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Anti-vaccine activists, Web 2.0, and the postmodern paradigm – An overview of tactics and tropes used online by the anti-vaccination movement

Anna Kata*

McMaster University, Psychiatry and Behavioural Neurosciences, 555 Sanatorium Road Hamilton, Ontario, Canada L9C 1C4

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ABSTRACT

Websites opposing vaccination are prevalent on the Internet. Web 2.0, defined by interaction and user-generated content, has become ubiquitous. Furthermore, a new postmodern paradigm of healthcare has emerged, where power has shifted from doctors to patients, the legitimacy of science is questioned, and expertise is redefined. Together this has created an environment where anti-vaccine activists are able to effectively spread their messages. Evidence shows that individuals turn to the Internet for vaccination advice, and suggests such sources can impact vaccination decisions – therefore it is likely that anti-vaccine websites can influence whether people vaccinate themselves or their children. This overview examines the types of rhetoric individuals may encounter online in order to better understand why the anti-vaccination movement can be convincing, despite lacking scientific support for their claims. Tactics and tropes commonly used to argue against vaccination are described. This includes actions such as skewing science, shifting hypotheses, censoring dissent, and attacking critics; also discussed are frequently made claims such as not being "anti-vaccine" but "pro-safe vaccines", that vaccines are toxic or unnatural, and more. Recognizing disingenuous claims made by the anti-vaccination movement is essential in order to critically evaluate the information and misinformation encountered online.

1. Introduction

Vaccinations are a significant public health achievement, contributing to dramatic declines in morbidity and mortality from vaccine-preventable diseases [1]. However, by reading certain websites, one might be persuaded to think the opposite – that vaccines are actually ineffective, useless, or even dangerous. These are merely some of the arguments posed by the anti-vaccination movement, an amorphous group holding diverse views that nevertheless shares one core commonality: an opposition to vaccines. The popularity and pervasiveness of the Internet today has facilitated the transmission of such beliefs.

Many people search online for health information, and the information found impacts patient decision-making; it is therefore essential to understand what is shared online. This paper provides an overview of how the new generation of the Internet (Web 2.0) and its emphasis on user-generated content has combined with characteristics of the current postmodern medical paradigm, creating a new environment for sharing health information. The anti-vaccination movement has taken advantage of this milieu to disseminate its messages. Strategies the movement employs, found on various anti-vaccine websites, are then described; this includes various tactics the movement engages in (e.g. misrepresenting science, shifting hypotheses, censorship, attacking their critics), as well as commonly argued tropes (e.g. that they are "pro-safe vaccines", that vaccine advocates are "shills", that vaccines are unnatural, etc.). Such narratives may be compelling, and help anti-vaccination protests persist despite a lack of scientific support. Identifying and analyzing these tactics and tropes is not only an important exercise in critically evaluating medical advice found online, but also a necessary step in ensuring individuals searching online are not misinformed.

2. Web 2.0, health communication, and the postmodern medical paradigm

Though the exact definition of the term "Web 2.0" is debated, its meaning is generally derived from comparison against the first generation of the Internet – Web 1.0 [2]. The main difference between the two is the amount of interaction and user-generated content; whereas Web 1.0 content was controlled by the provider, Web 2.0 allows users to create information. Anybody can contribute content via blogging, photo-sharing, video-uploading, and more. The creation and sharing of user-generated content is supported by applications known as social media (e.g. YouTube, Blogger, Facebook, Twitter, etc.).

* Tel.: +1 905 387 3141.
E-mail addresses: aniakata@gmail.com, kataa@mcmaster.ca

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Web 2.0 facilitates health communication – users can engage and educate others by sharing medical histories, treatment successes and failures, or experienced side-effects [3]. Several salient themes have been identified when using the Internet in this way: the increased participation of patients as "active contributors" in their own care, and their subsequent empowerment; the emergence of online communities and social networking; the sharing and collaboration of knowledge; and the personalization of healthcare [4,5]. These characteristics relate to the current medical paradigm, which is one of postmodernism. The postmodern medical paradigm has developed new priorities for healthcare: an emphasis on values as well as evidence; preoccupation with risks over benefits; and the rise of the informed patient [6]. There has been a transition from the "white coat ethos of the 'traditional' physician" to the current environment of shared decision-making between patients and professionals [7]. Web 2.0 lets patients actively engage in their own care. While medical knowledge was previously bound to textbooks and journals, the Internet allows access to the "school of lay medicine" [8], shifting the locus of power from doctors as sole directors of a patient's care to the patients themselves. Patients are depicted as consumers with access to information diversity, their choices no longer restricted by the higher status allocated to "experts" [9]. In fact, postmodern characteristics of disillusionment and suspicion towards science and the notion of expertise have contributed to decreased trust in "expert systems" [10]. The postmodern medical paradigm questions the legitimacy of science and authority, stressing the need for patients to hold more power [11]. Indeed, it can be argued that in a postmodern society, everybody is an "expert" [12].

