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FACTORS AFFECTING MEDIA COVERAGE OF TOBACCO RESEARCH NEWS

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Abstract
Scientific publications with perceived relevance to public health or safety are often picked up by the popular press. The accuracy of such coverage by electronic and print media varies substantially. Reviewing examples of coverage of recent scientific publications on health effects of tobacco, nicotine or e-cigarettes reveals patterns in the quality and nature of press coverage, as well as its apparent motivation. This presentation focuses on the process by which journalists decide whether to cover a health-related news story; common points of confusion that affect quality of coverage (*e.g.*, correlation vs. causation, or statistical vs. real-world significance); and ways that researchers might act to improve the likelihood and quality of media coverage of research.

According to the latest U.S. National Science Board survey about public attitudes and understanding about science and technology, medical news is extremely popular; 59% are "very interested" in medical discoveries—more than any other category of news—with just 5% "not at all interested."

One topic of growing interest is research on new electronic nicotine delivery systems. Recent reviews of press coverage of e-cigarettes in the U.S. (2) and U.K. (3) suggest there is "much public confusion surrounding the new technology along with controversy regarding its regulation" (2). While useful, these quantitative studies of reporting provide little insight into why some research attracts more interest than others, how to improve the quality and accuracy of such coverage, and how to credibly address the flaws or limitations of research.

This presentation draws from a review of U.S. mass media coverage produced for Pinney Associates of four recent scientific publications on electronic cigarettes or vaping that received significant coverage in the general press. For space reasons, only two of these articles are addressed here. (Although there may be minor differences, in this document I use the terms "e-cigarettes" and "vaping" devices interchangeably.)

The review of the first article's coverage also looks at the process by which journalists decide whether and how to cover a health-related news story, what makes such coverage more or less effective, and the types of questions that journalists should be asking when assessing such stories.

Story #1: Hidden Formaldehyde

On January 15, 2015, *The New England Journal of Medicine (NEJM)* published a letter titled "Hidden Formaldehyde in E-Cigarette Aerosols"[4] that received global attention. The study measured the output of formaldehyde-containing hemiacetals (a formaldehyde-releasing agent) under laboratory conditions from a commercially available e-liquid when aerosolized by a tank system e-cigarette that used a variable voltage battery.

Formaldehyde is a colorless, flammable, strong-smelling, naturally occurring and common organic compound that can cause irritation of the skin, eyes, nose and throat. In addition to its best-known use as an embalming fluid, formaldehyde is used in many household products including construction materials, glues, paints, fertilizers, pesticides, and permanent press fabrics. It is also a byproduct of combustion, and can be found in cigarette smoke. There is no doubt about its cancer-causing properties given sufficient exposure. In 2014, the National Toxicology Program listed formaldehyde as a known human carcinogen (5).

The "hook" for the news media coverage of the letter was that it appeared to show new links between e-cigarettes and cancer that drew parallels with the well-established link between tobacco cigarettes and cancer. But did the research described in the letter really do that? And did the press report on that research accurately?

Concerns about the *NEJM* study are manifold and include such fundamental issues as validity (Am I measuring what I think I'm measuring?), reliability (Am I doing a good job of measuring the key variables?), and applicability (Is my model an appropriate representation of real-world situations?). For example:

- Are formaldehyde and "formaldehyde-releasing agents" equivalents when it comes to cancer risk?
- Was the voltage the researchers used in their experimental apparatus (5.0V) a realistic stand-in for real-world vaping, especially since formaldehyde-releasing agents were not detected at the more-typical 3.3V level?
- Are the reference levels for tobacco-generated formaldehyde valid and reliable, especially since they do not overlap at one standard deviation around their respective center points?
- Is the change in relative risk (if it exists) misleading because the absolute risk is so low?
- Is voltage of the delivery device the right independent variable? Power may be more useful since it's more likely to be associated with aerosolized formaldehyde.

Media Headlines for *NEJM* Story

At first glance—and especially to a non-scientist—the research seemed to show that a person using an e-cigarette would be exposed to approximately five times the amount of formaldehyde (14.4 mg/day vs. 3 mg/day) as a one-pack-per-day tobacco cigarette smoker, thereby challenging the claims that e-cigarettes are "safer" than tobacco cigarettes. In many cases that was, indeed, the headline.

- "E-cigarettes Can Produce More Formaldehyde Than Regular Cigarettes, Study Says" – *Los Angeles Times*, 1/21/15 (6).
- "Study Links E-Cigarettes to Formaldehyde, Cancer Risk; Research Found E- Cigarettes Produce New Type of Formaldehyde When Heating Nicotine-Laced Liquid" – *Wall Street Journal*, 1/21/15 (7).
- "E-Cigarettes Can Churn Out High Levels Of Formaldehyde"—National Public Radio, 1/21/15 (8).
- "E-cigarette Vapor Filled With Cancer-Causing Chemicals, Researchers Say" – CBS News, 1/22/15 (9).
- "Before You Vape: High levels of Formaldehyde Hidden in E-Cigs"—NBC News, 1/21/15 (10).

While those headlines were dramatic, some of the coverage was more nuanced. Many of the pieces featured a statement by Greg Conley, president of the American Vaping Association, calling into question the study's use of high voltage settings, *e.g.* "When the vapor device was used at the realistic setting of 3.7 volts, levels of formaldehyde were similar to the trace levels that are released from an FDA-approved [smoking-cessation] inhaler. However, when the researchers increased the voltage to 5 volts and continued to have their machine take three- to four-second puffs, this caused extreme overheating and the production of formaldehyde… These are not settings that real-life vapers actually use, as dry puffs are harsh and unpleasant." (9)

Media Coverage—CBS This Morning

This combination of an alarmist headline and/or "lede" (first paragraph of a news story) with a scientific perspective on the numbers and risks can be clearly seen in a roundtable set piece broadcast January 21, 2016 on *CBS This Morning* (11).

