

Vaccines, Social Media and the Public Health

by

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Introduction –Vaccines and Vitriol

Couples have babies, whether adopted or birthed, and raise children. That’s not typically national news, unless of course you are Mark Zuckerberg and his wife Priscilla Chan. Zuckerberg, who is chairman, CEO, and co-founder of Facebook, has over 90 million followers and his every personal and professional move is discussed by national media and followers alike. In 2016, when Mark announced that baby Max was ready for her first vaccine series, the web exploded with thoughts, advice, and critiques of the action including over 70,000 comments, many by anti-vaccine proponents including the quotes below (<<https://www.facebook.com/zuck?fref=nf>>, <<https://www.washingtonpost.com/news/morning-mix/wp/2016/01/11/mark-zuckerberg-angers-anti-vaxxers-with-photo-of-baby-at-doctors-office-getting-vaccinations/>>).

1. *Injecting newborns and infants with disease and neurotoxins is disgusting science that injures millions every year. ... Shame on all of you and your souls.*
2. *Poor baby.... Forget those natural immunities we got the good stuff right here in this syringe.*
3. *I am sorry to see you unnecessarily putting your kid at risk by responding to faux science and propaganda.*

Who knew that a routine childhood experience would raise such ire? And where do critics of vaccines get information regarding vaccine public health value or toxicity? Are these opponents immunologists, medical experts, or microbiologists? Have they read the scientific literature or carried out experiments to demonstrate a link between vaccine administration and adverse events such as death, neurological impairment, and physical disability? Or are their opinions shaped and formulated through social media, personal experience, and cultural bias? If it’s any of the explanations provided in the previous sentence, then their opinions are unwarranted and most likely grounded in pseudoscience. These individuals have failed to apply the scientific method (or accessed information derived from its application)—in particular, testing hypotheses to provide empirical support for their conclusions. When searching the web for information and guidance regarding personal health issues, it is important to remember that you can’t always believe what you read. Rather, it is imperative that you evaluate statements/posts/blogs critically to determine if the information is based upon research using the scientific method.

Assignment

View the following videos:

- Basic “earworm” on the steps of the scientific method (running time: 3:08 min). <<https://youtu.be/wlb7tLJy5AI>>
- Video clip “interview show” (original production) *Chit Chat with Carol Conley* (running time: 6:58 min). <<https://youtu.be/lqPvgLtB4Fo>>.

Part I – Science vs. Pseudoscience

The demarcation between science and pseudoscience has been debated by some and the use of the term “pseudoscience” dismissed by others. However, if we focus on the scientific process—*utilizing a set of defined methods (experimental analysis) to approach problems*—a clear difference emerges because pseudoscience statements arise from *opinion without or contrary to experimental analysis*, i.e., unwarranted opinion.

Network television talk shows often present “science” discussions. Dr. Phil, Ellen, Steve Harvey, personalities on *The View* and *The Talk*, and many others bring in guests who tell stories that often revolve around characters such as villains, victims, and heroes. These stories, or anecdotes, are usually emotional and appeal to the audience by tugging at their heartstrings. Media personalities (heroes) often strive to defend the “weak” (children as victims) against the strong (“big pharma” as villains). Anecdotes make for great entertainment because a function of media—either traditional or social—is to entertain, thus resulting in confusion for a public trying to distinguish medicine from quackery or science from pseudoscience.

Recall from the videos you viewed that in a scientific study, a hypothesis—an exploratory supposition that can be tested—is formulated after identifying a problem or study area about which one has asked several questions. Experiments and/or studies are then constructed and conducted using appropriate controls and variables to test the hypothesis. Once data is generated, it is evaluated in an objective manner, conclusions are drawn, and the hypothesis is either supported or rejected and reformulated. Although often presented in a linear fashion, steps of the scientific method may circle back to the hypothesis or experimental details for modification as necessary. It is important that experimental results be reproduced by others in the particular scientific field; in other words, independent confirmation of the study’s conclusions must take place—thus science is “self-correctable.” If a study/experiment cannot be repeated, the experimental conclusions are called into question, requiring further investigation. Unfortunately social media and network TV shows often fall into the single study trap, reporting only a preliminary study without following up on confirming or conflicting studies, and thus failing the repeatability test.