Using Web 2.0 for health collaboration has benefits – patient empowerment, consumer reviews and advice, supportive communities – but has drawbacks as well. The connective power of the Internet also brings together those previously considered on the fringe – members of marginalized groups (e.g. Holocaust deniers, 9/11 "Truthers", AIDS deniers) can easily and uncritically interact with like-minded individuals online [13]. There it is easy to fall into a trap of self-referencing and mutually reinforcing links that can fool users into believing there are many who share their beliefs, when in reality it may only be a small, committed group [14]. Web 2.0 has furthered postmodern ideals by "flattening" truth [15]; the infinite personalized truths presented online are each portrayed as legitimate. This is supported by the postmodern characteristic of relativism – that there are no objective facts, but rather multiple meanings and ways of "knowing" [6]. Web 2.0 places carefully scrutinized evidence next to the opinions of crusaders, critics, and conspiracy theorists, potentially weakening messages from qualified experts [16]. New theories are debated in public forums before the scientific community can examine their merits [17]. That officials speak with special authority or knowledge is a concept now rejected by laypeople, as readers encountering expertise may believe themselves to then be experts [18]. This is demonstrated by anti-vaccinationism on the Internet, where self-proclaimed "experts" tout conflicting messages; with the notion that multiple "truths" based on different worldviews are equally valid, evidence-based advice from qualified vaccine experts becomes just another opinion among many [17,19]. Anti-vaccine groups have harnessed postmodern ideologies [20], and by combining them with Web 2.0 and social media technologies, are able to effectively spread their messages.

3. The influence of the Internet on vaccination decisions

Eighty percent of Internet users search for health information online [21]. Those most likely to do so are adults providing unpaid care for loved ones, such as children. The most recent statistics available show 16% of seekers searched online for vaccination information, and of this group, 70% say what they found influenced their treatment decisions [22]. Surveys indicate the Internet now rivals physicians as the leading source of health advice [3].

Despite anti-vaccine messages being more widespread and unrestrained on the Internet than in other media forms [23], the body of research on this topic is not particularly large. A group of studies analyzed anti-vaccination websites for features such as content claims, design attributes, rhetorical appeals, and reasoning flaws [20,23–33]. Common assertions found online included: that vaccines cause illness; they are ineffective; they are part of a medical/pharmaceutical/government conspiracy; and that mainstream medicine is incorrect or corrupt. Misinformation was widespread, in the form of inaccuracies or outright deception.

Research has recently shifted to social media. An analysis of YouTube immunization videos [34] found that 32% opposed vaccination, and that these had higher ratings and more views than pro-vaccine videos; 45% of negative videos conveyed information contradicting reference standards. A YouTube analysis specific to HPV immunization [35] found that 25.3% of videos portrayed vaccination negatively. An analysis of MySpace blogs on HPV immunization [36] found that 43% were negative; these blogs referenced vaccine-critical organizations and disseminated inaccurate data. A study of Canadian Internet users tracked the sharing of influenza vaccine information on social media networks such as Facebook, Twitter, YouTube, and Digg [37]. Of the top search results during the study period, each which had been shared and viewed thousands of times, 60% contained anti-vaccination sentiments.

There is currently no direct evidence on the precise influence of anti-vaccine messages; online exposure linked to real-world harm is as yet anecdotal [38,39]. However, there is evidence that other media forms impact vaccination decisions. A Welsh study found vaccine uptake was significantly lower in the distribution area of a newspaper that ran a campaign against the measles–mumps–rubella [MMR] vaccine, compared with uptake rates in the rest of the country [40]. A Swedish study of parents who postponed or abstained from vaccinating their children found the main source of information for over 80% of respondents was the media [41]. An international study found that countries with anti-vaccination media campaigns had significantly higher rates of pertussis compared to nations with fewer such reports, which maintained higher vaccination levels [42].

In two case-control studies of exempted and fully vaccinated children [43,44], common reasons parents gave for not vaccinating included: fears vaccines might cause harm or overload the immune system; believing their child was not at risk for the disease, or that the disease was not dangerous; that it was better to develop immunity naturally rather than from vaccines; or that the vaccines might not work. These are all popular assertions on anti-vaccination websites. In both studies, parents of exempted children were more likely to have searched the Internet for information than were parents of vaccinated children. Their perception of information sources was revealing – exempting parents reported less trust in official sources (e.g. healthcare professionals, health departments, government agencies) but were more likely to rate the anti-vaccination organization Dissatisfied Parents Together [DPT] as a good/excellent source than were vaccinating parents. Conversely, the good/excellent ratings for the National Vaccine Information Centre [NVIC] were higher from vaccinating parents – yet the NVIC is merely the new, more neutral name of DPT. Not only does this demonstrate problems people may have gauging source credibility, but similar parental responses towards not vaccinating in both studies suggests a pervasiveness of anti-vaccine ideas.