This story is a useful exemplar because it combines some of the things that comprise excellent scientific reporting and others that demonstrate inaccurate and even dangerous reporting.

News anchor Norah O'Donnell begins:

> *There's a new warning this morning that e-cigarettes may not be as safe as they seem. The New England Journal of Medicine says that e-cigarette users are 5 to 15 times more likely to get formaldehyde-related cancers than long-term smokers. Formaldehyde is the toxic chemical found in the devices.*

Dr. Holly Phillips is with us. Dr. Holly, good morning.

Formaldehyde – we think about lab in high school when we were dissecting frogs. That's in e-cigarettes? How dangerous is it?"

At this point, Dr. Phillips tries to put the findings and the fears into perspective.

Formaldehyde is a really common chemical. It's not only in frogs in biology labs. It's in permanent press fabrics. It's in glues. And most importantly, it's in regular cigarettes. When you smoke a regular cigarette, you inhale the formaldehyde, which we know can cause cancer.

In the study, researchers took a high-power form of e-cigarette—it's called a tank system—and they basically created a vapor in a lab and studied it. They found that when you heated the vapor up at a low voltage, 3.3 volts, there was very little formaldehyde in it. In fact, none. But when you heated the vapor up at 5 volts, there was a lot of formaldehyde. In fact, two-and-a-half times the amount of formaldehyde that you would get if you smoked a regular cigarette.

News anchor Gayle King then introduces the industry's perspective:

Well, the American Vaping Association—no surprise—is not happy. They say that the study is flawed. How come?

Dr. Holly Phillips:

Not only the Vaping Association, but a number of critics have come out against this paper that was published in The New England Journal. Basically, they're saying what happens in the lab doesn't necessarily happen in real life. And even though they heated up the vapor to a very high voltage (sic) in the lab, real-life e-cigarette users wouldn't do that.

The vapor would taste terrible. It would basically overheat their device. And they would not enjoy the smoking. They would usually smoke at a lower voltage, which has less formaldehyde.

News anchor Jeff Glor responds:

So they're saying you'd have to crank up the e-cigarette in some way. That most e-cigarettes, you can't even do it with to achieve these levels.

Dr. Holly Phillips:

Exactly. They used a specific high-power e-cigarette called a tank system, and so most people wouldn't be exposed in that way.

Norah O'Donnell:

When are we really going to know if they're safe right now?

Dr. Holly Phillips:

> *Theoretically, they should be safer. We know that the main harm from cigarettes isn't the nicotine, even though that's an addictive substance. It's the 4,000 chemicals, 60 of which we know are carcinogens, that come from burning tobacco.*
>
> *E-cigarettes don't burn tobacco. So in theory they should be safer. But as we see today, the jury is still very much out on that.*

Jeff Glor:

> *Holly Phillips. Thanks very much.*

Deciding to Cover the Story: Points of Contact

Before dissecting this story, let's take a look at how it likely got on the air at all. Without that process, there would be nothing to examine. Stories like this are usually triggered by a news release—in this case, almost certainly from Portland State University (12) where the research took place. (Since the publication was a letter, not a refereed research article, it's doubtful that *NEJM* put it in its weekly outreach to journalists.) Because it was information published in a scientific journal, it would have been embargoed until the evening before the publication date of the print edition of that journal. Although they could not report on it until the embargo date, journalists would have had access to pre-publication copies of the letter, including contact information for the researchers.

Approximately one week before broadcast, that press release would have been received by or made its way to a producer at *CBS This Morning*, who would have pitched it for the "budget" (rundown of stories) of the first show to air after the embargo. The decision made by the producers during that budget meeting would be (1) whether to cover the story at all, (2) how to cover the story, *e.g.*, a "reader," field package, live satellite interview with a researcher, roundtable discussion, etc., and (3) how much time to allocate to it. The producers decided to go with a mid-level approach: a roundtable discussion with one of their in-house medical experts. They allocated two minutes and 30 seconds for the story, which is consistent with that mid-level ranking for a morning news program.

It's important to note that the three news anchors discussing this story have no training or expertise in science or medicine. (There are times when, from the journalists' perspective, this is not a problem and may even give them an advantage since it allows them to view news stories from their audience's perspective, acting as their surrogate.) Nor is it likely that any of the show or segment producers have any significant education in medicine or science, or any experience as a beat reporter/producer covering health issues or science; almost all producers have a "general assignment" background. They decided to bring in Holly Phillips, M.D.,

a board-certified internist and part-time journalist at CBS specializing in health and medicine.

In most cases, the graphics are ordered and assembled by the segment producer, who also writes the lede (read by Norah O'Donnell) and obtains background information and quotes such as the one from the American Vaping Association. The segment producer then briefs the journalist, who may do additional background research, and the anchors, including sharing descriptions of the proposed graphics so that they can allude to the information on them in a timely manner. In a roundtable such as this, everything after the lede is ad libbed. All of the participants, especially Dr. Phillips, will have notes on the key points they'd like to make during the ad lib discussion so that they can make use of the graphics. It's critical to understand this process and its correlates among print, online and radio outlets to appreciate that there are multiple points of potential contact that can be used to make the coverage of science-related news more accurate. Also, many of the people involved in screening and structuring health and science stories in all media have no significant training in those fields, and thereby have few ways to analyze the validity, reliability or importance of the data presented to them.