Questions

1. The *Chit Chat with Carol Conley* talk show hosted two guests. Which guest(s), Dr. Amy Ashton or Mr. Josh Jenkins, seemed to discuss details from a scientific perspective? Which guest(s) discussed the details from a pseudoscience perspective? Provide a rationale for your determination.
2. Was any empirical evidence (data) presented during the talk show? If the answer is yes, summarize the details.
3. Did any of the guests share stories or anecdotes to support their statements? If so, identify the guest(s) and the associated details in his/her (their) story.

4. Read the three Facebook posts in the Introduction to the case. If possible, in each post (1, 2, and 3), identify the victim, the villain, and the hero. If one or more roles are missing in the post, provide suggestions for individuals or groups that could function as the missing characters.

5. Do the individual posts in the Introduction reflect unwarranted opinions, anecdotes, or statements resulting from analysis of empirical data?

6. Characterize each post (1, 2, and 3) as either science (related) or pseudoscience (related). Explain your choice.

7. Another Facebook follower of Zuckerberg's posted the following comment:
How about you do the research yourself? This is doable. Compare existing data and see if there is a higher instance of vaccinated kids that get autism. Say you find that 3 percent of kids who get vaccinated get autism and 1 percent of kids who do not get vaccinated get autism. Then you would have found the proof that makes you right.
 - a. Is there a hypothesis (either stated or implied) in the above post? If yes, then identify the hypothesis.

 - b. Briefly describe the analysis of data you would perform to test your hypothesis.

 - c. Identify the acceptable limits (statistics) of your analysis. What difference (vaccinated vs. unvaccinated) indicates a significant connection between vaccines and autism (1%, 5%, 10%)? What tools do you use to determine this number? (For a quick reference on statistical significance, see: <http://www.dummies.com/education/math/statistics/what-a-p-value-tells-you-about-statistical-data/>)

 - d. Assume that your hypothesis has been supported by your data and analysis. What additional information/details would be necessary to gain acceptance as a legitimate scientific study?

Part II – Political Discussions

In the vigorously contested primary election for the 2016 Republican U.S. presidential nominee, questions about vaccines were asked in light of the measles outbreak originating in California at the time. What follows are some soundbites/tweets from three of the candidates:

Donald J Trump@realDonaldTrump

You take this little beautiful baby, and you pump — I mean, it looks just like it is meant for a horse, not for a child, and we had so many instances, people that work for me, just the other day, 2-years-old, beautiful child went to have the vaccine and came back and a week later got a tremendous fever, got very, very sick, now is autistic. –Sept 2015

Sen. Rand Paul (R-KY) (speaking to an interviewer)

- *I've heard of many tragic cases of walking, talking normal children who wound up with profound mental disorders after vaccines. I am not arguing vaccines are a bad idea. I think they are a good thing. But I think a parent should have some input. –CNBC, Feb 2, 2015*

Carly Fiorina, former Hewlett-Packard CEO

- *So a parent has to make that trade-off. I think when we're talking about some of these more esoteric immunizations, then I think absolutely a parent should have a choice and a school district shouldn't be able to say, "sorry, your kid can't come to school" for a disease that's not communicable, that's not contagious, and where there really isn't any proof that they're necessary at this point. –Iowa Freedom Summit, Des Moines, Iowa, Jan 24, 2015*

Questions

1. Are the speakers presenting empirical evidence, anecdotes, or unwarranted opinions? Support your identification with details from each post.
2. In her post, Carly Fiorina uses the terms “contagious,” “communicable,” and “esoteric.”
 - a. Provide a scientific definition for the first two terms and a dictionary definition of the third term.
 - b. View Table 1 (next page) regarding recommended childhood vaccinations. Based upon your definitions and information in the table, characterize each vaccine-preventable disease listed in Table 1 into one of the following categories: non-communicable, communicable, contagious, and esoteric.
3. Given your analysis of details (answers to questions and vocabulary definitions), determine if the statements attributed to each of the three politicians reflect either established science or pseudoscience. Support your conclusions.

