



Revising the “Hype Pipeline” Model in Scientific Communication

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1 INTRODUCTION

In this article, we present a new model for hype formation in science communication and in the public understanding of science. In this new model, the blame for hyping scientific results and/or the significance of research discoveries lies not in the traditional structures of science communication publicists and journalists but in politicians and social media celebrities, with grave consequences for public policy, as seen in the case of the hydrochloroquine (HCQ) in Brazil.

Hype can be both cause and effect of public interest in any scientific topic. The COVID-19 pandemic has brought about a sharp increase in public interest in health science-related news coverage; the online search for news stories containing the words “virus” and/or “vaccine,” for instance, increased substantially this year, according to Google Trends data, going to the highest level since 2008, the first year covered by the database, in March (“virus”) and in May (“vaccine”). But, whenever there is a peak interest in health science issues, it is usually followed by sensationalism (Ransohoff and Ransohoff, 2001). When dealing with medical and health science, sensationalism is usually a product of exaggerated interpretations from scientific papers that can both scare or delude the population (Ransohoff and Ransohoff, 2001). The same phenomenon is also addressed as “hype” (Weingart, 2017).

Media attitudes tend to get most of the blame for hyping science, and low quality science is usually more attractive. There is literature suggesting that low quality research in health and medicine tends to attract more attention from journalists than well-designed and carefully executed studies (Bartlett et al., 2002). More complex models of hype creation and hype dynamics, however, tend to distribute blame more equally among scientists, press officers, business people, and the conventional media (Ransohoff and Ransohoff, 2001; Marcinkowski and Kohring, 2014).

And what about the public? The public is commonly seen as a passive receptor/consumer/“victim,” who may perhaps lash out in anger when the dangers or benefits promised by the hype fail to materialize (Ransohoff and Ransohoff, 2001). This view of the public is a gross simplification, and many scholars recognize this fact (Caulfield and Condit, 2012).

Models don’t mirror reality exactly. But, simplifications can be, and often are, useful in all branches of science. As the late great physicist Sir Arthur Eddington wrote in his classic *The Internal Constitution of the Stars*, replying to a complaint against the “loose” use of mathematics by physicists, “a legitimate approximation is not just an unavoidable evil; it is a discernment that certain factors—certain complications of the problem—do not contribute appreciably to the result.” However, it is no longer tenable, not even in a simplified model, to see the public as a passive pole in the hyping process. The kind of modeling that places the public in a passive or, at most, reactive role in the health science hype dynamics has become direly inadequate in the context of the present pandemic; here, the public indeed does “contribute appreciably to the result.”

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1.1 The Old Model

Old models emphasize a hype-producing system centered in scientific institutions and media outlets. The “hype pipeline” proposed by Caulfield and Condit (2012) can describe the old information ecosystem very well; pressures from the “publish or perish” culture and from expectations of financial gain are taken up by institutional press releases; the news media may fail to filter the exaggerations in the releases and also has its own stake in making the content “sexy.” If the hype gains momentum, a “scientific bandwagon” emerges, with other research groups diving into the hyped research area, which will generate more press releases and news stories.

In this pipeline model, the only input from the public is what are perceived as their preferences: they influence the journalists on what to write and the press officers of research institutions on how to “angle” their press releases. This model, however, becomes quite inadequate to deal with what can be considered as the greatest hype of the pandemic—the hydroxychloroquine craze.

1.2 Background

Chloroquine (CQ) and its less aggressive version, hydroxychloroquine (HCQ), are both molecules that have been used for almost a century in the control of malaria and, more recently, for autoimmune diseases such as lupus erythematosus (SLE) and rheumatoid arthritis (RA).

The drugs have exhibited antiviral activity *in vitro*, attributed to blocking viral entry through the disruption of endosomal pH. Anecdotal evidence of the use of HCQ in SLE patients became available during the early days of the pandemic in China, and the Chinese government issued a statement—not a scientific paper—detailing the use of CQ as a possible treatment for COVID-19 (Gao et al., 2020).

The now infamous clinical trial conducted in France, at the Institut Hospital-Universitaire in the city of Marseille (IHU), by prominent doctor and researcher Didier Raoult, that created the HCQ hype, had several serious methodological flaws: it was not randomized, control patients were treated in different hospitals and not with a standardized protocol, there was no intention-to-treat, data were missing from several patients, and six patients in the treatment group were simply excluded from the final analysis, all of whom had deteriorated, left voluntarily because of side effects, or died (Gautret et al., 2020).

Nevertheless, Raoult went to social media announcing that HCQ was a “game changer” that would end the pandemic and cure COVID-19. The news reached President Donald Trump in the United States and echoed in Brazil in President Bolsonaro’s ears. There followed a great number of deeply flawed studies, with no control groups, questionable statistics, and biased methodology.