Analyzing the CBS News Story

The CBS story begins with an implicit link to the long-term misleading of the public and the press by the tobacco industry regarding cancer risks, following which that industry essentially lost all of its credibility on health-related matters. The thought that another industry, whether it's automobile airbags, pharmaceuticals, or laminated flooring, might be misleading the public on the health risks of its products is red meat to most journalists. Such temptation, combined with a lack of sophistication in science and statistics, can easily lead those journalists—even the ones with the best of intentions—and the public astray.

That implicit link helps explain the overall tone of the piece, including the constant bottom-third graphic that reads "Vapor Danger. Study: Hidden Carcinogen Found in E- Cigarettes." That tone sets the stage for the ominous lede:

> The New England Journal of Medicine *says that e-cigarette users are 5 to 15 times more likely to get formaldehyde-related cancers than long-term smokers.*

Such phrasing implies (inaccurately) to viewers that an august body of physicians (*NEJM*) has determined that e-cigarettes are inherently life-threatening. In reality, the journal simply published a peer-reviewed letter, not a peer-reviewed article, in which the authors describe an experiment they did and present what they see as its implications.

While it's useful and appropriate to consider the source of a story (*e.g.*, *NEJM* vs. a corporate or university public relations office) in an initial screening, most journalists do not appreciate or pay attention to the subtle differences between types of professional journals and types of pieces within those journals. Nor do they appreciate the need for independent replication of findings before they should be generally accepted.

Key Questions Journalists Should Ask

The producers and anchors should not be expected, by themselves, to know which questions to ask when assessing these types of data. But they should be open to and able to ask those questions when provided guidance by a credible source either inside or outside their newsroom. Those key questions include:

- **Validity:** Are the researchers measuring what they think they're measuring? (In this case, is the concentration of formaldehyde the same as concentration of formaldehyde-releasing agents?)
- **Reliability:** How good of a job are they doing at making those critical measurements? Is the experiment structured in such a way that others would get the same results using the same protocol? Would the results stay the same if the same researchers repeated the study a month from now?
- **Real-world modeling:** Is the research design a realistic way of simulating what real people who vape do? Is 3ml/day a reasonable estimate of consumption among vapers? Are the authors leaping to unfounded conclusions?
- **Relative risks vs. absolute risks:** Which are we describing? What sounds like a dramatic change in relative risk can be a trivial change in absolute risk. In this study, while the relative risk goes up by a factor of 5 (or even 15 in some models), the absolute risk is still extremely low. Indeed, in its response to the study, the American Council on Science and Health states, "Biologically, as scary as it sounds (embalming fluid) formaldehyde is actually a very weak carcinogen, with only a slightly increased chance of cancer among even highly-exposed workers over an entire lifetime." In addition, the majority of tobacco cigarette-related cancers are not caused by formaldehyde, but by other carcinogenic compounds that are not present in e-cigarettes. So while the risk of that small subset of cancers may go up, the overall theoretical risk of smoking-related cancers—what the journalists' audience should be concerned about—would go down dramatically! This also has implications for determining statistical vs. clinical significance.
- **Clinical vs. statistical significance:** Statistical significance, which is often a major component in whether an academic research paper is published, is a matter of calculating the odds that the difference on some variable between two or more groups is due to something other than chance or random variation. Clinical significance in a health-related study is a matter of whether the difference between those variables has an important effect on people's lives. The two are not always the same.

- **Frame of reference:** Are the risks and benefits couched in appropriate terms with respect to the reference groups? For example, are we comparing cancer rates among vapers to those among tobacco cigarette smokers or to cancer rates among lifetime non-smokers? Are the exposure statistics for tobacco cigarettes and e-cigarettes comparable? In this study, they're comparing e-cigarette users to tobacco cigarette smokers, which is a valid reference group since e-cigarettes are promoted as a way to quit smoking. But, as noted above, the conclusion about theoretical health risks with respect to that reference group did not cite the overall decline in all smoking-related cancers vs. the increase in formaldehyde-related cancers.
- **Clear definitions:** Are both the technical and general terms used by the researchers clearly and consistently defined? For example, what constitutes a "daily user" of an e-cigarette? What about a "regular user" or an "experimenter?" Do other researchers use those terms in the same way?
- **Appropriate statistics**: Are the researchers using appropriate mathematical techniques to analyze their data? Have others used those same techniques in similar studies?
- **Vested interests:** Do the authors have any vested interests or conflicts of interest that might influence how they gather, interpret or present their results?

Health and science beat reporters—especially those who have professional training in the sciences—routinely ask those and other questions. Unfortunately, most general assignment reporters and producers do not analyze stories and story pitches this way. The *CBS This Morning* story is a case in point. It begins with an ominous statement that sets the viewers' expectations by using the words "warning," "cancer" and "toxic":

> *There's a new warning this morning that e-cigarettes may not be as safe as they seem. The* New England Journal of Medicine *says that e-cigarette users are 5 to 15 times more likely to get formaldehyde-related cancers than long-term smokers. Formaldehyde is the toxic chemical found in the devices.*

The tone of the piece is reinforced by a full-screen graphic.

Dr. Phillips's initial statement on-air takes a different and more-scientific approach in an attempt to put the audience's exposure to formaldehyde into perspective and to rein in the credulousness of the anchors:

> *Formaldehyde is a really common chemical. It's not only in frogs in biology labs. It's in permanent press fabrics. It's in glues. And most importantly, it's in regular cigarettes.*

This temporarily shifts the tone of the piece away from melodrama and begins to explore some of the key questions mentioned above.

