“A matter of time”: Evidence-making temporalities of vaccine development in the COVID-19 media landscape

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Abstract
This article investigates how evidence of the safety and efficacy of COVID-19 vaccines is enacted in news media via a focus on the temporality of vaccine development. We argue that time constitutes a crucial object of and mechanism for knowledge production in such media and investigate how time comes to matter in vaccine evidence-making communication practices. In science communication on vaccine development, the vaccine object (along with the practices through which it is produced) undergoes a material-discursive shift from an imagined “rushed” product to being many years in the making and uninhibited by unnecessarily lengthy processes. In both these enactments of vaccine development, time itself is constituted as evidence of vaccine efficacy and safety. This article traces how time (performed as both calendar time and as a series of relational events) is materialized as an affective and epistemic object of evidence within public science communication by analyzing the material-discursive

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techniques through which temporality is enacted within news media focused on the timeline of COVID-19 vaccine development. We contend that time (as evidence) is remade through these techniques as an ontopolitical concern within the COVID-19 vaccine assemblage. We furthermore argue that science communication itself is an important actor in the hinterland of public health practices with performative effects and vital evidence-making capacities.

**Keywords**
Temporality, evidence-making, COVID-19, vaccine hesitancy, science communication, media

**Introduction**

The COVID-19 pandemic has made time hyper-visible: in public health strategies (e.g. slowing the spread of the virus); in its connections with distant pasts (e.g. the 1918 influenza pandemic) and uncertain futures (e.g. what a post-pandemic world might look like); and in its affective dimensions (e.g. the experience of timelessness during lockdown) (Kunisch et al., 2021). When narrativized in storytelling, structures of time, where events in the past are linked to anticipatory futures, become a powerful tool of meaning-making (Dawson and Sykes, 2019). This article explores the performative effects of this storytelling in the particular context of the COVID-19 pandemic in relation to the roll-out of vaccines. Specifically, it investigates what news media stories’ enactments of time can do in public health assemblages. Beyond its meaning-making capacities, we trace how time is materialized as an affective and epistemic object of evidence within public science communication, constituted as evidence of vaccine efficacy and safety.

The pandemic has highlighted the crucial role of news media in communicating rapidly changing information during an unfolding public health crisis (Lancaster et al., 2020; Rhodes et al., 2020). Information about COVID-19 vaccines has become increasingly central to news reporting in this space and with it has come a renewed media focus on the problem of vaccine hesitancy across various global contexts (Cookson, 2021; Ratzan et al., 2020; Wernau and Overberg, 2021). These discussions have evolved in the early part of 2021 to center around more specific public vaccine concerns, such as those related to recent possible links between the AstraZeneca COVID-19 vaccine and blood clots (e.g. Ellyatt, 2021), and how science communication can address such concerns. Research into COVID-19 vaccine hesitancy has highlighted the speed of vaccine development as a prominent and recurring public concern (World Health Organization, 2020; Zizzo, 2020), and public perception of the speed of vaccine development as “too fast” has also been reflected in news media (Carey, 2020; Davis, 2020; Dvorak and Pietro, 2020). Such concerns rely on a comparison against an imagined “normal” vaccine development time, which is often characterized as taking up to 10 years (Toshner,
Through this comparison, the development and approval timeline of COVID-19 vaccines is deemed to be unacceptably fast. This enactment (Law, 2004; Mol, 2002) of COVID-19 vaccine development as “rushed” is compounded in mRNA COVID-19 vaccines (e.g. the Pfizer/BioNTech vaccine) due to perceptions of mRNA vaccine technologies as “new” (Carlson et al., 2021). Unlike other new vaccine platforms such as viral vector vaccines (e.g. the AstraZeneca vaccine), which had previously been used with Ebola, mRNA vaccines had not been approved for use in commercial vaccines prior to the COVID-19 pandemic (Abbasi, 2020:125–126; Van Riel and De Wit, 2020). It is also worth noting that the 5-year period between Phase 1 trials and approval of the Ebola vaccine was previously considered to be “much faster than […] typical,” despite being several years longer than that of mRNA COVID-19 vaccines (Wolf et al., 2020:1). The “rushed” mRNA vaccine object is thus enacted twofold within vaccine news media, as both vaccine product and vaccine platform have been developed and approved in a seemingly unprecedented amount of time.

The cases we have assembled in this article investigate the material-discursive techniques through which time is remade as evidence of vaccine safety and efficacy within COVID-19 vaccine news media. These news media are normatively categorized as a type of science communication, where scientific news and information is translated (under an evidence-based intervention paradigm) to public (non-expert) audiences by scientists, journalists, and other writers. We argue that this specific form of science communication plays an important role not only in how information travels about the vaccines, but also in how knowledge—and evidence itself—comes into being. That is, how evidence is not only translated but made and transformed (Rhodes and Lancaster, 2019).