Good science, however, soon began to tell a different tale. Of note, an article published in *NEJM* analyzed postexposure prophylactic use and found no benefits (Boulware et al., 2020), and the Recovery trial, a thorough and comprehensive randomized trial conducted in the United Kingdom, found no benefits in mortality or time to recovery. After these results, HCQ trials enrollments were halted in the United Kingdom and in the Solidarity trials conducted by the WHO.

These decisions were echoed in the United States, and the FDA revoked its previous decision to allow emergency use of HCQ. In Brazil, the Ministry of Health carried on as if nothing happened. Not only did the Brazilian Ministry authorize and recommend the use of HCQ for COVID-19, at the earliest appearance of symptoms, it has recently extended the recommendation for pregnant women and pediatric use.

The politicization of the issue was doubly enhanced in Brazil after the announcement that President Jair Bolsonaro had contracted the new coronavirus, and the President himself went online to say that he was recovering well “thanks to chloroquine.” All in all, the chloroquine affair appears as one of those instances in which hype is no longer just an exaggeration of scientific research but simply becomes one more claim not backed by evidence, which in turn cannot be different from plain fraud (Weingart, 2017).

The hyping of HCQ had serious public policy and public health consequences for Brazil. The Ministry of Health issued two national guidelines for its use, recommending it for both hospitalized and early-stage patients (Ruprech, 2020), and Bolsonaro himself said, without presenting any evidence, that the use of HCQ could have avoided 30% of all COVID-19 deaths in Brazil (Bolsonaro 2020). The widespread belief—fostered by the Federal Government—that the early use of HCQ could prevent more serious forms of COVID-19 very likely contributed to the low public adherence to social isolation and mask-use protocols (Fávero, 2020; Afiune et al., 2020).

1.3 The New Model

In the new model, hype generation is no longer the end-product of a pipeline with the public in the receiving end but of an explosion with the public at the epicenter. In the present information ecosystem, it is no longer reasonable—even under a simplified model—to see the public as a passive target of hype. In an informational ecology dominated by social media, the public takes on an active role in propagating and amplifying hype.

The history of the CQ/HCQ hype is one of intense direct interaction between social media influencers and the public, without intermediaries. The hype began online, on YouTube, with Didier Raoult announcing the “cure” for COVID-19, on a video posted in February with the title “Coronavirus: Game Over!” and the warning: “The only thing I’ll tell you is, be careful: Soon the pharmacies won’t have any chloroquine left!” (Sayare, 2020). With this, Raoult subverted the “pipeline” order, from the scientific paper to press release; he went public before having a paper to back up and stabilize his claims (which is usually seen as bad form), and he did not use press releases at all.

Raoult’s announcement was amplified by people with large numbers social media followers. The next chapters played out on Twitter: James Todaro, a medical doctor who is also a financial market investor, and Elon Musk, owner of companies like SpaceX and Tesla Motor, tweeted about the “promise” of chloroquine (Figure 1).

The role of social media in disseminating falsehoods had already been established. An article published in *Science* showed that, on Twitter, false information travels way faster, deeper, and with greater reach than fact-based information, and

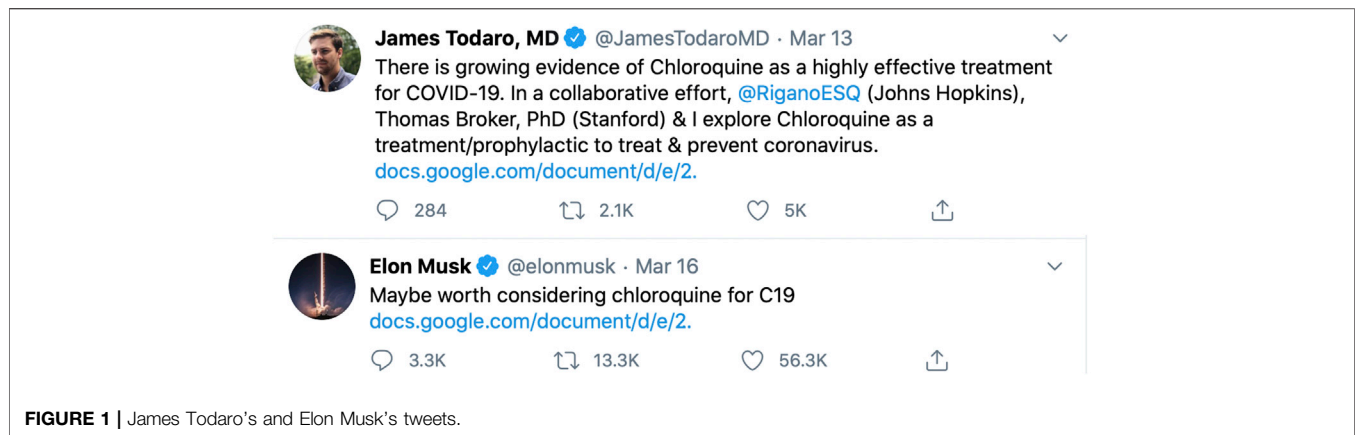


FIGURE 1 | James Todaro's and Elon Musk's tweets.