Table 1. Childhood Diseases and Available Preventative Vaccines. *CDC.gov*: <<http://www.cdc.gov/vaccines/schedules/easy-to-read/child.html#print>>

| <i>Disease</i> | <i>Vaccine</i> | <i>Disease spread by</i> | <i>Disease symptoms</i> | <i>Disease complications</i> |
|----------------------|---|--|---|---|
| Chickenpox | Varicella vaccine protects against chickenpox. | Air, direct contact | Rash, tiredness, headache, fever | Infected blisters, bleeding disorders, encephalitis (brain swelling), pneumonia (infection in the lungs) |
| Diphtheria | DTaP* vaccine protects against diphtheria. | Air, direct contact | Sore throat, mild fever, weakness, swollen glands in neck | Swelling of the heart muscle, heart failure, coma, paralysis, death |
| Hib | Hib vaccine protects against Haemophilus influenzae type b. | Air, direct contact | May be no symptoms unless bacteria enter the blood | Meningitis (infection of the covering around the brain and spinal cord), intellectual disability, epiglottitis (life-threatening infection that can block the windpipe and lead to serious breathing problems), pneumonia (infection in the lungs), death |
| Hepatitis A*** | HepA vaccine protects against hepatitis A. | Direct contact, contaminated food or water | May be no symptoms, fever, stomach pain, loss of appetite, fatigue, vomiting, jaundice (yellowing of skin and eyes), dark urine | Liver failure, arthralgia (joint pain), kidney, pancreatic, and blood disorders |
| Hepatitis B | HepB vaccine protects against hepatitis B. | Contact with blood or body fluids | May be no symptoms, fever, headache, weakness, vomiting, jaundice (yellowing of skin and eyes), joint pain | Chronic liver infection, liver failure, liver cancer |
| Flu | Flu vaccine protects against influenza. | Air, direct contact | Fever, muscle pain, sore throat, cough, extreme fatigue | Pneumonia (infection in the lungs) |
| Measles | MMR** vaccine protects against measles. | Air, direct contact | Rash, fever, cough, runny nose, pinkeye | Encephalitis (brain swelling), pneumonia (infection in the lungs), death |
| Mumps | MMR** vaccine protects against mumps. | Air, direct contact | Swollen salivary glands (under the jaw), fever, headache, tiredness, muscle pain | Meningitis (infection of the covering around the brain and spinal cord), encephalitis (brain swelling), inflammation of testicles or ovaries, deafness |
| Pertussis | DTaP* vaccine protects against pertussis (whooping cough). | Air, direct contact | Severe cough, runny nose, apnea (a pause in breathing in infants) | Pneumonia (infection in the lungs), death |
| Polio | IPV vaccine protects against polio. | Air, direct contact, through the mouth | May be no symptoms, sore throat, fever, nausea, headache | Paralysis, death |
| Pneumococcal Disease | PCV vaccine protects against pneumococcus. | Air, direct contact | May be no symptoms, pneumonia (infection in the lungs) | Bacteremia (blood infection), meningitis (infection of the covering around the brain and spinal cord), death |
| Rotavirus | RV vaccine protects against rotavirus. | Through the mouth | Diarrhea, fever, vomiting | Severe diarrhea, dehydration |
| Rubella | MMR** vaccine protects against rubella. | Air, direct contact | Children infected with rubella virus sometimes have a rash, fever, swollen lymph nodes | Very serious in pregnant women—can lead to miscarriage, stillbirth, premature delivery, birth defects |
| Tetanus | DTaP* vaccine protects against tetanus. | Exposure through cuts in skin | Stiffness in neck and abdominal muscles, difficulty swallowing, muscle spasms, fever | Broken bones, breathing difficulty, death |

* DTaP combines protection against diphtheria, tetanus, and pertussis.

** MMR combines protection against measles, mumps, and rubella.

*** Hepatitis A vaccine not a required childhood vaccine in the US, although recommended for travelers.

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Part III – What Is a Vaccine and What Is in It?

Before attempting this section, review the material presented in the video and website below.

