

Science communication:

A guide to creating online scientific content that engages

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Abstract

Science communication plays an important role in educating the public about scientific knowledge. Until recently, publishing in research journals and presenting at science conferences were the only options available to scientists for sharing their work. Now, technological advances have created several online platforms, including social media, that can be used for communicating science. This article discusses the challenges and opportunities for science communicators in creating content for social media and other online platforms.

Science communication is an overarching term to describe the practice of informing and educating the public about scientific knowledge. It plays a critical role in educating the public and policymakers about the world's most urgent issues (e.g., the COVID-19 pandemic, climate change), improving public understanding of science, and inspiring the next generation of scientists. The award of the 2021 Pulitzer Prize in Explanatory Reporting to Ed Yong, a science writer with *The Atlantic*, "For a series of lucid, definitive pieces on the COVID-19 pandemic that anticipated the course of the disease, synthesised the complex challenges the country faced, illuminated the U.S. government's failures and provided clear and accessible context for the scientific and human challenges it posed," underscores the importance of science writing in facilitating public outreach and engagement.^{1,2,3}

Until recently, publishing in a research journal and presenting at scientific conferences were the only avenues available to scientists for sharing

their work. Today, online platforms offer a multitude of options to communicate science to diverse audiences without the need for intermediaries (e.g., the press). This can be achieved through documentaries, blogs and articles, videos, podcasts, public talks, cartoons, infographics, and social media campaigns. However, relatively few scientists have embraced social media tools for sharing their work. This article discusses the important role of science communication in public health and provides an overview for creating and disseminating effective science content online.

Science communication: a public health imperative

Social media has changed how people interact with content and with each other online. More than 4.5 billion people are social media users.⁴ Internet users worldwide spend an average of 2.5 hours per day on social media.⁵ With such a vast user base, social media can be used to communicate science to the general public, increase public interest, and improve science literacy. However, a major disadvantage of any online platform is that information can be published online without rigorous fact-checking or peer review.⁶ This is evident in the number of websites and social media channels dispensing health-related advice or treatments with no scientific basis or evidence of effectiveness.^{7,8,9} The speed of information sharing on social media often contributes to the faster spread of such misinformation. Also, the cognitive overload resulting from large amounts of (often conflicting) information makes it hard for the non-expert reader to differentiate between scientifically sound vs. unreliable sources.^{10,11}

Misinformation on social media has now reached epidemic proportions, undermining public trust in science, and poses a risk to public and planetary health.^{12,13,14} Sources of

misinformation and disinformation may include news media,¹⁵ politicians,¹⁶ fiction,¹⁷ and word-of-mouth. Recent research has examined the public consumption of misinformation in the context of political elections, social network effects, and dynamics of misinformation spread.¹⁸ The impact of misinformation is evident in the lack of public support for policies to control the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), leading the World Health Organization (WHO) to declare an "infodemic".^{19,20} Recent incidents of cyberbullying and online harassment of journalists, physicians, and scientists working to counteract misinformation underline the scale of the problem.^{21, 22, 23, 24, 25}

A recent report²⁶ found that 50% of US adults searched the internet for information regarding their health issues, with 77% using popular search engines (e.g., Google, Yahoo, and Bing) to search for health and medical information. Another report²⁷ found that 89% of Americans looked for medical information online before consulting their healthcare providers.²⁸ Seeking health information may contribute to a patient's knowledge about their health condition and treatment options, and make them more involved in health decision making. However, given a large amount of inaccurate and potentially harmful information available online, it is easy for people to be misinformed.²⁹ It may also "change the way how patients interact with and participate in consultations with their physicians and how they feel about their relationship with their physicians,"³⁰ with detrimental consequences for patients' health.

