and protective behavior, but also misconceptions. Community sources most strongly linked with risk behavior.**	**Repetition of messages is crucial to maintain protective behavior and dec misconceptions.**	Strengths: **Random sampling, large sample size, timing of data collection. Survey included open-ended questions leading to dec likelihood of bias. High response rate.** Limitations: **Self-reported behavior may not correlate to actual behavior. Most questions were closed-ended.**
7 **Journalistic Fact-Checking of Information in Pandemic: Stakeholders, Hoaxes, and Strategies to**	Purpose statement: **"This paper is focused on the fact-checking of journalistic content using a combined methodology: content analysis of information denied by the main**	Setting: **Spain** Sample method: **Content analysis, questionnaire**	Design: **Descriptive analysis** LOE: **VI**	**Fake news spiked during the first wave of the pandemic and reduced afterward. Fake news during the first wave focused on fake cures and treatments. During the second wave, hoaxes were recycled and slightly altered. Fake**	**Fake news is a risk to public health. Main motivation for fake news is to produce confusion and disorder (55.71%). Next is political reasons, journalist**	Strengths: **Large sample size** Limitations: **Time period, specific to Spain, Whatsapp not widely used in US.**

Fight Disinformation during the COVID-19 Crisis in Spain (Lopez-Garcia et al., 2021)	**Spanish fact-checking platforms (Maldita and Newtral) and an in-depth questionnaire to these stakeholders (pg.1).”** Research question: **How did the amount, content, and format of fake news change between the first and second wave of the pandemic in Spain?**	Sample size: **146 hoaxes**		**news during this second wave focused on negative effects of preventative measures (masks, etc.) International hoaxes focused on remedies, vaccines, and disease caused by the virus. China and US linked to most disinformation. Table 2 shows breakdown of types of disinformation in relation to waves. Text was main fake news format (45.71%). Whatsapp, twitter, instagram have most fake news.**	**errors, and economic reasons. Volume of hoaxes is highest in first wave.**	
8 **Crowdfunding Campaigns and COVID-19 Misinformation** (Synder et al., 2021)	Purpose statement: **“To understand whether and how crowdfunding campaigns are a source of COVID-19–related misinformation (pg. 739).** Research question: **“Are GoFundMe campaigns a source of COVID-19–related medical misinformation and what unproven COVID-19 prophylaxes and treatments are drawing the most**	Setting: **GoFundMe campaigns** Sample method: **Search results based on key terms used** Sample size: **208 campaigns**	Design: **Descriptive analysis** LOE: **VI**	**Dietary supplements and purported immune system boosters were the most common topics in campaigns (85.6%). 82.2% of campaigns made definitive efficacy claims**.	**Campaigns promoting purported txs could distract from people seeking proven tx. Campaigns promoting prophylactic txs could give people a false sense of invulnerability to COVID. Individuals may delay care.**	Strengths: **Large sample size** Limitations: **Sampling results limited to the key terms used.**

	interest by crowdfunders? (pg. 739)"					
9 **See Something, Say Something: Correction of Global Health Misinformation on Social Media** (Bode & Vraga, 2018)	Purpose statement: **"To investigate these two issues (see research questions) and discusses how findings inform theories of motivated reasoning, misinformation, opinion leadership, and credibility, as well as implications for how public health efforts can engage users in a campaign via social media to correct misinformation and associated beliefs about emerging health issues (pg. 1132)?"** Research question: **"Will social or algorithmic correction be more effective in correcting**	Setting: **A mid-atlantic university** Sample method: **Convenience** Sample size: **613 total, 136 were analyzed**	Design: **Experimental, randomized controlled** LOE: **II**	**Corrective information via algorithm and social correction dec belief in misinfo. No signif diff btw the two, or in credibility evaluation. Algorithmic correction effective no matter what level of conspiracy beliefs. Algorithmic correction rated more highly on credibility. Those with higher conspiracy beliefs rate lower credibility of corrective info. High conspiracy individuals trust algorithms less than social correction.**	**Social correction may be a highly effective way of correct health misinfo. Users should be encouraged to refute misinfo and provide sources for proof. Although effective, algorithms have many limitations. Corrective measures are effective if employed quickly and clearly. Ust provide supporting evidence though a related stories algorithm or link from a social contact.**	Strengths: **Experimental, randomized controlled study.** Limitations: **Student sample, focus on American Zika perceptions, small sample size, artificiality of the experiment. Study focuses only on Facebook as a way to correct misinfo.**