- *How a Vaccine Works*. Running time: 7:18 min. Created by MITK12 Videos, 2012. <<https://youtu.be/7MaiT5w5NWQ>>
- *How Vaccines Work*. Interactive web site created by The College of Physicians of Philadelphia that provides an introduction to cells of the immune response. <<https://www.historyofvaccines.org/content/how-vaccines-work>>

In the introduction to the case, several posts critical of vaccination were provided. Post #1 mentions injection with “neurotoxins.” And while it is difficult to determine the source of the poster’s information, the reference to neurotoxins may be linked to a vaccine component called thimerosal (mentioned in the *Chit Chat with Carol Conley* video), a methyl mercury compound formerly used as a preservative in multi-use vials of vaccine. As of 2003, required childhood vaccines in the United States were free of thimerosal (influenza vaccine is an exception but is not a required vaccine for school entry in most states). In many other countries the compound was removed in the early 1990s.

The first post in the introduction also refers to vaccines containing “disease.” Vaccines contain modified or attenuated whole pathogens (infectious agents such as bacteria and viruses) or subcellular components of pathogens that are unable to cause disease. The modified pathogens, or their components, serve as antigens to stimulate an immune response to protect the vaccine recipient from disease.

Post #3 in the introduction suggests babies have “natural immunities” to the infectious agents that vaccines protect against. If humans have a protective response that can occur naturally without medical intervention, why does the medical community overwhelmingly support vaccination programs?

Questions

1. Post #1 in the introduction identifies vaccines as containing “disease.” How was use of the term “disease” by the poster incorrect with regard to vaccine composition?
2. In spite of the removal of thimerosal from many childhood vaccines, several scientific reports have concluded that the incidence of autism has continued to rise regardless of vaccine composition.
 - a. Given this information, formulate a hypothesis.
 - b. Does the following scientific study on autism incidence support your hypothesis?
Hurley, Anne M., D. Mina-Tadrous, Elizabeth S. Miller. 2010. Thimerosal-containing vaccines and autism: a review of recent epidemiologic studies. *J Pediatr Pharmacol Ther.* 15(3): 173–181, <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3018252/>>.
 - c. Some parents say they opted out of MMR vaccine for their children because it contains the mercury compound thimerosal. Identify the components of the MMR vaccine. Does it now or did it in the past contain thimerosal?
3. What are “natural immunities”? Are these the same as immune responses generated as a result of vaccination? (Refer to the material presented in the two links at the top of this page to review the cells and proteins involved in an immune response.)

Part IV – It’s About the Herd

In response to the 2014–2015 measles “outbreak” in California that originated in Disneyland, Governor Jerry Brown signed a bill (SB 277) that “eliminates religious and philosophical exemptions” to required school vaccines. Consequently, only documented health objections are accepted to opt-out of childhood vaccines required for admission to public school in California. Home schooled students remain exempt. During deliberation of the bill, vaccine compliance supporters found a good example for their cause, seven-year-old Rhett Krawitt, a leukemia patient who was not able to be protected through routine vaccination because of his weakened immune system. Ryan’s parents boldly asked school authorities to ban unvaccinated children from school attendance because they posed a threat to Rhett’s health. The entire family later testified in support of SB 277.

Rhett Krawitt’s situation emphasized that the community should not only be concerned about individual children and vaccine preventable disease but also about members of the community who need to be protected but can’t receive vaccination. If a majority (for measles it is 95% but the percentage differs for various infectious diseases) of a population is vaccinated, infectious agents cannot find susceptible hosts, thus outbreaks typically die out in a short time frame and morbidity and mortality are kept low. This is known as herd immunity (also called community immunity).

But social media posts reveal that not everyone agrees on or accepts the important role of herd immunity, as strongly stated in the blog post below.

