

PCBs 
anatomy of a health scare
in SALMON

A STATS Report by Trevor Butterworth

Introduction

The Food and Drug Administration (FDA) is under increasing pressure to tighten its limits on contaminants in food after a recent study claimed that farm-raised salmon contained potentially dangerous levels of polychlorinated Biphenyls (PCBs), banned in the United States since 1979.

The warning generated enormous media coverage in the United States and around the world, even though FDA officials, industry experts and many independent scientists denied there was any health risk.

The authors of the study (Hites et al.), which appeared in the January 9 issue of Science magazine, relied on Environmental Protection Agency (EPA) guidelines for determining whether the PCB levels they found in farm-raised salmon were likely to increase the risk of cancer. They claimed that the FDA limits were out of date and did not reflect recent research.

Yet the EPA's use of animal testing to determine whether a substance is a potential carcinogen in humans is highly controversial. Indeed, a previous STATS survey of America's leading cancer experts found that a majority disagreed with the practice of assessing human cancer risks by giving animals a maximum tolerable dose of a suspected carcinogen.

In this case, the claim that PCBs levels in farmed salmon increase the risk of cancer is not supported by any scientific evidence showing that PCBs in fish or the environment have ever caused cancer in humans. In fact, research has not even shown that workers exposed, on a daily basis, to high levels of PCBs in industrial settings experience higher rates of cancer than the rest of the population.

Given the impact of health scares on the public and on industry, STATS analyzed breaking news coverage of the Science study to see whether the media accurately reported this controversy and provided the key scientific data the public needed to make sense of this study. The results are far from reassuring.

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Background

Last summer, another warning issued in a long peal of alarms about the food we eat. The Environmental Working Group (EWG), a small, non-profit “public interest watchdog” announced that it had found such high levels of polychlorinated biphenyls (PCBs) in farm-raised salmon in the United States that it would be unsafe for anyone to eat more than one eight-ounce fillet per month.

PCBs are a family of synthetic organic chemicals composed of 209 separate compounds that were widely used as coolants and lubricants in manufacturing for almost half a century. As experimental studies began to show evidence that some PCB compounds could be toxic, the United States banned their use in 1979. By this point, however, hundreds of thousands of tons of PCBs had been dumped into the nation’s rivers and lakes; and the chemical stability that had made PCBs so useful to industry meant that they would be slow to break down and disappear.

How much of an environmental threat these deposits present is still unclear. For example, the PCBs buried in the sediments of the Hudson River are not leaching into surface waters at a rate that appears likely to cause any health problems (which is why the Environmental Protection Agency’s decision to force General Electric to dredge the river may actually do more harm than good); on the other hand, the clean up of smaller hotspots that have leached at a much faster rate has cleaned up rivers and lakes that posed a genuine threat to publih health.

The issue is that being fat soluble, PCBs can be absorbed by and accumulate in the fatty tissue of marine and animal life, from where they can be passed on to humans. The question is at what point this process begins to threaten public health (if at all). The problem is that toxicology is bitterly divided over how to calculate these types of risk. One side (which includes a majority of the world’s regulatory bodies) takes a cautious approach to the risk from contaminants; the other (which includes the Environmental Protection Agency and many environmentalists) takes an extremely cautious approach.

Unsurprisingly, the Environmental Working Group’s announcement that “cancer-causing chemicals” had made their way into farm-raised salmon proved irresistible to the media, even though the levels were well within Food and Drug Administration (FDA) and World Health Organization (WHO) limits. EWG discounted this objection by arguing that the FDA limits, established in 1984, were out of date, and did not reflect the latest scientific research on PCBs; this is why they based their risk assessment on the limits set by the Environmental Protection Agency (EPA), which were established in 1999.

While the FDA regulates commercial fish, setting PCB limits at 2000 parts per billion (ppb), the EPA is responsible for wild fish, which may be caught from heavily polluted lakes and rivers. As PCB levels in such fish can reach over 3000 parts per million (ppm), the EPA’s consumption guidelines are much stricter than the FDA’s limits. Thus, the EPA estimates that eating one eight-ounce piece of raw fish per month with PCB levels between 24 and 48 parts per billion will increase your risk of cancer by one in 100,000 over seventy years.

There were significant problems with the EWG study, in particular the tiny sample of fish upon which they based their warnings, which at 10 fillets was far too small to be scientifically credible. But then in January 2004, a much larger study — the largest to date on PCB levels in farmed salmon — appeared to confirm the group’s warnings.

Scientists from Indiana University, the University of Michigan, the State University of New York at Albany and Cornell University (henceforth, Hites et al.) examined 246 samples of farmed salmon from around the world. They found PCB levels that ranged from 51 parts per billion in farm-raised salmon in Scotland (the highest) to 18 ppb in Chile (the lowest). The average amounts for North America were 34ppb (Western Canada), 30ppb (Maine) and 18ppb (Washington). They also examined samples of wild salmon from Alaska and British Columbia, which revealed significantly lower levels of PCBs. Using the EPA’s limits as a reference point, Hites et al. recommended limiting farmed

salmon consumption to one eight-ounce fillet per month.