To investigate how evidence is made in science communication, we conduct a close textual analysis of two cases assembling a sample of news media published in late 2020 focused on the speed of COVID-19 vaccine development. In analyzing these cases, we argue that evidence supporting the safety and efficacy of COVID-19 vaccines is not simply referenced and leveraged by journalists but is made within the science communication itself (Rhodes and Lancaster, 2019). Furthermore, given that the problem being addressed in such news media is whether or not COVID-19 vaccine development has been “rushed,” it is not only the scientific research itself that constitutes the relevant evidence for safety and efficacy but the relational temporality between COVID-19 vaccines and other vaccines that are popularly understood to have taken an acceptable time to develop. That is, time is made as evidence. Moreover, time is made as evidence through the affective engagements of audiences with familiar temporalities of technoscientific progress. The effects of this science communication are messy and diffuse and are one of the many elements that constitute the vaccine assemblage. In positing this argument, we seek to emphasize both time and evidence as ontopolitical concerns in the complex and unfolding COVID-19 vaccine situation.
Time and the storying of vaccine development

Within news media stories focused on the speed of vaccine production, time functions as both an ostensibly objective metric used to compare different vaccine timelines and as an affect-charged feature of storytelling that enables audiences to form an emotional relationship to the vaccine object. We contend that time is not a fixed phenomenon that is experienced equally by all (Puig de la Bellacasa, 2015); instead, time is made, and it is further made differently through the practices, contexts, and feelings of different people(s). The present and future are thus mutually implicated, with the future being performed in the present (Adam, 2013; Michael, 2017). Within a technoscientific imagining of futurity, the now does not simply precede the events of the future; instead, it advances towards the future in a progressive, linear fashion by innovations in the present (Lancaster and Rhodes, 2020; Puig de la Bellacasa, 2015, 2017). The uncertainty of the future is tamed through a trajectory of linear progress. Here, a singular future (where problems are solved by technological advancements) is set against a singular past (where these soon-to-be-solved problems exist) (Michael, 2017: 22). However, in the context of COVID-19, where the post-COVID-19 world of a vaccinated global population is publicly understood as unstable and potentially produced through risky and “rushed” processes in the present, we argue that the past must play a different role in science communication. No longer is the past a place where knowledge and resources are lacking; instead, the past is remade as a site of existing knowledge production and already-tested technologies.

Of particular importance to our investigation is the performance of alternative temporalities in news media advocating for the safety and efficacy of COVID-19 vaccines via a focus on the vaccine development process. Within these alternative temporalities, time is remade as longer or shorter through a variety of material-discursive techniques. Time here is enacted in two different ways: linear calendar time (similar to “clock-time”) (Davies, 1994; Reinecke and Ansari, 2016), which is divided into standardized units such as weeks, months, or years; and time materialized via a series of events (Latour, 1999), where the calendar time within and between each event is variable. Each of these enactments generates affect and is enacted through their relationships with familiar narratives of technoscientific progress. These dual enactments of time have vital implications for how time is understood as mattering in a vaccine development context.

Approach and methods

We assemble two qualitative case studies investigating the performance of alternative temporalities in news media focused on the timeline of vaccine development. In assembling these cases, we recognize that our selection of media is itself a mode of evidence-making; if, as we argue, a particular reality of time (as
evidence) is enacted within the news media, so too does our case assemblage enact the particular boundaries and realities of evidence-making to which our analysis attends. We follow John Law’s description of “method assemblage” as “the process of enacting or crafting bundles of ramifying relations that condense presence and (therefore also) generate absence by shaping, mediating and separating these” (Law, 2004: 122). In doing so, we note that these media assemblages are not external objects awaiting analysis, but are instead relationally constituted, both through their emergence in the context of a particular moment in the pandemic and through the assembling work.

The news media selected for these two cases represent only a small sample of science communication from a moment within the COVID-19 landscape. Yet our analysis of these cases testifies to the broader affordances of science communication as an evidence-making actor in public health assemblages. We are interested not only in how these two cases present the COVID-19 vaccines and the story of vaccine development, but also in their constitutive effects and performative capacities as material artifacts in the vaccine assemblage. In this way, our assemblage of these cases is itself a kind of story-making. In analyzing these cases within a framework of evidence-making temporalities, we attend to how time itself is made as evidence through and within the media texts.

Our first case study analyses a selection of news media from late 2020 reporting on mRNA vaccine technologies with a central focus on biochemist Katalin Karikó. Karikó’s decades of research into mRNA and its potential in vaccine and health technologies has become a focal point for news media seeking to provide a history of how the Pfizer/BioNTech and Moderna vaccines have been both developed and approved as safe and effective health interventions in the COVID-19 pandemic (Johnson, 2020; Kennedy, 2020; Kollewe, 2020; Newey and Nuki, 2020). Rather than focusing on recent trials, approval processes, or policy implementations in the 2020 context, these accounts of Karikó’s work instead present a story spanning several decades to offer an alternative narrative of vaccine development to those which have characterized the process as potentially “rushed.” In doing so, these news media stretch the timeline of vaccine development from less than a year to decades long. In telling Karikó’s story, these news media furthermore identify problems that have already been overcome in Karikó’s research into mRNA (e.g. rejected funding applications, immune responses to the injection of mRNA). Through this, the focus on potential “bad” outcomes of mRNA research undergoes a shift from being situated in the future to having already occurred (and resolved) in the past. This temporal adjustment in focus recontextualizes potential problems associated with the vaccine to being largely already-solved.

To investigate the material-discursive techniques through which this temporal adjustment is achieved, we conduct a close textual analysis of four examples of news media from major outlets released over a 2-week period in November and
December 2020: The Telegraph (Newey and Nuki, 2020), The Guardian (Kollewe, 2020), The Washington Post (Johnson, 2020), and The New York Post (Kennedy, 2020). These outlets are highly popular sources of news and their typical contents present a range in tone (i.e. sensational journalism versus broadsheet or “quality” journalism) and political leaning. Together, these presses reach a cross-section of UK and US society—two countries that are at the center of the pandemic outbreak and hence are key sites of vaccine implementation at the time of writing. Each example of news media tells a similar story—that is, the story of Katalin Karikó’s research into mRNA vaccine technologies—and through this storytelling a particular history of the Pfizer/BioNTech and Moderna vaccine emerges. In exploring these stories, we investigate how time is remade as evidence through the storytelling of Karikó’s research and how time functions as a source of anxiety or security in relation to the perceived safety and efficacy of vaccine development.

