The COVID-19 Misinfodemic: Using Triple Loop Learning to Guide a Process Evaluation of the COVID-19 Expert Database Project

This Doctoral Project, The COVID-19 Misinfodemic: Using Triple Loop Learning to Guide a Process Evaluation of the COVID-19 Expert Database Project, presented by Emily A. LaRose, and Submitted to the Faculty of The Harvard T.H. Chan School of Public Health in Partial Fulfillment of the Requirements for the Degree of Doctor of *Public Health*, has been read and approved by:

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THE COVID-19 MISINFODEMIC: USING TRIPLE LOOP LEARNING TO GUIDE A PROCESS EVLAUATION OF THE COVID-19 EXPERT DATABASE PROJECT

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Abstract

The COVID-19 pandemic has been a source of overwhelming hardship, grief, and tragedy. It has impacted all of us - how we live, our work, health, and relationships. In addition to the virus-induced health crisis, the world has been inundated by an epidemic of health misinformation – a misinfodemic – fueled by social media and messaging channels online.

Health misinformation is not new, but its recognition as a significant public health challenge capable of physical, emotional, and psychological harm has grown during the pandemic. In recent publications, researchers, public health advocates, and others have acknowledged that innovative, cross-sectoral partnerships are vital to curb the spread of health misinformation online. Additionally, there has been a growing acknowledgment that new workflows and resources are needed to support the production of high-quality health- and science-related digital content and counter circulating myths, rumors, and conspiracy theories.

In June 2020, Meedan's Digital Health Lab launched the COVID-19 Expert Database Project as a novel intervention to support journalists and fact-checkers in reporting on pandemic-related health and science topics. The project was designed as a resource where media partners could submit questions to a team of public health experts and receive responses in the form of evidence-based explainers that would also be posted to the project website.

This thesis reviews how I planned and executed a process evaluation of the first seven months of the project to determine if it was implemented fully and as intended; evaluate whether the assumptions that underpinned the project were valid; identify which parts of the project worked as planned and which did not; and explore the contextual elements that influenced the project and its implementation. This paper also discusses how I integrated the evaluation into a triple loop learning model that posed the following questions: *are we doing our work well* (loop one); *are we doing the correct work to serve our partners and deliver on*

our project outputs and outcomes (loop two); and *are we gathering information needed to make informed choices about our strategy, objectives, and direction* (loop three). Finally, I have highlighted how I applied the evaluation learnings to propose activities for continued monitoring and evaluation efforts in support of ongoing programmatic reflection, learning, and improvement in the coming year.

Through qualitative interviews with partners and the project team and a review of program materials, I found that the COVID-19 Expert Database Project was successfully implemented as intended. Between June and December 2020, the project team received pandemic-related questions from organizations representing more than 15 countries and delivered contextually relevant responses to more than 200 questions. In addition, partners universally endorsed the quality, trustworthiness, accessibility, and usefulness of the explainer content and reported routinely using the database alongside resources from the World Health Organization, Centers for Disease Control and Prevention, and other leading health authorities.

Despite the overwhelmingly positive feedback provided by partner organizations, the evaluation underscored the need for improved readability and accessibility to meet the project team's targets in support of health literacy. Additionally, it is essential to acknowledge that the pandemic contributed to the successful launch of the project and its utility. First, data gaps and rapidly emerging scientific findings increased the demand for health-related fact-checking. Second, efforts to combat health misinformation became a global priority in the interest of public safety. Third, the pandemic substantially elevated the perceived importance of addressing health misinformation among journalists and fact-checkers.

The COVID-19 Expert Database Project provided a model that successfully supported journalists and fact-checkers in combating health misinformation online. Though the pandemic persists, the project has been relaunched as Health Desk. Now, in addition to pandemic-related content, the project team has begun writing explainers to support fact-checking efforts on other health topics. In the coming year, the team also plans to continue to develop new partnerships and resources to ensure that professional communicators can provide the public with access to accurate, timely, and accessible health information.

Table of Contents

Abstract ..... *ii*

List of Figures with Captions ..... *vii*

List of Tables with Captions ..... *viii*

Acknowledgements ..... *ix*

Introduction *1*

Background, Literature Review, and Framework for Change *6*

Health Misinformation in a Digital World 7

Solidifying and Spreading Misinformation 10

Challenges to Countering Misinformation at the Scale of the Internet 13

Fact-Checking Health-Related Content 15

Cross-Sectoral Collaboration Between Public Health Experts and Fact-Checkers to Address Misinformation 18

The COVID-19 Misinfodemic 20

The COVID-19 Expert Database Project 24

Process Evaluation Framed within a Triple Loop Learning Model 26

Methods and Analyses *31*

Process Evaluation Plan Overview 32

Project and Complete Project Delivery Descriptions 34

Evaluation Questions, Methods, and Resources 36

Key Evaluation Questions 38

Data Sources, Sampling Procedures, Data Processing, and Data Analysis 40

Website, Question Tracking Spreadsheet, and Project Tools 40

Explainer Audit 42

Qualitative Interviews with Partners 44

Additional Qualitative Data 46

Data Limitations 46

Results *49*

Fact-Checking at the Start of the COVID-19 Pandemic 50

Loop 1: Are we doing our work well? 51

To what extent have the COVID-19 Expert Database Project activities been completed? 51

Is the COVID-19 Expert Database Project delivering high-quality content that is accessible to global partners? 53

Loop 2: Are we doing the right work? 58

Are the assumptions that have informed the creation of the COVID-19 Expert Database Project accurate? 59

How have participants (partners) interacted with database content? 61

How has the COVID-19 Expert Database Project influenced partners' fact-checking processes?...... 63

Loop 3: Are we gathering information needed to make informed choices about our strategy, objectives, and direction? 66

What are the structures, adaptations, and processes through which the COVID-19 Expert Database Project has been delivered?..67

Application of Process Evaluation Insights..68

Conclusion..*72*

Bibliography..*78*

Appendix A: Project Description & Acceptable Project Delivery Description..............................*90*

Appendix B: Learnaboutcovid19.org Website Audit for Adherence to IFCN Principles.............*92*

Appendix C: COVID-19 Database Content Audit April 2021..*94*

Appendix D: Qualitative Interview Guide for Database Partners..*100*

Appendix E: Mean SMOG Index scores and mean Clear Communications Assessment scores across thematic categories..*102*

List of Figures with Captions

Figure 1: The triple loop learning model used to inform how the process evaluation was designed 29
Figure 2: The Saunders Model for process evaluation design 32
Figure 3: Assumptions that underpinned the COVID-19 Expert Database Project 36
Figure 4: IFCN code of principles 42
Figure 5: Chart displaying mean SMOG Index scores and mean Clear Communications Assessment scores across thematic categories 58
Figure 6: Progressive application of findings 69
Figure 7: Simplified logic diagram 70

List of Tables with Captions

Table 1: Information sources to support process evaluation planning..32
Table 2: Project domains listed with narrative domain descriptions and relevant project activities 35
Table 3: Elements of the process evaluation plan 37
Table 4: Key process evaluation questions 39
Table 5: Key process evaluation questions mapped to the adapted TLL questions 39
Table 6: Information types and sources identified to support process evaluation data collection 40
Table 7: Key project activities, target outputs, and results 52
Table 8: Mean SMOG Index scores by content area 55
Table 9: Summary of key findings from the Clear Communication Assessment.......................... 57
Table 10: Change in assumption importance or relevance during the COVID-19 pandemic 60
Table 11: Likert scale responses to partners' views on COVID-19 Expert Database usefulness and trustworthiness, and the likelihood of recommending the database to others............................64

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The COVID-19 pandemic has brought immeasurable sadness, grief, and loss to the world. The pandemic has exposed weaknesses in our public health systems and challenged governments, health professionals, researchers, and others to identify ways to improve communications, health literacy, and preparedness for future public health crises. With humble acknowledgment, I recognize the immense honor of working with a team of dedicated public health experts in improving the infosphere during the past year.

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Introduction

Although misinformation is not a new phenomenon, the speed of transmission and its potential for undermining public health messaging has never been greater. The viral spread of misinformation in the form of fiction, partial truths, and misapplied evidence has been particularly evident during the COVID-19 pandemic. In this thesis, I will be focusing on one attempt to counteract misinformation – the COVID-19 Expert Database Project – and presenting an evaluation of the project's approach and implementation together with significant learnings captured during the first seven months of the program.

Many scholars argue that misinformation, propaganda, and disinformation have persisted throughout history and are as old as communication itself (Abrams, 2021; Anderson, 2021; Ireton & Posetti, 2018; Perakslis & Califf, 2019). Over the past two decades, however, the world has entered an Information Age where internet use has become a ubiquitous part of life. Globally, there are about 4.66 billion active internet users who represent 59.5% of the population (Johnson, 2021). Social media use is also massive, with about 4.2 billion active users globally (Clement, 2020; Johnson, 2021). Unfortunately, while the internet, social media channels, messaging, and other virtual communication pathways give society a wealth of valuable information and enable us to connect with people from around the world, they also provide a platform where manipulated, twisted, misapplied, or false information can be amplified, shared, and spread at lightning-fast – or viral – speeds (Abrams, 2021; Ireton & Posetti, 2018).

The term misinformation is preferentially used in the literature and media to encompass any type of false information, but information disorders can be more specifically classified into one of three categories: misinformation, disinformation, and midinformation. Misinformation is inaccurate or false information that is shared unknowingly or unintentionally. Disinformation refers to intentionally misleading or false information and spread with the intent to cause harm or confusion (Ceron et al., 2021; LaRose et al., 2021; Mina, 2020; Morley et al., 2020).

Midinformation describes unclear or ambiguous information that arises when scientific knowledge is limited (Mina, 2020), and evolving circumstances bring new, conflicting, and incomplete knowledge that can result in confusion (Lewandowsky et al., 2012). Finally, the term misperception has also been used in the literature to capture "false beliefs" occurring as a result of misinformation exposure; however, the term is not widely used (van der Meer & Jin, 2020).

While the presented definitions have been used in the literature and may seem straightforward, there is not an objective benchmark to determine whether or not a piece of information qualifies as misinformation. Frequently cited definitions suggest that misinformation describes content that is counter to the current knowledge, best available evidence, and expert consensus of the scientific community (Chou, Gaysynsky, & Cappella, 2020; Murthy, 2021; Viswanath et al., 2020; Vraga & Bode, 2020). However, it is essential to acknowledge that scientific study and knowledge generation are dynamic processes wherein new findings, changing contexts, and continuous learning alter the very nature of what is known (Vraga & Bode, 2020). Thus, as knowledge advances and more evidence is gathered over time, content classified as misinformation can change (Murthy, 2021).

Though political misinformation has been a known influencer of elections and democracies for decades, the recognition of health misinformation as an influencer of personal and public health is nascent (Morley et al., 2020). Health misinformation has resulted in children being given bleach to “cure autism” (Zadrozny, 2019), an increased spread of Ebola during the 2014 outbreak in West Africa (Allgaier & Svalastog, 2015), delayed or disrupted pediatric cancer treatment (Guidry et al., 2021), vaccine avoidance (Guidry et al., 2015), and hospitalization and death from home remedies (Adegboyega, 2021; Aljazeera News Agency, 2020a) and unapproved medications (U.S. Food and Drug Administration, 2021). Health misinformation has also been cited as a contributor to health inequities, in part because of existing racism, poverty, and mistrust in some communities (Viswanath et al., 2020). Unfortunately, however, many health professionals have been slow to acknowledge the prevalence of health misinformation and its impacts on patient and community health-related decision-making practices (Chou, Gaysynsky, & Cappella, 2020; Ioannidis et al., 2017; Perakslis & Califf, 2019).

Ignoring the complex intersection between health misinformation and public health holds potentially catastrophic consequences (Ioannidis et al., 2017; Perakslis & Califf, 2019). The acceleration of health misinformation online via social media, messaging, and other avenues is under-discussed and underappreciated. In the interest of both health and safety, health misinformation must be viewed as a significant global public health problem attributable to our increasingly digital world (Gyenes & Marrelli, 2019; Walter, Brooks, et al., 2020). New frameworks, tools, and methodologies are desperately needed to define, identify, prevent, combat, and curb the viral spread of health misinformation online (Gyenes & Marrelli, 2019; LaRose et al., 2021).

Online health misinformation commonly arises from rumors, myths, and conspiracy theories; misinterpreted, misunderstood, or misapplied findings from the scientific literature; and commercial or other vested interests. Given its complexity, there is no singular solution to curb the creation and spread of false information. Moreover, any misinformation exposure has the potential for harm. Preventing misinformation from being introduced and spread online would be a helpful but impractical expectation for the virtual environment since there are few barriers to generating, posting, and sharing content, regardless of accuracy or truthfulness (Lewandowsky et al., 2012). Targeted, proactive messaging that is carefully curated and tailored to different audiences may help to shape narratives to prevent the spread of misinformation (R. Smith et al., 2020). Still, these messages would do little to counter already circulating false claims.

To address existing misinformation that is actively spreading online, reactive measures, including platform-driven content moderation and independent fact-checking activities, are often used. Many social media platforms (e.g., Twitter, Facebook, WhatsApp) employ content moderation to monitor, judge, and act on user-generated content. The process uses algorithms, manual techniques, and crowd-sourcing activities to identify potentially harmful content then determine how and when to apply and enforce policies, guidelines, or standards. False content can then be deprioritized, hidden, or removed from the platform, among other possible content interventions (Lo, 2020).

Fact-checking online content is a relatively new intervention that acts in the public interest to correct, refute, and debunk viral misinformation and promote truth (Luengo & García-Marín, 2020; Sippitt & Moy, 2020). To conduct a fact-check, journalists and fact-checkers identify popular, active, or engaging claims circulating on social media, messaging, or other platforms. Next, they research the origin of the claim and determine whether aspects of the claim are true, partially true, or false using data and information from experts, published literature, and other sources. If the content is found to be partially or entirely false, they publish a fact-check to refute or counter the claim, often explaining the origin of the content, why it is inaccurate, and provide accurate information in its place (Nat Gyenes, personal communication, March 24, 2021).

As trained communicators, the work of fact-checkers and journalists is critical in improving the quality of health information online. However, these professionals often lack the science or health training needed to deliver messages based on complex and nuanced health communications. Additionally, they require support from health experts to clarify, validate, and apply the latest scientific evidence to circulating claims. External reliance on experts and researchers can cause delays in the fact-checking process. Unfortunately, the more time that misinformation remains uncorrected online, the more potential harm it can do and the further it can spread (Nat Gyenes, personal communication, March 24, 2021).

The COVID-19 Expert Database Project is an endeavor launched by the Digital Health Lab within the technology nonprofit Meedan to support pandemic-related fact-checking efforts. First conceptualized at the start of the COVID-19 pandemic in early 2020, the project aimed to improve the quality of COVID-19-related health information in global media channels by providing timely access to public health experts to support fact-checking efforts and science communications. The endeavor brought together public health professionals who gathered questions posed by journalists and fact-checkers and answered them in the form of non-technical, evidence-based explainers. Once complete, the explainers were posted on the project's *learnaboutcovid19.org* website and were forwarded to the requesting organization for integration into their fact-checking and media work.

This thesis discusses the planning and execution of a process evaluation of the first seven months of the COVID-19 Expert Database Project. With a rapid, pandemic-driven project launch, there was minimal structure to support programmatic evaluation. I planned the evaluation within the triple loop learning (TLL) model as an initial step on a long-term continuous monitoring, evaluation, and learning pathway. To frame the evaluation, I applied adapted versions of the key TLL questions: *are we doing our work well* (loop one); *are we doing the correct work to serve our partners and deliver on our project outputs and outcomes* (loop two); and *are we gathering information needed to make informed choices about our strategy, objectives, and direction* (loop three) (Flood & Romm, 2018; Georges L. Romme & van Witteloostuijn, 1999; Peschl, 2007; H. L. Smith, 2014). Under these questions, I sought to identify lessons learned and areas for growth and improvement by evaluating the implementation of the COVID-19 Expert Database Project, challenging the underlying project assumptions, auditing the quality of the database content, and exploring how partners used and interacted with the database. Finally, using applied learnings gained through the process evaluation, this thesis will also discuss how the TLL model was used to propose activities for continued project monitoring and evaluation in support of intentional and ongoing programmatic reflection, learning, and improvement in the coming year.

Background, Literature Review, and Framework for Change

The global *infosphere* is an invisible, metaphysical information environment (Morley et al., 2020) that encompasses information, data, communications, and knowledge that individuals encounter and interact with in their daily lives. People, cities, and our society have been transformed by the digital and technological revolution (Rice & Sara, 2019). As a result of technology, the internet, and social media, global citizens are more interconnected than ever before. Information sharing and consumption online are part of daily life, with adults spending more time on screens and online than doing anything else (World Economic Forum, 2016).

Even in our Information Age, where many people have access to vast amounts of unvetted content online, the infosphere is not widely acknowledged as an influencer of health in the social determinants of health models (LaRose, 2021a; Morley et al., 2020; Rice & Sara, 2019). Over the past 30 years, the virtual world of information and communication technologies has become seamlessly integrated into daily life and influences physical, mental, and social health (Rice & Sara, 2019). How individuals connect and access information have arguably been the most significant adaptations imposed by the internet and social media (Viswanath et al., 2020).

Health and safety information has always been available from friends and family members, healthcare providers, and the news media. However, we are no longer bound by social circles, historically dictated by geographical boundaries. Many people have immediate access to seemingly endless amounts of health-related content via social media platforms, online media sources, and search engines. Widespread access to health information online has both positive and negative implications for individuals and societies.

Perhaps the most favorable attribute of our online environment is the opportunity for connectedness that transcends physical boundaries and facilitates social interaction and empowerment. Additionally, online tools and resources provide education and learning opportunities for users to develop and hone skills, seek and gather information, and explore content across cultures and geographies. Digital engagement fosters community creation and development even in the absence of physical proximity. Finally, technology has introduced employment flexibility for both employers and staff (Rice & Sara, 2019; World Economic Forum, 2016).

The potential negative impacts of the online infosphere on health are multifactorial. First, unlike direct interpersonal connections that are guided by social norms, online information is influenced by algorithms that can alter decision-making, reinforce unfounded beliefs, amplify users' attitudes and preferences, and shape individuals' perceptions and political views (Cinelli et al., 2020; LaRose, 2021c; World Economic Forum, 2016). Second, technology has been shown to alter social skills and reduce empathy, promoting bullying and harassment online and off. Third, spending excessive amounts of time online can increase stress, fosters addictive behavior, and decreases physical activity, all of which collectively may impact physical and mental health. Finally, digital content, especially on social media, provides an unchecked avenue for anyone to share their views and opinions, making it easy to create and spread misinformation and disinformation that can be deleterious to health (Rice & Sara, 2019; World Economic Forum, 2016).