The study appeared in the January 9 issue of *Science* magazine, and thus carried the imprimatur of peer-review by a prestigious journal. The authors were all reputable scientists at mainstream institutions (one of the authors, Jeffrey Foran, is also president of the environmental advocacy group, Citizens for a Better Environment). And in summing up what their findings meant for public health, they had simply spelled out the implications of the EPA's limits on PCBs.

In short, all the ingredients were in place for an international health scare. Salmon, after all, is widely regarded as one of the most beneficial foods you could eat. Packed with omega-3 fatty acids, which research has shown to protect the heart from cardiovascular disease, the American Heart Association recommends that adults consume at least two (2-3oz) servings of fatty fish such as salmon per week - three times as much as the meager ration proposed by the Environmental Working Group and Hites et al. It seemed that consumers were faced with the choice between protecting against heart disease and risking cancer. Given the legacy of similar health scares in the past, the salmon industry faced the possibility of economic ruin.

But Hites et al.'s warnings did not go unchallenged. In the United States, FDA officials, toxicologists and industry representatives all vigorously disputed the threat from farmed salmon. In Europe critics were came out swinging: the study was characterized on British television as an example of America trying to manipulate the market; salmon industry officials in Scotland and France talked of suing Hites et al.; and the Pew Charitable Trusts - the philanthropic organization who financed the study - was charged with environmental extremism. As journalist Magnus Linklater wrote in the *Times* of London (15/01):

*all the ingredients
were in place for an
international health scare*

"This is the true story of the salmon scare which threatened last weekend to bring British salmon farming to its knees. It is a sorry saga of flawed science, selective research and hidden commercial bias. That it was allowed into the pages of the apparently respectable journal Science is inexplicable. Its worldwide promotion by an organization with a vested interest in undermining farmed Atlantic salmon in favor of wild Alaskan salmon is a scandal."

A tale of two measures

The controversy over PCBs in farmed salmon is driven by two very different measures for evaluating the health risks from exposure to chemicals in food and in the environment; one is cautious, the other is *extremely* cautious. These approaches reflect the enormous scientific challenge in trying to observe and quantify the effects of trace amounts of substances as they accumulate and dissipate in the body over a lifetime. How do you separate their impact - if any - from the influence of a vast array of other far more deleterious environmental and lifestyle factors such as lack of exercise and poor diet? How do you account for mechanisms that can repair or eliminate damage?

In terms of PCBs, the Food and Drug Administration and the World Health Organization (WHO) believe that most of them have to reach a certain "threshold" concentration in the body before they can inflict or promote damage. Their limits of 2000 parts per billion per fish takes a cautious view of the risk from PCBs.

The Environmental Protection Agency rejects the idea of a threshold, and takes the view that a substance must be considered a "probable" carcinogen in humans if it can be linked in any way to cancer in animals. Physiological differences across species are unimportant, as are the massive doses administered to the animals in the experiments. For the EPA, there is a linear relationship between dosage and damage, and exposure to tiny amounts of the substance simply means a lower risk. Given that the risk only disappears when the substance disappears, the EPA's guidelines reflect an extremely cautious view of the risk from PCBs in fish.

Both methods have their advocates; however, the assumptions underlying the linear model are more controversial. According to a 1993 STATS survey of 401 randomly chosen members of the American

Association for Cancer Research, only one in four thought that cancer-causing agents were unsafe regardless of the dose (28 percent).

Similarly, only one in four (27 percent) endorsed the practice of assessing human cancer risks by giving animals a maximum tolerable dose of a suspected carcinogen. And only twelve percent thought that chemicals should be banned from food if they ever caused cancer in any species.* (*S. Robert Lichter and Stanley Rothman, Environmental Cancer — A Political Disease, Yale 1999.*)

The EPA's no-threshold approach to assessing the risk from other chemicals, such as dioxins, has also drawn criticism from its own scientific advisory board.* (*Michael Fumento "EPA's Own Panel Says It Masquerades Dioxin Policy as Science."*)

Quantifying the risk

If we assume, for the moment, that the EPA limits represent a "true" assessment of the risk of cancer from PCBs, what, then, is that risk? According to the EPA, if PCB levels in raw fish tissue are 24 - 48 parts per billion, then consumption of eight ounces per month over a lifetime of 70 years would increase one's risk of cancer by one in 100,000.* As Hites et al. found an average of approximately 36 parts per billion in farm-raised salmon, then it would appear that one should restrict oneself to one meal per month — as the authors of the study recommend. (*http://www.epa.gov/ost/fish/pcbs.pdf*)

The immediate problem with these figures is that Hites et al. conducted their analysis with the skin on the fillets. This ensured that the highest possible residues were found, given that PCBs accumulate in fatty tissue. Yet cooking reduces the PCB levels in fish by 30 to 50 percent, and thus either significantly reduces the risk of cancer or enables you to eat more farm-raised salmon than the authors claim. And of course, you can simply avoid eating the skin.