Public confidence in science has remained stable since the 1970s;³¹ 76% of individuals report having confidence in scientists in general, and people trust scientists to provide reliable scientific information.³² Even so, improving the accuracy of information shared by science communicators, correcting errors, being trans-

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parent about funding and other disclosures, and taking advantage of social media tools are critical in countering the effects of misinformation and disinformation.³³ Several studies have found that health education materials exceed the eighth-grade reading level of the average American,³⁴ indicating a need for effective science communication practices and improved science literacy. As Nobel Laureate Dr Jennifer Doudna emphasises, “Science literacy is more important than ever before, and we need more innovative ways to inform, engage, and inspire the public around critical discoveries and technology.”

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Dr Jennifer Doudna
Nobel Laureate



Science communicators who got it right

While the explosion of science misinformation on the internet and social media are a cause for concern, there are plenty of stellar examples

where social media has served science communicators in sharing information with the public. Some of the most recent examples are discussed below.

Ed Yong was famous for his brilliant storytelling skills in science long before his coverage of the COVID-19 pandemic earned him the 2021 Pulitzer Prize in Explanatory Reporting.^{1,2,3} In his words, “If you do it well, science writing trains you to grapple with uncertainty, to embrace nuance, to run toward complexity, to try to make sense of the world.”

Dr Anthony Fauci’s media interviews during the COVID 19 pandemic are case studies in effective science communication. His simple, consistent approach of *what we know, what we don’t know, and what we should do*³⁵ focuses on the key data, translates the latest research into everyday language, and inspires public trust in science. “The purpose of your communication is not to impress people about how smart you are. The purpose is to get them to understand what the heck you’re talking about,” says Fauci, the director of the US National Institute of Allergy and Infectious Diseases (NIAID) and President Joe Biden’s chief medical advisor.



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Dr Anthony Fauci
Director NIAID

Patients are also science communicators. Long-term effects of the coronavirus, or “long COVID”, is a term now used to describe the lingering symptoms that persist or worsen over several weeks or months after infection.³⁶ However, long COVID came to be recognised by the scientific and medical community only after patient-led groups collected evidence and advocated for themselves on social media. Several Facebook groups and Twitter handles were created to share information about long COVID symptoms and offer support to patients. A YouTube video on long COVID made by patient advocates captured the WHO’s attention.³⁷ Patient advocacy eventually led the WHO and medical community to accept long COVID as a diagnosis. The US Congress has now



authorised more than \$1 billion for research on long-term consequences of coronavirus infection and the US National Institutes of Health has launched a \$470 million initiative to study the condition. This story of long COVID is an excellent example of patient-led activism and involvement in research, and shows how social media can be harnessed to advance public health initiatives.

There are plenty of other examples of innovative science communication. Consider Adi Utarini, who pioneered a dengue prevention technique that used mosquitoes carrying the *Wolbachia* bacteria.³⁸ A randomised clinical trial where researchers from the World Mosquito Programme released the infected mosquitoes into an Indonesian city saw a 77% drop in dengue cases. This ground-breaking research placed

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Utarini on the *Time* list of 100 Most Influential People of 2021.^{39,40} The clinical trial was made possible due to the support of the public and policymakers. Utarini's team used media announcements, wall paintings, movie competitions, and in-person meetings to educate the local community and to drive public engagement and support for their research.

David Attenborough joined Instagram for a brief time to communicate science to a younger audience, "because, as we all know, the world is in trouble".⁴¹ His debut earned him a place in the book of *Guinness World Records* for the fastest time to reach 1 million followers. Attenborough's first Instagram message, "Continents are on fire. Glaciers are melting. Coral reefs are dying. Fish are disappearing from our oceans. The list goes

on," was a call to rally the young audiences on Instagram into taking action to improve planetary health before it is too late.

The late Nadia Chaudhri, a professor of neuroscience at Concordia University in Montreal, Canada, used Twitter to share her palliative care journey with ovarian cancer to raise awareness about the disease to an audience of more than 143,000 followers.⁴² She also launched the Nadia Chaudhri Wingspan Award to provide funding to neuroscientists from minority and historically marginalised communities, raising over \$615,000 from a record 8,600 donors. Chaudhri passed away on October 5, 2021, leaving behind her a lasting legacy as a fine scientist and humanitarian.