FIGURE 2 | Donald J. Trump's and Jair M. Bolsonaro's tweet. Bolsonaro's tweet says: "The treatment of COVID-19, based on hydroxychloroquine and azithromycin, has been shown to be effective in patients undergoing treatment. In the coming days, results shall be presented to the public, bringing the necessary atmosphere of tranquility and serenity to Brazil and the world."

this is true for all categories of information (Vosoughi et al., 2018). Importantly, Vosoughi et al. determined that falsehoods do not succeed because they are falsehoods but because they tend to be more novel, unusual, or surprising than truths; also, that politically motivated novelties are more retweeted (Vosoughi et al., 2018). Such motivation was brought to bear by the early adoption of chloroquine by both the President of the United States, Donald Trump, and the President of Brazil, Jair Bolsonaro. Both presidents went to Twitter to brag about the medicine (Figure 2) and later went public to say that they were taking the drug, Trump as a preventive, Bolsonaro as therapy.

The new information ecosystem requires new tools to deal with hype. Most of the literature about the management of hype in science communication deal with suggestions of how to stop it at the source (Weingart, 2017) not on how to defuse it after it has

been released. But, in the new information ecosystem, when the public—including national leaders and their hundreds of thousands of social media followers—is a fundamental part of the hype engine, defusing becomes essential. If the media can no longer take the blame for spreading hype but rather hype comes directly from the public, influenced by political leaders, doctors, medical associations, and media influencers, techniques to defuse misinformation must also be adapted. These new tools should come from studies on fighting conspiracy theories and long ingrained misconceptions about science. There is literature that deals with the correction of misconceptions, "rebutting" and "debunking" (Schmid and Betsch, 2019; Caulfield, 2020). In the pandemic scenario, the CQ/HCQ hype becomes part of the "infodemic" described by the World Health Organization (Zarocostas, 2020).

For some years, the mere possibility of fighting ingrained misconceptions has been in doubt, but this scenario is changing. During the past decade, the perspective for debunking and rebutting has been gloomy. An article by Nyhan and Reifler (2010) suggested that attempting to correct misinformation often "backfired," reinforcing unwarranted beliefs in the mind of the people one is trying to inform. But, a review of recent research showed that the backfire effect was not that common (Caulfield, 2020). In one study, Wood and Porter (2019) conducted five experiments, with more than 10,000 subjects and tested "52 issues of potential backfire." The authors found no backfire effect for all debunking corrections tested, even though they included controversial and polarized themes, where this effect should be expected. Among the issues tested were a few "hot" topics on the borderline between science and politics, like the environmental dangers of fracking for oil or the real cause of the pay gap between men and women.

To combat the conjoined issues of hype and blame in the general population in COVID-19, it may be worth considering research from "debunking" in cognitive psychology. Techniques from "debunking" have been tested with some success. Viable strategies are presented in the study by Caulfield (2020) and Schmid and Betsch (2019). Suggestions include presenting facts in a causal and explanatory manner, so they will have a better chance to fill the cognitive "gap" left by the misconception and,

when dealing with promoters of misconceptions, to lay bare their rhetorical tricks for the public. When social media-fueled hype gains momentum, the “bandwagon effect” predicted by the “pipeline” model takes up not only other research groups—which HCQ also did—but also the public, its hopes, and political passions. In the face of this, science communicators will have to adapt debunking techniques for the control of hype. The creation of hype in this new ecosystem may be diffused, but the blame is not, necessarily. In the new model, with the public front-center in the hype-generating machinery, it may seem that the blame for creating hype and for its social, medical, and scientific consequences gets diluted among the multitude. This is not true: the new communication ecosystem is not an evenly distributed network but has its own privileged voices, nodes, and influencers (Garibay et al., 2019; Wadman, 2020). In social media, every member of the public is responsible for the content they choose to divulge, but there are focal points where most of the blame can be placed. As a science communication strategy, such

points ought to be mapped and surveilled, and its content countered as quickly as it is produced. When such focal points become the focus of misguided public policy, as it happened in Brazil and, to a lesser extent, in the United States, the debunking efforts should be coupled with societal and political reaction.

AUTHOR CONTRIBUTIONS

NT and CO contributed equally to this manuscript by reviewing the literature and wrote the manuscript. LA participated in the review and wrote the manuscript.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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