Our second case study moves away from a focus on narrative storytelling to instead investigate how “normal” vaccine timelines become figured as an important point of comparison in news media about COVID-19 vaccine development. In such media, a “normal” timeline of vaccine development (often imagined to be 10 years long) is recontextualized as a series of primarily administrative and bureaucratic processes. These processes are then delegitimized as not counting as the real time of vaccine development. To explore the techniques through which this taxonomy of processes is produced, we analyze four examples of news media published in late November and early December 2020. These are published by The Guardian (Davis, 2020), news.com.au (Carey, 2020), The Conversation (Toshner, 2020), and NPR (Langfitt, 2020). While The Guardian and news.com.au are both major media news outlets, with typical political biases leaning left and right of center (respectively), The Conversation and NPR are not-for-profit media outlets which (when reporting news) typically focus on translating rigorous, expert-led information to public audiences. These four outlets represent a sample of the kinds of sources a non-expert person might seek out when looking for reliable and easy-to-understand information on a current issue.

Rather than producing a narrative storytelling genre of writing, these news media are educational in tone and focused on explicitly addressing public concerns about the development (and therefore safety and efficacy) of the COVID-19 vaccines. A core concern of each of these media narratives is the speed of vaccine development and why time that is quantified in weeks, months, or years is an imperfect measure of the work of vaccine development. In recontextualizing vaccine development as a pattern of events, these news media map “normal” vaccine development timelines against the COVID-19 vaccine development timeline, and through this mapping a new pattern of time emerges. This pattern identifies specific events, rather than time quantified as calendar time, as most important in making the time of vaccine development. Within this
imagining, particular events are included or excluded as constituting the “real” vaccine development timeline.

Our analysis of these two case studies is framed by an “evidence-making intervention” (EMI) approach (Rhodes and Lancaster, 2019: 1). This challenges the dominant “evidence-based intervention” approaches in health and medicine (Rhodes and Lancaster, 2019: 1). Within the latter approach, evidence tends to be assumed to be objective, stable, and located external to the contexts and practices through which it comes to be known. Under this paradigm, health interventions must be enacted as “evidence-based” in order to have authority and legitimacy. In contrast, an EMI approach recognizes evidence as being “in-the-making” and co-constituted with the practices it ostensibly informs (Rhodes and Lancaster, 2019: 1). Here then, the production of evidence can be understood as performative, as the methods of evidence-making simultaneously enact the realities they describe (Law, 2009: 240). As Rhodes and Lancaster (2019: 1) write:

An EMI approach invites a critical shift away from thinking with evidence primarily as a matter of epistemology – the different ways interventions can be known – towards thinking with evidence as a matter of ontology – how interventions are performed, and thus come into being, through knowledge-making practices. […] an EMI approach challenges presumptions of separation between the material and social, nature and culture, and evidence and practice, which dominate mainstream EBI paradigms, instead proposing these as entangled and performative.

Within such an approach, time (where, as we will argue, time is made as evidence) must be understood as relational, performative, and in a process of becoming. Time operates as an object that is relationally entangled with other human and non-human actors within the evidence-making apparatus of the COVID-19 vaccine. Instead of time being a stable measurement of practices and events, within which humans make and objects are made, time is performed through the (re)production of such practices, events, humans, and non-human objects. Time and the material object of the COVID-19 vaccine are thus mutually implicated, as the practices of vaccine development both enact and are bound by time. Furthermore, when other vaccine objects are assembled in science communication of the COVID-19 vaccine, the capacities of these objects are shown to be similarly entangled; the relational ontology of COVID and non-COVID vaccines reveals that the safety and efficacy of the COVID-19 vaccine can only be understood when situated within multiple, reticulating, and intra-acting timelines of vaccine development.

Within these timelines, material-discursive cuts (Barad, 2007) are made to articulate the boundaries between what does and does not constitute vaccine development. Through this process, events become legitimized or delegitimized as part of the work of vaccine production, which in turn enacts alternative
temporalities of vaccine development. The reality of the vaccine development timeline is thus performed via specific material-discursive practices that produce affective and epistemic claims to knowing. This challenges the normative assumption that science communication is speaking to “ignorant” publics who may be moved to adopt particular health behaviors if evidence of the efficacy of such behaviors (which is presumed to be located external to the communication) is “translated” to them. Instead, we argue, the evidence-(time)-making of vaccine safety and efficacy is located within the communication itself. News media presenting such stories are therefore not simply accounts of relevant histories but sites of knowledge- and reality-making within a broader hinterland of evidence-making practices.

(Re)telling the history of mRNA vaccine technologies

This case study investigates two key alternative temporalities of vaccine development that emerge and entangle in news media detailing Katalin Karikó’s research into mRNA. The first is produced through the use of historically significant dates that have ostensibly led to the present-day development of the Pfizer/BioNTech and Moderna vaccines. These dates span from 1961 to 2013 and include personal and professional events in Katalin Karikó’s history (e.g. Karikó moving to the US after losing her job studying mRNA in Hungary), key moments of problem-solving in mRNA research (e.g. Karikó and co-researcher Drew Weissman working to overcome an inflammatory response produced through the injection of mRNA), the publication of important research (Karikó et al., 2005), and Karikó’s subsequent job offers from the leading implementers of mRNA vaccine technologies in COVID-19 vaccines (Moderna and BioNTech).

