Natural stings: alternative health services selling distrust about vaccines on YouTube

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2 ABSTRACT

3 In this study, we investigate YouTube's videos related to vaccines to understand the particularities
4 of the opposition to vaccines in Brazil. The World Health Organization considered vaccine
5 hesitation as one of the greatest threats to global health in 2019. Researchers associated this
6 hesitation to a strengthening of the anti-vaccination movements, suggesting that social media is
7 currently the main spreader of this position. YouTube increasingly becomes a matter of concern,
8 since its recommendation system is identified as a promoter of misinformation and extreme
9 content. Despite YouTube's statements, misinformation and disinformation (M&D) about vaccines
10 continue to be disseminated in videos in Portuguese, reaching a large audience. We found 52
11 videos containing M&D about vaccines. The main M&D were the claim of dangerous ingredients
12 in vaccines, the defense of self-direction — freedom of choice, independent research —, the
13 promotion of alternative health services, the myth that vaccines cause diseases, conspiracy
14 theories, and the allegation of vaccine's severe collateral effects. We identified 39 brands
15 advertising on 13 videos of our M&D sample. Although the YouTube Partner Program is an
16 important source of income, the channels use different economic strategies, such as the selling
17 of courses, and therapies and the use of fundraising platforms. We also found that alternative
18 health channels spread distrust about traditional institutions to promote themselves as trusted
19 sources for the audience and thereby profit with alternative health services.

20 **Keywords:** Alternative Health, Disinformation, Misinformation, Vaccines, YouTube.

1 INTRODUCTION

21 The World Health Organization considered vaccine hesitation as one of the greatest threats to global health
22 in 2019 (World Health Organization, 2019b). With the decrease in immunization coverage, 170 countries

registered cases of measles, increasing 300% when compared to the first three months of 2018 (World Health Organization, 2019a). In this scenario, Brazil was the sixth country by reported cases of measles in 2019 (Castelvecchi et al., 2019), despite the National Immunization Program, one of the strongest Brazilian public health policy programs (Domingues et al., 2012), offering 20 different types of vaccines free of charge to the population (G1 DF, 2020). Researchers associated the decrease in immunization to a strengthening of the anti-vaccination movements (Dubé et al., 2015; Benecke and DeYoung, 2019), suggesting that social media is currently the main spreader of this position (Stecula et al., 2020).

In the last two decades, several researchers studied vaccine misinformation and disinformation (M&D) on different online platforms and sites, such as Facebook (Faasse et al., 2016; Orr et al., 2016; Hoffman et al., 2019), YouTube (Keelan et al., 2007; Ache and Wallace, 2008; Briones et al., 2012; Cambra et al., 2016; Covolo et al., 2017), among others (Nasir, 2000; Wolfe et al., 2002; Zimmerman et al., 2005; Kata, 2010; Bean, 2011). According to them, the amount of vaccine M&D on sites and social media platforms have varied throughout the time (Ache and Wallace, 2008; Briones et al., 2012). Despite that, the online presence of anti-vaccination movements seems to increase in recent years (Donzelli et al., 2018; Johnson et al., 2020). These communities use strategies to reach a larger audience — personal narratives (Duchsherer et al., 2020), anti-vaccination advertisements (Jamison et al., 2020) — and create workarounds to avoid being flagged as “harmful content” on social media — e.g., using lexical variations and emphasizing concepts like “informed consent”, “health freedom”, and “pro-choice” (Kata, 2012; Koltai, 2020; Szeto et al., 2020).

YouTube increasingly becomes one of the most popular social media services, reaching over two billion users each month (YouTube About, 2020). YouTube’s recommendation system is responsible for 70% of total viewing time, and drives the promotion of certain content within the site (Popken, 2018). YouTube’s reach is a reason for concern, since its recommendation system is identified as a promoter of misinformation and extreme content (Mozilla, 2019; Avaaz, 2020).

After a series of complaints from academics and journalists (Geurkink, 2019), YouTube stated the implementation of measures to reduce recommendations of harmful misinformation and to remove advertisements from anti-vaccination videos (Ingram, 2019). Such claims can not be confirmed without access to its data. Also, these measures are even more complex when considering content in languages other than English and countries without proper regulation. For instance, YouTube has great influence in the spread of anti-vaccination content in Portuguese: almost 90% of the videos analyzed in (Avaaz and SBIm, 2019) presented some misinformation about vaccines, reaching 7.4 mi of visualizations in the last three years. These are concerning results, since 57% of the interviewed subjects that did not vaccinate themselves or their children declared misinformation about vaccines as a reason (Avaaz and SBIm, 2019).