The fact is that CDC works for big pharma/special interests not public safety as the CDC whistle blower documents prove. The fact is that this is about money not public safety. The fact is that some of these vaccines have little benefit/effectiveness and serious risks. The fact is real natural immunity and vaccine derived immunity are not the same thing at all and our babies would be protected from many/most infectious diseases if their mothers were allowed to have natural immunity and pass it to their babies in breast milk, and we had true herd immunity through adults who had life long natural immunity. The fact is vaccine induced immunity typically does not hold for long and often misses the target, and the neurotoxins and foreign ingredients/DNA, etc. are causing a generation of allergic/arthritis/immune system damaged children and adults. The fact is immunocompromised children can die from cold or flu viruses and bacteria so there is always risk when they leave their homes and go into a school/ public setting and no amount of vaccination will remove those risks. –Aug 2015

Let’s consider the above post in the context of previously presented information and Table 2, which displays information on vaccine efficacy in Great Britain (England and Wales).

Table 2. Impact of Selected Vaccine Introduction on Disease Incidence in Great Britain¹.

| Vaccine Introduction Year | Disease | Pre-vaccine Cases ² | Cases 2014 | % Reduction | Location |
|---------------------------|--|--------------------------------|------------|-------------|------------|
| 1942 | Diphtheria | 50,804 | 1 | 99.9% | Eng./Wales |
| 1957 | Pertussis | 92,407 | 3,506 | 96.0% | Eng./Wales |
| 1968 | Measles | 460,407 | 130 | 99.9% | Eng./Wales |
| 1992 | Haemophilus influenzae B infection | 862 | 12 | 99.0% | Eng. |
| 1999 | Group C invasive meningococcal disease | 883 | 28 | 97.0% | Eng. |
| 2006 | Invasive pneumococcal disease | 3,552 | 858 | 76.0% | Eng./Wales |

¹Source: Vaccine Knowledge Project, Oxford Vaccine Group. <<http://vk.ovg.ox.ac.uk/vaccines>>

²Cases per year in the year prior to vaccine introduction.

Questions

1. What is a fact? How are scientific facts established?

2. Does this section's blog post reflect scientific facts, unwarranted opinions, or anecdotes? Provide specific examples of each in the post if you find them.
3. Does the blog post emphasize villains, victims, and heroes? If so, identify and list them.
4. Identify one to two statements in the blog post that you can refute using scientific data from Table 2. Provide details/data from the table to support your repudiation.
5. Speculate on the validity of the following statement from the post: "Our babies would be protected from many/most infectious diseases if their mothers were allowed to have natural immunity and pass it to their babies in breast milk, and we had true herd immunity through adults who had life-long natural immunity."
6. To develop "natural" immunity as described by the poster, one would likely need to develop an infectious disease. Discuss/brainstorm ideas concerning the public health and economic implications of treating disease in the population versus vaccinating the population.

Conclusion

In conclusion, readers can easily find media posts regarding the safety and efficacy of vaccines as well as other debated scientific topics. Learning to sort unwarranted opinions and anecdotes from empirical evidence attained through application of the scientific method will help you to become a scientifically savvy consumer who can make sound personal decisions based upon science rather than pseudoscience.

Here is one final test to check your ability to sort science from pseudoscience. The two posts below make use of unwarranted opinions, anecdotes, heroes, villains, victims, and empirical data.

“We don’t need 40 stinkin’ vaccines, get it? Nobody does, and especially they don’t need them when they are 2 years old. I’ve seen what they did to my niece. Full of mercury and other chemicals and drugs and viruses, they cause autism and other disasters in all races of babies. Big Pharma creates drugs to make money. Helping people in any way is down on the list; it’s there, because it has to be, but it’s not what drives the industry. Cancer has been cured many times, many times over. Thousands die being vaccinated for diseases (sic) they have one chance in 5 hundred million of ever catching anyway.”

Response to the above post:

“‘Thousands die being vaccinated for diseases (sic) they have one chance in 5 hundred million of ever catching anyway.’ Really? Could you please provide a citation showing that thousands of deaths are caused by vaccines? Where is the chance of getting a disease just one chance out of five hundred million? The USA has a population of a bit over three hundred million, yet there are people getting mumps, measles, pertussis, rubella, tetanus, chicken pox, Hib, etc. So how do you figure out the odds of not getting a disease, please provide the data and source of data.”

Which post reflects pseudoscience and which attempts to present or request scientific evidence?