The second point is whether a one in 100,000 lifetime risk of cancer is really a risk worth worrying about. According to the EPA's calculations, such a risk would result in approximately 3,000 cases of cancer in the U.S. population (currently 300 million) over seventy years if, that is, everyone ate at least eight ounces of raw farm-raised salmon per month at current PCB levels. By any measure, this is an *extremely* small risk — and it is one that is getting smaller and smaller given ongoing measures by the salmon industry to reduce PCB levels farmed salmon by changing salmon feed.

By way of contrast, the Centers for Disease Control (CDC) recorded 700,142 deaths from heart disease in 2001; and the Harvard Center for Risk Analysis currently puts your odds of dying from heart disease at one in 397. Given the growing body of evidence showing that omega-3 fatty acids confer substantial benefits in the fight against heart disease, the benefits of eating salmon — one of the best sources for omega-3 fatty acids — would appear to vastly outweigh any possible cancer risk from PCBs.

Do PCBs cause cancer in humans?

Of course, the premise behind the EPA guidelines is that there really is a quantifiable risk of developing cancer from consuming trace levels of PCBs in salmon (as well as beef and dairy products, which also contain minute traces of PCBs).

The EPA believes that PCBs are probable human carcinogens based on occupational studies of workers exposed on a daily basis over many years to high levels of PCBs in industrial settings and, more significantly, on studies showing that chronic exposure to high doses of PCBs produce tumors in rats. ("PCBs Cancer Dose-Response Assessment and Application to Environmental Mixtures," National Center for Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, 1996).

The problem with the EPA's case against PCBs is that scientific research has yet to prove that prolonged exposure to high levels of PCBs in industrial settings causes cancer, let alone that exposure

to much lower levels of PCBs in the environment is equally deleterious.

This is not to say that scientific inquiry has conclusively proved that PCBs cannot cause cancer in humans; the occupational studies on workers who came into direct contact with PCBs in industrial settings are limited in scope and sample size. Nevertheless, the largest of these studies, conducted by the National Institute for Occupational Safety and Health (NIOSH), found that the rate of cancer among such workers was *slightly lower* than that of the general population, and that there was no statistically significant increase in the rates for individual types of cancers (Brown and Jones 1981).

We are unfortunate enough to also have two cases where PCB mixtures were accidentally ingested. The first involved 1,665 people in Western Japan in the late 1960s who consumed rice bran oil contaminated with PCB mixtures at 2000 to 3000 parts per million. Immediate effects included chronic acne, nausea, fatigue and several incidences of liver disorders. During the next 11 years, 51 people died, one-third from cancer. In a similar unexposed group, only one-fifth would have been expected to die of cancer.

In 1978 in Taiwan, there was another incident of rice bran oil contamination that resulted in elevated levels of liver disease. And children of those poisoned in both groups showed a variety of developmental abnormalities. Yet subsequent research has concluded that the toxicity of the oil was not directly attributable to PCBs, but rather to a complex series of chemicals produced when the PCBs degraded after the oil was heated.

Given such evidence, the American Council for Science and Health (ACSH) has concluded that, "There is no credible evidence that PCB exposure in the general environment, in fish, or even very high levels in the workplace, has ever led to an increase in cancer risk." Although the ACSH has drawn flak from environmentalists and other activists for accepting money from industry and corporate sources, their 1997 analysis of the risk from PCBs — "Public Health Concerns about Environmental Polychlorinated Biphenyls" — was published in the peer-reviewed journal, "Ecotoxicology and Environmental Safety."

Dueling evidence - who's right?

In determining its cancer guidelines, the EPA favor studies based on dose-response assessments, which means that the higher the dose of a substance administered, the greater the likely effect. Therefore, to assess the risk of a given substance in humans, it is necessary to know how much of it they have been exposed to, how often, and what the result was. As the occupational studies on PCB exposure in humans cannot provide this level of precision (and as it would be unethical to conduct dose-response assessments on humans), the EPA dismisses much of the epidemiological evidence on PCBs as "inconclusive" — except, that is, when it appears to support their case.

Even the EPA concedes that studies of chronic exposure to PCBs in humans "provide limited to inadequate evidence of carcinogenicity"

Thus, the EPA cites three occupational studies for showing small but "statistically significant" increases in cancer among workers exposed to PCBs: Bertazzi et al. (1987), Brown (1987), and Sinks et al. (1992). There are compelling reasons to discount each of them.

In 1997, the Supreme Court reviewed a lawsuit brought by Robert Joiner, an electrician who claimed that exposure to PCBs, furans and dioxins in the course of working with materials manufactured by General Electric (GE) had "promoted" his small cell lung cancer.

A review of "General Electric Co. et al. v. Joiner et ux. was occasioned by arguments over how much discretion lower courts could exercise in determining what counted as admissible scientific evidence. And both the District and the Supreme Courts agreed that the four epidemiological studies Joiner's lawyers cited for a link between exposure to PCBs and cancer failed to show any such link and were therefore inadmissible. Bertazzi et al. was one of those four studies.