Gayle King pivots to the industry comment while expressing her skepticism:

> *Well, the American Vaping Association—no surprise—is not happy. They say that the study is flawed.*

This cynicism about industry sources has profound implications for determining who has credibility on health and science matters with journalists.

Dr. Phillips attempts to buttress the concerns about the researchers' apparent design flaws:

> *Not only the Vaping Association, but a number of critics have come out against this paper that was published in The New England Journal. Basically, they're saying what happens in the lab doesn't necessarily happen in real life. And even though they heated up the vapor to a very high voltage (sic) in the lab, real-life e-cigarette users wouldn't do that.*
>
> *The vapor would taste terrible. It would basically overheat their device. And they would not enjoy the smoking. They would usually smoke at a lower voltage, which has less formaldehyde.*

The unnamed critics that she cites are amorphous and therefore lack credibility. The audience does not know if these are reputable scientists, defensive vapers, or public relations flacks.

Jeff Glor responds by recapitulating what Dr. Phillips is saying about the study's design flaws:

> *So they're saying you'd have to crank up the e-cigarette in some way. That most e-cigarettes, you can't even do it with to achieve these levels.*

This is a key point in covering this story: the real-world situation being modeled is unrealistic. Therefore, the conclusions about cancer risk do not appear to be valid. Since we don't have measurements at voltages other than 3.3V and 5.0V, and we don't know from this study what voltage a typical vaper uses, we simply don't know what the risk from vaping for formaldehyde-related cancers is. Unfortunately, this key point is missed in the exchange at the end of the story:

Norah O'Donnell:

> *When are we really going to know if they're safe right now?*

Although it's awkwardly phrased, this is the most important question to the viewers: What light does this study shed on the absolute dangers of using e-cigarettes and their relative dangers when compared to tobacco cigarettes? Dr. Phillips responds:

> *Theoretically, they should be safer. We know that the main harm from cigarettes isn't the nicotine, even though that's an addictive substance. It's the 4,000 chemicals, 60 of which we know are carcinogens, that come from burning tobacco.*
>
> *E-cigarettes don't burn tobacco. So in theory they should be safer. But as we see today, the jury is still very much out on that.*

Everything in her comments is accurate until that last line. The research they reported on did not confirm that "the jury is still very much out" on e-cigarette safety. It was a flawed study that was treated by the anchors and the graphics as if it signaled a dramatic increase in cancer risk when it did nothing of the sort.

Media Coverage – National Public Radio

National Public Radio's *Morning Edition* ran a piece by Rob Stein on the *NEJM* formaldehyde story. (14) Stein is the senior editor on that network's science desk who's spent most of his career covering medicine and science for newspapers and broadcast media. While he was more circumspect, he also indulged in a bit of melodrama and missed some key issues.

Renee Montagne, host:

> *Here's something to think about when taking a puff of an e-cigarette—formaldehyde. New research is raising more concern about the safety of electronic cigarettes, finding the vapor they produce contains more formaldehyde than previously reported. NPR's Rob Stein has this story.*

Rob Stein:

> *E-cigarettes work by heating up a liquid that contains nicotine. That makes a vapor that users inhale. It's called vaping. E-cigarettes are generally considered safer than tobacco cigarettes, but David Peyton of Portland State University and his colleagues decided to take a closer look at what's in that vapor.*

Dr. David Peyton:

> *We simulated vaping by drawing the vapor—the aerosol—into a syringe, sort of simulating the lungs… (e)*
>
> *To our surprise, we found a form of formaldehyde in e-cigarette vapor.*

Rob Stein:

> *A form that might make it easier for formaldehyde to slip into someone's lungs. And they didn't just find a little formaldehyde; they found a lot.*

Dr. David Peyton:

> *We found this form of formaldehyde at significantly higher concentrations than even regular cigarettes—between five and 15 fold higher concentration of formaldehyde than in cigarettes.*

Rob Stein:

> *And formaldehyde can be nasty.*

Dr. David Peyton:

> *Long-term exposure is recognized as contributing to lung cancer and so we would like to minimize, to the extent one can, contact with formaldehyde, especially delicate tissues like lungs.*

Stein does a good job of quickly explaining how e-cigarettes work and that they're generally considered to be safer than tobacco cigarettes. He reached out to one of the study's authors to get greater insight. However, that author's statement, "To our surprise, we found a form of formaldehyde in e-cigarette vapor" strains credibility given the researchers' backgrounds in chemistry. While the quantity of formaldehyde released at different voltages may have been surprising, its presence should not have been given the composition of the e-liquid they were heating. It makes it sound all the more frightening, as if formaldehyde was a hidden and unexpected threat.

Rob Stein:

> *For their part, companies that make e-cigarettes are dismissing the study. Gregory Conley of the American Vaping Association says the researchers only found formaldehyde when the e-cigarettes were cranked up really high.*

Gregory Conley:

> *No real-life human is ever going to vape at that setting throughout the day because after a couple puffs, they'd be unable to puff anymore. They would take the vapor product and take a puff for one second and it would burn. Not burn like a third-degree burn, but it would feel extremely unpleasant in your lungs.*

By including only an industry representative, Stein is setting up the story as "science vs. industry," ignoring some of the serious questions other scientific researchers

have about the experiment and the interpretation of its results. This skews the information in favor of the *NEJM* letter's authors, even if that's not warranted.