As we will argue, these events are significant for two reasons. First, they establish and orient the reader towards an alternative timeline of progressive vaccine development beginning decades prior to the COVID-19 pandemic. For example, where the first human dosing in BioNTech’s Phase 1/2 clinical trial in April 2020 (Pfizer, 2020) might be conventionally performed in science communication as a medical event in the early stages of the history of COVID-19 vaccine development, this event is instead re-oriented in relation to a much longer history of technological developments and significant medical events. When situated within a timeline of all mRNA research, the history of the Pfizer/BioNTech and Moderna COVID-19 vaccines might, for example, instead begin in 1978 when Katalin Karikó began researching mRNA in Hungary (Newey and Nuki, 2020) or in 1961 with the discovery of mRNA (Johnson, 2020). This alternative timeline enacts a security in vaccine efficacy and safety through its performance of already-produced knowledge (i.e. these technologies are not new, but rather many decades in the making).
The second reason these events are significant is that they highlight important moments of failure and success in Karikó’s story and connect Karikó’s professional success with her personal life; as we argue later, events such as Karikó moving to the US from Hungary cannot be isolated as purely professional moments within a career as they are necessarily entangled with the failure of losing a job, the fear from fleeing one’s home (and the corresponding financial insecurity), and the emotional ties to Karikó’s husband and infant daughter who moved with her. These actors and affects in Karikó’s story assemble to produce a second alternative temporality of vaccine development through the affective telling of stories. Rather than mobilizing dates and years as a measure of passing time, this second temporality emerges in the narrative structure of Karikó’s story, which parallels the familiar emotional arc of hegemonic narratives of technoscientific success (historical and fictional): Karikó’s story begins with her losing her job and receiving little recognition or funding for her work and ends with her research being globally recognized as fundamental to the development of some of the leading COVID-19 vaccines. In taking readers through this emotionally charged arc of technoscientific success, the shifting and stretching of the vaccine development timeline to encompass “enough” time-passed is not simply known in a rational sense—it is felt.

These temporalities entangle to remake time as an affective and epistemic object that dynamically constitutes evidence of vaccine safety and efficacy now. In this way, the hesitancy ordinarily produced by the uncertainty of new discoveries and unknown futures is offset against the certainty that these discoveries are not new, but several decades in the making. The “unknown future” that follows new developments within progressive technoscientific narratives thus becomes a known present, as the future performed in such narratives is understood (felt, known) to be happening in the now. Together these performances work to remake time as evidence itself.

Each of the examples of news media selected in this case study present the same core information. A significant portion of each story is dedicated entirely to Karikó’s history of working on mRNA. This includes notable dates, descriptions of obstacles faced, key collaborators, and sometimes more personal details relating to Karikó’s family. Each story presents Karikó’s work as previously underappreciated and each author suggests that Karikó might one day receive a Nobel Prize for her work. All of the media examples except for The New York Post also include a brief explanation of mRNA and its relationship to COVID-19 vaccines using simple language and minimal scientific jargon. The Washington Post, for example, presents the following description of mRNA:

Since 1961, scientists had known about messenger RNA, the transient genetic material that makes life possible, taking the instructions inscribed in DNA and delivering those to the protein-making parts of the cell. Messenger RNA is
a powerful, if fickle, component of life’s building blocks — a workhorse of the cell that is also truly just a messenger, unstable and prone to degrade. (Johnson, 2020)

This presents mRNA vaccines as a powerful yet non-threatening technology (mRNA is “truly just a messenger”) that has been researched for decades. Through this simple and reassuring language, a particular kind of public is enacted—one with minimal expert knowledge of vaccine technologies and who is receptive to the argument that COVID-19 vaccines using mRNA technologies are safe and effective (though they may be unconvinced that this is true yet).

The use of specific dates in this case study constitutes an important part of the storytelling. Time is remade as evidence through the stretching of calendar time to encompass a chronology of events leading up to the implementation of mRNA vaccine technologies in COVID-19 vaccinations. The New York Post and The Washington Post both begin their timelines at the earliest date: in 1961 with the discovery of mRNA itself. The Telegraph and The New York Post mark 1978 as the beginning of Karikó’s research in mRNA in Hungary, which Kennedy (2020) describes as the beginning of “40 years of research into synthetic messenger RNA.” The authors note other important dates over the next two decades: Karikó joins Temple University in Philadelphia in 1985 after being fired from her previous job studying mRNA at Szeged Biological Research Centre; she then joins the University of Pennsylvania in 1990 where she spends years unsuccessfully applying for funding for mRNA research but also first sees evidence “that mRNA worked” (Kollewe, 2020); in 1998 she meets HIV researcher Drew Weissman who eventually becomes her collaborator; in 2004 Karikó and Weissman discover a way to prevent an inflammatory response from mRNA injection and publish their findings in 2005; in 2010, Derrick Rossi (a stem cell biologist familiar with Karikó and Weissman’s work) becomes a co-founder of Moderna; and in 2013 Karikó joins BioNTech after receiving job offers from both BioNTech and Moderna.