Health Misinformation in a Digital World

Individuals commonly rely on external information to make decisions about their health and behavior, and studies have shown that misinformation negatively impacts health-related decision-making (Cinelli et al., 2020). Unfortunately, however, the internet has provided a forum for misinformation to profligate in a relatively unchecked manner, and misinformation has become persistent, pernicious, and pervasive across global communication channels (Allcott et al., 2019; Bridgman et al., 2020; Lewandowsky et al., 2012; van der Meer & Jin, 2020; Walter, Brooks, et al., 2020).

Online misinformation is incredibly widespread. However, there is no data to quantify the exact amount of misinformation globally available across platforms and websites – health, political, environmental, or otherwise (Allcott et al., 2019). Even companies like Facebook are unaware of the amount of misinformation on their platforms (Frenkel, 2021). In a brief web search for health advice, one is likely to be met with thousands, if not millions, of links to news stories, social media posts, blog articles, informational websites, and promotional advertisements from drug companies, hospitals, and spurious promoters, including self-proclaimed experts or advisors. Online content is largely unregulated, and some experts believe that most results yielded from basic internet searches are inaccurate (Ioannidis et al., 2017; Morley et al., 2020). It is generally thought that most of us have believed or shared misinformation at one time or another because it can be challenging to confidently assess whether the content is entirely false, misleading or twisted, misinterpreted, recontextualized, or partially true but misapplied (United Nations (UN), 2021).

There are surging epidemics of health misinformation online, termed *misinfodemics,* that have yielded adverse health outcomes worldwide (Chou, Gaysynsky, & Vanderpool, 2020; Gyenes & Mina, 2018; Krause et al., 2020). For example, social media-fueled misinfodemics have contributed to poor vaccination rates leading to the reemergence of virtually eradicated disease (Guidry et al., 2015; Perakslis & Califf, 2019), medication avoidance for conditions like heart disease and cancer (Perakslis & Califf, 2019), disordered eating behaviors proliferated by fad diets and detoxes (Pinterest, 2021), and, in some cases, premature death (Hill et al., 2019; Murthy, 2021). A recent systematic review also found that health misinformation is widespread across social media platforms. The study reported that inaccurate posts about smoking and drug use, vaccines, diseases (e.g., non-communicable diseases, infectious diseases), and diets appear frequently (Suarez-Lledo & Alvarez-Galvez, 2021). Finally, in addition to the adverse health outcomes directly attributable to misinformation, widespread misinformation can undermine people's perceptions of the existing scientific evidence and consensus, fostering confusion and mistrust of science and health experts. Mistrust can result in apathy and decrease health-seeking behaviors (Chou, Gaysynsky, & Cappella, 2020; Murthy, 2021).

Though the source of particular claims often remains obscured, misinformation commonly arises from rumors, myths, anecdotes, or conspiracy theories; influential political figures and celebrities; profiteers, activists, or those with vested interests; and through media communications (Center for Countering Digital Hate (CCDH), 2020; Donovan, 2020; Lewandowsky et al., 2012). Rumors, myths, anecdotes, and conspiracy theories are generated based on fiction, misunderstanding, or beliefs purported as truths (Lewandowsky et al., 2012). They also commonly arise from a desire for knowledge in the face of data deficits – situations where there is high demand for information but the supply of information is restricted by limited scientific knowledge or emerging facts (Mina, 2020; Shane & Noel, 2020; R. Smith et al., 2020).

Political figures and celebrities maintain audiences who listen, follow, and observe their statements, narratives, and recommendations. As a result, they wield immense power in shaping the type and flow of information to their audiences, whether true or false. In addition, companies, organizations, activists, and others with vested interests may be incentivized to misinform the public with ideologically-based communications or advertising and may influence public-facing political narratives through lobbying efforts (LaRose, 2021c; Lewandowsky et al., 2012). Finally, media communications can result in misinformation if inaccurate or incomplete information is conveyed. Additionally, with limited health or science training and pressure to create newsworthy headlines, media outlets may oversimplify, misrepresent, or dramatize findings from scientific studies, which can fuel misinformation (Lewandowsky et al., 2012).

While less frequently discussed, complex, high-level, or expert health and science communications are also a potential source of unintentional health misinformation. Human rights guidance and crisis and health communications frameworks consistently state that people must have the knowledge and ability to make well-informed decisions about their health using accessible, understandable, and factual information (Greenwood et al., 2017; Human Rights Council, 2020; Lewandowsky et al., 2012; Reynolds & W. Seeger, 2005; World Health Organization (WHO), 2020a). However, health communications are inherently complex and nuanced and can be difficult to convey using plain language. Information accessibility may also be influenced by content-related factors, including availability and readability, and personal factors, including digital access, literacy skills, cognitive factors, linguistics, and cultural relevance (LaRose, 2021a; Roundtable on Health Literacy et al., 2020). For example, studies have shown that health-related content online is often not at an appropriate reading level for those with average or below-average literacy skills (Basch et al., 2020; Ferguson et al., 2021; LaRose, 2021b; Worrall et al., 2020). A lack of accessible information can worsen health inequities and create confusion, misinterpretation, and fear that can result in the development and spread of rumors, myths, and other forms of misinformation (Gyenes & Mina, 2018; LaRose, 2021b; Mina, 2020; Murthy, 2021; R. Smith et al., 2020).

Solidifying and Spreading Misinformation

In a recent publication, the Surgeon General of the U.S., Dr. Vivek Murthy, suggested that "limiting the spread of health misinformation is a moral and civic imperative that will require a whole-society effort" (Murthy, 2021). As an emerging multidisciplinary field, global misinformation research employs methods and perspectives from psychology, public health, social and behavioral sciences, communication sciences, and technology as researchers look to better understand the etiologies of health misinformation, quantify the prevalence of health misinformation, understand how and why misinformation spreads online, and describe the potential implications for individuals, communities, and groups exposed (van der Meer & Jin, 2020).

Before considering how information is spread, it is essential to consider how people approach and process new information. Regrettably, most individuals do not consider new information from an objective position (Chou, Gaysynsky, & Vanderpool, 2020). Instead, many people are prone to believe new information they encounter –a disposition termed *reflexive open-mindedness* (Lewandowsky et al., 2012; Pennycook & Rand, 2020). Even in health crises, as people seek to continuously learn, build, and update their integrated memories (Swire & Ecker, 2018), individuals are driven to explore new or seemingly important messages closely to remember critical information, even if it is inaccurate (Swire & Ecker, 2018; van der Meer & Jin, 2020; Walter, Brooks, et al., 2020). Reflexive open-mindedness can be dangerous when people encounter misinformation, especially when there is a data deficit. However, suspension of this tendency is possible when a statement is too outlandish to be plausible, when there are high levels of existing distrust when the message is received, or when an individual can accurately and objectively analyze the information (Lewandowsky et al., 2012).

Worldviews are often central to an individual's identity, sense of self, and sense of belonging. Together with education, cultural and social influences, and other factors, worldviews can alter how people respond to new information. When people evaluate casually encountered information for truthfulness, for example, they tend to explore it through a lens that is closely tied to existing knowledge and familiarity with the subject. They compare the new information against what they know or believe, determine if the narrative is sensible within their worldview, evaluate the information source, and explore whether the information is believable to others in their social circles (Lewandowsky et al., 2012).

However, using personal experiences and familiarity to evaluate new information online is problematic because internet environments are carefully curated and not reflective of true reality. Online, people are prone to selective exposure wherein they tend to search for information that supports their existing beliefs and viewpoints (Lazer et al., 2018). These search patterns create silos or "echo chambers" that are reinforced by internet algorithms and contribute to increasing polarization and belief-centered decision-making (Lewandowsky et al., 2012; Swire & Ecker, 2018). Furthermore, echo chambers support individuals' existing views and encourage people to accept questionable content (Walter, Brooks, et al., 2020), which may further spread misinformation (Cinelli et al., 2020).

Virtual peer-to-peer relationships via social media or messaging channels create ties that foster trust (Walter, Brooks, et al., 2020) through an alignment with communal norms and beliefs (Lazer et al., 2018). However, social media platforms are not designed to consistently deliver authoritative, accurate, or timely health-related information (Donovan, 2020). Thus, the viral spread of misinformation has been enabled by social media and messaging platforms that engage billions of global users (Bridgman et al., 2020). Studies have found that factual articles are less likely to be shared across social media channels than those that are inaccurate or misleading (Chou, Gaysynsky, & Cappella, 2020; Obiała et al., 2020; Vosoughi et al., 2018). In a study of nearly 126,000 stories shared via Twitter between 2006 and 2017, researchers found that the rapid spread of false information was largely because the information was more novel than information that was factually correct (Vosoughi et al., 2018). Fundamentally, people seem to be more motivated to share emotionally charged content to evoke happiness, fear, or disgust regardless of the level of truthfulness conveyed (Lewandowsky et al., 2012; Swire & Ecker, 2018). Additionally, online, peer-to-peer information sharing, even in the absence of medical or health expertise, is viewed as neutral, altruistic, and non-persuasive, reducing skepticism and increasing "share-ability" or spread (Walter, Brooks, et al., 2020).

Experts have called for further research to understand how to better identify communities or groups that are particularly vulnerable or susceptible to misinformation (Chou, Gaysynsky, & Cappella, 2020). For example, perceived social norms and consensus; worldviews; cultural, political, and religious ideologies; digital, health, and science literacy; and educational attainment are factors that contribute to how and whether people can differentiate between accurate health information and misinformation (Okereke et al., 2020; Zimmer et al., 2019). Additionally, research has shown that people with conservative or right-wing views and older adults may be more likely to believe and spread misinformation (Baptista & Gradim, 2020).

However, highly educated individuals may also be vulnerable to misinformation if it aligns with their cultural, social, or individual identity (Chou, Gaysynsky, & Cappella, 2020).

Challenges to Countering Misinformation at the Scale of the Internet

Misinformation is resistant to truth and correction (Chou, Gaysynsky, & Vanderpool, 2020; Lewandowsky et al., 2012; Swire & Ecker, 2018), but "regardless of how ridiculous information seems, once it is in the public sphere, it can take on a life of its own and may never be fully retractable" (Swire & Ecker, 2018). However challenging, correcting, countering, or mitigating misinformation is critical to promoting public health messaging and fostering public health and safety. *How* to most effectively identify and counter misinformation remains an area of emerging research (Chou, Gaysynsky, & Cappella, 2020). Still, studies have shown that leaving health misinformation undisputed and uncorrected undermines public health efforts, limits the adoption of protective and preventive health measures, and can accelerate the spread of disease. In attempting to counter false information, however, there is a risk of reinforcing or amplifying the claims that must be avoided (Swire & Ecker, 2018; van der Meer & Jin, 2020; Walter, Brooks, et al., 2020).

Memory is vulnerable to influence from internal and external factors. Scientific literature has detailed how emotions and cognitive patterns may explain why some types of misinformation become accepted and normalized (Chan et al., 2017; Chou, Gaysynsky, & Vanderpool, 2020). First, false memory research suggests that correcting misinformation or providing contrary information may challenge a person's understanding and foster discomfort that may result in the rejection of new information. Second, retrieval failure can occur due to memory lapses or faulty memory of specific details; and contextual factors may result in the recall of false information over factual information. Third, exposure to misinformation may foster familiarity with content that permits individuals to form attachments to other pieces of information at a later date. Reactance describes a tendency for people to reject "authoritative retractions" that may make countering misinformation difficult (Chou, Gaysynsky, & Vanderpool, 2020; Lewandowsky et al., 2012; Swire & Ecker, 2018). Finally, confirmation bias may make people resistant to corrective information that runs counter to their preferred beliefs or existing narratives (Chou, Gaysynsky, & Cappella, 2020).

Further challenges arise once misinformation has been widely spread and "solidified" into popular thinking. It can be challenging to counter established narratives even with volumes of published evidence (van der Meer & Jin, 2020) – a scenario also called a *continued influence effect* (Lewandowsky et al., 2012; Swire & Ecker, 2018). For example, the link between vaccines and autism has been studied extensively and is rooted in misinformation informed by poorly conducted studies and false or only partially true information peddled by financial opportunists and polarizing political figures (Gyenes & Mina, 2018; Larson, 2018). However, despite evidence and global scientific consensus in support of routine vaccination for diseases like measles, mumps, and chickenpox, vaccine myths are continually perpetuated widely online. For example, a 2015 study found that 75% of vaccine-related posts on Pinterest express distrust or negative views about vaccination (Guidry et al., 2015). As a result of persistent misinformation that has been ingrained and accepted as truth in some social circles, vaccine avoidance or "vaccine withholding" has increased vaccine-preventable illnesses (Guidry et al., 2015; Lewandowsky et al., 2012; Swire & Ecker, 2018).

Ultimately, though there is a benefit to promoting truth online and decreasing circulating misinformation, changing mental models that grip inaccurate information is likely a Sisyphean task. Reaching the target audience who was exposed to misinformation can be challenging. And, even when people are presented with corrected content, the reference to the misinformation is halved- *not eliminated* (Lewandowsky et al., 2012). Finally, when people are exposed to new information, they may or may not accept it (Chou, Gaysynsky, & Cappella, 2020; Sippitt & Moy, 2020).

Fact-Checking Health-Related Content

Social media platforms have been widely criticized for lack of sufficient action to limit the quantity and spread of health misinformation online (Aljazeera News Agency, 2020b; Allcott et al., 2019; Bridgman et al., 2020; Kanno-Youngs & Kang, 2021). Current actions to counter misinformation online may be broadly categorized as preventive, proactive, or reactive. Preventive measures prevent a platform user from submitting content without first agreeing to platform rules of engagement. Proactive measures allow for content to be reviewed after being submitted but before it is published or posted online. Finally, reactive measures respond to content that has already been posted or shared online (Lo, 2020).

Companies and websites employ different strategies and rules to better identify and reduce health misinformation on their platforms. Some have implemented preventive or proactive efforts to improve their algorithms and manual processes. However, the amount of misinformation has remained stubbornly high, and successes have been limited (Allcott et al., 2019; Bridgman et al., 2020). In response to the perpetual deluge of misinformation, many current efforts to reduce misinformation online are reactive in nature. Platform-driven content moderation and independent fact-checking activities are often the most commonly discussed.

Many social media platforms use content moderation (e.g., Twitter, Facebook, WhatsApp) to monitor, judge, and act on user-generated content. While efforts vary considerably by platform, content moderation processes employ multiple techniques, including algorithms, manual methods, and user-centered and community content moderation, to identify potentially harmful content and then determine how and when to apply and enforce policies, guidelines, or standards. Content deemed inappropriate or false may be deprioritized, hidden, or removed from the platform, among other possible interventions (Lo, 2020).

Global fact-checking activities aim to promote truth and decelerate the viral spread of misinformation, rumors, and conspiracies online (Luengo & García-Marín, 2020). While there are multiple types of corrective information used in fact-checking work, including simple rebuttal, factual elaboration, and others (van der Meer & Jin, 2020), much of the work aims to *debunk* circulating claims by offering a "corrective message that establishes that the prior message was misinformation" (Chan et al., 2017). Unfortunately, debunking is difficult when the facts are emerging or unknown (Roundtable on Health Literacy et al., 2020), so sometimes the only counter is acknowledging that a piece of content is false (Swire & Ecker, 2018).

To debunk or fact-check circulating content, journalists and fact-checkers typically identify popular, active, or engaging claims on social media, messaging, or other platforms that may have emerged online or via news media, political speeches, celebrity interviews, or other sources. Next, they collect factual information using data and information from experts, published literature, and other sources then determine whether aspects of the claim are true, partially true or misleading, or partially or entirely false (Lazer et al., 2018; Nat Gyenes, personal communication, March 24, 2021; Walter, Cohen, et al., 2020). Finally, fact-checkers publish their findings—or fact-checks—as refutations that explain the source of the content, why it is inaccurate, and provide accurate information in its place with the goal of "switching out" the false information in an individual's mental model with correct information (Swire & Ecker, 2018).

Fact-checking is employed as a major technique against online health misinformation, but it does have limitations. Unfortunately, fact-checking cannot keep pace with the largely unmonitored content generated and spread across social media and messaging platforms (Allcott et al., 2019). As a result, misinformation experts have recommended that communicators monitor circulating claims and debunk them only when there is a critical need because of newsworthiness, celebrity or political endorsement, or notable surge in virality (Donovan, 2020). While fact-checking organizations, journalists, media outlets, and others commonly prioritize fact-checking claims based on virality, in some instances, ease of fact-checking or alignment with organizational priorities may also play a role. For example, some fact-checkers are compensated by the number of fact-checks they complete without regard for the qualitative nature or potential harm that some claims carry above others (Ananny, 2018; Madrigal, 2019).

Research has shown that when people are exposed to factual information about a debunked claim, they change their intention to act and respond by following the new information (van der Meer & Jin, 2020). However, when misinformation aligns with an individual's worldview or core beliefs, some studies have suggested that there could be a "boomerang" or "backfire" effect when someone encounters a refutation or correction. If users are deeply engaged with misinformation, they may perceive a correction as a personal threat and, as a result of feeling threatened, they may become immune to corrections in any form, reject the truth when it is uncovered, and increase their belief or acceptance of the false information (Lewandowsky et al., 2012; Swire & Ecker, 2018; Walter, Brooks, et al., 2020). Evidence of a potential backfire effect has been limited and has not been observed consistently, but its potential remains a consideration for how fact-checking work is conducted (Lewandowsky et al., 2012; Walter, Brooks, et al., 2020).

Fact-checker bias has also been identified as a limitation in political fact-checking. Research has shown that fact-checkers' work can be influenced by their beliefs, existing knowledge, and ideologies (Walter, Cohen, et al., 2020). Additionally, fact-checkers may be prone to familiarity bias resulting when people accept information after repeated exposure, even if the information is false (Lazer et al., 2018). While research on fact-checker bias is limited, some experts believe that the effect of fact-checker bias in health misinformation may be less than in political misinformation because health-related fact-checking serves to protect the public and may be less prone to confirmation bias (Walter, Brooks, et al., 2020).

Finally, though it is outside of the scope of this project, the volume of online traffic across social media will require advanced, technology-enabled fact-checking solutions to truly reach the scale of the internet. Research is underway to develop, train, and employ software to conduct text-similarity and recognition work, cluster posts and topics to address thematic groupings (Ceron et al., 2021), understand language use, elucidate the sources of misinformation, and identify "chatter" before rumors or claims reach viral spread.