Another study examined how effectively users assessed the accuracy of Internet-based medical information, using the terms "vaccine safety" and "vaccine danger" in search engines [45]; 59% of

student participants thought retrieved sites were accurate on the whole, although 55% of the sites were actually inaccurate on the whole, as defined by the study (i.e. sites were not evidence-based, and argued vaccines were inherently dangerous). The majority of participants (53%) left the exercise with significant misconceptions about vaccines. Research has found that viewing an anti-vaccine website for merely 5–10 min increased perceptions of vaccination risks and decreased perceptions of the risks of vaccine omission, compared to visiting a control site [46]. More importantly, in this study viewing the anti-vaccine website significantly decreased intentions to vaccinate, which persisted five months later – this translated into parents having their children receive fewer vaccinations than recommended [47].

Vaccine decision-makers may be overwhelmed with information. In-depth parental interviews [48] found even those favourable to vaccination were confused by the debate and data provided, leading them to second-guess their choices. When asked where they would turn for further education, 70% of parents would look online, and when explicitly asked whether they would use the Internet, 93% responded affirmatively. Almost all (93%) said they would use a general search engine, and easily produced search terms (e.g. vaccination, MMR vaccine) – when entered into search engines, these terms returned anti-vaccination websites in the first page of results. Such sites are most accessible to users looking for basic information on vaccines, and who therefore may be easily persuaded. Another series of focus groups [49] found that compared to those who fully vaccinated, parents struggling with vaccination decisions were more likely to use a wider variety of resources – they more frequently mentioned using the Internet, and had difficulty assessing source credibility. Only parents of fully vaccinated children trusted their physicians, pharmaceutical companies, or the government; others were distrustful and felt data provided to them was one-sided. This distrust of legitimate information sources is reflected not only in vaccination rates – 11.5% of parents have refused at least 1 vaccine their doctor recommended [50] – but also in surveys where the majority of parents (71%) of unvaccinated children say doctors are not influential in shaping their vaccination decisions [51].

When this multitude of factors – the convenience of searching the Internet, the misinformation present online, the influence other media forms have had on vaccination rates, difficulties assessing source credibility, the effect mere minutes of viewing a negative website has on risk perception, and the lack of trust in authorities – is considered together, it seems inferable that anti-vaccine information from websites and other social media sources would impact vaccination decisions in some way. Despite no direct data on precisely how influential the movement is, the potential for persuasion is not only present, but also is an explicit goal.

4. The online anti-vaccination community

Anti-vaccine sentiments are not a new phenomenon. They can be traced back to the origins of vaccinology, with little change since [52,53]. Pinpointing the beginning of the modern-day anti-vaccination movement may depend on one's age. The airing of a 1982 television documentary, DPT: Vaccine Roulette [54], prompted thousands of parents to withhold pertussis vaccines, inundated pharmaceutical companies with personal-injury lawsuits (many then stopped producing vaccines), and led the US Congress to pass a law protecting vaccine manufacturers while compensating those allegedly harmed by vaccines [55,56]. The documentary was also the impetus for the creation of the organization Dissatisfied Parents Together. Newer generations of parents may be more familiar with Andrew Wakefield's 1998 paper [57]. After Wakefield held a press conference and suggested that MMR vaccine was linked to autism, intense media coverage spread the story worldwide. It was during this wave of anti-vaccine sentiment that books [58] and popular media outlets [59] linking vaccines to various ills followed and received considerable attention; perhaps most influential was the star-power harnessed with the release of a book by actor Jenny McCarthy [60]. Through various appearances on Larry King Live, Good Morning America, and Oprah, where she touted her "mommy instinct" and degree from the "University of Google" [14] (examples of postmodern relativism and self-proclaimed "expertise"), McCarthy became a celebrity spokesperson against vaccines and pushed the issue into the mainstream. A key component of her narrative was bypassing the traditional gatekeepers of medical knowledge by searching for information online.

Copious anti-vaccination websites exist online, and demonstrate considerable diversity. Some sites foster an activist identity, including SafeMinds [61] (which promotes the hypothesis that autism is a novel form of mercury poisoning [62]), Generation Rescue [63] ("Jenny McCarthy's Autism Organization"), and Generation Rescue's blog site, Age of Autism [64] (the "Daily Web Newspaper of the Autism Epidemic"). They have had considerable media influence, even taking out full-page advertisements in major US newspapers [65]. The American-based National Vaccine Information Center [66], the Canadian-based Vaccination Risk Awareness Network [67], and the Australian Vaccination Network [68] portray themselves as neutral watchdog organizations for their respective countries, but in reality dispense information biased against vaccines. Some sites may appear unsophisticated [69], while other promote similar allegations but with a more professional appearance [70]. Prominent "natural" health sites, such as NaturalNews.com, Mercola.com, and Mothering.com tend to not only spread irresponsible health information in general (e.g. discouraging chemotherapy or radiation for cancer treatment, antiretrovirals for HIV, and insulin for diabetes), but also have large sections with dubious information on vaccines [71–73]. Some sites are incredibly popular – Mothering.com, the website for a now-defunct magazine often disparaging of vaccination [74], receives 1.5 million unique visitors per month and has been ranked as the most active online community for parents [75]. Even general news and blogging websites, such as the Huffington Post, have numerous entries on vaccines [76], where articles written by doctors sit side-by-side with celebrity posts by Jenny McCarthy and Jim Carey. All of these websites use various social media platforms, such as Facebook and Twitter, allowing users to further promote and share information. If McCarthy "tweets" about autism or vaccines [77–79], over 450,000 followers (as of this writing) instantly receive her comments and can forward them on to others. Some users even use Twitter to ask her for medical advice [80–82].