In this study, we investigated M&D about vaccines circulating on YouTube in Portuguese using a sample obtained from the terms “*vacina+autismo*” (vaccine+autism, in English). These terms were used due to the prevalence of the false link between vaccines and autism (Suelzer et al., 2019), a disinformation spread first in 1998 with the publication of a fraudulent paper (Deer, 2011) and still used as an argument by the anti-vaccination movements (Venkatraman et al., 2015; van Schalkwyk, 2019). In our sample, we found a community of content creators that collaborate to promote alternative health services meanwhile spread M&D about vaccines. These channels have financial gains selling courses, books, and alternative treatments, requesting donations through fundraising platforms and deposits in bank accounts, and even from large companies, through advertisements on YouTube.

2 MATERIALS AND METHODS

2.1 Acquiring and pre-processing the data

We used YouTube Data Tools (Rieder, 2019) to obtain the data used in this study. The tool was set up using the option “Video Network,” which creates a network of relations between videos via YouTube’s “related videos” feature: YouTube defines “related videos” from the `relatedToVideoId` parameter, which contains a list of videos related to a given video (YouTube, 2020). We selected the following parameters on YouTube Data Tools:

- **Search query:** “*vacina+autismo*” (in English, “vaccine+autism”)
- **Iterations:** 1
- **Rank by:** relevance
- **Crawl depth:** 2

The data was obtained in triplicate on February 10, 2020, between 19:00 and 21:00 UTC. This way, we obtained 1714, 2135 and 2286 videos in each extraction. Then, we combined the three datasets and used Gephi (Bastian et al., 2009) to obtain specific videos: containing the word *vacina* — vaccine — in their title; connected to the network, with a network degree higher than one — i.e., connected to the network by more than one related video; with more than 10,000 views. We used the following queries on Gephi:

Giant Component → *Degree Range*: ≥ 2 → *Range (viewcount)*: → 10000

These processes reduced the data to 191 videos. From these videos, we excluded the irrelevant ones — information on animal vaccination, technical material addressed to health workers, advertisements and videos on the Vaccine Revolt, a historical moment in Brazil. Then we reached the initial sample of our study, consisting of 158 videos.

We performed the classification on the initial sample between February 11–18, 2020, using a protocol of vaccine misinformation and disinformation (M&D) developed for this research. We also identified the brands advertising on each video. We watched the videos on the Tor browser (The Tor Project, Inc, 2020), to minimize the personalization of YouTube’s algorithm system.

We also created a secondary sample visiting the channels containing M&D videos from the initial sample between March 3–11, 2020. The videos selected contained the word “*vacina*”, or related to *vacina* — e.g., *VACINAS: Você acredita Nelas?* (VACCINES: Do you believe in them?) — in the title. These videos were classified between March 12–20, 2020, using the same protocol from the initial sample. Therefore, our sample has 52 videos containing M&D about vaccines in total — 23 from the initial sample and 29 from the second sample.

2.2 Classifying the videos

To specify what videos on our sample contain misinformation or disinformation, we label them according to six main categories created for this study. Each category consists of the main M&D spread about vaccines:

1. **Safety:** vaccines cause diseases (A); vaccinated people transmit the disease (B); vaccines cause autism (C); vaccines cause severe collateral effects (D); vaccines contain dangerous ingredients (E); it is safer to contract the disease than vaccinate (F); vaccines can impair the immune system (G); overload on vaccines and its consequences (H); alternative vaccination schedules are safer (I)
2. **Effectivity:** vaccines do not work (J); vaccines are not responsible for the decrease in diseases (K)

3. **Alternative health:** promotion of alternatives to vaccination, mainly naturopathic and wellness services (L)
4. **Morality:** association between HPV vaccine and promiscuity, and/or religious issues (M)
5. **Conspiracy theories:** narratives about powerful institutions or actors with nefarious intentions and secret plans (N)
6. **Other:** self-direction — freedom of choice, independent research (O); claim that people that know the “truth” do not vaccinate (P); emotional appeal (Q)

These categories are based on myths about vaccination most heard by Brazilian physicians, most spread M&D about vaccines in Brazil (Avaaz and SBIm, 2019), and in research analyzing content of sites or videos about vaccination on the last two decades (Nasir, 2000; Wolfe et al., 2002; Zimmerman et al., 2005; Kata, 2010; Bean, 2011; Ward et al., 2015; Yiannakoulis et al., 2019; Ekram et al., 2019). Self-direction, as presented in the category Other, is based on Koltai’s research on the anti-vaccination movement in the United States (Koltai, 2020).