Through this history telling, a linear, progressive timeline of mRNA vaccine development emerges that in some versions is 60 years long. While all the events listed above are implicitly linked to the Pfizer/BioNTech and Moderna vaccines, particular events invariably emerge as especially significant milestones in the vaccine development, such as Karikó and Weissman’s 2005 paper (Karikó et al., 2005), which The Telegraph argues “paved the way not just for the coronavirus vaccine developed by BioNTech […] but the candidate from American firm Moderna” (Newey and Nuki, 2020). Within this framing, Karikó and Weissman’s earlier work is imagined as leading directly to the development of a COVID-19 vaccine. Through this imagining, a linear model of time once again emerges that maps into hegemonic technoscientific narratives of progress.
The use of dates detailed above directly feeds into the prominent public narrative that vaccines should take many years to develop. As The Washington Post writes:

Vaccine development typically takes years, even decades. The progress of the last 11 months shifts the paradigm for what’s possible, creating a new model for vaccine development and a toolset for a world that will have to fight more never-before-seen viruses in years to come. But the pandemic wasn’t a sudden eureka moment — it was a catalyst that helped ignite lines of research that had been moving forward for years, far outside the spotlight of a global crisis. (Johnson, 2020)

The message here is simple: yes, other vaccines take many years to develop, but so did these ones. The labor of science in the making, which often becomes obscured or erased in the celebration of great discoveries (the “eureka moment”) within historical reconstructions of technoscientific development (Latour and Woolgar, 2013), here plays a strategic role in making up the time of vaccine development. Yet specific instances of labor are not as important within such history retellings as their collective existence—an existence which, in making up many years of research, invokes a different kind of legitimacy. This rhetorical shift away from the “eureka moment” suggests that the “evidence-enough” (Lancaster et al., 2020) of vaccine safety and efficacy of most importance to this case study is not the result of studies and trials or even expert opinion—it is time itself. Thus, time becomes the primary object of scientific inquiry and its measurement becomes a core technique of the evidence-making.

Of course, time is not the only object of inquiry within news media addressing the vaccine development timeline—indeed, the material-discursive techniques explored throughout this article exist within a broader hinterland of stabilizing practices through which scientific evidence is ontologically produced (Law, 2004). In focusing on the specific problem of time, however, we argue that temporality (and the remaking of time) is necessarily implicated in the broader evidence-making of vaccine safety and efficacy for public audiences of science communication. Within this framework, evidence-making involves the performance of temporalities, where historical events are made significant or insignificant and folded in or excluded as necessary. In this way, evidence is made through and within the science writing itself. Rather than evidence “waiting” as an external object to be recognized and cited in the implementation of health policies, the evidence (time) is relational and is performed through its own communication (Lancaster, 2016; Law, 2009; Rhodes and Lancaster, 2019).

Other dates outside of Karikó’s research also assemble within public history tellings of vaccine development to suggest a long and careful process of vaccine research. Like Karikó and Weissman’s publication in 2005, these dates mark moments of successful problem solving, once again shifting the linear narrative of
scientific progress in which the past holds problems to be solved in the future. In these accounts, problems emerge as being already-solved in the past. Take for example the development of the spike protein used in the Pfizer/BioNTech and Moderna COVID-19 vaccines and in particular the work of scientist Barney Graham. According to The Washington Post, following the 2003 SARS outbreak and then the 2012 MERS outbreak, Graham noticed that new coronaviruses seemed to come around every decade and thus began work preparing for the next one (Johnson, 2020). When a colleague returned to the US infected with a significantly less deadly coronavirus, Graham and his colleagues used the opportunity to begin researching how to stabilize spike proteins in coronaviruses broadly. The Washington Post describes the “painstaking process” of “trying hundreds of genetic mutations” before success was achieved, and then, the five journal rejections that took place before the findings were published in 2017 (Johnson, 2020).

The Washington Post argues that because of this previous work, when the threat of COVID-19 gained global recognition vaccine development could begin immediately. As Johnson (2020) writes: “The company could start making the vaccine almost right away because of its experience manufacturing experimental cancer vaccines, which involves taking tumor samples and developing personalized vaccines in 45 days.” Through this framing, the long work of problem-solving embedded in narratives of scientific progress (and therefore assumed to be involved in vaccine development) becomes situated as prior to the event of COVID-19’s discovery. Thus, vaccine research can be reimagined as the implementation of already-developed technologies. Again, this reimagining is key to the evidence-making apparatus of science communication. Rather than communicating external evidence to audiences, stories of scientific problem-solving and discovery assemble within the science communication, and through this assemblage, new temporalities of vaccine development emerge. These stories are thus transformed from accounts of scientific events into a performative re-making of time, where time is both measured by and reveals/enacts the boundaries of a timeline of vaccine development.

The emotionality of these stories of vaccine development, and in particular Karikó’s personal story, is entangled with stories of vaccine success in 2020. Karikó is centered within each story as a central character who is not only competent but likable. The New York Post, for example, opens with the following description of Karikó:

Half an hour outside Philadelphia, in a modest suburban home, lives a quirky, cheerful 65-year-old scientist who’s a big part of the reason people might be able to throw away their masks next year. The pioneering Dr. Katalin Kariko — who fled Communist-run Hungary at 30 for the US in 1985 with $1,200 hidden inside her 2-year-old daughter’s teddy bear — isn’t as powerful or rich as Moderna’s Stéphane
Karikó is transformed from being a figure within a story of technoscientific success to the underappreciated hero of that story. She is described as a “workaholic […] who rises at 5 a.m. every day and still has a lab in her basement,” the survivor of a cancer scare, and the proud mother of “a two-time Olympic gold medalist in rowing” (Kennedy, 2020). These details make for an entertaining story, but they are also dynamic components that come together in the vaccine assemblage. Karikó’s modest home, basement laboratory, infant daughter’s teddy bear, now-grown athlete daughter, and experience with cancer make affective and formative connections with moments of professional failure and triumph, as well as the final object of the vaccine itself.