	misinformation beliefs (pg. 1133)?" **"How do users evaluate the credibility of the corrective algorithmic and social responses to the misinformation post (pg. 1133)?"** **"Will conspiracist ideation have a moderating effect on the credibility evaluations of corrective information (pg. 1134)?"**					
10 **Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in North Kivu, DR Congo: a population-based survey** (Vinck et al., 2019)	Purpose statement: **"To investigate the role of trust and misinformation on individual preventive behaviours during an outbreak of Ebola virus disease (EVD) (pg. 529)".** Research question: **"Is institutional trust associated with the adoption of preventive measures, including**	Setting: **DR Congo** Sample method: **Multistage cluster sampling** Sample size: **961 adults**	Design: **Descriptive survey** LOE: **VI**	**Most people did not hear about Ebola from a local authority or national government. 1 in 4 believed Ebola does not exist. 45.9% believed at least one misinfo statement was true. EVD trsut scores were signif lower in those who believed health misinfo. Low government trsut scores correlated to not seeking formal med care. Use of prevnetative measures correlated with higher trsut.**	**Trust is essential for effective public health interventions. Local trusted leaders and HCPs can help to build trust in communities.**	Strengths: **Large sample size.** Limitations: **Urban setting. Explored trust in health workers without specifying if they were government workers or non-gov workers. Data was self-reported (social desirability bias).**

	exposure avoidance and vaccination? (pg. 530)? **"Is belief in EVD misinformation associated with lower adoption of preventive measures? (pg. 530)"**					
11 **Intentions to trust and share online health rumors: An experiment with medical professionals** **(Chua & Banerjee, 2018)**	Purpose statement: **"To investigate medical professionals' intentions to trust and share online health rumors as a function of their personal involvement, the rumor type, and the presence of counterrumors. (pg. 1)"** Research question: **RQ 1. How is personal involvement related to intentions to trust and share rumors?** **RQ 2. How is rumor type related to intentions to trust and share rumors?**	Setting: **Public hospital in Asia** Sampling method: **Convenience, volunteer, within-particpants** Sample size: **60 HCPs**	Design: **Experimental design with random assignment.** LOE: **II**	**Personal involvement was positively related to intention to trust and share. Dread rumors were more likely to be trusted and shared. Counter-rumors did not have a great effect on trust or sharing.**	**Medical professionals need to play an active role in correcting health minsinfo on the Internet. Health info seekers need to be wary of info they find online, check with doctor before trusting.**	Strengths: **Study included a wide range of med professionals. Experimental design.** Limitations: **Focused on cancer realted rumors. Within participants experimental design could have resulted in fatigue among the HCPs. Personal experience with cancer may have affected their responses. Area of specialization was not taken into account.**

	RQ 3. How is the presence of counter-rumors related to intentions to trust and share rumors? **RQ 4. To what extent does rumor type moderate the relation between personal involvement and intentions to trust and share rumors?** **RQ 5. To what extent does the presence of counter-rumors moderate the relation between personal involvement and intentions to trust and share rumors? (pg. 3)**					
12 **Who Is Susceptible to Online Health Misinformation? A Test of Four Psychosocial Hypotheses**	Purpose statement: **"To examine whether certain people are susceptible to many types of health misinformation, regardless of the health topic at hand (pg. 274)"**	Setting: **US** Sampling method: **Convenience** Sample size: **923**	Design: **Within-subjects experimental design** LOE: **II**	**Those who spent more hrs/day on social media were more likely to rate misinfo as accurate and influential. Older adults and high household income individuals perceived misinfo as less accurate and influential. Those with higher literacy/education were less**	**Knowing who is susceptible to misinfo can help with targeting effective messaging toward those audiences. Experts need to provide a balanced**	Strengths: **Experimental design, large sample size, participants had race and education distributions very similar to the US population.**

(Scherer et al., 2021)	Research question: **"Are some people generally more susceptible to online health misinformation than others, regardless of the particular health topic at hand? (pg. 275)"** **"What type of person is susceptible to online health misinformation? That is, what are some important psychosocial predictors of misinformation susceptibility? (pg. 275)**			**likely to believe misinfo would influence their decisions. Low educ, lower health literacy, greater positive attitude toward alternative medicine, and lower trust in the health care system were assoc with inc suscep to misinfo.**	**perspective when engaging the public.**	Limitations: **Social media content was not randomly selected, although put through a rigorous selection process. Results may be limited to the 3 topics examined. Researchers did not assess pre existing health knowledge before the study began. Participants were recruited through Dynata survey company and compensated with lottery entries.**
13 **Factors affecting individual online rumor sharing behavior in the COVID-19 pandemic** (Luo et al., 2021)	Purpose statement: **"To explore the impacts of peer condition and peer communication on fear of COVID-19, and the impact of fear of COVID-19 on online rumor sharing behavior" (1)** Research question: **Does peer communication and online rumor sharing**	Setting: **China** Sampling method: **Convenience, volunteer** Sample size: **1167**	Design: **descriptive survey** LOE: **II**	**Peer communication and conditioning increases fear of Covid-19, and that fear results in online rumor-sharing. However, health self-efficacy can reduce this positive correlation and decrease the amount of fear and online rumor sharing.**	**Knowing that fear increases misinformation and rumor-sharing allows experts a clear path to reduce rumors: by reducing the initial panic and fear.**	Strengths: **Large sample size with high overlap between the respondents and the people intended to be studied because it was conducted online, where the actual rumor-sharing takes place.** Limitations: **Takes place in China so population trends could vary from**