Though Bertazzi et al. found elevated rates of lung cancer deaths among former employees of an Italian capacitor manufacturing plant, the authors concluded that “there were apparently no grounds for associating lung-cancer deaths (although increased above expectations) and exposure in the plant.” In delivering the opinion of the court, Chief Justice Rehnquist pointed out the obvious: “Given Bertazzi et al. were unwilling to say that PCB exposure had caused cancer among the workers they examined, their study did not support the experts’ conclusion that Joiner’s exposure to PCBs caused his cancer.” [The other three studies were dismissed for different scientific reasons].

The EPA’s description of Bertazzi et al. does not mention the authors’ reluctance to link elevated rates of cancer with exposure to PCBs.

Brown (1987) looked at rates of cancer mortality among workers at two capacitor-manufacturing plants in Massachusetts. According to the EPA “there were statistically significant increase in death from cancer of the liver, gall bladder, and biliary tract (5 observed, 1.9 expected).”

But the U.S. Army’s Medical Research and Materiel Command’s Deployment Toxicology unit at Fort Detrick notes that “a review of pathology reports indicated that two of the liver tumors counted in the follow-up study were not primary liver tumors. When these liver tumors are excluded, the elevation in incidence is not statistically significant. The result also may be confounded by population differences in alcohol consumption, dietary habits, and ethnic composition.” None of these caveats are noted by the EPA.

Finally, Sinks et al. (1992) compared the mortality rates of 3,588 capacitor manufacturing workers known to have been exposed to PCBs with national rates for those with a similar demographic profile. Mortality in general, and total mortality from cancer, turned out to be *lower* in the workers than in the general population. Again, this aspect of the study did not make the EPA report.

Although there were elevated rates for malignant melanoma and cancer of the brain and nervous system, the authors stated that the risk of malignant melanoma “was not related to cumulative PCB exposure,” and that the increase in cases of brain cancer was too small to be statistically significant. In conclusion, they noted that “These results provide some evidence of an association between employment at this plant and malignant melanoma and cancer of the brain. The possibility that the results are due to chance, bias or confounding [factors] cannot be excluded.”

In sum, the scientific case for PCBs causing cancer in humans, based on chronic exposure in the workplace, remains unproven. In 2001, the German Federal Institute for Consumer Health Protection and Veterinary Medicine concluded in a consultation on behalf of the World Health Organization that the evidence from occupational studies amounted to “only a modest association for melanoma.” Even the EPA concedes that “Overall, the human studies have been considered to provide limited to inadequate evidence of carcinogenicity.”

Do PCBs cause cancer in animals?

There is robust evidence that PCBs, when administered in sufficiently large doses, can inflict cancerous tumors upon rats. And as far as the EPA is concerned, if a substance can be shown to cause cancer in animals, it *must* be treated as a probable carcinogen in humans. Yet such a cautionary principle does not take into account nature’s delight in inconsistency: to be human is to be more than merely a very large rat, at least in terms of extrapolating the effects of grave research across species.

The problem is that while animal dose-response testing may show that *something* causes cancer, it cannot show what the actual causal mechanism is. Causal mechanisms may differ between species, between closely related members of a single species, or even between the sexes of the same species. Thus, not all proven carcinogens in humans will produce cancers in mice or rats, even after chronic exposure; and likewise, not all carcinogens in rodents (or other animals) will turn out to cause cancer in humans. (See Hugh La Folette and Niall Shanks, “Brute Science: Dilemmas of Animal Experi-

mentation,” Routledge, 1996).

Though it is hardly a revelation that physiology is not always and everywhere the same in nature, the failure to account for possible differences between sexes and across species can produce spectacularly misleading results. For instance, when animal testing showed that the artificial sweetener saccharine “produced” bladder cancer in male rats, the Food and Drug Administration announced that it was a “probable carcinogen” in humans, after dallying with an outright ban. Years passed before further research revealed that the mechanism which triggered the cancer in male rats was neither present in female rats or humans.

The other major problem with animal dose-response testing is that any substance will prove toxic if consumed in sufficiently large quantities. Yet because researchers are trying to find health effects that are hard or impossible to detect in the general population, they are forced to compensate by giving very high doses of a substance to a relatively small number of animals over a sustained period of time. The dosages and the effects are then scaled back down to establish the lifetime exposure risk for humans.

This method assumes that the relationship between dosage and damage is linear; in other words, if a large amount of a substance produces widespread illness in a short space of time among laboratory animals, a tiny amount will produce a much lower rate of illness in an average person across an average lifetime.

While plausible (indeed, elegantly so), this method yields little to precision; for even the most benign substance can prove toxic if administered in a large enough measure or with sufficient frequency to overwhelm the body’s ability to repair damage. In testing whether saccharine was carcinogenic, for example, rats were given dosages equivalent to a person drinking over 1000 cans of diet soda per day. Should anyone be foolish enough to attempt such a feat, he or she would die from overhydration somewhere between the fortieth and fiftieth can.