Conley questions the applicability of the experimental design to real-world vaping and follows that soundbite with his charred steak analogy. *("I can take a steak and I can cook it on the grill for the next 18 hours, and that steak will be absolutely chock-full of carcinogens. But the steak will also be charcoal, so no one will eat it.")*

Rob Stein:

> *Peyton, the researcher, acknowledges that he found no formaldehyde when the e-cigarettes were set low. But he says he thinks plenty of people are using the high settings.*

Dr. David Peyton:

> *As I walk around town and look at people using these electronic cigarette devices, it's not difficult to tell what sort of setting they're using. You can see how much of the aerosol they're blowing out. It's not small amounts. It's pretty clear to me that at least some of the users are using the high levels.*

Rob Stein:

> *Peyton hopes the government will limit the sale of these devices, especially to kids. The Food and Drug Administration is in the final stages of trying to decide how strictly the agency will regulate electronic cigarettes.*

Rob Stein, NPR News.

> Peyton's claim that he can "tell what sort of setting [vapers are] using" is unsubstantiated and questionable. It should be challenged.

Media Coverage – Reuters
Toni Clarke, a biotechnology reporter for Reuters, did an excellent job of covering the story on January 21, 2015 (15). She begins:

> **Ramping up e-cigarette voltage produces more formaldehyde—study**
>
> *People who smoke high-voltage e-cigarettes have greater exposure to formaldehyde, a suspected carcinogen, than those who keep the voltage low, according to a study published in the New England Journal of Medicine on Wednesday.*
>
> *The study, which critics say is misleading and lacks context, is the latest contribution to a debate on the safety of e-cigarettes that so far has yielded little long-term data, though most experts believe they are less toxic than combustible cigarettes…*

After explaining the underlying science and the research design, Clarke then does something basic that the other reporters cited above failed to do: she speaks with both a researcher who wrote the NEJM letter and other researchers in the field to clarify some issues. Her interview with coauthor Dr. James Pankow brings to light some very important limits to interpreting the findings that were missed by other press reports.

> *It is not known exactly where formaldehyde contained in hemiacetals gets deposited in the body or whether it is similarly toxic, said James Pankow, one of the study's authors.*
>
> *"There has never been a cancer study with hemiacetals," Pankow said in an interview.*
>
> *Absent such a study, the authors estimated the formaldehyde-related cancer risk associated with e-cigarettes by extrapolating from data on formaldehyde in cigarettes.*

This is the essence of strong science reporting: clarity not only about the research but also about its limits and implications. Hemiacetals may not be a valid surrogate for aerosolized formaldehyde. Extrapolated risk may not translate from one chemical to the other. Relative overall cancer or health risk may be more important than absolute formaldehyde-related cancer risk.

What's particularly powerful is that these challenges to the interpretation of the results of the study come not from industry representatives, who would be perceived to have a financial interest in a particular outcome, but from other researchers who are professional peers of the authors: Dr. Jed Rose, director of the Center for Smoking Cessation at Duke University Medical Center, Dr. Neal Benowitz, a nicotine expert at the University of California, San Francisco, and Dr. David Abrams, executive director of the Schroeder Institute for Tobacco Research and Policy Studies at the anti-tobacco group Legacy. Each of these commentators brings with him the imprimatur of his institution, giving greater weight to their statements and therefore greater credibility and usefulness to the reporter's piece.

STORY #2: FLAVORED E-CIGARETTES AND YOUTH

On November 7, 2016, the journal Pediatrics published a study by Hongying Dai and Jianqiang Hao (16) on "Flavored Electronic Cigarette Use and Smoking Among Youth." Their paper used data from the 2014 National Youth Tobacco Survey (NYTS) (17) an annual questionnaire given to students in grades 6-12 who comprise a representative sample of students that age throughout the country. (Note that children who drop out of school in those grades are significantly more likely to use tobacco products than children who are still in school, so the sample may not be representative of the overall population when it comes to smoking and vaping.)

> *A logistic regression model was used to assess whether flavored e-cigarette use was associated with (1) intention to initiate cigarette use among never-smoking youth (n=16,471), (2) intention to quit tobacco use among current-smoking youth (n=1,338), and (3) perception of tobacco's danger among all respondents (n=21,491).* (16)

Logistic regression is a way of combining several independent variables in an attempt to predict a dependent variable that's categorical, *e.g.*, alive/dead, smokes/doesn't smoke, diagnosis of Disease A/Disease B/Disease C.

> *Concern is growing that widespread availability of flavored e-cigarettes will increase the use of e-cigarette products by youth and will thus reinforce the acceptability of vaping behavior. The normalization of e-cigarette use among youth could also lead to e-cigarettes becoming a gateway for future smoking, marking a setback in the decades-long antismoking battle.* (16)

This is a "hot button" issue for journalists as well as public health advocates. If we embrace harm reduction by promoting e-cigarettes as a way of quitting tobacco cigarettes, are we unintentionally luring children who otherwise wouldn't smoke tobacco to start vaping, thereby increasing their health risks? Or are children (or most of those children) who vape the ones who otherwise would have taken up smoking tobacco cigarettes, and are thereby reducing their health risks—although not as much as they would have by abstaining completely?

Media Coverage – Reuters

Kathryn Doyle, a health reporter for Reuters, picked up on this research in an article published on November 7, 2016 titled "Kids Who Use Flavored E-cigs More Likely to Want to Try Cigarettes." (18) It begins:

> *U. S. kids who use flavored e-cigarettes more often intend to start smoking traditional cigarettes than kids who did not use flavored vapes, according to a 2014 national survey.*

A few paragraphs down, however, she interviews another researcher who questions the conclusions implied by the headline.