2.3 License and reusability

The algorithms and functions implemented in this study were written in Python (van Rossum and Drake, 2009), using the packages Numpy (Oliphant, 2006; van der Walt et al., 2011), Scipy (SciPy 1.0 Contributors et al., 2020) and Matplotlib (Hunter, 2007). All code and data published with this paper is available under the BSD 3-clause license, and all figures generated in this paper are available under the CC-BY 4.0 license.

3 RESULTS

Our initial sample contained 158 videos. We classified twenty three videos from this sample with at least one misinformation or disinformation (M&D) about vaccines. The main categories identified were Safety — dangerous ingredients in vaccines (E) —, Alternative health — the promotion of products and therapies as vaccine alternatives (L) —, and Other — the defense of self-direction (O). These specific M&D examples, E, L and O, were mentioned in at least ten videos. On the second sample, the main categories were Safety — vaccines cause diseases (A), severe collateral effects (D), dangerous ingredients (E) —, Alternative health — promotion of alternatives (L) —, Conspiracy theories — vaccines are part of conspiracies (N) —, and Other — defense of self-direction (O). These M&D examples were also mentioned in ten or more videos. In total, the main examples of M&D in both samples were E (appearing in 28 videos), O (25 videos), L (22 videos), A (18 videos), N (17 videos), and D (14 videos).

To characterize how the amount of M&D in a video is related to its duration and the engagement it received, we defined an engagement metric, ε , based on the number of views, comments, likes and dislikes in the videos containing M&D in both samples:

$$\varepsilon = \frac{N_{likes} + N_{dislikes} + N_{comments}}{N_{views}} * 100$$

The largest part of our sample that contains M&D — 38 videos out of 43 — has less than 40 minutes and 20% of engagement (Figure 1).

Considering both samples, 32 videos referred to vaccines in general. Some discuss specific vaccines: fourteen of them mentioned flu vaccines; twelve cited the yellow fever vaccine; seven discussed the HPV vaccine; two referred to the measles vaccine and yet meningitis B, varicella, rubella, smallpox, diphtheria, polio, whooping cough and tuberculosis vaccines were each mentioned in one video. An interesting find is the reference to a cancer vaccine in four videos of the sample. According to the content producers,

Figure 1. (a) engagement metrics — views, comments, likes and dislikes — from videos containing misinformation and disinformation (M&D) in our samples. **(b)** quantity of M&D in each video, according to its duration and engagement. Here we represent only 43 videos, since the other ones do not make their numbers of likes, dislikes or comments available. The largest part of our M&D sample — 38 videos out of 43 — has less than 40 minutes and 20% of engagement. Also, more videos present a single example of M&D — 12 videos, according to our classification. Y axes in logarithmic scale. Colormap: YlOrRd.

143 vitamin D and sun exposure would be the “real” cancer vaccine, a claim that appears in videos that promote
 144 alternative services in regard to vaccination.

145 We identified 39 brands advertising on at least one M&D video in our sample through YouTube: *Seconds*,
 146 *7 Springs Orthopedics*, *Adler Pharma*, *Andreas Grosz*, *Banza*, *Baumdick*, *Boiron*, *Bondic*, *Buscopan*
 147 *(Boehringer Ingelheim)*, *Christen in not*, *Datrium*, *Digital Dream Lifestyle*, *DG Achieve*, *Erie Metal*
 148 *Roofs*, *Eucerin (Beiersdorf)*, *Fiat*, *Happn*, *Health and Wellness Tools*, *Incredible India*, *Japan Gov*, *Kia*,
 149 *Leap4Freedom*, *Lecturio*, *Lume Deodorant*, *Mindvalley*, *Mobil*, *OPPO*, *Patrick van Diemen*, *Philips*,
 150 *PragerU*, *RapidfFN*, *SDI Broker*, *SEAT*, *Spotify*, *Ticketmaster*, *The Online Traveller*, *Unichamp*, *Vileda*,
 151 and *Weiterdenker*. Besides YouTube advertisements, the channels in our sample profit in other ways: they
 152 sell courses, books, alternative treatments, ask for donations through fundraising platforms or via deposits
 153 directly into bank accounts.