Turning sick rats into human risks

The daily PCB doses administered to rats in the studies cited by the EPA ranged from zero parts per million (the control group) to 200 ppm over periods of one to two years. Elevated rates of liver tumors first became noticeable at 25ppm, although the numbers of rats affected varied depending on the PCB mixture. Similarly, some PCB mixtures in some of the studies produced high rates of liver tumors at 100ppm, while others didn’t.

A dose of twenty-five parts per million is between 15,625 and 31,250 times greater than the EPA monthly fish consumption limits for eight ounces of fish (.024ppm – .048ppm).

A STATS survey in 1993 found that a majority of American cancer researchers disagreed with the practice of assessing human cancer risks by giving animals a maximum tolerable dose of a suspected carcinogen

The EPA’s method of translating rat tumors into a quantifiable risk for cancer for humans has drawn fire from other scientists. Again, STATS’ survey of 401 randomly chosen members of the American Association of Cancer Research in 1993 found that almost two-thirds (63 percent) rejected assessing human cancer risks by this method. And during coverage of the Salmon study, the practice drew fire from some leading scientists. For instance, Professor Emeritus André McLean, a consultant toxicologist in the department of clinical pharmacology at University College London complained in the *Times* of London that,

“...the risk statements are based on variants of a technical procedure known to toxicologists as the linear-forced-through-zero extrapolation, where risk to humans who get minute doses of some chemical is calculated simply in proportion to the cancers that a few unfortunate mice may get when stuffed with large amounts of the chemical. If it worked like that, we would all be dead from the dangerous mutation-producing effects of oxygen.”

Britain’s Food Standards Authority (FSA) has also questioned the appropriateness of the EPA’s model for calculating the risk from PCBs in salmon. The FSA states that:

“This process is not recognized by international organizations responsible for food safety and public health who consider it scientifically flawed... The World Health Organization set safety levels for dioxins and PCBs in 2001 based exclusively on public health detection. These form the basis of safety levels set for consumers who eat fish sold in shops.”

Non-cancer health risks

Despite all these objections, one of the authors of the study, David Carpenter, Director of the Institute for Health and the Environment at the University of Albany, told the BBC (Newsnight, 08/01/04) that:

“our cancer risk assessment is in fact an underestimate of the true risk, because we have only dealt with cancer risks from three of the 14 contaminants, and we have not yet been able to do a risk assessment with the non-cancer health effects of these contaminant, which are very significant.”

The non-cancer health risks consist of developmental problems in fetuses and children, and endocrine and thyroid problems. These have long been a concern to scientists and regulatory bodies, given that wild fish caught around PCB hotspots in lakes and rivers may contain considerably higher levels of PCBs (over 3000 parts per million) than farmed salmon.

Dr. Carpenter went so far as to tell the *Vancouver Sun* that women of childbearing years should, as the paper put it, “be particularly wary of eating farmed salmon from any source because of the threat that PCB accumulations pose to reproductive systems and intellectual development.” Similar statements appeared in many other news accounts; but nowhere was it mentioned that the EPA had calculated a much lower risk for these problems — four times lower — than for cancer.

The *Vancouver Sun* did balance Dr. Carpenter’s warnings with comments from John Salminen, chief of chemical health hazard assessment at the health products and food branch of Health Canada, the Canadian equivalent of the FDA.

“Salminen... described Carpenter’s suggestion of health risks for women and children as ‘alarmist.’ He said a researcher could portray any protein source, including fish, cows, pigs and chickens, as unsafe simply by applying a sufficiently restrictive set of contaminant standards... ‘If you take a conservative enough approach and take an excessively high uncertainty factor you can conclude that you should not eat anything that has any fat content.’”

Other issues

In the days that followed publication, questions were raised about exact provenance of the sample of fish from Scottish salmon farms, which recorded the highest levels of PCBs in the study. An editorial in the Scotsman (16/01) pointed out that the sample had been purchased in March 2002, when supermarket fish sold in the United Kingdom was not labeled as to its origin. “... the scientists do not actually know if they tested Scottish farmed salmon,” claimed the paper, adding, “Indeed the American scientists concerned were blithely unaware that you could buy wild salmon in a Scottish fishmonger’s or supermarket.”

Another consequence of analysis conducted on fish bought in 2002 is that the PCB levels may well be out of date. Industry efforts to reduce PCBs in fish resulted in a decline of 28 percent between 1998 and 2001 (the most recent FDA figures). America’s salmon industry association “Salmon of the Americas” claims that industry-wide sampling has shown a further reduction of 30 percent since 2001. The replacement of fish oil feed with vegetable oil feed will bring about further substantial reductions.

Media coverage - what you needed to know

The only information the public received about Hites et al. was from the news media, which ran most of its coverage of the research on the day it was published in *Science* magazine (January 9, 2004). The question is whether the public got the right kind of information to make sense of the claim farmed salmon posed a risk to their health. As this was, fundamentally, a story about numbers and what they mean, the reader needed to have the following information.