Cross-Sectoral Collaboration Between Public Health Experts and Fact-Checkers to Address Misinformation

Like many aspects of epidemiology, clinical care, and public health, combatting health misinformation and promoting evidence-based health-related communications require interdisciplinary attention and effort. Innovative partnerships within and across technology, academia, communications, public health, governments, and civil societies are paramount for large-scale and sustainable change across the health infosphere (Tangcharoensathien et al., 2020). In addition, partnerships between public health experts and professional communicators, including journalists and fact-checkers, are vital for accurate, high-quality health communications and fact-checking efforts.

Public health experts, physicians, health professionals, researchers, and others are frequently engaged in communicating about health-related topics. For example, experts issue reports and recommendations via medical centers, health departments, private practices, and other avenues; are frequently interviewed or quoted by the news media; write and report on health topics for media outlets; and engage with the public through social media channels. These experts are tasked with ensuring that vetted and contextualized health messages reach all vulnerable communities since information availability and accessibility are critical to personal and public safety and informed decision-making (Donovan, 2020; LaRose et al., 2021; Swire & Ecker, 2018; Tangcharoensathien et al., 2020). Additionally, high-quality and accessible communications can minimize misinterpretations and miscommunications that may result in or facilitate the spread of misinformation (Swire & Ecker, 2018). However, these health and science professionals may not have the training needed to communicate effectively with the general population.

During emergencies, community responses to public health or government recommendations have been mixed. In some instances, governmental agencies have been viewed as more credible than other health information sources. However, research has suggested that the public may view official governmental responses as slow or delayed, favoring the news media for crisis communications (van der Meer & Jin, 2020). For example, during the 2014 Ebola outbreak in West Africa, the World Health Organization (WHO) and U.S. Centers for Disease Control and Prevention (CDC) had difficulties addressing rumors, myths, and conspiracy theories on the ground because they were not integrated and connected with the community. Additionally, misinformation resulted in a pervasive mistrust of local aid (Allgaier & Svalastog, 2015; Vinck et al., 2019). Interestingly, retrospective analyses of health communications during the outbreak suggested that efforts may have been more successful if public health agencies had employed journalists and local-level communicators who were part of the affected communities to support interdisciplinary messaging across platforms (e.g., social media, radio, messaging) (Allgaier & Svalastog, 2015).

Providing contextually relevant content is key to supporting equitable access to health information. Journalists and fact-checkers are uniquely positioned to promote scientific truths in partnership with experts and researchers (Luengo & García-Marín, 2020) by working at the local level, responding directly to queries and topics that surface in their communities, and ensuring that the information they deliver is relevant and meaningful. However, fact-checkers and journalists often lack the health-specific resources needed to address social media, politicians, or community-based claims, so they rely on external public health experts when a fact-check is required. Limited access to experts can result in communications delays and the continued spread of misinformation. If the latest scientific research were contextualized and accessible to communications professionals, the communicators could improve the flow of vital information into their communities (Roundtable on Health Literacy et al., 2020).

Similarly, recent research has further supported the need for collaborative communication efforts to counter misinformation during crises (van der Meer & Jin, 2020). Health experts often have specialty knowledge and experience gained through education, research, and years of work experience. Still, many health experts are not professional communicators trained to create engaging and relevant content for the public. As trained communicators, fact-checkers and journalists often lack the science or health training needed to deliver messages based on complex and nuanced health communications (Gyenes & Marrelli, 2019; Nat Gyenes, personal communication, March 24, 2021). Symbiotic partnerships between public health professionals and journalists and fact-checkers have successfully been employed to ensure that community-focused health messages are actionable, accurate, and clear; appropriately contextualized for different communities and groups; and achieve broad reach (Donovan, 2020; LaRose et al., 2021; Swire & Ecker, 2018).

The COVID-19 Misinfodemic

COVID-19 has significantly affected our entire world. Health and health systems, work, education, commerce, travel, communications, and information systems – nothing has gone untouched. Yet, when it was first identified, little was known about the SARS-CoV-2 virus, also called the novel coronavirus or COVID-19. Its origin, how it spread, symptoms, risk factors for illness, or likelihood of survival after infection were all shrouded in mystery. Fear and uncertainty drove people to eagerly search for information, and media outlets saw record-breaking amounts of web traffic (Luengo & García-Marín, 2020).

As the first major global outbreak in 100 years, the COVID-19 pandemic has yielded a plethora of new information, both true and false. To describe this new flood of information, in February 2020, the WHO declared that the world was experiencing an *infodemic* which they defined as "an overabundance of information – some accurate and some not – that occurs during an epidemic" (Tangcharoensathien et al., 2020; World Health Organization (WHO), 2020c). While availability and access to information may seem more helpful than harmful, infodemics can make it difficult for people to find the reliable and trustworthy guidance they need to make decisions about their health (Islam et al., 2020; Murthy, 2021). Furthermore, labeling the infodemic served as an acknowledgment that 1) information overload is known to create confusion that leaves people wondering which sources to trust; 2) exposure to any type of information can shape initial understanding and conceptualization of a health topic; and 3) the prevalence and rapid spread of crisis-related misinformation on social media has been shown to complicate response efforts (van der Meer & Jin, 2020).

Acknowledging the infodemic early in the pandemic was critical to ensure that care and attention were placed on creating intentional pandemic-related communications. Worldwide, public health experts and scientists were immediately challenged to create pandemic-related crisis communications that were accessible, actionable, trustworthy, relevant, timely, and understandable (World Health Organization (WHO), 2017). However, with little known about the virus, information gaps and data deficits rapidly gave way to a misinfodemic. Rumors, unfounded theories, and speculation that traveled quickly, especially through messaging and social media channels, and were fueled by polarizing political figures, celebrities, self-proclaimed experts, misleading news media headlines, and individuals and organizations with profit motives (Falade & Coultas, 2017; Mina, 2020; Sallam et al., 2020; World Health Organization (WHO), 2020a).

While the majority of currently circulating COVID-19 misinformation is focused on vaccines, the diversity of COVID-19 misinformation has varied around the globe and has included content related to origins and spread of the virus, misleading data or statistics, economic impact reports, medical science, societal impacts, politicization and discrediting news outlets, content-driven by financial interests, and celebrity-driven content (Posetti & Bontcheva, 2020a). Internet and social media companies implemented misinformation policies in response to the misinfodemic (Skopeliti & John, 2020), although many experts believe that their actions and enforcement have been insufficient (Murthy, 2021). Misinformation has contributed to vaccine avoidance, resistance to face mask and social distancing practices, and the use of unproven prevention and treatment interventions (McDonald et al., 2020; Murthy, 2021; R. Smith et al., 2020; U.S. Food and Drug Administration, 2021) that have undoubtedly resulted in increased morbidity and mortality (Aljazeera News Agency, 2020b; Bagherpour & Nouri, 2020; Samet, 2021).

Some COVID-19-related claims have appeared relatively harmless on the surface, while others could be dangerous, if not lethal, even in the short-term. For example, experts have responded to rumors about 5G mobile networks spreading COVID-19 or hot climates preventing the spread of COVID-19 (Health Desk Staff, 2020, 2021b; World Health Organization (WHO), 2021). Misunderstanding how COVID-19 spreads may have resulted in individuals not practicing proven illness prevention measures, including social distancing or mask-wearing. However, a more immediately dangerous claim was made last year by Philippine President Rodrigo Duterte, who suggested that gasoline or diesel could be used as a disinfectant on surfaces, skin, and masks. After his statement, there was a rush to counter his potentially dangerous suggestion since contact with gasoline or diesel can cause skin or eye irritation, breathing problems, or death in some cases (Health Desk Staff, 2021a; Poynter, 2020b). There have also been many claims about foods or supplements, including hot tea or lemon juice, that could be used to treat or cure COVID-19 infections (National Academies, 2020; Poynter, 2020a; World Health Organization (WHO), 2021). While foods or beverages are commonly safe in reasonable amounts and may help people feel better when they are sick, suggesting that they cure disease can encourage people to delay or avoid medical care even when it is required.

Health experts have spent more than a year communicating with the media and the public about science under constantly evolving circumstances to ensure that everyone remained informed about COVID-19. Despite global efforts to consistently communicate what was known, what was unknown, and how information and learning were progressing (World Health

Organization (WHO), 2020a), the effects of the infodemic have been observed worldwide. Public health experts commonly lack the extensive media and communications training or experience needed to convey complex topics simply for general audiences. Research has suggested that connection with audiences is an essential aspect of public health communications (Ellis, 2018), but maintaining consistent and clear health and risk-based messaging to promote health literacy and public engagement has been challenging. Misinformation has been rampant (Roundtable on Health Literacy et al., 2020) and, together with an unavoidable lag in scientific information and peer-reviewed literature, has resulted in confusion that has contributed to public distrust in leading national and global health organizations (Cinelli et al., 2020; Hameleers et al., 2020).

Fact-checking organizations, media outlets, social media platforms, public organizations, and others have also worked tirelessly to keep pace with the barrage of information published online. In a global study that reviewed 2,311 social media reports of COVID-19 related misinformation from early in the pandemic, researchers found that 82% of the claims were false (Islam et al., 2020). In another study conducted between January and March 2020, researchers found that the number of English-language fact-checks performed by media outlets and fact-checking organizations rose by more than 900% (Brennen et al., 2020; Luengo & García-Marín, 2020).

Despite a considerable increase in the demand for health-related fact-checks, journalists and fact-checkers commonly lack health- and science-related training. To support the herculean task of maintaining accurate and timely communications during the pandemic, global health agencies, communications agencies, and others have implemented programs to support reporting and fact-checking efforts and address COVID-19-related misinformation. For example, the WHO held its first infodemiology conference (World Health Organization (WHO), 2020b), and the WHO Information Network for Epidemics organized a global online conference on managing the infodemic (Tangcharoensathien et al., 2020). The United Nations Educational, Scientific and Cultural Organization (UNESCO) issued policy briefs and training sessions for journalists to support public health reporting and communications during the pandemic (Ireton & Posetti, 2018; Posetti & Bontcheva, 2020b, 2020a). Organizations, including the Knight Center for Journalism in the Americas (Knight Center for Journalism in the Americas, 2021), the International Center for Journalists (International Center for Journalists, 2020), and many others, have developed programs, held webinars, and compiled lists of trainings, resources, and other tools to support accurate and timely pandemic-related reporting.

While journalist and fact-checker trainings have been critical for pandemic-related communications, many training programs maintained professional silos between communication professionals and health experts rather than fostering cooperative collaborations that could support ongoing health communication efforts. Collaborative partnerships between health experts and journalists are vital to advancing public health and ensuring that emerging findings are clearly conveyed to broad audiences (Donovan, 2020; Nat Gyenes, personal communication, March 24, 2021).

The COVID-19 Expert Database Project

Meedan is a global technology nonprofit organization founded in 2006 that aims to improve information equity both online and off by building software and developing programmatic initiatives to strengthen journalism, digital literacy, and accessibility of information. Under their vision of "a more equitable internet," Meedan engages technologists, communicators, fact-checkers, public health professionals, and other nonprofits and academic institutions to address topics ranging from election monitoring to pandemic response by developing open-source tools for creating and sharing context on digital media (Meedan, 2020).

Within Meedan, the Digital Health Lab (DHL) was founded in 2018 to conduct research and develop applied initiatives to address health misinformation in the media and online. In late 2019, the DHL team set out to research, design, and test a digital response framework and began exploring the idea of creating a database resource to support journalists and fact-checking organizations (FCOs) in reporting on health-related topics (Nat Gyenes, personal communication, March 24, 2021). At the start of the COVID-19 pandemic in early 2020, the urgent need for new initiatives to support health-related fact-checking became even more evident.

The pandemic exposed a structural weakness in the global fact-checking industry: media professionals, journalists, and fact-checkers were tasked with ensuring that pandemic-related communications clearly relayed what was known and what was unknown about the virus, yet many did not have immediate access to public health experts or leading health authorities to support their work. For many FCOs and media outlets, expert consultation was required for content validation before publication. Heavy reliance on external experts created bottlenecks and delays that negatively impacted workflows and influenced what content could be fact-checked and at what speed.

The COVID-19 Expert Database Project was launched in June 2020 as a collaborative effort to engage public health experts, journalists, fact-checkers, and media partners in strengthening the infosphere, improving the quality of health information in global media channels, and decreasing circulating COVID-19-related misinformation online. Using agile workflows with collaborative idea generation and brief publication cycles (or sprints) to accommodate rapidly changing science, the project provided an added layer of expertise to build capacity, provide content, and distill complex topics to support health communications and fact-checking efforts globally.

The intervention was designed for journalists and fact-checkers from around the world to submit COVID-19-related questions to public health experts and receive evidence-based explainers to support their health-related media communication and fact-checking efforts. While external agencies submitted most questions, additional queries were developed by the expert team based on new scientific publications, changing health guidance, and emerging findings. The team discussed all of the pending questions and assigned them to writers during the three weekly editorial meetings. Explainers were written and provided to the requesting organization within 48 hours, and questions submitted to support breaking news stories were prioritized to meet tight editorial deadlines, sometimes within less than eight hours. Finally, once a response was completed and provided to the requesting organization, the explainers were published on the *learnaboutcovid19.org* website where they were reviewed and updated regularly to ensure that they reflected the best available evidence and remained relevant (LaRose et al., 2021).

In the first seven months of the project, questions were submitted to the expert team in English from over 15 countries globally, including Nigeria, Kenya, Senegal, South Africa, India, the Philippines, Mexico, Brazil, France, Canada, the U.S., and the U.K. The project team wrote a total of 213 explainers that answered queries from partner organizations (n= 108) or addressed emerging scientific findings and reports; potentially confusing, unclear, or conflicting COVID-19-related public health advice; or topics circulating on social networks (n=105).

Process Evaluation Framed within a Triple Loop Learning Model

The COVID-19 Expert Database Project was planned and launched as a pilot intervention in response to the pandemic, but, with a deep focus on developing workflows to support rapid implementation, there were few monitoring, evaluation, and learning structures in place to capture programmatic knowledge generation and foster long term continuous project improvement. The following pages will review how I designed and executed a process evaluation to explore project implementation and outputs from the first seven months of the project, between June and December 2020. I will also review how I have viewed the process evaluation as an entry into a triple loop learning (TLL) model to foster continuous programmatic learning.

Historically, significant focus has been placed on outcome and impact evaluations to measure programmatic effectiveness. However, project outcomes and impact are directly related to implementation activities, and too often, there is limited awareness, documentation, and reflection on how the project implementation is completed. As a result, poor planning, incomplete implementation, incorrect or unrecognized assumptions, or environmental or contextual changes cause some projects to veer off course from the outset and, despite investment, these projects may be deemed "failures" in later evaluations (Linnan & Steckler, 2002; Saunders et al., 2005).

Using foundational theories from the field of implementation science, process evaluations employ flexible and iterative, yet rigorous, methods to capture incremental learning that has occurred during a project (Balasubramanian et al., 2015; Linnan & Steckler, 2002; McGill et al., 2020; Saunders et al., 2005). While process evaluations have been used in implementation work for decades, there is no singular process, universal definition, or list of key components agreed upon. Of the multiple process evaluation definitions in the published literature, each offers a distinct perspective and potential benefits for evaluators based on program or project type, resource availability, timeline, and learning goals (Balasubramanian et al., 2015; Linnan & Steckler, 2002; McGill et al., 2020; Moore et al., 2014; Saunders et al., 2005).

Process evaluations are often used to explain why the project outcomes occurred, link the underlying project theory to the intervention, and understand relationships within and between the program elements and outputs (Linnan & Steckler, 2002). Definitions for common terms, including fidelity, dose, and exposure, overlap with one another, and data generation and analysis methods are diverse (Linnan & Steckler, 2002; McGill et al., 2020; Saunders et al., 2005). While these characteristics make comparisons across process evaluations difficult, they allow for interpretation and application that is entirely customizable to the project or program.

Process evaluation activities can be used to capture unplanned programmatic changes, adjustments, and contextual factors that influence project performance. Findings can then be used to strengthen implementation and support programmatic adaptation to changing contextual circumstances (Balasubramanian et al., 2015). The holistic and dynamic nature of the process evaluation, together with its inherent flexibility and reflexivity, is an ideal entry-point into a TLL model that supports programmatic learning through technical, technical and adaptive, and adaptive lenses, similar to those posed by Heifetz and colleagues' adaptive leadership model (Heifetz et al., 2018).

In their model, Heifetz and colleagues describe technical problems as having a clear definition and solution; adaptive challenges require learning to define the challenge and develop a possible solution; and challenges that are both technical and adaptive often have a clear problem definition but require learning to arrive at a possible solution (Heifetz et al., 2018). These categories, technical, technical and adaptive, and adaptive, overlap with the first, second, and third loops of a TLL model, respectively.

While there are multiple TLL models in the literature, each generally describes the single loop as a technical problem that requires a technical solution often framed as "are we doing our work well?" or "are we doing things right?" The second loop is a problem that requires a technical and adaptive approach often framed as "are we doing the right work?" which challenges how the work itself is conceptualized. Finally, the third loop describes an adaptive challenge that may be difficult to define and is influenced by the contextual environment (Flood & Romm, 2018; Georges L. Romme & van Witteloostuijn, 1999; H. L. Smith, 2014). The third loop is often framed as "can we make well-informed choices about our strategy and objectives?" (Georges L. Romme & van Witteloostuijn, 1999; H. L. Smith, 2014) or, alternatively, "is rightness buttressed by mightiness or mightiness buttressed by rightness?" (Flood & Romm, 2018).

The COVID-19 Expert Database Project process evaluation was designed using a systematic framework informed by the following adapted key TLL questions: *1) are we doing our work well (technical)*; *2) are we doing the correct work to serve our partners and deliver on our project outputs and outcomes (technical and adaptive)*; and *3) are we gathering information needed to make informed choices about our strategy, objectives, and direction* *(adaptive)* (Flood & Romm, 2018; Georges L. Romme & van Witteloostuijn, 1999; Peschl, 2007; H. L. Smith, 2014) as shown in Figure 1 below.