154 Another relevant aspect is the number of verified channels in the sample. Verified channels are official
 155 channels of a creator, artist, company, or public figure. Channel verification helps distinguishing official
 156 channels from other ones with similar names (YouTube Help, 2020). Eight channels, from twenty in our
 157 sample, are verified (Table 1): two are associated with broadcast TV programs, while the other six are
 158 self-made amateur videos.

159 The main M&D examples spread by the eight verified channels are the promotion of alternatives to
 160 vaccination (L) — present in seven channels —, the defense of self-direction (O) — cited in five channels
 161 —, and the allegation of dangerous ingredients in vaccines (E) — mentioned in four channels. The channels
 162 are also subscribed to different YouTube categories, indicating that M&D about vaccines can appear in
 163 several content spaces; for example, the eight verified channels have categories ranging from “Education”
 164 to “People & Blogs” (Table 1).

165 There is a collaboration between channels that promote alternative health services. From 20 channels
 166 spreading M&D about vaccines, 11 mentioned Lair Ribeiro (Dr. Lair Ribeiro Oficial), a cardiologist and

Channels	YouTube Category	M&D examples
<i>nutrição Alimentos & Cia</i>	Education	A, D, E, G, H, J, L, M, N, O
<i>Palestrante Tiago Rocha</i>	People & Blogs	L
<i>U MIÓ QUE TÁ TENO</i>	Science & Technology	E, H, L, O
<i>Domingo Espetacular</i>	Entertainment	E, F, J, L, O
<i>Junior Hallak Medicina e Saúde</i>	People & Blogs	L
<i>Hoje em Dia</i>	Entertainment	E, F, J, L, O
<i>Criar e Crescer</i>	Education	G, N
<i>SAÚDE & BEM ESTAR</i>	People & Blogs	H, L, O

Table 1. Verified channels spreading M&D about vaccines and main examples of M&D. The channels are subscribed to different YouTube categories, indicating that M&D can appear in several content spaces.

167 nutrologist that promotes alternative therapies, diets and pseudoscience — homeopathy, detox, law of
 168 attraction, quantum medicine — in his videos and talks. The collaboration occurs through the reproduction
 169 of videos from “associate” channels or via endorsement of content creators and their courses (Figure 2).
 170 Besides that, the channels promote other professionals that support alternative therapies or other content
 171 creators that endorse M&D about vaccines.

Figure 2. Collaboration between channels that promote alternative health services and M&D about vaccines. Eleven channels spreading M&D in our sample endorse *Dr. Lair Ribeiro Oficial*. There are collaborations from other channels as well; for example, *Minha Saúde — Curas Naturais* and *nutrição Alimentos & Cia* endorse each other.

172 One strategy used by six channels is to ask testimonials from the audience, aiming to demonstrate the
 173 effectiveness of alternative therapies or courses they promote. Besides sending testimonials, the public
 174 has access to other services using social media platforms such as WhatsApp or Telegram. Some channels
 175 send daily “health tips,” offer discounts to products and claim that the use of these services are necessary
 176 to ensure that the public will receive new contents. Five of twenty channels make these communication
 177 services available, and one channel maintains ten WhatsApp groups.

4 DISCUSSION

178 The belief that vaccines contain dangerous ingredients (E), the “toxin gambit,” persists between the anti-
179 vaccination movements (Kata, 2012). The videos mention specific ingredients such as aluminum, mercury,
180 formaldehyde, thimerosal, nagalase, aborted fetal tissues, poison, toxins, and chemicals. This belief is
181 associated with two other M&D from the Safety category — vaccines cause diseases (A) and vaccines
182 cause severe collateral effects (D). The narrative of unsafe vaccines is strengthened by the popularity of
183 conspiracy theories (N), sowing doubt about public health organizations, physicians, scientists, universities,
184 and mainstream media.

185 Conspiracy theories are attempts to explain events and circumstances from secret plots by powerful and
186 malevolent actors (Douglas et al., 2019). The spread of conspiracy theories is a matter of concern, since
187 exposition to conspiracy theories may have negative consequences, such as decreasing science acceptance
188 (van der Linden, 2015), reduction in intention to engage in politics (Jolley and Douglas, 2014b) and, in the
189 specific case of anti-vaccine conspiracy theories, can affect vaccination intentions (Jolley and Douglas,
190 2014a). The issue of mistrust — of vaccines, vaccination providers, or policy makers — is considered a
191 driver for vaccine hesitation (Brown et al., 2018). Thus, the spread of distrust acts as a strategy to promoters
192 of alternative therapies: in doing so, they affirm themselves as trusted sources for the audience and create
193 potential consumers to the courses, books, and therapies they sell. The association between vaccine
194 opposition and alternative health services has been made several times before (Ernst, 2001; Busse et al.,
195 2008; Kata, 2010); for instance, (Caulfield et al., 2017) analyzed 330 naturopath websites to understand the
196 role of complementary and alternative medicine providers on the vaccine hesitation, and found that 40 of
197 them presented anti-vaccination rhetoric, while 26 promoted vaccine alternatives.