Regulatory limits

The FDA limits for PCBs in fish — or if outside the United States, the limits set by Canada Health, the World Health Organization, the European Union, the Food Standards Authority (United Kingdom) etc; the EPA limits for PCBs in fish; the PCB levels in the salmon analyzed by Hites et al.

Without these numbers, the reader has nothing to go on except adjectives. How high is high? Many newspapers, for example, used some variant on “within FDA limits” to describe the PCB levels in the salmon analyzed by Hites et al; but what did that really mean — just within or well within?

Why the EPA limits differ from the FDA's (and WHO's, EU's, etc)

The discrepancy between the EPA and FDA limits would also lead most readers to ask how each organization could have a different estimation of the same risk, and which estimation is the most accurate.

The increased risk of getting cancer according to the EPA's limits for PCBs in fish

Given that the point of covering the salmon study was to warn the public about an apparent health risk, one would expect journalists to tell readers that consuming eight oz of raw salmon per month containing PCBs with levels similar to the average found by Hites et al. produces an increased risk of cancer by 1 in 100,000 over 70 years.

Without this information, it is impossible to decide whether to change one's diet or whether to dismiss the risk as too small to worry about. Moreover, it is unconscionably alarmist to warn about “cancer-causing contaminants” — as many news stories did — and then fail to state what the risk of getting cancer is.

The EPA's lower risk estimation for non-cancer health risks

Given that the study's authors were quoted in many news stories on the developmental and neurological risks associated with PCBs in farmed salmon, one would expect journalists to point out that the EPA's estimation of risk for such health effects is four times lower than it is for cancer.

The risk context

In discussing the potential risks from eating farmed salmon, it is vital that those risks are put into a broader context by noting the relative benefits of eating salmon, the presence of PCBs in other foodstuffs, and the risks from other health problems related to diet such as heart disease and obesity.

The controversy over the claim that PCBs are probable carcinogens

Finally, any discussion of the risk of getting cancer from PCBs in fish should address the controversy over the EPA's belief that PCBs in fish are *probable carcinogens* in humans. In many ways, this is the key element in the story, the very reason why we are being told about the study in the first place — we might get cancer from PCBs in farmed salmon!

And yet, as we have seen, neither PCBs in fish, nor chronic exposure to PCBs in industrial settings, have ever been shown to *cause* cancer in humans. Instead, the EPA has inferred this probability from tests where animals have been repeatedly dosed with massive amounts of PCBs, a method of risk assessment disputed by many scientists.

Results

These are the most important elements in this story, and they are the criteria STATS used to analyze breaking news coverage of the study in the United States, Canada and the United Kingdom. We also looked at newspaper headlines to whether they reflected a sense of controversy over the findings or boosted their impact with alarmist phrasing. Our goal was to find out whether the media gave readers and viewers the information they needed to make sense of the risk presented by PCBs in salmon, or whether the coverage was more likely to result in an unnecessary health scare.

U.S. newspapers

- Fewer than one out of every two stories (47%) provided the numbers on the EPA's consumption limits for PCBs in fish.
- Fewer than one in three stories (29%) reported the FDA's limits on PCBs.
- Only one out of every four stories (24%) provided readers with both the EPA and the FDA limits on PCBs in fish (and in some of these cases, the reader had to do a little math to get one figure or the other).
- Fewer than one in five stories (18%) adequately explained why the EPA and FDA PCB limits differed.
- Two out of three stories (65%) reported the PCB levels found by Hites et al.
- Fewer than one in five stories (18%) explained the EPA's estimated risk for cancer.
- No story (0%) reported that the EPA's estimation for non-cancer health risks was significantly lower than for cancer.
- Almost all stories (94%) put the risk from PCBs in salmon into a broader context.
- Fewer than one in three stories (29%) mentioned the controversy over the EPA's claim that PCBs are probable carcinogens in humans.
- Two out of every three newspaper headlines (65%) were alarmist.

U.S. Broadcast

- Only one out of four stories (25%) provided the numbers on the EPA's consumption limits for PCBs in fish.
- No stories (0%) provided the numbers for the FDA's limits on PCBs or explained why the EPA and FDA limits on PCBs differed.
- No story (0%) noted the PCB levels found by Hites et al.
- One out of every two stories (50%) explained the EPA's estimated risk for cancer
- No story (0%) explained that the EPA's estimation for non-cancer health risks was significantly lower than for cancer.
- Every story (100%) put the risk from PCBs in salmon into a broader context.
- One out of four stories (25%) mentioned the controversy over the EPA's claim that PCBs are probable carcinogens in humans.

Canadian newspapers

- No story reported the numbers on the EPA's consumption limits for PCBs in fish.
- Two out of five Canadian newspaper stories (40 percent) provided readers with Canada Health limits for PCBs.
- Two out of five stories (40%) noted the PCB levels found by Hites et al.
- One in five stories (18%) explained the EPA's estimated risk for cancer.
- No story (0%) explained that the EPA's estimation for non-cancer health risks was significantly lower than for cancer.
- A majority of stories (80%) put the risk from PCBs in salmon into a broader context.
- No story (0%) mentioned the controversy over the EPA's claim that PCBs are probable carcinogens in humans.
- A majority of Canadian newspaper headlines (80 percent) were alarmist.