These actors and affects entangle within these stories to produce affective investments in the reality of the vaccine. The vaccine is not an independent object; it is both singular and multiple—the final product of decades of research and the assemblage of those decades and the people, emotions, and events that (co-)constitute them. Time becomes comprehensible through this assemblage via its emotional resemblance to the familiar pattern of a rising “rags to riches” story arc in fictional stories (i.e. the protagonist begins at their lowest point and then progresses towards a happy ending) (Reagan et al., 2016). This pattern also mirrors the arcs of popular Euro-American narratives of technoscientific progress and innovation. Karikó begins at her lowest point (being fired from her job and “flee[ing] Communist-run Hungary”) (Kennedy, 2020), faces early challenges, but achieves success through perseverance and collaboration. Her recent recognition of success (exemplified in the multiple suggestions that she should receive a Nobel Prize for her work) suggests that we have reached the end of her narrative arc. Given that Karikó’s personal arc is inextricably entangled with the technoscientific arc of mRNA research, this further produces the affective response that we have reached a similar end point in the narrative of vaccine development.

This entanglement of personal and technoscientific arcs as a mode of temporally constituted knowledge-making is especially important here due to the novelty of mRNA technologies. As noted earlier, these media stories are aimed at public, non-expert audiences who likely have little to no scientific knowledge in the area of vaccine technologies and may be particularly hesitant to accept mRNA-based vaccines due to their novelty. This concern is illustrated in the following paragraph in The Washington Post:

Messenger RNA has never been used in an approved medical product, an oft-repeated fact that has added to its mystique. There isn’t yet a long safety track record, but the platform has been in human tests for years, including in tens of thousands of
people in the coronavirus vaccine trials. Even before the coronavirus emerged, the
technology had reached a tipping point where it seemed a matter of time before it
would begin to have an impact on medicine. “It’s new to you,” [vaccine scientist
Deborah] Fuller said. “But for basic researchers, it’s been long enough. … Even
before covid, everyone was talking: RNA, RNA, RNA.” (Johnson, 2020)

Here, Johnson draws attention to a conceptual threshold between “non-evi-
dence” and “evidence.” Within the above understanding, mRNA vaccines may be
felt to be “new” and lacking “a long safety track record” by non-expert publics but
for those with expertise in the area, this technology is not new—it has “reached
a tipping point,” it has seemed “a matter of time,” and “it’s been long enough.”
The threshold of “enough” evidence is thus mutually constituted with an affective
sense of “enough” time-passed (with time in this case enacted via an alternative
temporality of calendar time).

These temporalities are multiple, affective, and relational (Sharma, 2014: 4). It
is through their intra-action (Barad, 2007) that the legitimation of particular
vaccine-making practices (and the temporality in which these practices are
implicated) emerges. Vaccine hesitancy is thus reframed as avalid response to
incomplete knowledge that may be assuaged in a presumed to be rational,
knowledge-seeking public through an understanding of the temporality of vaccine
development. The remaking of time as evidence within this case study still aligns
with an understanding of evidence as an existing external and knowable object, it
simply suggests that our relationship to this time needs to shift. Where the point of
“now” might be understood by non-expert publics as being situated at close to the
beginning of the technoscientific arc of vaccine development, when situated
within the longer narrative arc of Karikó’s struggle and eventual success with
mRNA research, the now instead emerges as sitting near the end.

This shifting of “now” further enables audiences to form a new relationship
with the future. Actions in the present are ordinarily understood as enacting
a future; new technologies and practices in the present can therefore produce
uncertainty in what the future may hold (Michael, 2017). However, in these
history tellings of past vaccine development, the inverse occurs. No longer is the
present oriented against an unknown and uncertain future; instead, the past is
oriented against the present. Security is thus produced via the remaking of the
present as the future of already-completed scientifci developments. A similar
affective shift takes place when it comes to desire for a future. An uncertain
biomedical future may prompt feelings of hope for desirable technoscientifc
eventualities (Brown, 2003; Michael, 2017). In reorienting the present as a future,
these feelings instead translate to trust in technoscientifc histories.

Interestingly, in reorienting the present as a future, the actions of the past are
retroactively afforded an impossible aim—that they were, in fact, building to-
wards the successful development of a COVID-19 vaccine. The authors of these
media accounts, of course, do not attempt to claim that scientists such as Karikó, Weissman, and Graham had any prior knowledge of the impending COVID-19 pandemic, yet within a narrative of scientific progress, this historical research is remade as always moving toward a particular future, even if that future was at the time unknown. Indeed, speculations of a future, flu-like pandemic, are presented as part of the rationale for the Graham’s research into the spike protein. Thus, the affect generated within these stories reassures readers that we are progressing forward along the familiar path of scientific development—and we are much further along that path than it may previously have seemed.

**Relationally constituted time in vaccine narratives**

Where the previous case study demonstrates how familiar narratives of technoscientific progress are referenced and mapped onto the COVID-19 vaccine to stretch the timeline of its development, our second case study pays closer attention to the relational ontology between the COVID-19 vaccine and other, non-COVID vaccines, and in doing so reveals how the timelines of non-COVID-19 vaccine development are compressed. This produces the effect that the COVID-19 vaccine should not be felt as “rushed” but prioritized and hyper-visible in relation to other vaccines before it. Unlike the storytelling genre of communication utilized in the history tellings of Katalin Karikó’s work, the sample of news media assembled in this second case instead takes a more explicitly educational tone. Some of the pieces are structured in a question-and-answer format, while others simply focus on “debunking” common misconceptions about the speed of vaccine development and its impact on safety. This moves the temporality of “normal” vaccine development away from a near-fetishized imaginary of scientific progress and instead situates it within a much more tedious landscape of approval processes and grant applications through which readers might disqualify particular practices from the narrative of vaccine development if they are not sufficiently felt to be part of the work of vaccine development. We argue that time is enacted through this affective relationship between audience and narrative as a dynamic apparatus which assembles events, people, processes, and power structures, as opposed to a simple measurement of months or years.