> *"This study does not show e-cigarettes are definitely a gateway to smoking cigarettes," said Shu-Hong Zhu, principal investigator of the California Smoker's Helpline, who was not part of the new study. "It shows that students who tried e-cig are more interested in cigarettes than students who have not tried e-cig," but is not sure evidence of a gateway from one to the other.*

In other words, the Dai and Hao study confuses correlation with causation. It may be, for example, that students who are interested in smoking tobacco cigarettes are

more likely than non-smokers to want to try e-cigarettes for reasons that influence both decisions.

Media Coverage – HealthDay News
On November 7, 2016, HealthDay News, a syndication service specializing in medical stories, published a piece by Steven Reinberg titled "Flavored E-Cigarettes May Entice Teens to Smoke." (19) It leads with:

> *Fruit- or candy-flavored electronic cigarettes may entice American teens to start smoking tobacco, a new study suggests.*
>
> *… "Due to a proliferation of e-cigarette flavors on the market, flavored e-cigarette use among youth in the U.S. has increased significantly," study author Hongying Dai said. She's an associate professor of health services and outcomes at Children's Mercy Hospital in Kansas City.*

That first statement is a confusion of correlation with causation. So is the second. (Do we know that the number of youth trying e-cigarettes is "due to a proliferation of e-cigarette flavors?" Or were the range of flavors developed to capture segments of the e-cigarette using population?)

The second statement is also a distortion due to confusing absolute numbers with relative numbers or ratios. The modern e-cigarette was invented in 2004 (20). It has only been marketed nationally for a few years. As with any successful new product, we would expect its use to increase significantly because the denominator (the absolute number of youth vaping) in that ratio starts at a low number. Since its base rate (reference point) is so small, any growth is exaggerated when expressed in those terms.

For example, the US Centers for Disease Control and Prevention issued a press release in April 2015 with the headline "E-cigarette Use Triples Among Middle and High School Students in Just One Year."

On its own, that sounds terrifying. But a few sentences into the release we learn that the dramatic percentage jump is due to two things: a broad definition of e-cigarette use and a low reference point. Current use was defined as at least one puff in the previous 30 days, thereby including those students who experimented with and rejected e-cigarettes. Among middle school students, the "current use" rate went from 1.1 percent in 2013 to 3.9 percent in 2014.

There's another likely reason for the dramatic jump: the survey questions changed. For example, in 2013 the NYTS question about use of "other forms of tobacco" during the previous 30 days was:

In 2014, that question was changed to:

Indeed, the CDC admits that this might be the case in an article in *Morbidity and Mortality Weekly Report* (22) about the survey's methodology:

> *Changes between 2013 and 2014 in the wording and placement of questions about the use of e-cigarettes, hookahs, and tobacco pipes might have had an impact on reported use of these products.*

A quote from Greg Conley in the *HealthDay News* piece called Dai and Hao's research design into question for yet another reason:

> *"In this study, any teen who answered 'probably not' when asked if he or she thought they would smoke a cigarette in the next year was marked as 'intending to smoke,' " said Gregory Conley, a spokesman for the American Vaping Association.*
>
> *Only a small number of participants answered "definitely" to the cigarette smoking question, Conley said. "So in order to give themselves statistical power, the researchers enlarge the category to include 'probably not,'" he said.* (19)

This is a recurring issue in scientific research. Even though their value to science may be the same, journal editors are much more likely to publish articles in which the findings show a statistically significant difference of some sort. That puts pressure on researchers to design their studies to show some type of statistical significance, even if it's an inappropriate or suboptimal design.

The piece ends with a quote from Dr. Stanton Glanz of the University of California at San Francisco, who is a strong advocate of the abstinence approach.

> *"This reality makes the fact that the Obama White House dropped regulation of flavors, which especially appeal to kids, from the FDA's recent rule taking jurisdiction over e-cigarettes worrisome," Glantz said. "The effect of this deletion will delay regulation of flavors in e-cigarettes by years, leading more kids to get addicted to nicotine," he said.* (19)

This once again conflates the supposed dangers of nicotine with the well-established and far-worse dangers of smoking tobacco.

Coverage of this *Pediatrics* article was an interesting case study in the translation of an academic paper into journalism for the lay public. The intersection of health risks and teenagers is always a provocative topic. Fruity flavors, perhaps because of their association with even younger children, would normally make this subject matter catnip to reporters and editors.

Given the press response to earlier studies of e-cigarettes as "gateway drugs" to tobacco cigarettes, this research received comparatively little coverage—probably due to its publication online on November 7, 2016, one day before the U.S. presidential election. The study was simply overshadowed by more pressing issues.

Common Errors In News Coverage

In sum, while some of the reporting on tobacco research was clear, practical and evocative, other media interpretations had repeated and predictable patterns of distortions, poor interpretation and missed opportunities. These problems included:

- **Alarmism.** With the *NEJM* study coverage, many reporters latched onto the implicit and explicit dangers of aerosolized formaldehyde without putting those dangers into a useful (and calming) context. Such key words as "cancer" and "cigarettes" appear to have contributed to this, as did the association of formaldehyde with embalming fluid, and therefore death. Very few reporters paid close attention to the potentially positive finding of no detectable level of formaldehyde in the low-voltage condition, which is the setting used by many vapers, especially those who use single-voltage systems.
- **Credulity.** Most reporters either didn't have the knowledge or felt it inappropriate to question the findings of the research. Non-specialists also showed little understanding of the nature of scientific research, viewing the results of a single experiment or survey as a kind of immutable truth rather than a step toward greater understanding that should be challenged to determine its robustness. Such constant challenging is at the heart of science and drives progress.
- **Poor choice of interview subjects.** Many journalists simply reached out to a small number of industry spokespeople or public health advocates. The best reporters not only reached out to the original researchers for clarification of details and interpretation, they also contacted other researchers who specialized in this field but had no financial ties to industry. Such scientists are seen as experts and credible peers of the original researchers, and their concerns or support are given greater weight by readers/viewers/listeners.
- **Failure to acknowledge constraints of the study.** Most studies are narrowly focused, but the reporting on them often presented them as broad or generalizable. The journalists' interpretation of the study's results and implications often went well beyond the actual data.
- **Not specifying reference groups.** In multiple reports, words like "healthier" and "riskier" were used without specifying healthier than whom or riskier than what. There was also a confusion of absolute risk with relative risk.
- **Hidden motives.** This is often thought of in terms of industry spokespeople wanting to promote their products and downplay any risks, or researchers wanting to burnish their reputations or get tenure at their university. But

there are others, including conflicts of interests by journalists or news outlets. For example, the local news website CapeCod.com ran a feature story on November 23, 2015 titled "Do E-cigarettes Help You Quit Smoking?" (23) that linked to the *NEJM* article.

Although it's not obvious at first glance, the piece is simply a reprint of a press release issued by Cape Cod Health News, which is owned by Cape Cod Healthcare (CCHC). CCHC owns two hospitals and manages the practices of 450 physicians in Cape Cod, Massachusetts. Thus, the main purpose of Cape Cod Health News is to provide a venue for promoting its physicians and services, not to provide the most accurate health information. This is not made clear to the reader. But it does explain why the two physicians (a cardiologist and an emergency physician) who commented on the study were not appropriately qualified experts in the fields in which they expressed their opinions. They were selected because of the CCHC-employed writer's mandate to burnish the image of the CCHC hospitals.

- **Beat and general assignment reporters tend to cover these stories differently.** Those journalists who have expertise in science or medicine tend to view research results more skeptically and to ask questions that challenge that research. General assignment reporters tend not to challenge researchers' methods or conclusions.

The news media want to get it right. There's no long-term incentive for journalists to distort their coverage of science stories. But as demonstrated in the examples above, news media of all types have difficulty covering complex health and science-related topics accurately and insightfully for a variety of reasons. Here are some key points to keep in mind:

- **Many of the reporters/producers/editors charged with interpreting these stories have little or no formal training or experience in science and mathematics,** which may result in their being inappropriately credulous or alarmist, and which makes it more difficult for them to put research findings into an appropriate perspective. Those who have significant professional experience and/or academic training in health or science tend to approach covering scientific research differently than those who are general assignment reporters and cover these fields infrequently.
- **Stories tied to smoking—and especially tied to smoking and cancer—are tainted by the history of misrepresentation of scientific data on risk to the media and to the public by the tobacco industry.** This predisposes journalists and the public to assume that all smoking- and vaping-related products have similar health risks, when that's not true. People tend to act based on their emotions, not on their logical thoughts. This is a constant challenge in the coverage of health-related topics.
- **Industry representatives and spokespeople have little credibility when it comes to discussing the health risks of their products,** even when they have independently gathered data to back up their claims. They are called

upon to comment because it's easy to reach them and it provides support for a claim of balanced coverage. There's no resource not controlled by the industry that helps reporters make sense of this research.

- **Protecting children from new technologies, whether it's video games or e-cigarettes, because of their unsubstantiated but purported dangers has shown itself to be a powerful political bandwagon.** No one wants to be accused of being against children's safety. This makes a practical *harm reduction* approach (*e.g.*, getting teenagers who smoke tobacco to switch to vaping) less emotionally attractive than an impractical *harm elimination* approach (*e.g.*, get teenagers who smoke tobacco to quit completely). Many of those who promote harm elimination position that approach as if it's an easily achievable state, which it is not. In fact, it's likely impossible. Adolescents are biologically driven to take risks as a way of testing adulthood and establishing their independence (24).
- **There are times when media outlets confuse accuracy with the appearance of balance.** In the *CBS Morning News* story, for example, we have no doubt that the journalists strove for accuracy. The problem was that most of them didn't have the expertise and perspective to know what questions to ask that would help explicate the study. In their efforts to achieve accuracy, they looked for balance. In this case, it meant getting a comment from a group that was bound to disagree with the researchers' conclusions: a representative of the vaping industry. The grudging quality of this attempt at balance is shown by Gayle King's statement, "Well, the American Vaping Association—no surprise—is not happy."

Obtaining this type of industry comment does not improve the accuracy of the science news story in part because *the source of that information is inherently perceived as tainted, even when the information is independently gathered and accurate.* Although the formaldehyde study was published as a letter to the editor and not as a full peer-reviewed article, it carried with it the imprimatur and gravitas of *The New England Journal of Medicine*. A spokesperson for an industry group or corporation has no such weight behind his or her words.

- **Even when journalists try to achieve balance, they sometimes do so by creating false equivalencies.** This is most obvious when journalists covering emotionally charged issues such as evolution, which has been agreed upon by the vast, vast majority of scientists for decades, feel obligated to obtain a countering quotation from a non-scientist who claims that the Earth is only 6,000 years old and was created in seven days. Such false equivalencies run counter to the scientific method.