198 The channels offered alternatives for vaccines and for treatments of health problems in a narrative of
199 return to nature, as seen before by (Kata, 2012). Expressions like “God’s pharmacy” and “disease’s industry”
200 are repeated to denominate the opposition between the right option — alternative products and therapies
201 — and the “unnatural,” wrong one — vaccines, drugs and mainstream medicine. “Disease’s industry”
202 is a reference to one of the most reiterated arguments of anti-vaccination conspiracy theories, where
203 governments, scientists and physicians would be involved in a conspiracy with pharmaceutical companies
204 to cause suffering and to profit (Jolley and Douglas, 2014a). Therefore, the advocates for alternative health
205 services present themselves simultaneously as brave antagonists and victims persecuted for their resistance
206 to a “corrupt system” (Lewandowsky and Cook, 2020).

207 A common strategy used by the channels is the production of free materials such as recorded talks,
208 courses and e-books. The offering of free content helps to reinforce the idea of a selfless mission where the
209 creators have no financial interests and is also a tactic to attract and retain an audience for the channels.
210 Two of the content creators, Ribeiro and Bussade — an orthomolecular physician and nutrologist that
211 promotes the chemical compound known as Miracle Mineral Solution and vitamins as treatments for
212 autism — affirm that they do not practice medicine, but continue their studies and produce content because
213 they are motivated by the mission of helping people to find good recommendations of natural health and
214 cures for their sufferings. This mission is reinforced by their claims of persecution, an argument present in
215 vaccination opposed spaces (Smith and Graham, 2019; Avaaz and SBIm, 2019; Koltai, 2020). Ribeiro, for
216 example, criticizes the unpreparedness of traditional physicians and accuses the pharmaceutical industry.
217 (Kata, 2012) describes this trope as the “Galileo gambit,” an argument that invokes the attacks from the
218 scientific orthodoxy of the past against scientists such as Galileo Galilei — the claim is that the currently
219 persecuted ideas will eventually be accepted as truth.

220 The alleged persecution cited by the content creators in our sample is also associated with the recent
 221 changes in social media policies to contain the spread of M&D. The content creators adopt workarounds to
 222 the moderation practices, as seen on anti-vaccine communities on Facebook (Koltai, 2020), for instance.
 223 One of the workarounds on the alternative health channels is using other social media platforms, such as
 224 Telegram or WhatsApp, to ensure the content circulation and the perception of community in and out of
 225 YouTube. WhatsApp is one of the most popular information resources for Brazilians (Deloitte, 2019), and
 226 it has favored the spread of health and political misinformation in the last years (Smallman, 2018; Resende
 227 et al., 2019; Evangelista and Bruno, 2019). In addition to enabling constant interactions with community
 228 members, these WhatsApp and Telegram groups encourage the sharing of audience testimonials, which are
 229 used in new videos aiming to demonstrate the effectiveness of alternative therapies and courses promoted by
 230 the channels. Testimonials or anecdotes are also an important tactic used by anti-vaccination communities
 231 (Davies et al., 2002; Zimmerman et al., 2005; Kata, 2010; Shelby and Ernst, 2013; Ward et al., 2015;
 232 Duchsherer et al., 2020; Rallo Shimizu, 2020), possibly impacting the perception of risk about vaccines
 233 (Betsch et al., 2011). Apart from the sample's six channels asking for testimonials from the audience,
 234 another one used a dramatic testimonial of a young girl to alarm the viewers against the HPV vaccine.