Rather than using narrative storytelling to stretch the timeline of mRNA vaccine development, an imagined “normal” timeline of vaccine development is remade within the science communication through making visible particular, often administrative practices. These practices are reframed as a navigation of bureaucratic systems and structures of power and are in turn de-legitimized as not truly making up the time of “normal” vaccine development. Through this process, a new timeline of “normal” vaccine development emerges. This “normal” timeline makes connections with the timeline of COVID-19 vaccine development in a progressive, but not necessarily linear fashion; instead, particular events (e.g.
participant recruitment, clinical trials, regulatory approval, and manufacturing) within multiple timelines of vaccine development intra-act in a reticulate pattern, where the calendar time between such events varies according to factors that become distinguished from practices relating to safety and efficacy. Within such an imagining, it is the events at the points of intersection, rather than the calendar time between such points, that makes up the true vaccine development timeline. Time is thus performed via a classification of which events legitimately constitute vaccine development and which are de-legitimized as wasted, bloated, or stalled time.

The news media assembled for this second case study all position the speed of COVID-19 vaccine development as a public concern. For example, The Guardian opens:

The emergence of vaccines against Covid-19 has been hailed as gamechanger by experts, but polls have revealed the speed of their development and approval is a matter of concern for some people. We take a look at how and why such processes were so rapid. (Davis, 2020)

These acknowledgments are paired with quotes by experts suggesting such fears are based on misconceptions of vaccine development. The Conversation and NPR take this a step further by fully centering the expert figure, with NPR directly presenting an (edited) interview with Dr Richard Hatchett (CEO of Coalition for Epidemic Preparedness Innovations) and The Conversation piece being written by Dr Mark Toshner (Director of Translational Biomedical Research, University of Cambridge).

The dichotomy between (misinformed) public opinion and reality presented throughout these media is demonstrated most clearly in the opening paragraph of The Conversation:

I’m a clinical trials geek. I keep hearing people talk about the seven to ten years it takes to make a vaccine and how dangerous speeding this up might be. The word that keeps popping up is “rushed”, and it is making the average person nervous about vaccine safety. So, as a clinical trials doctor, I am going to tell you what I do for most of those ten years – and it is not very much. (Toshner, 2020)

Presenting public concerns and ostensible realities in this format acknowledges the fears of the reader as understandable and common while leveraging “expertise” to reassure the reader that these fears are misguided. The particular audience enacted within these news media thus holds existing but incomplete knowledge of the vaccine process that might be strengthened through their consumption of science communication. Knowledge-making is thus constituted as a dynamic process where public understanding might be enriched through an
engagement with a particular kind of expertise. Within this framework, the reader is imagined as building a more nuanced understanding of a complex health problem through an interrogation of their own incomplete knowledge (rather than passively receiving the knowledge). This framework further cites the same familiar narratives of vaccine development investigated in the previous case study and through this citation the boundaries of audience vaccine literacy (as well as potential points of traversal) are enacted.

One of the key popular understandings of vaccine development re-contextualized within this case study is the figure of “seven to ten years” as a “normal” timeline of vaccine development. Within such understandings, “normal” vaccine development timelines are imagined as a monolithic control group against which COVID-19 vaccines might be compared. Within the science communication analyzed in this case study, the metric of “seven to ten years” is not “debunked” as incorrect; instead, “seven to ten years” is reframed as neither a desirable nor aspirational indicator of rigor and evidence of safety, but rather the result of bureaucracy and insufficient support: “It’s not ten years because that is safe, it’s ten hard years of battling indifference, commercial imperatives, luck and red tape” (Toshner, 2020).

A distinction is drawn here between whether the process has been sped up and what in the process has been sped up. In his interview with NPR, for example, Dr Hatchett emphasizes that the risks that have been taken in the COVID-19 vaccine production have been with manufacturing rather than clinical development, which, he reassures NPR, does not translate to “cut corners” when it comes to safety or efficacy (Hatchett in Langfitt, 2020). The vaccine timeline that emerges from such a framing is one where events unfold in a progressive fashion, but the calendar time between such events can be stretched and compressed as dictated by the demands and resources of the vaccine context. Within this framing, time is remade as a topology of integers where the proximity/distance between such integers is malleable (Serres and Latour, 1995). Therefore, where the calendar time of different vaccine developments can be metrically measured and compared as linear, the object of time made as vaccine development events is relationally constituted as changeable, multiple, and fluid.

The space/time between crucial, non-negotiable events of vaccine development is illuminated in the following description of “normal” vaccine development by Dr Mark Toshner (2020):

I submit grants, have them rejected, resubmit them, wait for review, resubmit them somewhere else, sometimes in a loop of doom. When I am lucky enough to get trials funded, I then spend months on submitting to ethics boards. I wait for regulators, deal with personnel changes at the drugs company and a “change of focus” away from my trials, and eventually, if I am very lucky, I spend time setting up trials: finding sites, training sites, panicking because recruitment is poor, finding more
sites. I then usually have more regulatory issues and, finally, if my big pot of luck is not used up, I might have a viable therapy – or not.