  We should be concerned about false equivalencies involving the health risks of vaping. We should especially be sensitive to the differences between absolute risk and relative risk. No one can legitimately claim that vaping is risk-free. There is significant evidence, however, that vaping carries

fewer health risks and different health risks than smoking tobacco. It's unrealistic—a false equivalency—to assume that no one will take any type of drug that alters their state of consciousness. Yet that position of total abstinence is often used unquestioningly as the reference point for assessing potential risk of a substance or product.

- **There are multiple points of contact within news media that can be used to improve the accuracy of news coverage of scientific research.** Using the example of the formaldehyde related cancer story reported by *CBS This Morning*, the program producer, the segment producer and the beat reporter each had considerable influence in how that information was presented. In other media, the contact person might be an assignment editor or a health editor.

Conclusion

There are several things that those involved in noncombustible nicotine delivery products can do to improve the quality of science news reporting in this area:

- **Focus on improving accuracy of reporting rather than just burnishing image or boosting sales.** Remember the lessons learned by the tobacco industry when it undermined its own credibility by hiding and distorting data. If you're perceived as simply pushing a self-dealing agenda, you will not be listened to.

  There are times when research studies will point to increased risks, problems and other negative effects. These are to be expected; no product or procedure is perfectly safe and effective. But industry spokespeople and researchers must maintain their credibility with journalists if they are to help put these stories into perspective. Let's say, for example, that a new and well-designed study finds that the theoretical risk of formaldehyde-related cancers among long-term e-cigarette users is three times the theoretical risk of formaldehyde-related cancers among long-term one-pack-per-day tobacco cigarette smokers. If the data are solid, it would be important to acknowledge that increased risk. At the same time, you should offer some perspective by pointing out the dramatic *decrease* in the theoretical risk of many other forms of cancer if a tobacco smoker were to switch to vaping. Without that credibility (and integrity), such an attempt at putting the results into a larger perspective would likely fall on deaf ears.
- **Consider providing media training resources for researchers, both inside and outside industry.** Surveys of scientists, and my own experience providing media training to academics, suggest that many researchers want to explain their research to the public but face barriers such as finding journalists unpredictable (25) and not understanding their needs and motives; fears about how they will look to their peers; and lack of structured practice in explaining their work in simple, accessible terms with helpful analogies (26). A website available to all scientists is one possibility. An

open web-based resource is immune to concerns or potential discomfort about industry support.

- **Go beyond promoting comments from industry sources.** This goes against common wisdom. Industry groups routinely promote their executives or spokespeople to comment on scientific research. However, as shown above, journalists are naturally wary of industry sources (27), and particularly those linked with the tobacco industry.

  One alternative is building a database of highly qualified university-based and independent (non-industry) researchers who are approaching vaping, nicotine and related issues such as youth risk behaviors from the perspective of harm reduction, and who can be referred to journalists to help them interpret research accurately in their areas of expertise. Researchers would of course need to give permission for such referrals, with the shared goal of broadening journalists' access to experts who can improve the public's understanding of science.
- **Develop a list of key journalists** who are likely to cover health and science stories in a variety of media, and build relationships with them. Previous research and the examples above clearly show the difference in the quality of reporting of complex scientific information between those reporters who covered health and science as a beat (and likely had academic training in science or medicine) and those who were general assignment reporters who were asked by their editors to cover a vaping-related science research story. Do not neglect online-only journalists, who may have considerable expertise in health and science (29).

  Because of the significant turnover among media outlets, this list will have to be continually updated. Build relationships with these journalists ahead of time so that they know you can refer them to independent and useful resources (interview subjects) when they are covering a vaping-related story. Let the journalists know that the researchers you'll refer them to are not connected to or receiving funds from the e-cigarette industry, but simply want to promote the accurate coverage of this complex area of science.

  Also remember that there are multiple potential "touch points" (both times and people) for reaching out to news media to increase the odds of accurate interpretations of scientific studies.
- **Develop simple online materials that can help journalists** ask the types of questions about such studies that scientists would ask in order to assess the quality of the data and of the conclusions. There is a need and demand for such training, but journalists frequently lack time and money to attend formal training courses.

In my earlier work at the Harvard Medical School/Massachusetts General Hospital Center for Mental Health and Media, and under a grant from the

National Institutes of Health, we developed a training program in conjunction with the National Press Foundation. It was aimed at helping general assignment reporters in all media improve their critical thinking skills when screening press releases and reporting science-related stories. It was called "Spot the Crap!" That experience taught us that reporters, producers and editors strongly preferred such professional education to be online and available when they need it rather than live classroom instruction.

Multimedia web content might cover topics such as how to communicate about relative risk, a quick-and-dirty- guide to statistics, and how to "spot the crap" in misleading press releases about research findings. Materials could include interviews with reporters specializing in health and science who share their reporting tips and give examples of successes (*e.g.*, seeing the connection between a technical research paper and a community issue) and failures (*e.g.*, not being appropriately skeptical of a study's results).

- **Build an online repository of resources** on nicotine, reduced-harm products, tobacco smoking cessation and health that can be accessed by reporters when they need it. These should be from independent (third-party) sources such as research publications and white papers by independent researchers. Thus, for example, when it would be helpful for a journalist to have an authoritative source cite the theoretical (and eventually, clinical) decline in cancer risk when a tobacco smoker switches to vaping, you can quickly provide it.

Finally, to help non-specialist reporters understand the issues, consider supporting the creation of plain-language summaries of tobacco-related technical reports that are issued to members of the media. For example, media coverage of the 2016 Cochrane Collaboration report, "Electronic Cigarettes for Smoking Cessation," drew heavily on and was greatly improved by the plain-language summary included in their otherwise daunting report.

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