United Kingdom newspapers

- Not one story contained numbers pertaining to any regulatory level.
- Only one out of ten stories (10%) noted the PCB levels found by Hites et al.
- Fewer than one in three stories (30%) explained the EPA's estimated risk for cancer.
- A majority of stories (90%) put the risk from PCBs in salmon into a broader context.
- No story (0%) explained that the EPA's estimation for non-cancer health risks was significantly lower than for cancer.
- Only one out of ten U.K newspaper stories (10%) mentioned the controversy over the EPA's claim that PCBs are probable carcinogens in humans.
- Every U.K. newspaper headline in our sample (100 percent) was alarmist.

Toxic fish or toxic reporting?

In the coverage of the Science study, there were many well-written stories that sought to balance discussion of controversial material with caveats and quotes from critics. Among the best were the *New York Times*, the *Philadelphia Inquirer*, the *Chicago Tribune*, the *San Francisco Chronicle*, the *Vancouver Sun* and the *Toronto Star*.

And even though television scored poorly on our index of key data, a close look at the transcripts shows far more caution about endorsing the conclusions reached by Hites et al. than was found in many newspaper stories. On one key measure, the EPA's estimation of the risk posed by the PCB levels found in fish, television news did much better than its print counterparts.

But overall, the media failed to give readers the facts they needed to make sense of the risk from PCBs in salmon. Even when stories provided numeric data, it was either incomplete or misleading. For example, many U.S. news stories mentioned only the average PCB level for the entire sample of farmed fish analyzed by Hites et al. (36.6 parts per billion), and not the average levels for farmed fish in the U.S. — or even those for farmed fish sold in the U.S. — both of which were significantly lower.

And it is simply astonishing that, in covering a study claiming to have found an increased risk for cancer, so few news organizations told readers what the likelihood of that risk was, or that the evidence that PCBs are a probable carcinogen in humans is so controversial.

Why this matters

Increasingly, health risk studies are pushing toxicology beyond the limits of meaningful measurement. And given the daunting complexity of such research, there is a tendency to defer to scientists when it comes to explaining what it all means. But as researchers claim to find risks in ever smaller increments (parts per billion, parts per trillion), we need to ask whether the assumptions behind their reasoning can be justified by evidence and logic. Or rather, journalists need to ask these kinds of questions. A new health risk study should be treated no differently than a rumor of political scandal: it needs to be checked out, thoroughly, before it appears in print.

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One important consequence of the way the media covered Hites et al. is that the public remains largely clueless about the assumptions that go into assessing the health risks from contaminants in food and the environment, or that science is so divided on the methods for calculating and interpreting risk. Yet within two weeks of the salmon study's publication, an editorial in the *Los Angeles Times* accused the FDA of having "outmoded" standards for contaminants in fish, and of being more concerned about protecting "the food industry's profit margin" than protecting public health ("The FDA's Fishy Standards," 24/01/04).

The evidence for these claims? Hites et al. "The report published in Science magazine this month **demonstrated** the need for the Food and Drug Administration to update its standards for such toxins in fish and all food," said the *Times* (emphasis added).

Now, unless you happen to know the backstory, this sounds impressively persuasive; after all, who would argue against updating "outmoded" limits and lowering health risks? Yet the LA Times promotes this policy recommendation on the basis of a partial interpretation of the facts. And, unfortunately, it is through this kind of alchemical certitude that the media, all too frequently, turn science into public policy.

Tables

Breaking news sample

Our sample of newspaper articles and broadcast transcripts were drawn from Lexis Nexis, and run from Jan 8 through 9, when the Science study received most of its media exposure. Not every national news organization chose to cover the study as news, notably, NBC and the *Wall Street Journal*. We did not have access to transcripts of Canadian or British broadcast news coverage.

United States print:

The *New York Times*, *Los Angeles Times*, *Washington Post*, *USA Today*, *Chicago Times*, *Philadelphia Inquirer*, *Atlanta Journal Constitution*, *San Francisco Chronicle*, *Seattle Post Intelligencer*, *Seattle Times*, *Oregonian*, *Newsday*, *Detroit Free Press*, *San Jose Mercury News*, *New York Post*, *Orlando Sentinel*, *St Paul Pioneer Press*.

United States broadcast:

ABC's "World News Tonight", CBS' "Evening News," CNN's "Wolf Blitzer Reports" and NPR's "All Things Considered."

Canada print:

The *Vancouver Sun*, *Toronto Star*, *Ottawa Citizen*, *National Post*, *Edmonton Sun*.

United Kingdom print:

The Times (London), *Financial Times*, *Guardian*, *Daily Telegraph*, *Daily Mail*, *Express*, *Mirror*, *Birmingham Evening Mail*, *Scotsman*, *Herald* (Glasgow).