These websites are but a sampling of the many in cyberspace, yet all contain arguments that previous anti-vaccination studies [20,23–33] have discussed. The common errors and myths they relay are debunked elsewhere [83–88]. This overview focuses on some of the tactics and tropes used to further such anti-vaccine storylines. The tactics described are the movement's ways of operating – i.e. actions they undertake to spread their messages (see Table 1). The tropes are commonly recurring themes and motifs used to make their arguments – i.e. oft-repeated mottos, phrases, and rebuttals, listed as they are typically phrased on anti-vaccination sites (see Table 2). The tactics and tropes were derived from prior work on quantifying and analyzing broader themes on anti-vaccination websites [20], although discussion of them was beyond the scope of that paper. They are elaborated upon and added to here, although this list is by no means exhaustive and will no doubt evolve over time. The aim of this overview is not to quantify the use

Table 1
Tactics used by the anti-vaccination movement (i.e. actions undertaken to spread their messages).

Tactics	Description
Skewing the science:	Denigrating and rejecting science that fails to support anti-vaccine positions; endorsing poorly-conducted studies that promote anti-vaccine agendas.
Shifting hypotheses:	Continually proposing new theories for vaccines causing harm; moving targets when evidence fails to support such ideas.
Censorship:	Suppressing dissenting opinions; shutting down critics.
Attacking the opposition:	Attacking critics, via both personal insults and filing legal actions.

of these tactics and tropes, but to exemplify what they are and how their spread is facilitated by Web 2.0 and the postmodern paradigm.

Works critiquing the anti-vaccine movement are often accused of being propaganda [89–91]; those on the other side of the issue accuse anti-vaccine activists of propaganda as well [92,93]. The intent here is not to enter that fray. Rather, the purpose is to increase awareness of common anti-vaccine techniques. It is also important to note that the criticisms levied here are not meant to belittle individuals with good-faith questions about vaccines, or those worried or swayed by what they find online – it is easy to succumb to flaws in reasoning, for cognitive or motivational/social reasons (e.g. difficulty detecting biases, a desire for order, false impressions of social support [26]). The tactics and tropes discussed take advantage of such reasoning flaws; indeed, some of the tropes listed are actually logical fallacies. It is an important exercise in critical thinking to be able to identify the misleading arguments that engage audiences through emotional appeals, anecdotes, or fallacious reasoning, rather than through evidence. An awareness of these issues is needed to help audiences recognize and evaluate the information and misinformation they encounter.

4.1. The anti-vaccination movement's tactics

4.1.1. Skewing the science

The anti-vaccination movement often denigrates scientific studies (and the scientific method in general), while simultaneously craving scientific legitimacy for their theories that vaccines are harmful. Science is praised when appearing to bolster their position – such as on the Fourteen Studies website [94], which ranks studies supporting and discrediting the vaccine–autism hypothesis. The ranking system is biased against pro-vaccine studies – for example, the Conflict of Interest criterion reads, "We considered a

Table 2
Tropes used by the anti-vaccination movement (i.e. oft-repeated mottos, phrases, and rebuttals).

Tropes	Description
"I'm not anti-vaccine, I'm pro-safe vaccines":	Denying one opposes vaccination, instead claiming they are for safer vaccines and further research.
"Vaccines are toxic!":	Listing potentially toxic vaccine ingredients while providing disingenuous explanations of their dangers (a.k.a. the "toxin gambit").
"Vaccines should be 100% safe":	Because absolute safety cannot be promised, vaccination is therefore flawed and dangerous.
"You can't prove vaccines are safe":	Demanding vaccine advocates demonstrate vaccines do not lead to harm, rather than anti-vaccine activists having to prove they do.
"Vaccines didn't save us":	Attributing improvements in health over recent decades to factors other than vaccines (e.g. better sanitation).
"Vaccines are unnatural":	Designating something "natural" to be the better option (e.g. naturally acquiring immunity from diseases rather than from vaccination).
"Choosing between diseases and vaccine injuries":	Framing vaccination choices as restricted between undesirable outcomes (e.g. catching a disease versus serious vaccine side-effects).
"Galileo was persecuted too":	Invoking the names of those persecuted by scientific orthodoxy, implying ideas facing close-mindedness will eventually gain acceptance (a.k.a. the "Galileo gambit").
"Science was wrong before":	Citing prior instances of scientific errors to imply the scientific evidence supporting vaccination is also in error.
"So many people can't all be wrong":	Implying anti-vaccine claims are true because many people support such ideas.
"Skeptics believe. . .":	Ascribing false motives to vaccine supporters, which are then easily attacked.
"You're in the pocket of Big Pharma":	Claiming those supporting vaccines do so because they are hired by pharmaceutical companies (a.k.a. the "pharma shill gambit").
"I don't believe in coincidences":	Rejecting that health problems can occur coincidentally after vaccination.
"I'm an expert on my own child":	Redefining expertise, where parents are the experts on their own children while medical authorities are discounted.