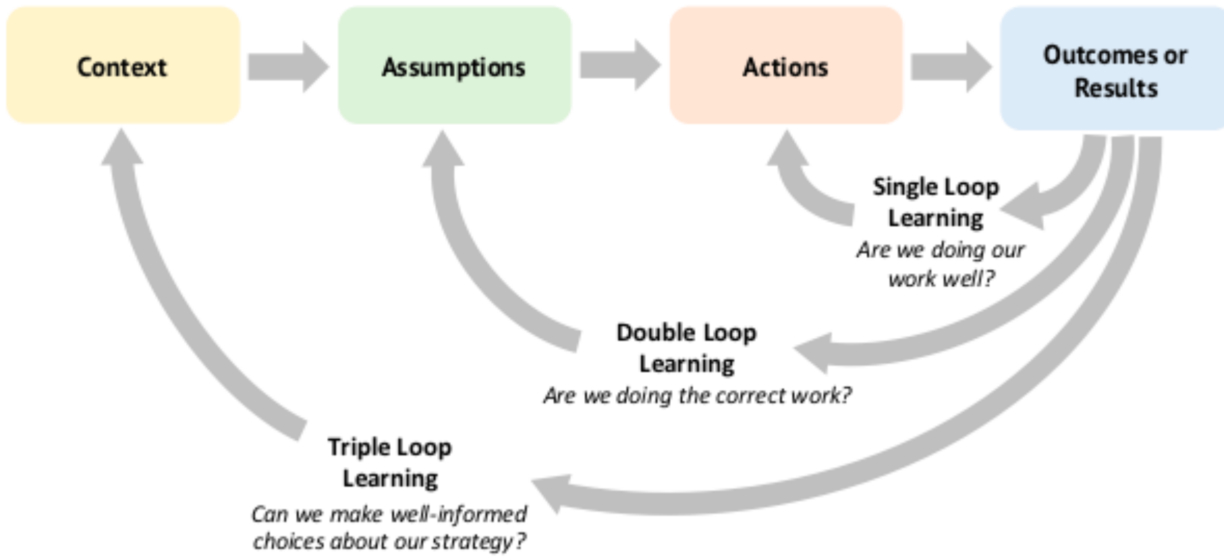

Figure 1: The triple loop learning model used to inform how the process evaluation was designed

Within this framework, I designed the evaluation to determine if the project was implemented fully and as intended; evaluate whether the assumptions that underpinned the project were valid; identify which parts of the project worked as planned and which did not; and explore the contextual elements that influenced the project or its implementation. I also sought to understand how partners viewed and used the database as a resource and whether the database was a valuable tool in their pandemic-related fact-checking efforts and communications.

Learning is central to continuous programmatic improvement, reporting, user and funder engagement, and thought leadership. It is also critical to agility and iteration since feedback loops allow for adaptation to contextual changes that are part of "real world" programmatic operations (Balasubramanian et al., 2015). While the process evaluation could have been designed as a singular evaluation activity, because the COVID-19 Expert Database Project was launched in response to the pandemic, it was essential to integrate the evaluation into the TLL model to promote programmatic monitoring, evaluation, and learning as a continuous process. It will be critical for the team to continually evaluate the quality of their work, explore whether the work provides utility and meaning for partners and users, and challenge the contextual assumptions that underpin the project to maintain relevance as the pandemic-induced misinfodemic continues to shift.

Methods and Analyses

I designed a process evaluation to systematically explore the COVID-19 Expert Database Project's implementation, capture how partner organizations viewed the project, and identify weaknesses or gaps in the project design or launch. Because the COVID-19 Expert Database Project was not a typical health-related behavior change or health intervention project, I used tools and resources from public health, social sciences, user research, and organizational learning, and I applied elements from multiple theoretical frameworks to customize the evaluation for the project (Centers for Disease Control and Prevention (CDC) Office on Smoking and Health (OSH) and Division of Nutrition, Physical Activity, and Obesity (DNPAO), 2011; Linnan & Steckler, 2002; Medical Research Council, 2019; Moore et al., 2014; Saunders et al., 2005). Additionally, I employed participatory methods for knowledge generation to maintain engagement with the project leadership team and support the progressive application of learning captured during the evaluation period (Baker & Bruner, 2010; Chevalier & Buckles, 2021).

This chapter details how the COVID-19 Expert Database Project process evaluation was designed and planned, including the tools and methods employed, data sources and sampling techniques, and limitations to the approaches used. The project used qualitative methods to explore programmatic materials and gather insights from staff and partner organizations who used the database in their work. Given the nature of the project as a public health and technology hybrid, the qualitative interviews employed traditional public health research methods and objectives with insights from user research. In addition, quantitative methods were selectively used to gather summary statistics from programmatic tools, assess Likert-scale responses included in partner interviews, and conduct explainer quality analysis.

Finally, this chapter also reviews how the evaluation questions were designed to fit within the guiding TLL model questions as an entry-point for continuous programmatic learning.

Process Evaluation Plan Overview

To develop an evaluation plan I used the model proposed by Saunders and colleagues, outlined in Figure 2 below (Saunders et al., 2005). Details relevant to each of the elements of the model are further detailed in the sections that follow.

1. **Project Description:** Includes purpose, underlying theory and aims, strategy, and expected impacts and outcomes.
2. **Complete Project Delivery Description:** Includes a detailed description of the project and includes fidelity (quality) and reach elements.
3. **Questions, Methods, & Resources:** Includes tools, resources, methods, and contextual factors considered iteratively and interdependently.
4. **Final Plan:** Once the process evaluation has been planned, a detailed review may commence.

Figure 2: The Saunders Model for process evaluation design

Formalized project documents (e.g., logic model, defined aims, learning plan) to inform and guide the process evaluation were limited. To develop the evaluation plan, including the project and delivery descriptions and evaluation questions, I identified information sources as noted in Table 1 below.

Table 1: Information sources to support process evaluation planning

Type	Information Source	Learning Goals
Literature	Evaluation structure, health misinformation, trends in health communications, COVID-19 infodemic	Structure and background for the process evaluation; inform thought leadership writing activities
Internal Documentation	Funding proposals, meeting minutes, brainstorming notes, previous research	Historical aspects of project, goals, initial performance indicators, prior project adaptations based on user research
Qualitative Interviews and Focus Groups	Meedan Staff & Leadership Team	Strategy, capacity planning, funding, partner engagement, learning, and process documentation
	Writer Focus Group	Work engagement and satisfaction, areas for project improvement, recommendations, context

In addition to the literature and documentation used to inform the theoretical grounding for the process evaluation, I conducted a series of foundational, semi-structured, qualitative interviews (n=6) with Meedan and DHL leadership team members, including the Chief Executive Officer, Chief Operating Officer, DHL Director, the COVID-19 Expert Database Editorial Lead, the COVID-19 Expert Database Global Health Lead, and the DHL program manager. While I maintained regular communications with the project and leadership teams in line with participatory evaluation practices, the focus of the individual interviews was to document and understand how the project was conceptualized, designed, and delivered; elucidate perceptions about how the project developed during the pilot period; identify organizational learning goals for the process evaluation; and discuss plans for future project directions, goals, and strategy.

The team of COVID-19 Expert Database writers (n=4) participated in a single hour-long focus group and responded to questions in two qualitative surveys that were administered online. The goal of the focus group discussion and surveys was to gather the writers' thoughts and views on the project, significant project learnings, editorial standards, and operational procedures, including meetings, record keeping, and team collaboration.

I compiled the qualitative information gathered from the interviews, surveys, and focus group into a single spreadsheet and conducted both deductive and inductive thematic analysis. Deductive themes were created using the guiding questions in the surveys and discussions. Additional thematic identification was conducted during the survey and discussion data analysis (inductive analysis) (Braun & Clarke, 2006). The qualitative data informed how the evaluation was conceptualized and planned. It also addressed a portion of a question that explored the structures, processes, and adaptations that supported the project, as further detailed later in the next chapter.

Though they were not planned as part of this exploration, the COVID-19 Expert Database Project team and Meedan's leadership team participated in a series of Summit

Meetings designed to extend the qualitative data identified in the interviews, surveys, and focus group. The Summit Meetings (n=5) were used to identify additional learnings; conduct a team strengths, weaknesses, opportunities, and threats (SWOT) analysis; support the writers with training on editorial standards and writing for broad audiences; and discuss future strategic priorities. Data from the meetings were not included in the evaluation though it was integrated into my recommendations for the next phase of the project.

Project and Complete Project Delivery Descriptions

Under the broad mission *to support health communicators with high-quality, health-related content*, the COVID-19 Expert Database Project was designed across three primary domains: content creation and COVID-19 database development, thought leadership in the prevention of health misinformation, and community engagement in reducing health misinformation. While the team participated in thought leadership activities via the project blog and panel discussions, in the pilot period, the project's focus was on content creation to provide evidence-based explainers for fact-checkers and journalists reporting on complex health-related topics arising from the COVID -19 pandemic. Community engagement activities were not part of the pilot due to resource limitations and a desire to test the concept before expanding the project by recruiting additional partner organizations and users. The domains and project activities are further detailed in Table 2 (on the next page) and are included in the *Project Description & Acceptable Project Delivery Description* document shown in Appendix A.

Table 2: Project domains listed with narrative domain descriptions and relevant project activities

Domain	Domain Description and Activities
Content Creation and COVID-19 Database Development	The COVID-19 Expert Database Project will fill a knowledge and information gap by developing an expert database that is available and accessible to fact-checkers, journalists, and newsrooms. The COVID-19 Database Team will prioritize entries based on partner demand and current trends in public health information. All entries will meet journalistic standards for balance, objectivity, and accuracy. The DHL and COVID-19 Expert Database Project Team will do the following: o Collect critical pandemic-related queries directly from fact-checking organizations and other community information leaders. o Triage queries to elicit public health expert responses. o Perform database content updates to ensure information is correct and accurate.
Thought Leadership in the Prevention of Health Misinformation	Through publications, presentations, and other engagements, the COVID-19 Expert Database Project will promote best practices in health communications to prevent the spread of misinformation, midinformation, and disinformation to the public. The DHL and COVID-19 Expert Database Project Team will do the following: o Work with journalists and third-party fact-checkers to disseminate COVID-19 content. o Write blog posts, op-eds, and other content about public health misinformation. o Plan and deliver health misinformation and fact-checking trainings for external organizations. o Design content packages for responses grounded in responsible health communications.
Community Engagement in Reducing Health Misinformation	Engagement from public health professionals and the fact-checking community is needed to ensure that any tools, processes, and resources developed by and for the DHL and COVID-19 Expert Database Project are accurate, timely, and accessible. To support the fact-checking community and improve their access to high-quality health information, the DHL and COVID-19 Expert Database Project Team will do the following: o Curate a roster of active and potential experts to contribute to topical areas in the COVID-19 Expert Database Project. o Recruit and engage fact-checking organizations, journalists, and newsrooms as partners interested in supporting high-quality health information.

In the absence of project-specific aims, I applied the DHL aims to visualize alignment with the project activities as displayed in Appendix A. The project fit within the departmental aims, but the language used in the aims would have made it challenging to use them in the evaluation directly, so I deferred to focusing on the project activities and outputs to develop the evaluation questions.

Testing and challenging assumptions is a crucial aspect of TLL to ensure that the assumptions underpinning the project are both valid and relevant. As part of the project description, I worked with the leadership team to articulate the underlying project assumptions (shown in Figure 3 below) in order to test and explore the statements with partner journalists and fact-checkers during the evaluation.

1. Journalists/fact-checkers care about health misinformation and accurate health communications.
2. Journalists/fact-checkers will be receptive to improving health messaging.
3. Fact-checking or media organizations want to build health capacity.
4. In the media, there is a capacity to accommodate the newest health information to ensure relevance.

Figure 3: Assumptions that underpinned the COVID-19 Expert Database Project

Evaluation Questions, Methods, and Resources

Elements relevant to evaluating programmatic delivery have been summarized in Table 3 (on the following page) using theoretical frameworks from the process evaluation and implementation outcomes literature (Linnan & Steckler, 2002; Proctor et al., 2011; Saunders et al., 2005).

Table 3: Elements of the process evaluation plan

Evaluation Component	Definition and Purpose	Component Source for Current Evaluation
Fidelity (Quality)	Extent to which the intervention was implemented as planned, including the quality of what was implemented or produced as part of the intervention.	Determining if the project was implemented as planned; quality and accessibility of explainer content; searchability of content on the website.
Dose Delivered (Completeness)	Amount of intervention delivered or produced during the project period.	Number of explainers written per week that were delivered to partners and posted to the database website.
Dose Received (Exposure and Satisfaction)	Amount of intervention received and satisfaction with intervention from the user or participant perspective.	Volume of partner requests; how partners use content; partner satisfaction with content.
Reach (Participation Rate)	Proportion of audience engaged in the program.	For this evaluation, reach is outside of the scope of the pilot period since the group of pilot partners was intentionally small. Scale and reach will become more relevant as the project matures.
Recruitment & Maintenance	Processes to recruit and engage participants (or partners).	For this evaluation, recruitment is outside of the scope of the pilot period. Informal processes were in place to recruit a small number of partners with existing organizational relationships. Recruitment, maintenance, and engagement will be critical to the future of the project.
Context	Aspects of the environment that may influence the intervention implementation, outputs, or outcomes.	Exploring how the pandemic influenced partners' work and testing the project's assumptions with partners.

The elements listed in Table 3 were integrated into the evaluation to determine if the project was implemented as planned (fidelity), if the quality of the project or project outputs were appropriate (fidelity), if the amount of content produced met the project's targets (dose delivered), if users received and were satisfied with the content produced (dose received), and whether or how the context of the pandemic or organizational environment may have influenced the project (context).

However, given the unique design of the COVID-19 Expert Database Project and the nature of the pilot, not all of the elements listed in Table 3 were relevant to this process evaluation. For example, participation rate (or reach) and participant recruitment and maintenance were not part of the initial project goals, so they have not been included in the evaluation, though they will be important as the team considers the future directions of the project. Expanding recruitment and reach would not have been possible during the pilot phase since the project team was small (between five and seven writers at any given time between June and December 2020), and project funding was limited. While questions were periodically submitted to the expert team by non-partner media or fact-checking organizations, the number of regularly engaged partner organizations was kept intentionally small to ensure that high-quality explainers could be delivered quickly in less than 48 hours.

Key Evaluation Questions

Many questions could have been explored as part of the process evaluation. However, due to time and resource limitations, the list of evaluation questions was narrowed to those deemed most critical to inform the next stages of the endeavor. Using insights gained from an internal review of project materials, foundational qualitative interviews with Meedan and project team members, and the development of the complete project description, I identified key evaluation questions summarized in Table 4 below. The questions were framed using tools from the U.S. Department of Health and Human Services (U.S. Department of Health and Human Services (DHHS), 2018), the W.K. Kellogg Foundation (W.K. Kellogg Foundation, 2017), and other resources (Linnan & Steckler, 2002; Moore et al., 2014; Saunders et al., 2005).

Table 4: Key process evaluation questions

Implementation	Aims and Activities	Impact Mechanisms
• Are the assumptions that have informed the creation of the COVID-19 Expert Database Project accurate? • What are the structures, adaptations, and processes through which the COVID-19 Expert Database Project has been delivered?	• To what extent have the COVID-19 Expert Database Project activities been completed? • Is the COVID-19 Expert Database Project delivering high-quality content that is accessible to global partners?	• How have participants (partners) interacted with database content? • How has the COVID-19 Expert Database Project influenced partners' fact-checking processes?

I also integrated the evaluation questions into the TLL model (Flood & Romm, 2018; Georges L. Romme & van Witteloostuijn, 1999; H. L. Smith, 2014) using the adapted questions presented previously: 1) are we doing our work well; 2) are we doing the correct work to serve our partners and deliver on our project outputs and outcomes; and 3) are we gathering information needed and challenging our contextual assumptions to make informed choices about our strategy, objectives, and direction? In Table 5 below, I have shown the evaluation questions and their link to technical vs. adaptive challenges as described by Heifetz and colleagues (Heifetz et al., 2018).

Table 5: Key process evaluation questions mapped to the adapted TLL questions

Loop 1: Technical	Loop 2: Technical and Adaptive	Loop 3: Adaptive
• To what extent have the COVID-19 Expert Database Project activities been completed? • Is the COVID-19 Expert Database Project delivering high-quality content that is accessible to global partners?	• Are the assumptions that have informed the creation of the COVID-19 Expert Database Project accurate? • How have participants (partners) interacted with database content? • How has the COVID-19 Expert Database Project influenced partners' fact-checking processes?	• What are the structures, adaptations, and processes through which the COVID-19 Expert Database Project has been delivered?

Data Sources, Sampling Procedures, Data Processing, and Data Analysis

To address the questions outlined in Table 4 and Table 5 above, I identified potential data sources, including the project website and programmatic materials, database explainer content, and key participants for qualitative interviews, summarized in Table 6 below. While the project tools are primarily used for internal purposes, they were also linked to the project website, so gaps and shortcomings could have influenced how partners could have accessed and used website data in their fact-checking work.

Table 6: Information types and sources identified to support process evaluation data collection

Type	Purpose	Link to Evaluation Component or Other Learning Potential
Website	Alignment with International Fact-Checking Network standards, searchability of content	Fidelity (quality) for external audiences; consistency with project values.
Question Tracking Spreadsheet & Project Tools	Completeness and utility of entries, how fields are used	Fidelity (quality); dose delivered (completeness); information and data quality for future reporting.
Explainer Audit (Quality/Content)	Readability, Clear Communication adherence, links to glossary terms, literature used, generalizability	Fidelity (quality); dose delivered (completeness).
Qualitative Interviews	Partners/Users	Fidelity (quality); dose received (satisfaction and usefulness); dose received (exposure); context (including assumptions).

Website, Question Tracking Spreadsheet, and Project Tools

To evaluate project implementation and accessibility of content for database users, I designed an audit of the *learnaboutcovid19.org* website, question tracking spreadsheet, and other internal tools to gather data about the number of questions answered in total and per week, question source (e.g., country, partner organization), and completeness of the entries, including completion of database fields.

The *learnaboutcovid19.org* website was a public-facing resource where partners, media outlets, and members of the public could access submitted questions and explainer content (the website has since changed to *health-desk.org*). To briefly test the website's search features, I created a list of keywords and similar or related words to test the website's search feature (e.g., immunity and immune, recommend vs. recommendation). With a well-performing search function, I expected that search terms with similar meaning (e.g., recommend vs. recommendation) would return the same search results. Similarly, I expected that searches for specific terms known to be part of explainer content (e.g., ingredients, sodium) would yield results inclusive of any explainers that contained the words in the text.

I found that search results varied, suggesting that users may also have difficulties searching for content on the website. For example, searches for *vaccine* and *vaccines* both yielded the same number of explainer results (n=52). However, the search results differed from searches for *vaccinated* (n=8) or *vaccination* (n=6). In other comparisons, *immune* (n=25) vs. *immunity* (n=17); *mutation* (n=7) vs. *variant* (n=2) vs. *mutant* (n=6) vs. *strain* (n=6); and *recommend* (n=22) vs. *recommendation* (n=1) yielded different results. When I searched for more specific terms that I knew were part of explainer content, including *polyethylene glycol, sodium, potassium,* and *ingredients,* no results were returned, which suggested that there are gaps in the website search function that could negatively influence how and whether the website is used in fact-checking work.