Regulatory limits

(news stories providing numbers in parts per million or parts per billion)

	EPA	FDA	Both	Why Different
US print	47%	29%	24%	18%
US broadcast	25%	0%		0%

Given that Hites et al. used the EPA consumption limits for the basis of their risk assessment, we also looked for U.S. regulatory limits in Canadian and UK news coverage, as well as other international and local limits, specifically Canada Health (CH), World Health Organization (WHO), European Union (EU) and Food Standards Authority (FSA).

	EPA	FDA	CH	Why Different
Canada Print	0%	40%	40%	20%

	EPA	FDA	WHO	FSA	EU	Why Different
U.K. Print	0%	0%	0%	0%	0%	0%

PCBs in Salmon anatomy of a health scare

Levels of PCBs found in salmon

(news stories providing numbers in parts per million or parts per billion)

U.S. print	65% (Atlanta Journal Constitution listed dioxin levels but not PCBs)
U.S. broadcast	0%
Canada print	40% (Vancouver Sun listed dioxin levels but not PCBs)
U.K. print	10%

Increased risk of cancer

(news stories that provided the EPA's estimate of one additional case of cancer in 100,000 over 70 years based on the PCB levels found in Hites et al.)

U.S. print	18%
U.S. broadcast	50%
Canada print	20%
U.K. print	30%

Lower risk of non-cancer health effects

(news stories which noted the difference between the EPA's risk estimation for cancer and non-cancer health risks)

U.S. print	0%
U.S. broadcast	0%
Canada print	0%
U.K. print	0%

Risk context

(news stories which covered the benefits of eating salmon, levels of PCBs in other foods, other health risks, etc)

U.S. print	94%
U.S. broadcast	100%
Canada print	80%
U.K. print	90%

Controversy over cancer-PCB link

(news stories which explained the controversy over claims that PCBs cause cancer)

U.S. print	29%
U.S. broadcast	25%
Canada print	0%
U.K. print	10%

PCBs in Salmon anatomy of a health scare

Headlines

	Balanced	Concerned	Alarmist
U.S. print	18%	18%	65%
Canada print		20%	80%
U.K. print			100%

(figures rounded up)

U.S. print

Balanced

“Report cites health risks of farm-raised salmon; levels of contaminants are higher than in wild fish. Industry officials dispute conclusions” — *Los Angeles Times*

“Farm-raised salmon called risky choice; a study found more contaminants than in wild salmon. The industry and federal officials objected” — *Philadelphia Inquirer*

“Study warns of danger in eating farmed salmon. Critics blast report, saying it ignores health benefit” — *Seattle Post Intelligencer*

Concerned

“Study raises concerns about farmed salmon” — *Atlanta Journal Constitution*

“Farmed salmon leave more contaminants than wild ones, study finds” — *New York Times*

“Farmed salmon more tainted than wild” — *Oregonian*

Alarmist

“Study cites toxins in farmed salmon” — *Chicago Tribune*

“Study says farm salmon dangerous” — *Detroit Free Press*

“Salmon-slammin study says farmed fish are foul” — *New York Post*

“Farmed salmon fears. Study links popular fish to carcinogens” — *Newsday*

“Eat fewer farm-raised salmon, study says” — *Orlando Sentinel*

“Limit on eating salmon is urged” — *St Paul Pioneer Press*

“Toxic risks in farmed salmon – consumers told to be wary. Study finds PCBs, dioxins, pesticides, probably from diet” — *San Francisco Chronicle*

“Study finds risk in farm fish; intake should be limited to once every two months, researchers say” — *San Jose Mercury News*

“How safe is your salmon? Study sees higher level of toxins in farmed fish” — *Seattle Times*

“Some salmon are highly toxic” — *USA Today*

“Toxins cited in farmed salmon. Cancer risk is lower in wild fish, study reports” — *Washington Post*

PCBs in Salmon anatomy of a health scare

Canada print

Concerned

“Contamination risk slightly higher from farm-raised salmon” — *Edmonton Sun*

Alarmist

“Farmed salmon have higher PCB counts: study: consumption is a threat to pregnant women, children, researchers say” — *Vancouver Sun*

“Farmed salmon toxin alert” — *Toronto Star*

“Farmed salmon a health hazard: report” — *Ottawa Citizen*

“Wild salmon safer than farmed, study suggests: toxic chemicals” — *National Post*

U.K print

Alarmist

“Toxin alert on salmon; more than three meals a year ‘unsafe’” — *Birmingham Evening Mail*

“Only eat salmon three times a year” — *Daily Mail*

“Farmed salmon in cancer alert” — *Daily Telegraph*

“Only eat it 3 times a year; salmon health risk” — *Express*

“Scientists warn of farmed salmon contamination” — *Financial Times*

Cancer warning over Scottish farmed salmon” — *Guardian*

“New warning over poisons in farmed salmon; eat fish only three times a year, warns study” — *Herald* (Glasgow)

Don’t eat salmon more than once every month” — *Mirror*

“Consumption of farmed salmon linked to cancer” — *Scotsman*

“Farmed salmon linked to cancer risk” — *Times* (London)