scientist employed by a vaccine maker or a study sponsored by a vaccine maker to have the highest degree of conflict, with a public health organization (like the CDC) to be the second-worst." [95] A "good" study listed is by David and Mark Geier [96], a father-son team involved in questionable practices [97–100]. The Institutional Review Board overseeing the Geiers' studies was created and staffed by themselves, their family members and associates, and a lawyer working on vaccine injury suits [101] – Fourteen Studies does not acknowledge these conflicts of interest. Meanwhile, the pro-vaccine study scoring highest (5 out of 40) only received the ranking "because it appears to actually show that MMR contributes to higher autism rates" [102]. Studies refuting the vaccine–autism hypothesis are rated poorly while those supporting it are rated highly, despite repeated critiques of that research [103,104].

The movement constantly demands more research – namely in the form of randomised controlled trials comparing vaccinated versus unvaccinated children [105,106], expecting results will show unvaccinated children to be healthier. Various obstacles – e.g. the ethics of leaving children unvaccinated, or the logistics of recruiting enough subjects to sufficiently power a study [107] – make conducting such a study virtually impossible. These obstacles are not mentioned when making such demands. Properly conducted work on the issue that already exists, yet comes to the "wrong" conclusion, is rejected. For instance, Sallie Bernard (President of SafeMinds) provided input on the design of a study examining thimerosal exposure and neuropsychological outcomes [108]; it was only when results indicated no link between vaccines and neurodevelopment that she resigned and began criticizing the study's methods [109,110]. These are indications that the issue is about ideology rather than science. The democratization of data facilitated by Web 2.0 may allow for greater access to scientific information, but when combined with postmodern notions of relativism and questioning expertise, research can be reinterpreted in various ways to support specific ideologies.

4.1.2. Shifting hypotheses

Scientific studies have repeatedly refuted allegations that vaccines are harmful, forcing the anti-vaccination movement to continually propose new theories. When various studies failed to find a connection between MMR and autism [111–114], the culprit then became thimerosal and autism was rebranded as mercury poisoning [62]. Proponents of this theory predicted that after removing thimerosal from vaccines, autism rates would drop [115,116]. When this decrease did not occur by 2006, and then 2007 [117–121], the target date was pushed back to 2011 [122]. Rationalizations for the decrease not occurring included: mercury floating over from Chinese coal smoke, being released by forest fires, or being discharged when cremating individuals with mercury fillings [123]. When the mercury hypothesis floundered, the new culprit became aluminum [124,125]. When the Vaccine Injury Compensation Program settled a case where vaccines may have exacerbated a child's condition, autism was again rebranded as a misdiagnosis for mitochondrial disorders [126,127].

The vaccine–autism hypothesis has repeatedly shrunk – first vaccines themselves were a major cause of the "autism epidemic", then specific vaccine components led to autism misdiagnoses, and then vaccines exacerbated the condition only in rare cases [128]. Broadening the scope of vaccine protests again, "Green Our Vaccines" then became the movement's rallying cry [129,130] – the idea being that vaccines would be safer after removing "poisons" and "toxins" contained within. Another motto is "Too Many, Too Soon", the notion that children receive too many vaccines at too young an age, overwhelming their immune system before it has fully matured [131,132]. Web 2.0 facilitated the debate of these new theories in public forums before their merits could be examined scientifically; when they were studied, the theories were not supported [133]. The targets established by anti-vaccine activists are continually being redrawn in order for their key messages to endure in the face of contradictory evidence.

4.1.3. Censorship

The anti-vaccination movement is extremely disparaging of those criticizing them, to the point of censoring dissenting opinions. The Age of Autism blog often refuses to post critical comments under the guise of "comment moderation" or the need to "have a safe environment to talk within" – this prompted the creation of counter-blogs, such as Silenced by Age of Autism [134,135], where rejected comments are posted. Mothering.com hosts a community vaccination forum with thousands of threads and hundreds of thousands of individual posts by parents. The vaccination forum policy reads: "We would like all members to understand that this forum is not an anti-vax forum but rather is a forum to discuss issues and concerns so that parents can make an informed decision. We are not, however, interested in hosting discussions advocating for mandatory vaccination." [136] Posts opposing anti-vaccination views or supporting vaccines are removed, apparently due to "agenda-focused behaviour" [137]. While the connective power of Web 2.0 has created supportive communities, these may act as echo-chambers, where one point of view is unquestioningly repeated and reinforced while critiques are expunged.