Meedan works with organizations that are part of the International Fact-Checking Network (IFCN), and commitment and adherence to the IFCN principles were deemed necessary to display universal values in support of partner organizations. I audited the project website to evaluate compliance with the IFCN code of principles shown in Figure 4 below (International Fact-Checking Network (IFCN) & Poynter, 2021).

1. A commitment to non-partisanship and fairness;
2. A commitment to standards and transparency of sources;
3. A commitment to transparency of funding and organization;
4. A commitment to standards and transparency of methodology;
5. A commitment to an open and honest corrections policy.

Figure 4: IFCN code of principles

While the COVID-19 Expert Database was conceptualized in support of the IFCN principles, in the website audit I identified multiple gaps in transparency and principle adherence, including a lack of articulated methodologies used to conduct the project work and a stated corrections policy. A brief overview of the audit findings can be found in Appendix B.

Using the question tracking spreadsheet, I recorded count data for the number of new queries, the number of query updates, and requesting organization (if applicable) obtained between June and December 2020. The partner organization information was used to determine the country of origin for the query. I also reviewed other project records and tools to identify whether all of the fields for each database entry were completed. I recorded count data to summarize the level of completion of each field.

Explainer Audit

Research has shown that a significant amount of COVID-19-related content online is not at a reading level that is accessible for many Americans (Basch et al., 2020; Ferguson et al., 2021; LaRose, 2021b; Mokhtari & Mirzaei, 2020; Szmuda, 2020). However, the readability and accessibility of health-related content are critical for understanding and personal decision-making. In addition, for communicators, including journalists and fact-checkers, comprehension of content is vital to ensure accurate messaging and high-quality fact-checks.

I sampled a set of health desk explainers (n=27) to audit the content for readability and information accessibility. All selected explainers were questions submitted by partner organizations between June and December 2020 and were chosen from the database to represent the following topics: diagnosis, infection, masks, nutrition, prevention, risk, spread/transmission, statistics, testing, treatment, vaccines, and other. At least two explainers were selected for each topic to compare average scores.

In the U.S., most news outlets aim to publish content that accommodates a minimum reading level achieved between eighth and tenth grade. However, even a target of eighth to tenth-grade level exceeds the average American reading level that is often reported as grade five or six. Finally, for low-literacy audiences, experts recommend aiming for content readability at a third to fifth-grade level (LaRose, 2021b).

To assess for content readability, I scored the explainers using both the Flesch-Kincaid Grade Level (Kelly, 2017) and the Simple Measure of Gobbledygook (SMOG) Index (Mc Laughlin, 1969) using an online tool from Readable.com (*Readable*, 2021). While many readability tools correlate closely with one another, the Flesch-Kincaid Grade Level is perhaps the most commonly used (Kelly, 2017). However, the SMOG Index is recommended by health literacy experts as the "gold standard" for health-related text published in English. It is considered particularly beneficial for longer texts (>30 sentences) (Harvard T. H. Chan School of Public Health, 2015). The project team elected to establish a reading level target at or below the eighth-grade level using the SMOG Index.

Reading score alone is not sufficient to evaluate content accessibility. To further assess the explainers, I developed an adapted tool using the SMOG Index score and elements from the health literacy-focused U.S. CDC Clear Communication Index. The Clear Communications Index includes the use of a singular or “main message,” call to action, use of active voice, use of common words and plain language, explanation of risk, and other elements deemed necessary for health literacy-focused communications (*CDC Clear Communication Index: A Tool for Developing and Assessing CDC Public Communication Products—User Guide*, n.d.).

I scored all 27 explainers using the tool shown in Appendix C. Using the scored results, I gathered summary statistics, including minimum, maximum, mean, standard deviation, and 95% confidence interval, for the word count of the expert answer section of the explainer, the context section of the explainer, and the SMOG Index Score for each section, respectively. I evaluated each explainer and reviewed how well the audited explainers performed overall. An overview of the audit results is shown in Appendix C.

Qualitative Interviews with Partners

Theoretical approaches founded in pragmatism and user research maintain significant overlap that allows them to integrate into product-focused process evaluations seamlessly. Pragmatic approaches endeavor to identify targeted actions and defined solutions (Creswell, 2009). Similarly, user research aims to identify users' challenges or needs to improve products or services (The Interaction Design Foundation, 2021).

Considering these approaches in combination, I employed the user research principles of discovery, exploration, contextual inquiry, and listening to plan qualitative interviews to gather information about partners' fact-checking processes, resources and tools used to conduct their work, their experiences with the COVID-19 Expert Database Project, and their needs or requests for future iterations of the project. With the flexibility permitted through pragmatism and user research, I integrated brief quantitative elements into the interviews using Likert scales to test the project assumptions, evaluate perceived database trustworthiness and usefulness, and assess whether partners would recommend the database to their colleagues. Using quantitative measures for these selected elements, even with a small sample, added a level of specificity to the inquiry.

The Meedan team identified representatives from six partner organizations willing and able to participate in semi-structured qualitative interviews. The project team used convenience sampling to select partner organizations familiar with the project and who had requested

COVID-19-related content from the expert team at least twice during the pilot period. The six participating organizations represented teams from the U.K., India, the Philippines, Nigeria, Zimbabwe, and Senegal. In total, the qualitative interviews included insights from 10 individuals, as is further outlined in the following paragraphs.

I developed a qualitative interview guide framed using the key evaluation questions (shown in Appendix D). The questions were written to address the key evaluation questions and other questions of interest designated by the project leadership team. As mentioned, I did integrate assumption testing into the qualitative interviews using a Likert scale. Though there is a risk of recall bias when asking for a retrospective comparison, I also asked partners to use the scale to rank their agreement with the statement before the pandemic to validate the assumptions further and measure the relative change between pre-pandemic and current measures.

A total of four semi-structured, qualitative interviews were conducted via Zoom and recorded to ensure that their content was available for later reference. All participants provided consent to be interviewed (in advance via email), and I obtained verbal permission before recording. Two organizations elected to include multiple participants, so a total of eight participants gave responses during the interviews.

Two organizations declined interview participation via Zoom, phone, or another virtual platform, though they consented to respond to interview questions via email (one in English and one in French). The interview guide was formatted as a questionnaire (in English) then was translated into French. Both organizations received the questionnaires and responded via email.

I compiled the qualitative information gathered from the interviews and questionnaires into a single spreadsheet and used both deductive and inductive thematic analysis. I created deductive themes using the guiding questions from the interview guides framed using the key evaluation questions. I used inductive analysis to identify additional themes during the review of the qualitative data. Inductive analysis was used to identify common themes around partner's fact-checking practices at the start of the pandemic and to identify common "needs" or "requests" for future expert team support (Braun & Clarke, 2006).

Additional Qualitative Data

I interviewed four faculty experts (n=4) to gather information about their unique views on the importance of addressing health misinformation and producing content focusing on accessibility, health equity, and health literacy. While these interviews were foundational and informed how I developed elements of this work, they were not part of the process evaluation.

Data Limitations

For the explainer audit, I worked with the project leadership team to identify a suitable number of entries and develop auditing methods and tools. For this evaluation, we prioritized learning about comparisons among topics and exploring overall readability and accessibility, so I designed the audit to accommodate these goals. Outside of this multifaceted process evaluation, additional research endeavors could use a larger sample of the database and its explainers to explore readability and accessibility across thematic areas further, query origins, shifts in question type or theme during the pandemic, and more.

Using convenience sampling to identify participants for qualitative interviews, the program manager and I recruited partners who had submitted questions to the database team on multiple occasions. We identified partners from multiple locales and regions to participate; however, we did not recruit partners who were not 1) currently engaged with Meedan or the COVID-19 Expert Database Project during the evaluation period or 2) did not routinely submit questions to the COVID-19 Expert Database Team.

The small number of partner interviews was expected since there were few organizations actively involved with the project pilot. The total number of regularly engaged partners with the early stages of the COVID-19 Expert Database project was small, and the level of active partner engagement fluctuated during the pilot period. The project team estimated that there were approximately eight partner organizations formally involved in the project, but some partners were involved only in the first few months (in June, July, and August 2020). For example, some partner organizations underwent leadership changes, divisional restructuring, or staffing changes that shifted their engagement and attention to other priorities. While these teams may have provided valuable insight as to why their involvement with the project changed, none were successfully recruited for interview participation.

The question of sufficient sample size for data saturation often arises in qualitative research. Theoretical saturation occurs when no new issues, insights, or learnings are obtained from the data. However, there is great debate about the exact number of interviews needed for saturation (Gugiu et al., 2020; Hennink et al., 2017, 2019; O'Reilly & Parker, 2013; Sebele-Mpofu, 2020). Though I used qualitative methods, this evaluation maintained considerable overlap with user research wherein some experts suggest that five users will identify 85% of problems with a product and that adding more participants uses resources that could be better allocated (Nielsen, 2000, 2012). Additionally, we were looking to learn from partners' fact-checking experiences during the pandemic and with the database as a resource rather than develop a new theory or elicit meaning behind fundamental beliefs that would have potentially required a larger sample size (Hennink et al., 2017).

Notably, by the end of the partner interviews, the information reported had become consistent, and I noted few new insights. It is possible that adding more interviews may not have provided better or further information. Though we were not aiming to conduct mixed-methods research at this point, more partner data would have allowed for us to test the quantitative elements of the interviews for statistical significance.

Overall, the small sample size may limit the generalizability of this evaluation to partners or users in other regions. Additionally, it is possible that by using convenience sampling and recruiting partners who were current, active database users, we may have missed essential insights from partners whose use was less recognized. Finally, as discussed with the Meedan team, regular partner and user engagement should be planned to foster collaboration and support future evaluations and research endeavors. Future evaluations would likely benefit from a larger sample size to allow for additional insights, mixed methods approaches, focus groups, or regional comparisons.

Results

The process evaluation that I completed during my doctoral project highlighted the value and utility of the COVID-19 Expert Database Project for journalists and fact-checkers reporting on pandemic-related topics. The pandemic centered the attention of the public health community on global health misinformation in an unprecedented way. The results from this process evaluation underscored how the perceived importance of health-related fact-checking has shifted in the context of the COVID-19 infodemic. My findings also validated the difficulties journalists and fact-checkers experience in accessing experts to support health-related fact-checking and media publications – difficulties exacerbated by an increased demand resulting from the pandemic.

This chapter is organized into three sections. The first provides a summary of knowledge gained from partners on how the start of the pandemic influenced their fact-checking work, including the challenges they faced in addressing constantly emerging health misinformation. The second section shares a summary of learnings from the process evaluation by exploring the evaluation questions within each of the loops of the TLL model. To further the application of the model, I also discuss how the TLL model can be used to describe and define technical, technical and adaptive, and adaptive challenges. Finally, the third section discusses how some of the process evaluation learnings have been applied thus far. Since the pandemic is still a part of everyday life at the time of this writing, the final section also reviews how lessons learned from this evaluation within the TLL model can inform how the project team continues to complete their technical work in responding to health misinformation, tests the assumptions that informed the project, and identifies and responds to adaptive challenges to maintain relevance even as competing priorities in media and fact-checking re-emerge.

Fact-Checking at the Start of the COVID-19 Pandemic

The COVID-19 pandemic significantly altered our global landscape and created an immediate need for health and safety information. As a result, journalists and fact-checkers saw their roles shift virtually overnight. "The claims were all anyone could speak of during the start of the pandemic; all of us suddenly became health fact-checkers" (FC1, the Philippines). Despite a lack of science and health expertise and training, fact-checkers and journalists were immediately tasked with ensuring that people were informed because “with panic, a lot of people jump on anything that’s supposed to cure COVID. It is very difficult to [handle] information and raise awareness among internet users" (FC5, Senegal). In response, they reported that “all the fact-checking organization focused on debunking misinformation that is spreading via social media" (FC6, India).

However, with the novel virus, questions emerged faster than answers, and scientific findings and public health advice were complex and changed quickly. Additionally, there were few trusted sources that provided timely information about the virus, including what people should do to prevent illness and what treatments may be possible. In the absence of clear guidance, data deficits quickly yielded myths and rumors about the origin of the virus, preventing illness, and possible treatments or cures (Mina, 2020; Shane & Noel, 2020; R. Smith et al., 2020). Fact-checkers from Africa and the Philippines noted that “traditional healers” who recommended “home remedies” were a common source of misinformation, and media professionals expressed concerns about the vulnerability of older adults or people in communities where access to global or governmental health advisories was limited.

Fact-checkers perceived delays in the flow of information between health or governmental authorities and media communication channels. They recognized an immediate need for health and science expertise to improve the flow of information to their audiences so that they could effectively communicate about health and science topics. However, they found that local health and medical professionals were not always willing or able to answer virus-specific questions or contribute to fact-checks and articles. "For the first six months or so, it was tough going, but we were learning our footing as we went along. Then the COVID-19 Expert Database came about, and it was a bit of a game-changer for us because we didn't need to rely on our local experts [in the same way]" (FC3, Zimbabwe).

Loop 1: Are we doing our work well?

The first learning loop of the TLL model seeks to define technical actions to improve project performance within its existing organizational structure. Single-loop learning is not limited solely to efficiency, though it is oriented toward defined problems and solutions (H. L. Smith, 2014), similar to the technical aspects of the adaptive leadership model (Heifetz et al., 2018). Within the process evaluation, I sought to address the first learning loop using the following questions: to what extent have the COVID-19 Expert Database Project activities been completed; and is the COVID-19 Expert Database Project delivering high-quality content that is accessible to global partners? These questions aimed to aggregate data to guide technical decision-making, strengthen project resource development, and identify areas for content-based quality improvement. Given the technical nature of the guiding questions, much of the data used to answer these questions were obtained from the database and evaluated objectively as described in the project methods. However, partners' thoughts and qualitative feedback were used to address content accessibility.

To what extent have the COVID-19 Expert Database Project activities been completed?

The COVID-19 Expert Database Project content creation activities were fully implemented in the spirit intended. Partners embraced the resource by submitting questions to the team and providing feedback during the process evaluation. As noted in Table 7 , during the 26-week pilot period, the project team answered a total of 213 questions, averaging 8.2 new questions per week, which met the target output goal. While the stated turnaround time for explainers was within 48 hours, there were no project records to estimate the average time for explainer delivery or evaluate whether the stated target was consistently met.

Table 7: Key project activities, target outputs, and results

Key Project Activity	Target Output	Results
Collect critical pandemic-related queries directly from fact-checking organizations and other community information leaders.	Not established	213 Queries answered; 50.7% (108/213) were submitted by partners representing 15+ countries around the world.
Triage queries to elicit public health expert responses.	5-10 high-quality entries generated per week	Average of 8.2 new queries were answered per week during the study period; a maximum of 19 new questions were answered during one week in July 2020.
Perform database content updates to ensure information is correct and accurate.	Not established	Average of 4.5 explainer updates per week; explainer updates began in August though they were selectively completed based on the perceived importance of new scientific findings and writer time allocations.
Design content packages for responses grounded in responsible health communications.	Not established	Queries, responses, and glossary entries reflect current scientific knowledge and meet journalistic standards (*see the following section on content quality for further evaluation results*).

Demand for explainers was reasonably consistent during the pilot, with about half of the explainers written in response to partner submissions (50.7%; 108/213). However, these patterns may not be significant since multiple partners reported accessing the database content via the website as a crucial part of their health information reporting (further detailed in the second learning loop section that follows). Users who accessed the database may not have needed to submit questions to the team frequently since they may have relied on published explainers based on emerging science or questions submitted by other organizations. Though they were not available for this evaluation, in the future, website analytics, including visits to the project website, common search terms, and most frequently accessed explainers, may provide further insights about how the website is accessed and searched for content.

In the audit of the database and project tools, I found that all of the database entries were completed for the main content areas (expert answer and background/context) and were cited using external resources. However, there were gaps in the database for links to glossary terms and completion of all of the database categories (e.g., country of query origin; variation on answer based on country of residence; answer variation based on age, sex, or other factors). Glossary terms were used to explain new or complex terminology, so having only 86.2% (184/213) of entries with at least one glossary term was considered a weakness further explored in the explainer audit (discussed in the section that follows). The other incomplete database fields were not regularly used or referenced by partners or the database team, so their status was not critical for project operations or database utility.

While explainer updates were identified as a priority to ensure that the database reflected current scientific evidence, regularly updating the database content was impossible with a small team of up to seven writers (n=5 at the time of this writing), given the significant volume of new and emerging scientific findings each week. As noted in Table 1, the team completed an average of 4.5 updates per week. Explainer updates were completed as time permitted following the completion of new explainers, upon request from partner organizations, or if there was a significant publication that yielded new information (e.g., virus transmission, treatment) or a change in public health guidance (e.g., social distancing, face masks).

Is the COVID-19 Expert Database Project delivering high-quality content that is accessible to global partners?

Health literacy is vital for health, and public health professionals play an essential role in improving health literacy, especially in the multi-level response to the COVID-19 misinfodemic

(Damian & Gallo, 2020). Misinformation experts have suggested that public messages to counter misinformation should be direct, succinct (Donovan, 2020), and “more plausible and easy-to-understand than the original” to ensure acceptance (Swire & Ecker, 2018). However, while there are best practices to guide how the media communicates health risks with the public (Parmer et al., 2016; World Health Organization (WHO), 2020a), there are no established guidelines for how public health experts can effectively convey complex health information to fact-checkers, journalists, and other media professionals (Ellis, 2018; Généreux et al., 2020).

As a novel intervention, partners expressed high satisfaction with the COVID-19 Expert Database content and working with the expert team. They universally endorsed the quality of the content provided and suggested that the explainers were written at a level that was easy to understand. A partner from the Philippines summarized some of the challenges in researching health information and the value of the database content as follows: “We would need to deal with a lot of jargon, especially if we are reading journals.... I would need to not only check one study; we need to double-check with other studies, so that means we need to deal with more jargon. That's one difficulty in understanding since we are not medical experts. We still need to consult with medical experts to help us in interpreting information. That's why again Learnaboutcovid has been very helpful because it laymanizes these information for us” (FC1).

Despite partners’ endorsements, it is essential to acknowledge that self-reporting is not the best way to assess content comprehension, scientific knowledge, and health literacy. Given the scope of this evaluation, I viewed partners’ feedback as my primary data source to learn about how the tool was both perceived and used. Content testing with partners using comparative text samples, comprehension testing, or other activities could be explored in the future.