235 According to the vaccine opposed conspiracy narrative, people need to exercise their self-direction — as
 236 in freedom of choice and independent research — to protect themselves and their families from malevolent
 237 and powerful actors. Freedom, choice and individuality are values associated with anti-vaccination beliefs
 238 (Moran et al., 2016). The emphasis on freedom of choice is a strategy used by vaccine opponents to
 239 rebrand the anti-vaccination movement and to avoid being censored by platforms (Koltai, 2020). The
 240 need for independent research about vaccines — as in research for yourself; the ability to do research for
 241 oneself and to ask questions is cited as a condition to freedom (Koltai, 2020) — is a recurrent argument
 242 among vaccine opposed actors to advocate for more informed choices (Hoffman et al., 2019; Duchsherer
 243 et al., 2020). However, the correct way to conduct independent research is already set by the alternative
 244 health community narratives — since they are part of a conspiracy plan, mainstream media, traditional
 245 physicians, and public health organizations cannot be trusted. Meanwhile, the constant collaboration
 246 between channels that promote alternative health services affirm content creators as reliable sources for
 247 their viewers, strengthening a sense of community and belonging (Koltai, 2020; Rallo Shimizu, 2020)
 248 that favors the creation of a loyal audience. (Duchsherer et al., 2020) analyzed parent testimonials from
 249 the anti-vaccination documentary *Vaxxed* and found an association between community building and the
 250 division of people and institutions in two groups: trustworthy — community members such as parents who
 251 do not vaccinate, like-minded online groups, and alternative medical professionals — and adversaries —
 252 governmental agencies and health providers that endorse vaccination protocols.

253 An important aspect of the spreading dynamics of M&D about vaccines is the adoption of different strate-
 254 gies to profit. Although researchers already identified advertisements running on climate misinformation
 255 videos (Allgaier, 2019; Avaaz, 2020) and on videos disseminating M&D about vaccines (Avaaz and SBIIm,
 256 2019), and despite YouTube's statements about measures to fight harmful misinformation on the platform
 257 (O'Donovan, 2019), we found that monetization of these kind of content still persists. We identified 39
 258 brands advertising on 13 videos of our M&D sample. Besides global brands such as *Mobil*, *Kia*, *Fiat*,
 259 *Philips*, *Spotify*, *Eucerin* (Beiersdorf), and *Buscopan* (Boehringer Ingelheim), we found advertisements
 260 from the governments of India and Japan. We also highlight the presence of advertisements from companies
 261 of alternative health and wellness products — *Boiron*, *Lume Deodorant*, *Adler Pharma*, and *Health and*
 262 *Wellness Tools*. It is possible that the brands could be unaware that they are helping to fund channels that
 263 spread M&D about vaccines, although alternative health advertisers are potentially reaching the audience
 264 they want to reach.

265 Although the YouTube Partner Program — advertising revenue, channel memberships, and Super Chat —
266 is an important source of income, it is not the only funding option for content creators (Alexander, 2019).
267 They maintain profiles on fundraising platforms or sell merchandise as well, and selling products and
268 courses is a regular activity, particularly between alternative health channels (Avaaz and SBIm, 2019). For
269 example, the host of the channel *nutrição Alimentos & Cia* encourages the audience to buy alternative
270 health courses in a large number of their videos. To validate these courses, he stresses the adoption of
271 alternative health practices by the Brazilian Unified Health System.

272 Despite YouTube's statements on their fight against misinformation, M&D about vaccines continue to
273 be disseminated in videos in Portuguese, reaching a large audience. For example, five channels from our
274 sample — *nutrição Alimentos & Cia*, *O Melhor Para Você*, *U MIÓ QUE TÁ TENO*, *Dr. Lair Ribeiro*
275 *Oficial*, and *Ana Paula Palagar* — were already identified by Avaaz (Avaaz and SBIm, 2019) and all of
276 them are part of the collaboration's network described in this study (Figure 2). We found that M&D about
277 vaccines are associated with alternative health channels that spread distrust about traditional institutions —
278 public health organizations, physicians, scientists, universities, and mainstream media — to promote and
279 profit with alternative health services. YouTube must adopt transparent approaches to counter M&D and
280 ensure that content creators follow the user policies. The platform also needs to guarantee that M&D will
281 not be financially stimulated through the YouTube Partner Program. Special attention should be given for
282 languages other than English, since YouTube's current policies to fight harmful content do not seem to be
283 applied to these languages.

CONFLICT OF INTEREST STATEMENT

284 The authors declare that the research was conducted in the absence of any commercial or financial
285 relationships that could be interpreted as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

286 DFTM, AFS and LG conceived the study. DFTM and AFS collected the data and wrote the manuscript.
287 All authors read and approved the final version of the manuscript.

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DATA AVAILABILITY STATEMENT

293 The code and datasets generated for this study can be found on GitHub (<https://git.io/JJfVK>).

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