More underhanded methods have also been used to silence vaccine advocates. For example, Orac is the pseudonymous author of the Respectful Insolence blog, which often censures the anti-vaccination movement. A misspelling of the domain name of his other website, oracknows.blogspot.com, was bought by JB Handley, co-founder of Generation Rescue [138] – oracknows.com redirects to generationrescue.org [139]. Posts at Age of Autism also alleged Orac has pharmaceutical ties, as his university received pharmaceutical company funding [140]; one commenter posted the university's address, which was bombarded with complaints regarding the supposed conflict of interest in attempts to have him fired [141]. More recently, another public health blogger was forced to cease all social media activities when a critic complained about his pro-vaccine opinions to his employer [142].

4.1.4. Attacking the opposition

Anti-vaccine activists have filed legal actions against their critics. After one blogger wrote about a family's vaccine lawsuit [143], she was subpoenaed [144] despite no involvement in the case. Handley sued Dr. Paul Offit, author of books critical of the movement [56,145], for a particular passage he wrote [146]. Barbara Loe Fisher, co-founder of the National Vaccine Information Center, sued Offit and journalist Amy Wallace for libel over a comment Offit made in Wallace's Wired magazine article [147] – specifically, "She [Fisher] lies." [148] The British publishers of Offit's latest book [56] were threatened with a libel suit over a sentence suggesting a lawyer paid Andrew Wakefield to conduct his infamous study for litigation purposes [149].

Some anti-vaccine activists attack their detractors in more personal ways. Dr. Offit is often called a "biostitute" (i.e. a 'bioscience prostitute') or Dr. "Proffit" [150]; he has even received death threats [145]. After publication of her article on the anti-vaccination movement [147], Wallace endured various misogynistic slurs [151,152]. After journalist Trine Tsouderos' articles on biomedical treatments for autism were published [153–155], her writings were criticized and motives impugned [156–159]. After Seth Mnookin's book [14] was released, his journalistic integrity was assailed [160]. Moving beyond verbal attacks, for Thanksgiving 2009 the Age of Autism blog posted a Photoshopped image showing Wallace, Tsouderos, Offit, and other vaccine advocates sitting down to a dinner of a dead baby [161]. Rather than debating the merits of the evidence,

the anti-vaccination movement tries to win through intimidation. Web 2.0 makes it easy for their protests to be heard.

4.2. Common anti-vaccination tropes

4.2.1. "I'm not anti-vaccine, I'm pro-safe vaccines"

A common evasion is denying one opposes vaccination, but instead is for safer vaccines [162,163]. Some oppose the label of "anti-vaccine", complaining it is pejorative and deflects attention away from legitimate questions and gaps in scientific knowledge [91,164] – for instance, claims that vaccines are not adequately studied [165,166]. This is difficult to argue against, for who objects to safe vaccines or further research? Yet calls for "a balanced, scientific, and safe approach to vaccination" [167] tend to be misleading, due to the erroneous and distorted information coming from those making this assertion [168]. Such websites promote informed consent and doing research before vaccinating, but tend to subtly *mis*inform readers with worrisome and unsupported claims.

4.2.2. "Vaccines are toxic!"

Many websites list toxic ingredients supposedly in vaccines (e.g. ether, anti-freeze, formaldehyde, aborted fetal tissues, animal viruses, and foreign DNA [169,170]). This is known as the "toxin gambit". While some ingredients listed are technically present, explanations of their dangers are often disingenuous. Their risks are frequently emphasised in terms of larger or prolonged exposure, not acknowledging that "the dose makes the poison". Nor is it mentioned that some substances occur naturally in the human body (e.g. formaldehyde [171]), or accumulate in greater amounts through acts such as breastfeeding (e.g. aluminum [172]). Variants on the toxin gambit include "Vaccine Challenges" issued to doctors, offering cash rewards in exchange for injection with infant vaccines adjusted for adult weight, to prove they are safe; with no applicants accepted, challengers claim that doctors do not trust the vaccines they administer [173]. Also, a Vaccine Ingredients Calculator [174] shows exposure to various ingredients via vaccination, but the results are deceptive – for instance, comparing aluminum from a one-time vaccine dose to the daily estimated safe dose based on chronic, long-term exposure, making the vaccine dose appear dangerous [175].

4.2.3. "Vaccines should be 100% safe"

Anti-vaccine activists may claim that because vaccination is not perfect, it is therefore flawed – yet even if vaccines were perfectly safe, some still would not vaccinate [176]. A document on numerous websites is the Physician's Warranty of Vaccine Safety [177], meant to intimidate doctors by asking them to promise something they cannot – namely, absolute safety. This ignores the fact that nothing can ever be 100% safe; it also ignores the complexity of the issue, in that vaccines are safer than allowing vulnerability to the diseases they prevent. This exemplifies the postmodern preoccupation with risks over benefits.