As discussed previously, ensuring accessibility and readability of information is critical to encourage and support health literacy (Basch et al., 2020; LaRose, 2021b; Mokhtari & Mirzaei, 2020). Additionally, if the information is difficult to understand, it can be misinterpreted or misapplied and may contribute to the development and spread of midinformation (LaRose, 2021b; Mina, 2020). To objectively evaluate the database content, the following subsections detail how a subset of explainers (n=27) were audited using readability scores and an adapted version of the CDC Clear Communications Index (*CDC Clear Communication Index: A Tool for Developing and Assessing CDC Public Communication Products—User Guide*, n.d.).

Readability Assessment

Using an online tool (*Readable*, 2021), I found that the mean SMOG Index readability scores for the database explainers far exceeded the common journalistic threshold of between grades eight and 10, with some explainers achieving levels higher than grade 18 (post-graduate or professional level). As summarized in Table 8, the mean reading level for the context section of the explainers was slightly higher than that of the expert answer. However, using a paired t-test for the two sample means, the difference between the expert answer and context means failed to achieve statistical significance at the 0.05 level (p=0.46).

Table 8: Mean SMOG Index scores by content area

Content Area	Mean SMOG Index Score Results
Expert Answer	14.96 (11.6, 20.46) 95%CI: 14.31, 15.78
Context	15.28 (12.16, 18.77) 95%CI: 14.58, 15.97
Combined Score: **Expert Answer and Context**	15.12 (11.6, 20.46) 95%CI: 14.61, 15.62

While partners were satisfied with the readability of the explainer content, I question the following: 1) what an appropriate reading level is for journalists and fact-checkers as an education, professional audience; 2) whether partners' comprehension of the complex topics was truly adequate to carry messaging forward to their audiences; 3) whether partners' satisfaction was based on the relative difference in difficulty understanding content from papers published in peer reviewed journals in comparison to explainer content. While I was unable to further explore these questions further in this evaluation, as mentioned, additional content testing with partners will be important as the project moves forward. And, as a publicly accessible resource with the potential for content syndication with partners, it is undeniable that the content must be made easier to read for general audiences.

Clear Communications Assessment

Using elements from the U.S. CDC Clear Communications Index in combination with priority questions developed specifically for this evaluation, I created a rubric to audit explainer content and evaluate alignment with best practices to support health literacy (*CDC Clear Communication Index: A Tool for Developing and Assessing CDC Public Communication Products—User Guide*, n.d.; U.S. Centers for Disease Control and Prevention (CDC), 2021; U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2010). The rubric and complete results are shown in Appendix C; highlights of the assessment findings are summarized in Table 9 below.

Table 9: Summary of key findings from the Clear Communication Assessment

Meeting Targets	Areas for Improvement
• Targeted or main message was present and in the first part of the text in 96.3% (n=26) of entries. • 100% (n=27) of questions were fully answered, and the responses appeared to be factually correct and supported by the literature. • Background and context were directly related to the question and supported the expert answer.	• Explainer readability (SMOG Index Score) as detailed above. • Conveying actionability in explainers; only 40.7% (n=11) of entries provided one or multiple actionable recommendations. • Consistent use of active voice; only 11.1% (n=3) of entries were written in active voice. • Language of entries often used words that many people would not be familiar with; only 7.4% (n=2) of entries avoided specialized or complex words. • Gaps in glossary links and definitions also identified in the audit of workflow tools; 81.5% (n=22) of entries were missing glossary links for uncommon words. • Format/template adjustments are needed to improve accessibility.

I also explored readability scores and Clear Communications Assessment scores among topical content areas, as shown in Figure 5 below (data for Figure 5 is shown in Appendix E). While there appeared to be observable differences reflected in the reading level spread of 4.74 grade levels between the highest and lowest scoring content areas, the sample size was too small to evaluate whether the differences observed among the categories were statistically significant. While they do not appear related, since the SMOG Index score was included in the Clear Communications Assessment score, a test for statistical correlation between the two was not possible.

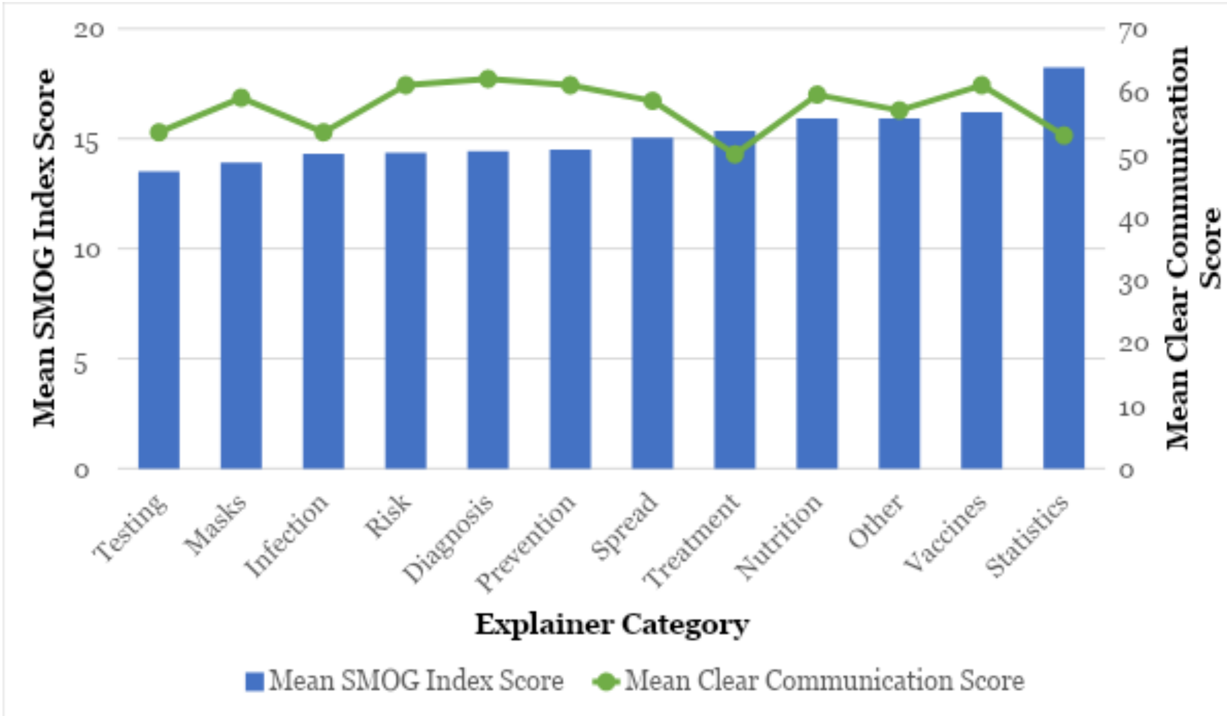

Figure 5: Chart displaying mean SMOG Index scores and mean Clear Communications Assessment scores across thematic categories

Loop 2: Are we doing the right work?

The second learning loop of the TLL model seeks to challenge organizational notions and practices to change or improve how the work is conceptualized. While the first learning loop explores the quality of the work, the second learning loop is designed to question if the work is relevant and tests underlying assumptions to ensure continued learning and evolution (Argyris, 1977; H. L. Smith, 2014). To further the application of Heifetz and colleagues' adaptive leadership model, the second learning loop also presents challenges conceptualized as both technical and adaptive that require learning and exploration to arrive at a possible solution (Heifetz et al., 2018).

To explore the combined technical and adaptive aspects of the project within the second learning loop, I sought to address using the following questions: are the assumptions that have informed the creation of the COVID-19 Expert Database Project accurate; how have participants (partners) interacted with database content; and how has the COVID-19 Expert Database Project influenced partners' fact-checking processes? Using qualitative and quantitative data gathered during partner interviews, the goal of these questions was to determine if the project assumptions were valid before *and* during the pandemic and understand how partner organizations used the project resources to address health-related misinformation online.

Are the assumptions that have informed the creation of the COVID-19 Expert Database Project accurate?

While partners reported that they do not consider themselves health communicators, the perceived importance of addressing and preventing health misinformation has been central to their pandemic-related communications. "After COVID-19 happened...then there was suddenly priority on health reporting that caused reporters and journalists to seek more information on how they could do reporting methods and... be more careful in their reporting related to health" (FC1, the Philippines).

To test the assumptions underpinning the COVID-19 Expert Database Project using a current and pre-pandemic comparison, I asked partners how much they agreed with each assumption using a Likert scale between one and five (1 being low or disagree; 5 being high or completely agree) during interviews conducted between February and April 2021. The project assumptions are listed in Table 10 with mean Likert scale values displayed in the pre-pandemic and pandemic columns. The final column shows the change in mean Likert score using the pre-pandemic and current values reported by participants.

Table 10: Change in assumption importance or relevance during the COVID-19 pandemic

Stated Assumption	Pre-pandemic (Recall)	Pandemic (February-April 2021)	Change in Score Pre-pandemic to During the Pandemic
Journalists/fact-checkers care about health misinformation and accurate health communications.	2.9	4.7	62% increase
Journalists/fact-checkers will be receptive to improving health messaging.	2.9	4.7	62% increase
Fact-checking organizations want to build health capacity.	2.4	3.6	50% increase
In the media, there is a capacity to accommodate the newest health information to ensure relevance.	3.2	4.2	31% increase

The data shown in Table 10 suggest that the pandemic has significantly influenced how journalists and fact-checkers view health misinformation and the perceived desire to build health capacity in the media. While the assumptions appear valid at present, the pre-pandemic scores indicate that health misinformation has not always been viewed as a priority. As a U.K. partner suggested, "I feel like a lot of people aren't quite on board with that yet. They haven't realized that during the pandemic, some of the problems have been about miscommunication" (FC4, United Kingdom).

At this point, it is not possible to know if health misinformation will maintain its relevance as the pandemic wanes; however, it would not be unreasonable to believe that the global perceptions of health misinformation could return to a baseline level. Before the pandemic, partners reported conducting fewer health-related fact-checks across a diverse cross-section of health-related topics (e.g., HIV, cancer, diabetes). Because information changed more slowly and content about established health topics was readily available, partners reported that fact-checks were easier to conduct.

While the importance of accurate health communications was well appreciated by interview participants, they identified many competing interests and priorities across reporting and fact-checking: elections, politics, education, science, health, environment, and more. Partners cited newsworthiness as a significant driver of how and when health reporting is prioritized. They also noted that the desire and investment in building health capacity remain limited in the industry. "We have noticed that we are lacking in journalism health capacity…. It is expensive to look for, to have a dedicated journalist to do health stories, but it is important, very important" (FC3, Zimbabwe).

How have participants (partners) interacted with database content?

When the project launched in June 2020, partners began contacting the expert database team for support with their health-related fact-checks. All interview participants reported that the database was a useful tool to support their COVID-19 writing and fact-checking work. Before the process evaluation and partner interviews, however, the project team did not know whether or not partners used the project website to access posted content.

In multiple interviews, partners enthusiastically reported that the COVID-19 Expert Database website was one of the first sources they searched when a new claim surfaced. For example, one interviewee suggested, “if there is a question that comes, my team would jump on the database and try to figure it out” (FC3, Zimbabwe). Similarly, another participant mentioned the following: “A lot of the time, if we get particularly difficult claims that we’re looking at and we don’t even know where to start, the first thing to do would be to check the database and reach out. Sometimes, if we’ve come to a conclusion and we need an extra comment, [we] maybe might reach out afterward, but that’s less likely” (FC4, United Kingdom).

However, not all partners use the website as part of their routine fact-checking work. Using inductive analysis, I identified that partners could be classified as “high-users'' or “low-users” based on their qualitative responses. For example, high-users reported that they searched the database often during their work, contacted the database team when they could not find the content they needed, and were more likely to report enthusiastically recommending the database to their peers. One participant reported the following: “Whenever we encounter a health-related fact-check, and we think that a take from Meedan's experts would be helpful for us, we check the database to see if there's already an existing entry for our topic that we're working on. If that is not the case, we immediately send an email to one of the members of Meedan containing our inquiry and our specific questions” (FC1, the Philippines).

Low-users reported more variable or episodic use of the COVID-19 Expert Database as a resource. They did not commonly search the database for content though they reported contacting the team for questions as needed. For example, one partner said that they “don't access database content regularly, but only in the case of special queries regarding health, we contact the health team" (FC6, India).

In this small sample, it is unclear why some partners were high-users and others were low-users of the database, and, unfortunately, I did not identify the differences between the groups until after I completed the interviews and qualitative analysis. While there were no project-specific onboarding or training sessions for any of the partner organizations, possible differences between the groups may include the following: the amount of routine health-related fact-checking the partner organization conducts; how eager the participant was to explore new health- or science-related resources; the user’s level of digital literacy; the participant's level of comfort conducting fact-checking work in English; or the level of engagement with the project or Meedan’s other programs.

How has the COVID-19 Expert Database Project influenced partners' fact-checking processes?

The COVID-19 pandemic considerably changed partners' fact-checking processes and priorities. As discussed, at the start of the pandemic, journalists and fact-checkers were immediately challenged to keep pace with the rapid emergence of health-related claims. Partners reported that the database was a critical tool for them to fact-check health claims quickly, without waiting for formal responses from other health officials. They also noted that the database helped them to understand complex health- and science-related study findings.

High-users often mentioned that the COVID-19 Expert Database was their "go-to" or “first stop” resource for COVID-19-related information, as described in the previous section. While all interviewees noted that the database is commonly used alongside references from national Centers for Disease Control and Prevention, Ministries of Health (MOH), the WHO, and major universities worldwide, low-users were more likely to default to the WHO and MOH (or national equivalent) to gather health-related information. Conversely, high-users were more likely to report significant reliance on the COVID-19 Expert Database *alongside* WHO and MOH resources.

To further explore how partners viewed the database in their work, I included quantitative scores to further examine how useful the COVID-19 Expert Database Project was to their work, how trustworthy they thought the project and team were, and how likely they were to recommend the database to a colleague. Each question was scored using a Likert scale between 1 and 5 (1 being low, not useful, not trustworthy, or unlikely to recommend; 5 being high, very useful, very trustworthy, or highly recommend). The scores are summarized in Table 11 below.

Table 11: Likert scale responses to partners' views on COVID-19 Expert Database usefulness and trustworthiness, and the likelihood of recommending the database to others

Quality Classification	Mean Likert Score
Usefulness	4.5
Trustworthiness	4.5
Likelihood of Recommending the Database	4.7

The scores across all three classifications were favorable, and there were no differences observed between high- and low-users. Usefulness was well captured in the evidence presented previously that detailed how partners use and view the database and its content. However, usefulness was negatively influenced by website searchability, which was consistent with results from the website audit that I conducted as part of the process evaluation. One partner suggested that "searching through it is sometimes quite hard. If it was like somehow easy to add a search function, keywords, or tags, that would be perfect" (FC4, United Kingdom). Additionally, usefulness was also negatively influenced by the standard explainer turnaround time of 48 hours, with some partners suggesting the timeframe was too long to support fact-checking viral claims. However, these users were not aware that the team could frequently accommodate urgent or "breaking news" requests.

Partners perceived the database and the expert team as very trustworthy in this small sample. One participant reported the following: "Every subject we sent with a thorough process of debunking we knew that experts were consulted before they posted any answers, and there were references, as well, as to where they got their information or answers. Most of them were in line with the NCDC [The Nigeria Centre for Disease Control] existing guidelines on protocols and all that, so we knew that was correct" (FC2, Nigeria). Database trustworthiness was negatively impacted by the expert team's perceived lack of transparency and users' lack of knowledge about who was contributing to specific explainers since bylines were attributed to the team rather than an individual. Furthermore, partners suggested that the project's trustworthiness could be increased with more known partners, greater numbers of users, or database inclusion in more global, regional, and national-level source lists.

Finally, participants universally reported recommending the database to colleagues because of the quality of information and accessibility of content that made fact-checking health claims easier. One partner said that they "highly recommend the database to our trainees whenever we conduct fact-check trainings and talks since we know that they won't find the information in there hard to understand" (FC1, the Philippines).

At the close of each interview, partners were asked about areas for project improvement, suggestions, and requests for how the database team could further support their health-related fact-checking work. Participants requested COVID-19 Expert Database Project infographics, graphics, and videos as tools to engage communities via social media. They also asked for improved source transparency through bylines, links to experts' LinkedIn pages, targeted quotes from experts, and a more straightforward and interactive landing page to learn more about the expert team.

While all of the interviews were conducted in English and one paper survey was completed in French, the small group of users all reported conducting their fact-checks entirely or primarily in English and maintained workflows to aid in translation into other languages. They reported that content in French, Hindi, and Nigerian Pidgin might be helpful in their work; however, they noted that localization and contextualization would also be essential to ensure that the content is helpful to their audiences if translation were available.

Loop 3: Are we gathering information needed to make informed choices about our strategy, objectives, and direction?

The third learning loop of the TLL model challenges the primary reason for being or purpose of the project (H. L. Smith, 2014). Ultimately, some would suggest that the third loop encourages learning so that the project team can cultivate wisdom through time and experience (Peschl, 2007) or foster "collective mindfulness" that results from deep learning (Georges L. Romme & van Witteloostuijn, 1999). In the case of the COVID-19 Expert Database Project, the third loop supports reflection to encourage learning, allows the project and its purpose to shift, and, if necessary, promotes reinvention based on changes in the contextual environment. To embrace uncertainty and foster programmatic knowledge generation, the third loop can also be applied to Heifetz and colleagues' adaptive leadership model as an exploration of an adaptive challenge that requires learning to define the problem, elucidate possible solutions, and modify what has previously been believed about the project and its environment (Heifetz et al., 2018).

Within the third learning loop, I sought to identify the structures, adaptations, and processes through which the COVID-19 Expert Database Project has been delivered. The project is in a nascent phase, and the third loop will become increasingly relevant as the project matures. It is vital to acknowledge that the project's launch was facilitated by the COVID-19 infodemic that underscored the importance of health misinformation as a global public health and communication challenge. In the coming months and years, it will be critical for the team to engage in deep learning and contextual exploration as they continually consider how they will remain dynamic and relevant even as the pandemic wanes and health misinformation resumes its place alongside other competing priorities in the digital infosphere.

What are the structures, adaptations, and processes through which the COVID-19 Expert Database Project has been delivered?

The COVID-19 Expert Database Project was designed as a new interdisciplinary initiative within Meedan's operational strategy and was positioned in alignment with the organization's five core pillars: technology development, network building, strategic training, collaborative and ethical data collection, and rigorous research (Meedan, 2020). With short-term funding from both technology organizations and health-related foundations, the pilot initiative was conceptualized, developed, and launched by a team of professionals dedicated to preventing and addressing health misinformation in pursuit of health equity at the scale of the internet.