Raven Baxter, also known as Raven the Science Maven,^{43,44} is an acclaimed science communicator, TEDx speaker,⁴⁵ and the founder of Black in Science Communication,⁴⁶ an organisation dedicated to advancing diversity in science and technology. Baxter is recognized as

one of *Fortune* magazine's 40 under 40 in *Healthcare*.⁴⁷ Her research focuses on the media representation of scientists and combines science-themed music with rap wordplay to drive public engagement with science.

How you can, too

According to Aristotle, rhetoric is the art of effective or persuasive speaking or writing, intended to inform, persuade, or inspire audiences.⁴⁸ A speaker's or writer's ability to persuade an audience depends on how effective they are in three areas that form the rhetorical triangle: *logos*, *ethos*, and *pathos*. All successful science communicators employ these rhetorical pillars, and you can also use them to craft your story.

1. **Logos** is the logic behind your content. Is your message clear and specific? Is there credible scientific evidence to support it? Are you logically building your story?
2. **Ethos** is about establishing your credibility and building trust with your audience. Where do you stand with your audience? How are you connected to the topic you are discussing? Are you using language or vocabulary that is appropriate for your audience?
3. **Pathos** is the appeal to the emotions, imagination, beliefs, and values of your audience. What are you doing to engage the audience's emotions or imagination? Are you using examples and language that the audience can understand and identify with?

Then, use the framework below to create your content.

Define your goal

You must be clear about your goal before you begin writing.⁴⁹ What is the topic you will focus on? Why is it relevant to the audience? What would you like to achieve? Who is your audience (e.g., scientists, policymakers, the public)? Where are they based (e.g., Twitter, TikTok, LinkedIn)? What do they know already about the topic? How much information do they need? How can you build trust with your audience? What should you do to gain their interest and engagement?

Choose your platform

A multitude of social media and online platforms are available, with more being added regularly. To find the platform that fits your needs, you

need to think about who your target audience is (e.g., scientists, policymakers, the public). Which social media platform do they use the most (e.g., YouTube, Twitter, LinkedIn)? What are the best ways to use the platform? How would you like to engage with your audience (e.g., writing, collaboration, discussions)?

Use the principles of persuasive communication to refine your story.

Persuasive communication is based on five principles: *clarity*, *brevity*, *context*, *impact*, and *value*.

1. **Clarity:** The purpose of science communication is to inform and engage the public. It respects the readers' time, intelligence, and attention. Don't make the reader work hard to understand your message!
2. **Brevity:** There is a reason that TED talks are 18 minutes or less. Brevity forces you to cut all unnecessary information and keep your content to the point. Use the inverted model of sharing information (most important content at the top and details later). Don't make the reader scroll down to the end of the page to understand the message.
3. **Context:** While designing scientific content it is important to be aware that biases exist in the audience and will influence how they engage with new information. Effective science communication depends on building positive associations with the content you create. Does your audience grasp the relevance to them? If not, your message lacks context. Be sure to include the "why" and "why now" into your message to engage the attention and interest of the audience.
4. **Impact:** Do you understand who your audience is? Did you tailor your message to make it relevant to different audiences? What are the implications of your message? Is your message memorable? Does it have a clear call to action? Creating clear messaging and reinforcing key points is also critical in gaining and retaining the reader's attention. If not, it will be quickly forgotten.
5. **Value:** A message that is clear, brief, relevant to the audience, and memorable. A balance of the four other principles mentioned above (clarity, brevity, context, and impact) creates value for the audience, educates, and empowers them.

The ultimate goal of science communication is to inform the audience, build an appreciation for

scientific knowledge, and provide a platform for public engagement. Often when we are working on an important project, we assume that the audience will understand and agree. This is not always the case. Asking "So what?"⁵⁰ at each stage of the writing process will make your writing concise and interesting to the audience.

Acknowledgements

The author would like to thank Dr Evguenia Alechine for the invitation to write for this issue and Dr Jonathan Pitt for editorial support.

Conflicts of interest

Surayya Taranum is a Scientific Writer at 4Clinics.

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