4.2.4. "You can't prove vaccines are safe"

This accusation demands vaccine advocates demonstrate vaccines do *not* lead to harm [178], rather than anti-vaccine activists having to prove they *do*. Claims such as "There is no definitive research proving a link between vaccines and autism or ADD, but there is also no definitive research ruling it out" or "Those who say autism and ADD are not linked to vaccines do not know what is causing the epidemics" [179] imply that because there is no conclusive answer to certain problems, vaccines remain a plausible culprit. This involves arguing based on a lack of evidence – not knowing something is true is taken as proof it is false, or not knowing something is false is proof it is true. Likewise, because there have been no studies conducted with the specific conditions anti-vaccination groups ask for [180], this lack of knowledge means vaccines are not safe. Lists of questions to ask vaccine proponents [181] are circulated with the intention of stumping them, with the inability to answer taken as evidence against vaccination.

4.2.5. "Vaccines didn't save us"

Rather than acknowledge the role vaccines played in improving health over recent decades, those gains are instead attributed to factors such as cleaner water, better sanitation, and less crowding [182]. This claim is usually accompanied by graphs [183] showing deaths from vaccine-preventable diseases were declining before vaccines were introduced. That mortality rates would have been decreasing due to improving medical and supportive care is not explained. Graphs showing decreasing disease *incidence* after vaccine introduction would be evidence of their efficacy, and are omitted.

4.2.6. "Vaccines are unnatural"

This designates something "natural" as being inherently good or right, while what is "unnatural" is bad or wrong. Vaccines are unnatural and therefore bad [184]. Acquiring immunity from diseases is natural and therefore the better approach [185], such as through "chickenpox parties" [186]. This logic overlooks higher risks from natural infection while fixating on comparably minute risks from vaccination. Alternative approaches may be seen as more "natural" than vaccination [187]; such options may be couched in terms of "health freedom" [188].

4.2.7. "Choosing between diseases and vaccine injuries"

Vaccination may be portrayed in terms of misleading dichotomies – e.g. the unlikelihood of catching a disease versus the supposedly greater likelihood of a vaccine injury, or the possibility of vaccine side-effects more serious than the diseases prevented. One blogger claims that vaccination is "Making parents choose between chronic and infectious disease" [189], while Jenny McCarthy has declared that "It shouldn't be polio versus autism" and "If you ask a parent of an autistic child if they want the measles or the autism, we will stand in line for the f***ing measles." [190] Such framing restricts the possible outcomes when others exist (e.g. vaccination without side-effects).

4.2.8. "Galileo was persecuted too"

Known as the "Galileo gambit", names such as Galileo, Semmelweiss, Copernicus, or other great minds attacked by the scientific orthodoxy of their time are invoked by those whose arguments are criticized [191,192]. This is related to the concept of the "brave maverick doctor" whose work flies in the face of the status quo and is considered heresy against the establishment. The implication is that ideas currently facing close-mindedness and persecution will eventually be accepted as truth.

4.2.9. "Science was wrong before"

Instances where science erred or was slow to acknowledge the dangers of something proclaimed to be safe (e.g. Vioxx, Thalidomide, or cigarettes [179,193]) are cited. The implication is that because of previous errors, the science supporting vaccination is also in error; this overlooks the self-correcting nature of the scientific method. This is related to the declaration that "science doesn't have all the answers" or the appeal to "another way of knowing", where it is alleged that science is not the only source of "truth" – a very postmodern assertion [20].

4.2.10. "So many people can't all be wrong"

Asserting that many children have been harmed by vaccines [194], that many people do not vaccinate [195], or that many

doctors question vaccination [196], does not make such claims true. For example, petitions signed by medical professionals opposed to vaccines [197] are held up as evidence against vaccination, despite signatories being in the minority among practitioners. The constant repetition of this and other tropes on various websites can fool readers into thinking anti-vaccination opinions expressed are shared by many.

4.2.11. *"Skeptics believe..."*

False motives are often ascribed to vaccine supporters, who are labelled as skeptics – for example, "Skeptics believe that ALL vaccines are safe and effective (even if they've never been tested), that ALL people should be vaccinated, even against their will, and that there is NO LIMIT to the number of vaccines a person can be safely given" [198] or "You believe everything about Autism is a coincidence." [199] These straw men not only misrepresent pro-vaccine positions and ignore the original issues, but also create easy targets which are then attacked instead.

4.2.12. *"You're in the pocket of Big Pharma"*

Colloquially called the "pharma shill gambit", this alleges those who defend vaccines do so because they are hired to promote pharmaceutical products for devious purposes or profit [200]. Dr. Offit is continually discounted because Merck bought the rights to his rotavirus vaccine, making him "a shill, the vaccine industry's most prolific propagandist." [201] After Amy Wallace's article, Wired published a follow-up in response to allegations of pharmaceutical company ties [202]. This forces the accused to defend themselves, rather than arguing the evidence.

4.2.13. *"I don't believe in coincidences"*

This argument rejects that health problems may coincidentally occur after vaccination without having been caused by the vaccine. At the individual level, this involves anecdotes about negative reactions occurring in children near the time of vaccination, with the vaccine blamed [203,204]. At the population level, the argument is that the increasing number of vaccines added to the immunization schedule over recent years has led to simultaneously increasing rates of autism (i.e. an "autism epidemic") and other illnesses [205,206]. This disregards factors such as changing diagnostic criteria or increased autism awareness [207]. That correlation does not prove causation is ignored, or even ridiculed [208].