During the pilot, team leaders interfaced directly with partner organizations, funders, staff, and the expert team and employed agile workflows and weekly sprints to facilitate collaboration and communication. Leaders maintained flexibility to quickly adapt to partners' needs and implement learnings in real-time by utilizing informal and rapid decision-making processes. Similarly, the team of writers embraced the dynamic workflows by actively participating in meetings and using messaging communications online. Finally, the entire project team shared an interest in fostering collaborative decision-making and engaging in strategic development to challenge and advance the project during the pilot period and beyond.

The teams' dedication was apparent, and the teaming process for the project team was unique. The writers were recruited and hired through a professional network of known associates, which resulted in a high level of interconnectedness, trust, psychological safety, and satisfaction within the workgroup. One writer shared the following in an anonymous survey: "I really value this work environment – it's one of the best I've ever been in and makes me feel extremely welcomed and valued." While overall satisfaction on the team was high, the expert writers also expressed a desire to support the public infosphere, not solely journalists and fact-checkers. One writer suggested that "we could be doing more to meet people where they are at, not just journalists.... I don't always feel like we are utilizing all of our skills or the way we share information to improve health and secure the public's health." Finally, despite their commitment to the project, the team of expert writers expressed concern and feelings of uncertainty around continuing the project as the pandemic wanes.

Within the organizational environment, I identified multiple challenges that inhibited the process evaluation or have the potential to undermine the project's success long term. First, despite the attributes of agile workflows and practices, with the rapid design and launch of the project, there were limited guiding structures to support evaluation work, as discussed previously. Similarly, project-specific goals were needed to fully explore alignment and identify synergies across project and organizational activities. Second, informal structures and limited recordkeeping made it difficult for team members to understand how the project and their roles were changing if they could not attend regular sprint meetings three times per week. And minimal programmatic documentation inhibited my ability to identify adaptations that had occurred during the pilot period. Third, funder engagement and improved funding stability will be critical to project sustainability. Given the nature of the pilot and funding limitations, the project relied heavily on a small team of writers, each sponsored with a limited number of hours per month. While the team was dedicated to the work, the writers all maintained external employment commitments because of contractual limitations.

Application of Process Evaluation Insights

Operating with agility and rapid application of learning during the process evaluation was a considerable advantage to the project. Based on the findings and observations of the evaluation, the project team successfully implemented a bi-weekly newsletter, new Health Desk website, DHL Summit activities, and editorial standards and methodology earlier this year (as further outlined in Figure 6).

- **Bi-weekly Newsletter:** A new newsletter initiative was started to highlight new database explainers and share team forecasts about upcoming topics of interest. This initiative was created to foster funder and partner engagement and promote thought leadership in the field.
- **New Health-Desk Website:** In early 2021, the COVID-19 Expert Database was relaunched as Health Desk. The project's relaunch was designed to increase the breadth of possible health-related content beyond the pandemic, and the new website was launched to improve content accessibility for partners.
- **Ongoing DHL Summit and Writing Workshops:** As mentioned, the team launched a series of summit meetings and workshops to foster writer engagement, support professional development, and encourage collaboration with new processes, goals, and workflows.
- **Editorial Standards and Methodology**: New editorial standards and methodologies have been developed and implemented to improve compliance with the IFCN principles, guide future content generation, and increase transparency.

Figure 6: Progressive application of findings

During the process evaluation, I identified multiple ongoing project-related challenges and areas for improvement. While the team has taken steps to mitigate some of the challenges, others will remain for the foreseeable future. First, ensuring appropriate readability and accessibility was challenging with complex medical and scientific language. While partners were satisfied with the content provided, the current explainer content did not meet accessibility standards using the Clear Communications Index health literacy framework. Second, demand for content fluctuated during the pandemic, and managing demand fluctuations with limited hours and a small team was challenging. Third, with a small group of part-time writers (n=5), it was impossible to keep up with more than 250 explainers (at the time of writing), especially with the constant demand for new content. A new update process and tools to flag explainers that have exceeded 90 days since an update were implemented to manage updates with the small expert team. Finally, as the pandemic wanes, it will be difficult to bolster the importance of health misinformation in media and fact-checking work. However, participation in thought leadership activities, partner and funder engagement, innovative partnerships, and public promotion could directly offer avenues to promote project sustainability.

Explainer content quality, demand, and updates primarily represented technical problems that could be addressed with defined solutions. However, as discussed, the influence of the pandemic on the project and its success cannot be overstated. The COVID-19 pandemic significantly changed how partners viewed the importance of addressing health misinformation in the media and online. The Likert results from the test of the project's underlying assumptions shifted from a relatively neutral before the pandemic to positive during early 2021, suggesting that health information was perceived as more important than ever before in this small group of interviewees. Additionally, the COVID-19 misinfodemic yielded unprecedented volumes of false information that exponentially increased health-related fact-checking demand as reported by interview participants and in the literature (Brennen et al., 2020; Luengo & García-Marín, 2020). These critical insights must be considered further as the team explores project sustainability, next steps, and future directions.

To capture the influence of the COVID-19 pandemic on the project, I created a diagram (shown in Figure 7 below) to display the organizational environment and inputs, project activities, and project outputs, similar to that of a simplified logic model. I then added a box (in blue) to display the areas influenced by the pandemic. For example, it is essential to acknowledge that even with adequate funding and human resources, query collection is influenced by the pandemic. In the absence of the pandemic, there may not be a sufficient number of questions for the team to address.

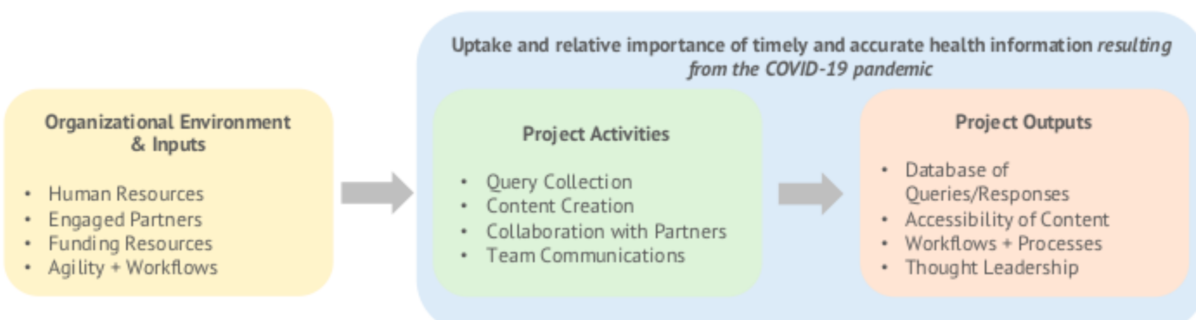

Figure 7: Simplified logic diagram

The breadth of health misinformation is expansive, and multiple topics could be prioritized in the absence of the pandemic to support ongoing programmatic operations. Following the successful pilot, the COVID-19 Expert Database Project was relaunched as Meedan's Health Desk earlier this year. Health Desk will continue to focus on gathering queries and writing explainers focused on COVID-19-related topics, including vaccines, therapies, variants, and other topics. However, the team will also expand its scope to include other emerging health topics, including nutrition, reproductive health, and noncommunicable diseases. The team will also respond to queries at the intersection of climate and health.

To guide Health Desk work in the coming year, the team has established goals for the team, including conducting trainings for fact-checking organizations and others; planned for monitoring, evaluation, and learning activities that will track content accessibility and continue to challenge the project's assumptions; and implemented partner, funder, and writer engagement programs. The team has also begun writing topical forecasts based on circulating health narratives to guide partners in preparing for emerging trends in health information. By closely monitoring these narratives and aiding partners to respond proactively, there is an ongoing opportunity to support the flow of accurate health communications and potentially limit the viral spread of misinformation (Tangcharoensathien et al., 2020).

Finally, the Health Desk team is planning a Health Desk Collaboration Consortium (HDCC) to bring together journalists, fact-checkers, media professionals, and health experts. The following objectives will guide the HDCC: foster cross-sectoral collaboration aimed at strengthening health communications in the media; promote coalition building to continually highlight and elevate the ongoing need for accurate health information in the media; and provide a supportive environment for training and learning with North-North, South-South, and triangular collaboration.

Conclusion

For more than a year, the world has observed rapid scientific learning unfold in real-time. At the start of the COVID-19 pandemic, little was known about the SARS-CoV-2 virus, how it spread, who was at risk for severe infection, or which treatment modalities may prove effective. The emergency nature of the pandemic did not allow for immediate access to robust scientific data, and public fear, limited scientific knowledge, and data deficits immediately yielded a deluge of false, misleading, and speculative content that was peddled as truth online.

Since its start in early 2020, the pandemic has yielded volumes of new information, labeled an infodemic by the WHO (World Health Organization (WHO), 2020c). Even prior to the WHO declaration, infodemiology, the study of infodemics, was recognized as a nascent interdisciplinary field that requires engagement from the public health community, communications experts, researchers, applied mathematicians, social and behavioral scientists, nongovernmental organizations, technology companies, professional communicators, and others to increase the academic rigor of its study (Tangcharoensathien et al., 2020; World Economic Forum, 2016). By employing advanced methodologies, experts hope that teams can generate the evidence needed to develop infodemic management solutions, support policy-making decisions, strengthen public health preparedness and response efforts (Tangcharoensathien et al., 2020), create a culture that promotes truth over misinformation (Lazer et al., 2018), and improve the quality and accessibility of health information available to the public.

A misinfodemic has paralleled the COVID-19 pandemic and increased our global awareness about misinformation as a public health threat capable of physical, emotional, and psychological harm. Fueled by social media and digital messaging platforms, cross-sectoral research has confirmed that misinformation can have widespread societal implications, including shaping perceptions and realities that influence health decision-making practices (van der Meer & Jin, 2020). Even before the COVID-19 pandemic, misinfodemics contributed to vaccine skepticism and the spread of diseases like Ebola or Zika (Allgaier & Svalastog, 2015; Gyenes & Mina, 2018; van der Meer & Jin, 2020).

Novel or exciting misinformation about the COVID-19 pandemic has been shared widely online, perhaps even more so than factual information in some cases (Obiała et al., 2020). Experts argue that not enough is being done to control the spread of health misinformation. They suggest that more robust measures are needed to prevent the spread of misinformation across social and mass media platforms. First, public education is required to promote digital, science, and health literacy so that people are better equipped to differentiate between the truth and false or misleading claims. Second, regulations, policy actions, standards, and network controls are required to govern content and prevent the spread of misinformation online. These actions are also needed to ensure that vulnerable communities, including children, older adults, and individuals with limited literacy skills, are protected from health misinformation exposure (Morley et al., 2020). Finally, technology companies need to invest in social responsibility activities that foster the safe use of digital media (World Economic Forum, 2016).

Despite their role in misinfodemics, social media platforms also offer potentially efficient avenues to counter misinformation through flagging of questionable content; real-time fact-checking through third-party fact-checking organizations, users, or algorithms; and mechanisms to facilitate rapid corrections (Walter, Brooks, et al., 2020). Fact-checking methodologies could be further adapted to fill health-related gaps in fact-checking frameworks. Improving the availability and accessibility of public health experts, streamlining communications, prioritizing topics of urgency and interest, and utilizing pre-populated databases could decrease the burden on journalists and fact-checking organizations and increase the number of fact-checks they can complete. In addition, engagement with global and local agencies is vital to ensure that the information shared is accurate, high-quality and reflects the latest scientific evidence (Allgaier & Svalastog, 2015; Gyenes & Mina, 2018).

At the start of the COVID-19 pandemic, Meedan's Digital Health Lab (DHL) team was uniquely positioned to mobilize public health professionals to respond to and support pandemic-related fact-checking efforts. The leadership team had completed formative study and planned to implement an expert database project wherein journalists and fact-checkers could submit questions to a team of public health professionals and receive answers in the form of explainers. The explainers would then be posted to an online database for others to reference as well. In early 2020, the team was working to narrow the field of potential health topics, and, when the pandemic began, their mission became clear: to support media professionals in reporting on and fact-checking COVID-19-related topics.

Since its launch in June 2020, the novel COVID-19 Expert Database Project has attempted to curb the spread of misinformation by delivering high-quality, accessible explainers referenced with the highest quality scientific information available. The project has engaged partner journalists and fact-checkers and served as a novel resource to support their work in delivering accurate health information to the public, even when little was known about COVID-19 and confusion was widespread. To explore how partner media and fact-checking organizations used the database, understand how users perceived value of the database as a resource, test the project's underlying assumptions, and evaluate the quality of the database content, I designed a process evaluation to review the pilot phase of the project between June and December 2020.

Continuous learning is vital for programmatic improvement, stakeholder engagement, reporting, and knowledge generation. Additionally, it is imperative that learning activities are structured to support agility and iteration through feedback loops that promote adaptation to accommodate shifting priorities, contexts, and opportunities (Balasubramanian et al., 2015). As the first evaluation activity for the COVID-19 Expert Database, it was essential to integrate the evaluation into the triple loop learning (TLL) model to promote continuous monitoring, evaluation, and learning across the technical and adaptive aspects of the project.

The previous chapters have detailed how I designed and conducted the COVID-19 Expert Database Project process evaluation and integrated the evaluation into a TLL model that aimed to answer the following questions: *are we doing our work well* (loop one); *are we doing the correct work to serve our partners and deliver on our project outputs and outcomes* (loop two); and *are we gathering information needed to make informed choices about our strategy, objectives, and direction* (loop three) (Flood & Romm, 2018; Georges L. Romme & van Witteloostuijn, 1999; Peschl, 2007; H. L. Smith, 2014). Using process evaluation methods in combination with the TLL model, I explored the project and identified strengths and weaknesses to guide future continuous learning activities.

Within the first learning loop, I identified that the technical aspects of the COVID-19 Expert Database Project were successfully implemented and delivered in the spirit intended under the project goal "to improve the quality of health information in global media channels by providing timely access to public health experts to support fact-checking efforts and science communications." Queries were submitted to the expert team often during the pilot period, and the public health experts generated content that supported partners' fact-checking efforts. Though partners endorsed the quality of the content, readability and accessibility assessments suggested that improvements were needed to ensure that the explainers were truly understandable for a larger community of users.

The evaluation questions integrated into the second learning loop were used to understand how partners used the database content and explore the assumptions underpinning the project. From a technical perspective, users suggested that the database content was useful in their work, trustworthy, and worthy of being shared with colleagues. Partners universally endorsed the database as a valuable resource that supported health-related fact-checking efforts. However, the validation of the project's underlying assumptions presented an adaptive challenge that deserves further monitoring. Interestingly, while partners validated the project's assumptions based on their experience fact-checking during the pandemic, their retrospective responses highlighted a level of conditionality that suggested that their views on the assumptions were not constant. In short, health fact-checking was perceived as less critical among competing priorities in the absence of the pandemic, which may influence the project's utility in the future as the pandemic wanes.

Finally, though the adaptive challenges inherent to the third learning loop will be more relevant in the coming year than in the pilot, exploring the project's contextual factors and its implementation yielded important results. Organizational attributes, team formation, and agile workflows were crucial for the COVID-19 Expert Database Project's launch and early successes. Similarly, external factors, including funding allocation, availability of public health experts to generate content, and engaged partner organizations, supported the project's implementation and advancement. However, it is critical to recognize that emergence of the pandemic provided a unique window that changed the global perception of health misinformation as a public health problem. While a health database project was in development before the pandemic, the COVID-19 infodemic and misinfodemic elevated health misinformation as an area of critical public health interest and underscored the need for new resources, workflows, and methodologies to address health misinformation. It is essential to acknowledge that these contextual changes highlighted the importance of health information as a vital component of everyday life and were key to the project's launch and partner engagement during the pilot period.

During the evaluation period, the COVID-19 Expert Database Project was relaunched as Meedan's Health Desk with plans to support the second year of the initiative. While the pandemic remains omnipresent at the time of this writing, lessons from the process evaluation can be applied to inform how the team creates content and engages with partner organizations in the subsequent phases of the misinfodemic. Using the process evaluation as an entry point into an integrated TLL model can support how the team considers the future of its adaptive learning processes, including how they will continue to develop content that is timely and relevant for global partners; challenge their assumptions within the dynamic infosphere; engage media and fact-checking organizations in continuing to create accessible, health-focused content; and foster collaborative, cross-sectoral partnerships between public health experts and communications professionals. By collaborating with and supporting journalists, fact-checkers, and newsrooms to strengthen health communications and improve health information access, Meedan's DHL continues to promote health equity at the scale of the internet.

Innovative, collaborative, and multidisciplinary partnerships across public and private sectors are needed to ensure that the public infosphere supports well-informed health decision-making. This project further underscores the need for accessible, evidence-based health and science resources to support journalists and fact-checkers in improving the infosphere. Researchers and health professionals should not expect media professionals to independently simplify and contextualize complex scientific findings in the absence of significant amounts of health and science training. Similarly, it is unreasonable to expect scientists and health experts to be the primary conduit for public health messaging when they are not community-based communication leaders. Through partnerships that extend across physical and virtual communities, that spread accurate information via news and social media, and contextualize the messaging so that it is relevant to the public at large, we can collectively improve the infosphere and endeavor to prevent and curb misinfodemics.

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Appendix A: Project Description & Acceptable Project Delivery Description

Meedan's Digital Health Lab (DHL) is an applied research initiative working towards equitable access to health information at the scale of the internet. In 2020, the DHL launched the COVID-19 Expert Database Project to support journalists and fact-checkers in addressing pandemic-related health information challenges. The Project began in response to an urgent and ongoing need to implement unique approaches that address health information challenges in the digital age, made particularly pressing through the COVID-19 pandemic. Participatory response efforts that underscore community information leaders' value, leverage existing health information networks, and apply tools and technologies that target audiences already use can effectively promote access to quality content and address the impacts of health misinformation. Community information leaders, including fact-checking organizations, have a wide reach, but they experience difficulties managing the nuances of health misinformation, especially during emergencies, due to a lack of in-house experts and limited resources.

Under the broad mission to support health communicators with high-quality health-related content, the COVID-19 Expert Database Project was designed to provide evidence-based explainers for fact-checkers and journalists; this novel resource allowed them to report on topics that otherwise may have been beyond their expertise. In an effort made possible with strategic planning initiatives, resource allocation, partner engagement, and support from funders and the greater Meedan organization, the DHL and COVID-19 Expert Database Project prioritized the following aims and activities to curb health-related misinformation in pursuit of health equity.