	increase fear of Covid-19?					**country to country, the study did not assess the origin of the different types of rumors and if they were started or just spread by individuals.**
14 **Readability of online COVID-19 health information: a comparison between four English speaking countries** (Worrall et al., 2020)	Purpose statement: **"To evaluate the readability of online information relating to COVID-19 in four English speaking regions: Ireland, the United Kingdom, Canada and the United States, and compare readability of website source provenance and regional origin (pg 1)"** Research question: **How does readability of online information effect the spread of reliable information within regions of differing reading abilities?**	Setting: **Ireland, UK, Canada, US** Sample method: **Google search** Sample size: **240 webpages**	Design: **Descriptive analysis** LOE: **VI**	**Only 17.2% of health information was at a universally readable level. Government and public health sources had the highest readability.**	**Health info needs to be revised to reflect the universal readability level. Unreadability may contribute to lack of knowledge and poor adoption of preventive measures.**	Strengths: **Large sample size. Multiple countries were involved.** Limitations: **Study focused on only English speaking countries. Online health info is always changing, as well as Google search results. Tests relied on number of words in a sentence and syllables in a word. Study did not account for infographics or other figures that may help with readability/ understanding.**

15 **Mixed and blended emotional reactions to 2014 Ebola outbreak** (Zhuang et al., 2020)	Purpose statement: **To study emotion, co-evolution, co-existence, and emotional shift over time and across geographic locations.** Research question: **What emotional reactions were most prominent when the news of Ebola outbreak was released?**	Setting: **30 countries with verified outbreaks** Sample method: **Twitter posts** Sample size: **435,700 tweets**	Design: **Descriptive analysis** LOE: **VI**	**Out of 435 700 tweets, 62.5% were neutral, 9.6% were positive, and 27.9% contained negative emotions. Among the negatively valenced tweets, 61.3% contained verbal expressions associated with fear, 34.2% contained verbal expressions associated with anger, and 4.5% contained verbal expressions associated with sadness**	**A better understanding about how the public respond to health threats such as Ebola emotionally will enable health campaign practitioners to design campaigns and education materials that address fear, assuage anger, and deliver optimism, hope, and empowerment.**	Strengths: **Large sample size** Limitations: **Majority of data came from US which limits ability to make claims about other countries in regards to their emotional response. Limited to only analysing the tweets.**
16 **Misinformation and the US Ebola communication crisis: analyzing the veracity and content of social media messages related to a fear-inducing infectious disease outbreak** (Sell et al., 2020)	Purpose Statement: **The purpose of this study was to describe the content of Ebola-related tweets with a specific focus on misinformation, political content, health related content, risk framing, and rumors.** Research question: **What content within Ebola-related tweets contained fear-inducing**	Setting: **English speaking countries** Sample method: **Twitter posts** Sample size: **3639 tweets**	Design: **Quantitative content analysis** LOE: **VI**	**10% of Ebola-related tweets contained false or partially false information. When comparing tweets with true information to tweets with misinformation, a greater percentage of tweets with misinformation were political in nature (36% vs 15%) and contained discord-inducing statements (45% vs 10%).**	**Anticipating the politicization of disease outbreaks, and the need for policy makers and social media companies to build partnerships and develop response frameworks in advance of an event.**	Strengths: **Samples were filtered to exclude foreign or irrelevant information related to Ebola** Limitations: **Limited content within the tweets. Interpretation of sarcasm and satire. Limited to English language tweets.**