4.2.14. *"I'm an expert on my own child"*

Genuine authorities on vaccines are denigrated for supporting vaccination and belittled as not having appropriate expertise [209]. Central to this issue is parents considering themselves the experts on their own children [210], claiming they have done their own research and again demonstrating the postmodern characteristic of redefining expertise. Alternatively, appeals may be made to authorities who are not experts on the particular subject – e.g. touting the late anti-vaccine spokesperson Bernadine Healy as an authority based on her former position as Director of the National Institutes of Health [211], doctors criticizing vaccination despite no training in immunology [212], or doctors noticing certain reactions in their patients after vaccinating or not vaccinating, implying they have special insight into the issue [213,214]. Authorities are invoked when they support the desired opinion.

5. Conclusion

The techniques used by the anti-vaccination movement are cunning, for not only are their protests camouflaged in unobjectionable rhetoric such as "informed consent", "health freedom", and "vaccine safety", they take advantage of the current postmodern medical paradigm. Calls to "do your own research before vaccinating" dovetail with the postmodern characteristics of patient empowerment and shared decision-making, where individuals play a more involved role in their healthcare. The Internet provides easy access to online health information, and through the redefinition of expertise and notion of relativism, postmodernism allows for that information to be interpreted in various ways – rather than an interpretation being "wrong", it can be reframed as "another way of knowing". With this paradigm in place, it is not difficult to see how Internet users attending "Google University" may be convinced by what they might find. Some anti-vaccine arguments may at first seem reasonable and to hold a grain of truth; the various tropes encountered, particularly when repeated through various channels, may make vaccinating seem like an extremely risky proposition. Rather than creating "informed patients", Web 2.0 is used by the anti-vaccination movement to spread fear, uncertainty, and doubt, thereby creating "*mis*informed patients".

What solutions exist to quell these fears? Some proposals include "immunizing" against misinformation through education [30,215], using emotional appeals [216,217], or even harnessing social media in return – such as by creating web-based decision aids about vaccination [218], using real-time Internet tracking to determine public attitudes [37], or launching social media campaigns [219,220]. While it is important to attempt such efforts and combat the misinformation that exists, it is doubtful that the anti-vaccination movement can ever be completely quashed. For instance, emotional narratives about vaccine side-effects have been found to increase risk perception and uptake intention to a greater extent than statistical information [221], demonstrating the power of emotional appeals and anecdotes over educational efforts. With many people desperate for answers, invested in their belief systems, and distrustful of authorities, it is unlikely that "the facts" alone will ever sway the truly committed [20,222]. Some individuals choose to disregard the evidence, and are essentially denialists [223].

That is not to say there is no reason for optimism, for the pendulum is now swinging in the other direction. Whereas prior coverage was supportive and largely unquestioning [163,224], popular media outlets have begun to lambaste the anti-vaccination movement. Various articles [147,225–227] have condemned the movement and its representatives; a PBS Frontline documentary [228] did not portray the movement in a positive light; and Robert F. Kennedy Jr.'s error-laden article on vaccines and thimerosal was removed from Salon.com, after acknowledging that keeping even a corrected version posted was a disservice to the public [229]. Such coverage is distinct from past reporting in that it largely ignored the journalistic mantra of "balance", where both sides of the issue are afforded equal time and respect, thus equating the positions. A particularly large blow to the movement's credibility was dealt by investigative journalist Brian Deer, whose series of articles exposed Andrew Wakefield's research as fraudulent [230–232]. However, these revelations did not appear to matter to Wakefield's followers and to others who distrust vaccines, as evidenced by numerous statements of support [233–235]; Handley even said, "To our community, Andrew Wakefield is Nelson Mandela and Jesus Christ rolled up into one. He's a symbol of how all of us feel." [236]

Such a statement is a reminder that finding common ground with those who question, fear, or crusade against vaccines is no easy task. Their arguments are constantly shifting and evolving – this has been furthered by the fluidity of the Internet and social media. While acknowledging and correcting flawed arguments is important, an approach that moves beyond providing "the facts" is likely needed. With the anti-vaccination movement embracing the postmodern paradigm, which inherently questions an authoritative, science-based approach, "facts" may be reinterpreted as just another "opinion". This issue is as much about the cultural context

surrounding healthcare, perceptions of risk, and trust in expertise, as it is about vaccines themselves. For these reasons it is possible the minds of deeply invested anti-vaccine activists may never be changed; therefore it is for both the laypersons with genuine questions or worries about vaccines and the healthcare professionals who work to ease their fears that keeping abreast of the methods of persuasion discussed here is essential. Recognizing anti-vaccine tactics and tropes is imperative, for an awareness of the disingenuous arguments used to cajole and convert audiences gives individuals the tools to think critically about the information they encounter online. It is through such recognition that truly informed choices can then be made.

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