The above paragraph paints a picture of slow, repetitive, and redundant practices taking place between crucial and non-negotiable events in the vaccine timeline; the proposal of a trial, successful funding of the trial, the trial itself, and the resultant therapy emerge as stable but temporally unfixed events (integers) that may be brought into closer proximity through an increase in resources and the elimination of bureaucratic barriers. Through this process, the work of science is simultaneously stretched to encompass a range of practices often obscured in hegemonic technoscientific narratives (in favor of the “eureka moment”) and delimited to mark particular practices as not worth measuring.

Financial investment is leveraged as an important (and emotionally charged) factor differentiating the development of COVID-19 vaccines from other historical vaccines. For example:

Under normal circumstances, […] researchers working on a potential vaccine would develop and test it in a laboratory setting and then apply for additional funding before taking the next steps of manufacturing and testing in humans. Testing larger populations would require “very large investments” which meant university researchers would have to partner with large pharmaceutical companies which would first determine whether the vaccine would be profitable enough to add to their portfolio. […] In a nutshell, because so much money was thrown at coronavirus research from the get go, it shaved years off the process. (Carey, 2020)

The “large pharmaceutical companies” highlighted above, who make funding decisions based on the profitability of a vaccine, become actors within the vaccine assemblage with the capacity to lengthen or shorten vaccine development time. Here, time is remade as evidence through its affective relationship with these actors. As Toshner (2020) argues, “ten years isn’t a good thing, it’s a bad thing. It represents barriers in the [vaccine development] process that we have now proved are ‘easy’ to overcome.” The figure of “ten years” is thus transformed from evidence of safety and rigor to instead constitute evidence of corporate greed.

The sequencing of events within a vaccine timeline also becomes crucial in making up the time of vaccine development. Rolling approaches to clinical trials and parallel trials and manufacturing are highlighted as two important strategies for a faster vaccine timeline. Neither of these processes is suggested to indicate that the events of the trials and manufacturing themselves have been performed faster—rather, these events have been allowed to overlap and run concurrently. Again, these events constitute necessary points that intersect with a timeline of “normal” vaccine development, but these points of intersection are brought closer
together (or to a single point) on the COVID-19 vaccine timeline when compared to other vaccine timelines.

Within these performances of vaccine temporalities, the elasticity of time forms a central mechanism through which evidence of safety and efficacy emerges. The events of vaccine development remain plotted in a way that resembles the familiar narrative of technoscientific progress, but the pattern is afforded a greater fluidity. This fluidity resides between established stable events of crucial vaccine work and this construction of time is made possible through the clarifying of boundaries between legitimate and non-legitimate work. This case study therefore illuminates the relational and performative nature of time in narratives of vaccine development. It furthermore demonstrates how temporalities of vaccine development are always informed by the affective investments audiences have in familiar narratives of technoscientific progress and points to a broader capacity for resistance against linear enactments of technoscientific development in evidence-making practices in health. Our analysis of this case study therefore shows how a critical interrogation of time and temporality as lively objects of evidence-making intervenes in hegemonic imaginings of time as a measure of evidence in public health interventions.

**Conclusion**

These cases reveal that the time of vaccine development is more than an experienced phenomenon and measurement of events—it is a performative, boundary-enacting, evidence-making actor within the vaccine science communication apparatus. The multiplicity and relationality of time emerges within news media and becomes a crucial mechanism of knowledge-making as audiences are invited to engage in the evidence-making process in complex and affect-charged ways. This engagement enacts a security in COVID-19 vaccines as health technologies built upon a long history of science-making; uncertainty in potentially unstable futures is thus assuaged not through a communication of risk management but instead through a remaking of the now as a future of past science-making. This assurance relies on a series of underlying assumptions and conceptual logics about linear time, technoscientific progress, the problem-solving paradigm, and publics as rational public health subjects who respond to “evidence.” Such assumptions and logics are highly political and open to critique—the cases analyzed throughout this article, for example, imagine a public whose hesitancy related to COVID-19 vaccines can be acknowledged and mitigated via the addressing and remaking of time as a core problem of vaccine evidence-making.

The effects of the work being done within these cases are real and vitally important in the pandemic response assemblage; yet our investigation of these cases reveals the ways in which media accounts of vaccine development both
open up and delimit how we might understand the time-as-evidence of vaccine safety and efficacy. In troubling the object of time, these cases establish time as an ontological concern with epistemic and affective investments that emerge within audiences’ relationships with existing and familiar narratives of technoscientific progress. Time is thus in negotiation with(in) a hinterland of evidence-making practices, of which these media are elements (in a broader communication assemblage).

More broadly, the context of the COVID-19 pandemic and the particular ways in which time has been made hyper-visible through various practices of pandemic response has presented an ideal opportunity to investigate the specific mechanisms through which time comes to matter in science communication. In attending to the performativity of alternative temporalities emerging within the COVID-19 vaccine assemblage, we have argued that public accounts of time have vital evidence-making capacities, the effects of which require further investigation. This careful attention to what communication can do in a health context has already been taken up in the so-called “performative turn” in Science and Technology Studies (Licoppe, 2010); our focus on vaccine development in the COVID-19 pandemic therefore identifies an empirical context within which the effects of such communication can be critically examined. An EMI approach (Rhodes and Lancaster, 2019) furthermore crystalizes the particular ways in which health interventions are performed through and within science communication. As we have demonstrated, the normative understanding of science communication within an evidence-based intervention paradigm as the translation of scientific evidence to publics must be reconsidered. Rather, we contend that science communication is itself a site of evidence-making, the techniques of which materialize evidence of public health practices through the intra-action of news media and public health subjects.

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