	information regarding the epidemic?					
17 **Social Media's Initial Reaction to Information and Misinformation on Ebola, August 2014: Facts and Rumors** (Chun-Hai Fung et al., 2016)	Purpose Statement: **to help public health agencies develop their social media communication strategies.** Research questions: 1. **What Ebola-related information and misinformation (and their proportions) was circulated on two popular microblogging platforms (Twitter and Sina Weibo) in the two most commonly spoken languages (English and Chinese) on the day of the PHEIC announcement?** **2. What changes could be observed a week later?**	Setting: **US and China** Sample method: **Twitter and Sina Weibo** Sample size: **1% of tweets containing the word "Ebola"**	Design: **Descriptive analysis** LOE: **VI**	**Misinformation on two speculative treatments (i.e., bathing in or drinking saltwater and ingestion of Nano Silver, an experimental drug) were found. A range of 36%–58% of the posts were news about the Ebola outbreak and 19%–24% of the posts were health information and responses to misinformation in both batches.**	**Communicating scientifically accurate information about an outbreak is important, because an informed public will likely be less susceptible to misinformation that could hinder outbreak control**	Strengths: **Manual coding. Representative sample.** Limitations: **Proportions of misinformation seen online may not line up to the amount of rumors circulating in rural public.**
18 **Contrasting misinformation and real-information dissemination**	Purpose Statement: **To provide a comprehensive workflow to identify top influential health**	Setting: **English speaking countries, jan 1-dec 31, 2016**	Design: **Descriptive analysis**	**Dissemination networks of Zika misinformation differed substantially from real information on Twitter,**	**Leads to a more holistic understanding of health**	Strengths: **Large sample size** Limitations: **Timelines affect what is**

network structures on social media during a health emergency (Safarnejad et al., 2020)	**misinformation about Zika on Twitter in 2016, reconstruct information dissemination networks of retweeting, contrast mis- from real information on various metrics, and investigate how Zika misinformation proliferated on social media during the Zika epidemic.** Research question: **During a health emergency, how are networks of information being disseminated from real information to misleading data?**	Sample method: **Twitter** Sample size: **5000 tweets**	LOE: **VI**	**indicating that misinformation utilized distinct dissemination mechanisms from real information**	**misinformation challenges on social media.**	**considered misinformation.**
19 **Measles, social media and surveillance in Baltimore City** (Warren, K.E., Wen, L.S., 2016)	Purpose Statement: **To explore city-wide infectious disease prevention and containment protocols in the social media age and its effects on healthcare misinformation.**	Setting: **Baltimore, Maryland, USA** Sample method: **n/a, reviewing relevant case studies** Sample size: **2**	Design: **Case studies** LOE: **III**	**Although social media and the new information age can spread misinformation, in the case of viral epidemics they can be very helpful for contact tracing and facilitating communication between individuals, healthcare teams, and the federal health department.**	**Social media should not only be used as a response to epidemics or issues, but should be used to educate the public proactively.**	Strengths: **Real-life examples that included communities, hospitals, and the healthcare department to showcase the interaction between all three and how it is facilitated by social media**

	Research question: **How can social media be used proactively to prevent to prevent panic with disease outbreaks and spur public health action?**			**There is a continuing need for use of media to proactively educate on diseases and shape public health ideation.**		Limitations: **There were only two case studies and they were both about the same disease in the same city at roughly the same time. The authors were unable to make causative links between social media use and vaccination rates.**
20 **Mitigating infodemics: The relationship between news exposure and trust and belief in COVID-19 fake news and social media spreading** (Melki et al., 2021)	Purpose statement: **"To examine the relationship between exposure to and trust in COVID-19 news (from Television, social media, interpersonal communication) and information sources (healthcare experts, government, clerics) and belief in COVID-19 myths and false information, as well as critical verification practices before posting on social media (pg. 1)."** Research question:	Setting: **Lebanon** Sample method: **Random sampling based on possible mobile number ranges** Sample size: **1,536**	Design: **Descriptive, quantitative cross-sectional phone survey.** LOE: **VI**	**Those who trust social media news about COVID-19 inc likely to believe false info. Inc education (univ educ) and those who trust gov info correlated with dec likelihood to believe false info. Those who underwent soc media literacy training more likely to engage in critical social media posting practices**	**Need inc comm from government sources. Training social media users may be effective in reducing the spread and adoption of misinfo.**	Strengths: **Large sample size. Quantitative. Random sampling.** Limitations: **Phone survey. Self-reported behavior may differ from actual behavior. Specific to Lebanon.**

	What is the relationship between news exposure and trust/belief in COVID-19 misinformation?					

Appendix C

Alexis Emich, Katrina Lamp, and Bethany Stefan have each contributed to the systematic review. Katrina Lamp was responsible for writing the abstract and the introduction. Bethany Stefan wrote the integrated review of literature and limitations sections. Alexis Emich wrote the methods, synthesis of evidence, and recommendations. All of the writers worked on the table of evidence, editing, and revising the systemic review.