Content Creation and COVID-19 Database Development

AIM: Conducting applied research to improve public health through digital innovation, participatory methods, and equity-centered design.

The COVID-19 Expert Database Project will fill a knowledge and information gap by developing an expert database that is available and accessible to fact-checkers, journalists, and newsrooms. The COVID-19 Database Team will prioritize entries based on partner demand and current trends in public health information. All entries will meet journalistic standards for balance, objectivity, and accuracy. The DHL and COVID-19 Expert Database Project Team will do the following:

- *Collect critical pandemic-related queries directly from fact-checking organizations and other community information leaders*
- *Triage queries to elicit public health expert responses.*
- *Perform database content updates to ensure information is correct and accurate.*

Thought Leadership in the Prevention of Health Misinformation

AIM: Co-designing "do no harm" best practices preparing practitioners with a set of principles, processes and approaches for health communications and corrections that align with established public health standards of care, and are specific to the distinct and significant risks associated with health misinformation.

Through publications, presentations, and other engagements, the COVID-19 Expert Database Project will promote best practices in health communications to prevent the spread *of misinformation, midinformation, and disinformation to the public. The DHL and COVID-19 Expert Database Project Team will do the following:*

- *Work with journalists and third-party fact-checkers to disseminate COVID-19 content.*
- *Write blog posts, op-eds, and other content about public health misinformation.*
- *Plan and deliver health misinformation and fact-checking trainings for external organizations.*
- *Design content packages for responses grounded in responsible health communications.*

Build a Community Engaged in Reducing Health Misinformation

AIM: Building a community of health practitioners, researchers, journalists, and activists and end-users actively engaged in reducing health misinformation, to support fact-checking organizations and to ensure that health content online is engaging, relevant, safe, and accessible.
AIM: Hosting gatherings and sharing resources for designing equity-centered health communications outputs and strengthening misinfodemic response efforts.

Engagement from public health professionals and the fact-checking community is needed to ensure that any tools, processes, and resources developed by and for the DHL and COVID-19 Expert Database Project are accurate, timely, and accessible. To support the fact-checking community and improve their access to high-quality health information, the DHL and COVID-19 Expert Database Project Team will do the following:

- *Curate a roster of active and potential experts to contribute to topical areas in the COVID-19 Expert Database Project.*
- *Recruit and engage fact-checking organizations, journalists, and newsrooms as partners interested in supporting high-quality health information.*

Appendix B: Learnaboutcovid19.org Website Audit for Adherence to IFCN Principles

IFCN Principle	Brief Findings
1. A Commitment to Non-partisanship and Fairness: Signatory organizations fact-check claims using the same standard for every fact check. They do not concentrate their fact-checking on any one side. They follow the same process for every fact check and let the evidence dictate the conclusions. Signatories do not advocate or take policy positions on the issues they fact-check.	Partial adherence: The website states the following: "Learnaboutcovid19.org, published by the 501(c)(3) nonprofit corporation Meedan, commits to independent, nonpartisan reporting and analysis of the topics it covers."
2. A Commitment to Standards and Transparency of Sources: Signatories want their readers to be able to verify findings themselves. Signatories provide all sources in enough detail that readers can replicate their work, except in cases where a source's personal security could be compromised. In such cases, signatories provide as much detail as possible.	Partial adherence: Citations are provided as links to sources used in explainers.
3. A Commitment to Transparency of Funding & Organization: Signatory organizations are transparent about their funding sources. If they accept funding from other organizations, they ensure that funders have no influence over the conclusions the fact-checkers reach in their reports. Signatory organizations detail the professional background of all key figures in the organization and explain the organizational structure and legal status. Signatories clearly indicate a way for readers to communicate with them.	Partial adherence: The website states the following: "As a non-profit organization, Meedan has funders that may in some cases be the subject of discussion and reporting on the Misinfodemia show. We commit to proactive disclosure of any funding, as well as disclosure of other relevant professional relationships between our reporters, editors, producers and funding organizations." Funders are also listed on the website with the following statement: "Funders of Meedan play no role in editorial decisions, including our selection of content, or hiring or commissioning of contributors." Staff biographies and contact information for the database team is included.
4. A Commitment to Standards and Transparency of Methodology: Signatories explain the methodology they use to select, research, write, edit, publish and correct their fact checks. They encourage readers to send claims to fact-check and are transparent on why and how they fact-check.	Partial Adherence: The website does not list methods used in performing the project work, though it does encourage fact-checking submissions via web-based form or email.

Appendix B (Continued)

IFCN Principle	Brief Findings
5. A Commitment to Open & Honest Corrections Policy: Signatories publish their corrections policy and follow it scrupulously. They correct clearly and transparently in line with the corrections policy, seeking so far as possible to ensure that readers see the corrected version.	Not included.

Appendix C: COVID-19 Database Content Audit April 2021

NOTE: Criteria marked with an asterisk (*) on the tables that follow were integrated directly from the CDC Clear Communications Index. Other criteria were developed to meet the specific project evaluation objectives.

	Criterion	Evaluation Criteria				Highlights of Results
Expert Answer	**Wordcount**	**Number**				**Min: 95** **Max: 492** **Mean: 239.59** **Std Dev: 111.69** **95%CI: 195.41, 283.78**
	SMOG Index (Simple Measure of Gobbledygook)	**Score** (Number of years of education one needs to understand the text; particularly useful for healthcare and longer passages)				**Min: 11.6** **Max: 20.46** **Mean: 14.95** **Std Dev: 2.09** **95%CI: 14.31, 15.78**
		0 Greater than grade 12	**1** Between grades 10 and 12	**2** Between grades 8 and 10	**3** Grade 8 or lower	**92.6% (n=25) of entries scored 0** **7.4% (n=2) of entries scores 1** **0 entries scored >1**
	Does the material contain one main message statement?* **CORE**	**0** No or the content contains multiple message statements		**1** Yes, there is a singular or main message		**100% (n=27) of entries scored 1**
	Is the main message at the top, beginning, or front of the material?* **CORE**	**0** No		**1** Yes, the main message is in the first section or block of text		**3.7% (n=1) of entries scored 0** **96.3% (n=26) scored 1**
	Does the material include one or more calls to action for the primary audience?* **CORE**	**0** No or call to action is for someone other than the primary audience		**1** Yes, the text includes specific behavioral recommendations, a prompt to get more information, a request to share information with someone else, or a broad call for change.		**59.3% (n=16) of entries scored 0** **40.7% (n=11) of entries scored 1**

Appendix C (Continued)

	Criterion	Evaluation Criteria				Highlights of Results
Expert Answer	**Do both the main message and the call to action use the active voice?*** **CORE**	**0** No		**1** Yes, the main message and call to action are in active voice.		**88.9% (n=24) of entries scored 0** **11.1% (n=3) of entries scored 1**
	Does the expert answer fully answer the question as written?	**0** Question is not directly or indirectly answered in response.	**1** Question is partially answered, but key aspects are unclear.	**2** Question is answered fully though it does so indirectly.	**3** Response fully and directly answers question as written.	**100% of entries scored 3**
	Does the entry contain errors or require clarification?	**0** Response contains errors or requires clarification		**1** Response does not contain errors or require clarification		**100% of entries scored 1**
Context	**Wordcount**	**Number**				**Min: 86** **Max: 591** **Mean: 185** **Std Dev: 108.35** **95%CI: 142.14, 227.86**
	SMOG Index (Simple Measure of Gobbledygook)	**Score** (Number of years of education one needs to understand the text; particularly useful for healthcare and longer passages)				**Min: 12.16** **Max: 18.77** **Mean: 15.28** **Std Dev: 1.75** **95%CI: 14.58, 15.97**
		0 Greater than grade 12	**1** Between grades 10 and 12	**2** Between grades 8 and 10	**3** Grade 8 or lower	**100% of entries scored 0**

Appendix C (Continued)

Criterion		Evaluation Criteria				Highlights of Results
Context	**Is the context relevant to the question and expert answer?**	**0** Context is not directly relevant to the question being asked.	**1** Context is related to the response, but links between the two are unclear.	**2** Supports the response, but information is redundant or overlaps with the primary response.	**3** Provides additional information to support the response; links between context and response are clear.	**0 entries scored 0 or 1** **7.4% (n=2) entries scored 2** **92.59% (n=25) entries scored 3**
	Does the entry contain errors or require clarification?	**0** Response contains errors or requires clarification		**1** Response does not contain errors or require clarification		**100% of entries scored 1**
Is the extra information (in context or answer) relevant to the question, and does it support the implications presented in the response?		**0** Additional information provided is confusing, not related to, or does not support or add to the key response message(s).	**1** Additional information *is related to* the key response message(s), but the link is somewhat unclear.	**2** Additional information *supports* the key response message(s), but information provided is redundant or overly long.	**3** Additional information supports the key response message(s) and is important to understand the full implications of the response.	**0 entries scored 0** **3.7% (n=1) of entries scored 1** **18.5% (n=5) of entries scored 2** **77.8% (n=21) of entries scored 3**
Does the material use bulleted or numbered lists when a list of more than 7 items is included?* **CORE**		Not applicable	**0** No	**1** Yes, bullets are used for a list of more than 7 items.		**Most entries (n=25) were N/A** **100% (n=2) entries with lists of 7 or more items scored 0** **No entries scored 1**

Appendix C (Continued)

Criterion	Evaluation Criteria				Highlights of Results
Does the material always use words the primary audience uses?* **CORE**	**0** No		**1** Yes, specialized words are described and abbreviations are spelled out and explained.		**92.6% (n=25) of entries scored 0** **7.4% (n=2) entries scored 1**
Communication Addresses Quality of Evidence **Does the material explain what authoritative sources, such as subject matter experts and agency spokespersons, know and don't know about the topic?*** **CORE**	**0** Response does not address the quality of evidence (e.g., preprint study, study size, national/international recommendation) or does not do so adequately.		**1** Quality of evidence (e.g., preprint study, study size, national/international recommendation) is included in the response.		**25.9% (n=7) of entries scored 0** **74.1% (n=20) of entries scored 1**
Does the entry address the quality of information provided and the current state of the scientific process?	**0** Response does not address the scientific update process (e.g., ongoing research) or does not do so adequately.		**1** The scientific update process (e.g., ongoing research) is included in the response.		**18.5% (n=5) of entries scored 0** **81.5% (n=22) of entries scored 1**
Are glossary terms used and linked in the response and context?	**0** Links to glossary terms are missing for >3 uncommon or atypical words.	**1** Links to glossary terms are missing for 3 uncommon or atypical words.	**2** Links to glossary terms are missing for 1-2 uncommon or atypical words.	**3** All challenging, atypical, or uncommon words are linked to glossary terms.	**81.5% (n=22) of entries scored 0** **11.1% (n=3) of entries scored 1** **0 entries scored 2** **7.4% (n=2) of entries scored 3**
Is generalizability addressed in the response?	**0** Generalizability of content to other regions, communities, or ethnic groups is not addressed or mentioned.		**1** Response discusses generalizability of content to other regions, communities, or ethnic groups.		**29.6% (n=8) of entries scored 0** **70.4% (n=19) of entries scored 1**

Appendix C (Continued)

Criterion	Evaluation Criteria			Highlights of Results
Does the material explain the nature of the risk?* **RISK**	Not applicable	**0** No, entry includes threat or harm, but does not explain risk.	**1** Yes, entry includes the stated threat or harm and how and why people may be affected.	**Multiple (n=8) entries were N/A** **Of those scored… 15.8% (n=3) of entries scored 0** **84.2% (n=16) of entries scored 1**
Does the material address both the risks and benefits of the recommended behaviors?* **RISK**	Not applicable	**0** No, entry includes only risks or benefits.	**1** Yes, entry includes both risks and benefits.	**Many (n=13) entries were N/A** **Of those scored… 28.6% (n=4) of entries scored 0** **71.5% (n=10) of entries scored 1**
If the material uses numeric probability to describe risk, is the probability also explained with words or a visual?* *Examples of probability information in a risk message are numbers (such as 1 in 5 or 20%).* **RISK**	Not applicable	**0** No, entry includes numerical risk, but does not explain risk.	**1** Yes, entry includes and explains numerical/probability of risk..	**Many (n=25) entries were N/A** **Of those scored… No entries scored 0** **100% (n=2) of entries scored 1**
Does the material always present numbers the primary audience uses?* **NUMBERS**	Not applicable	**0** No, entry uses fractions, decimals, or numbers are unnecessary in the text.	**1** Yes, uses whole numbers and numbers are needed to support the message.	**Many (n=18) entries were N/A** **Of those scored… 11.1% (n=1) of entries scored 0** **88.9% (n=8) of entries scored 1**

Appendix C (Continued)

<table>
<tr><th>Criterion</th><th colspan="3">Evaluation Criteria</th><th>Highlights of Results</th></tr>
<tr><td>Does the material always explain what the numbers mean?*

For example, “The amount of meat recommended as part of a healthy meal is 3 to 4 ounces – it will look about the same size as a deck of cards.”

NUMBERS</td><td>Not applicable</td><td>0
No, numbers are not explained in the text.</td><td>1
Yes, numbers, when included, are explained.</td><td>Many (n=23) entries were N/A

Of those scored…
25% (n=1) of entries scored 0

75% (n=3) of entries scored 1</td></tr>
<tr><td>Does the audience have to conduct mathematical calculations?*

Adding, subtracting, multiplying, and dividing involve calculations.

NUMBERS</td><td>Not applicable</td><td>0
Yes</td><td>1
No, calculations are not included.</td><td>Many (n=23) entries were N/A

Of those scored…
No entries scored 0

100% (n=4) of entries scored 1</td></tr>
<tr><td>Final Score</td><td colspan="3">Similar to the CDC Clear Communication Index, scoring can be completed as follows:
Total points from expert answer: _______ (11 possible points)
Total points from context: ________ (7 possible points)
Total points from INFO/CORE/GENERALIZE:
(10-11 points depending upon if N/A is applied)
Total points from RISK: ________ (0-3 depending upon if N/A is applied)
Total points from NUMBERS: ________ (0-3 depending upon if N/A is applied)

Total points earned / total possible points x 100 = final score
● 90 or > is likely accessible for many groups though the accessibility should be viewed together with the readability score. The target readability score is < grade 8.
● 89 or < could be improved. Review areas with low scores (0 in particular) for revision. Accessibility should be viewed together with the readability score. The target readability score is < grade 8.</td><td>Min: 46
Max: 73
Mean: 58.26
Std Dev: 6.24
95%CI: 55.78, 60.72

Distribution:
<table><tr><th>Final score</th><th>Number of entries</th></tr><tr><td><50</td><td>2</td></tr><tr><td>50-60</td><td>8</td></tr><tr><td>60-70</td><td>16</td></tr><tr><td>>70</td><td>1</td></tr></table></td></tr>
</table>

Appendix D: Qualitative Interview Guide for Database Partners

Name, Organization Type, Organization Name, Role
Personal description of work; goals of work

Health background

- When would you need to perform a health-related fact-check?
- What kind of content are you looking for? What is most helpful?

Are the assumptions that have informed the creation of the COVID-19 Expert Database Project accurate?

- For each of the following, I am going to ask the question "How much do you agree with the following statement?" and I will ask you to rate the statement between 1 and 5 (1/low = not at all, 5 = completely agree). Following that rating, I will then ask you to rate the statement again based on your level of agreement before the pandemic began.

  Key assumptions (for ratings):
  1. Journalists/fact-checkers care about health misinformation and accurate health communications.
  2. Journalists/fact-checkers will be receptive to improving health messaging.
  3. Fact-checking or media organizations want to build health capacity.
  4. In the media, there is a capacity to accommodate the newest health information to ensure relevance and accuracy.

- How has the COVID-19 pandemic changed your fact-checking process?
- What do you find is the most difficult aspect of the pandemic to report on?

(Partners who use Check): What are the structures, adaptations, and processes through which the COVID-19 Expert Database Project has been delivered? *This question is largely related to operational, funding, pandemic communications, prioritization globally - less about partners though exploring the link to other Meedan products may be helpful.*

- How has using the COVID-19 Database and Check together influenced your work and workflows?

Is the COVID-19 Expert Database Project delivering high-quality content that is accessible to global partners?

- How many times have you used the COVID-19 Expert Database since it started in June?
- Do you trust the content in the database?
  - Why/why not?
  - What would increase your trust in the database content?
- What would have influenced you to use it more often?
- How well do you feel that you are able to understand the content provided to you?
- Our current target response time is within 48 hours; does this target meet your needs? Why/why not?
- What language is your work conducted in? Would translation of the COVID-19 DB content be helpful to you? How would it impact your work?

How have participants (partners) interacted with database content? How has the COVID-19 Expert Database Project influenced partners fact-checking processes?

- Can you tell me about your full fact-checking process from identifying content to performing a fact-check through publication?
- How does the COVID-19 Expert Database fit into your regular fact-checking workflow?
- How do you access database content for your work?
  - Do you submit questions?
  - Search the website for content?
    - If so, how do you decide whether or not to use the content you find?
- Are there other tools or resources that you regularly use to perform your work?
  - What are some advantages and disadvantages to each?
  - Would it be possible to have only one tool or resource? Why/why not?

Has the DHL thought leadership (via publications, panels, conferences) influenced partners' use of the COVID-19 Expert Database?

- Are you aware that Meedan has sponsored and led misinformation-related publications, panels, or conferences?
  - Have you read, participated, or attended any Meedan-sponsored misinformation-related publications, panels, or conferences? (Examples)
  - How has your participation or this information influenced your fact-checking processes?
  - Has that changed or influenced if/how you use the COVID-19 Expert Database?
- Are there tools, supports, education that Meedan could provide to support your health-related fact-checking work?

Additional Questions:

- How would you rate the usefulness of the COVID-19 Expert Database overall? (Rating 1-5, low = not very helpful, 5 = very helpful)
- How likely are you to recommend the COVID-19 Expert Database to a colleague? (Rating 1-5, low = not very likely, 5 = very likely)
- How could the database better support your work? Why?
  - Examples include content, quality, user experience.
  - What would you like more of/less of?

Appendix E: Mean SMOG Index scores and mean Clear Communications Assessment scores across thematic categories

	Mean SMOG Index Score	Mean Clear Communications Assessment Score
Testing	13.50	53.5
Masks	13.90	59
Infection	14.32	53.5
Risk	14.36	61
Diagnosis	14.44	62
Prevention	14.49	61
Spread	15.04	58.5
Treatment	15.34	50
Nutrition	15.91	59.5
Other	15.92	57
Vaccines	16.21	61
Statistics	18.24	53